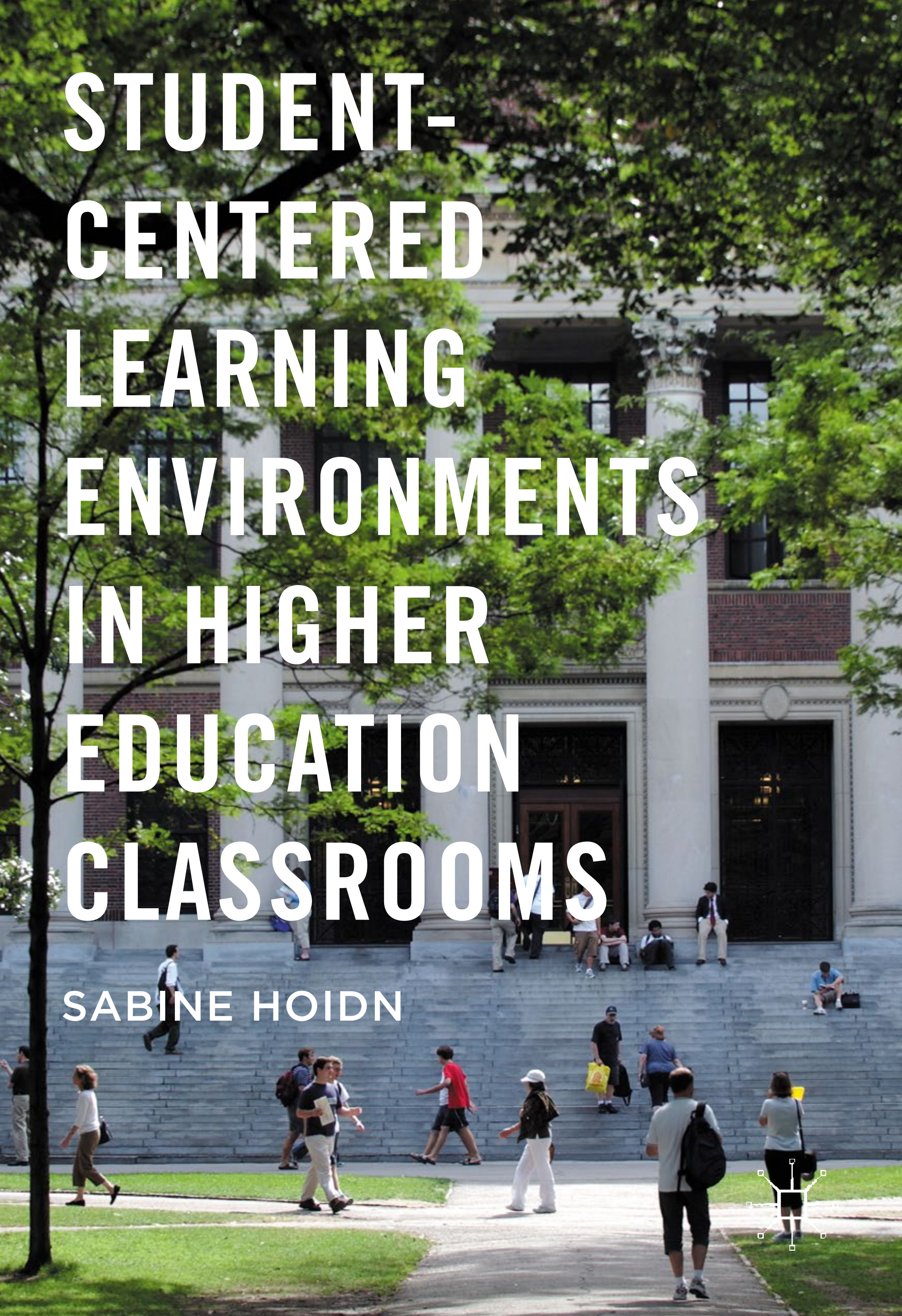
# STUDENT-CENTERED LEARNING ENVIRONMENTS IN HIGHER EDUCATION CLASSROOMS

SABINE HOIDN



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*For Hilda*

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# Contents

# Abbreviations

| | |
|---|---|
| CK | Content knowledge |
| EHEA | European Higher Education Area |
| HEIs | Higher education institutions |
| HGSE | Harvard Graduate School of Education |
| ODGs | Online discussion groups |
| PBL | Problem-based learning |
| PCK | Pedagogical content knowledge |
| PPK | Pedagogical/psychological knowledge |
| SCL | Student-centered learning |
| SCLEs | Student-centered learning environments |
| SRL | Self-regulated learning |

# List of Figures

# List of Tables

CHAPTER 1

# Introduction

In a constantly changing and increasingly globalized world, high-quality education is pivotal in order to better prepare students to actively and successfully participate in today's dynamic societies. Societal challenges, changes in higher education's goals, advances in classroom research, and higher education modernization efforts such as the Bologna Process have propelled European higher education institutions (HEIs)[1] to promote a paradigm and culture shift from teacher-centered to student-centered learning and instruction (Sect. 1.1). In recent years, policy makers, researchers, and educators alike have increasingly emphasized and demanded *student-centered learning* as a promising pedagogical approach to promote quality higher education (Sect. 1.2). This research project is rooted in educational science and higher education learning and instruction and aims to develop an educational model that helps educational managers, administrators, curriculum developers, instructors, and faculty developers in HEIs to navigate student-centered course design and instruction decisions. The research presented in this book makes important contributions to our understanding of how instructors can design and bring to life powerful, student-centered learning environments (SCLEs) for deep learning in higher education classrooms (Sect. 1.3). The findings are supported by an expansive literature review together with multiple ethnographic case study research (empirical study) conducted in the context of university-level (teacher) education at the Harvard Graduate School of Education (HGSE) in the USA between 2009 and 2012.



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## 1.1 The Changing Context of Higher Education in Europe

European higher education is facing several *societal challenges*: an aging population, globalization, a knowledge society shift, accelerated technological developments, an increasingly diverse student population in terms of cultural, economic, and social backgrounds, and the consequences of the global financial and economic crisis (European University Association [EUA], 2010). So far, European higher education has not been able to keep up with these realities and is currently confronted with a growing educational gap between the demand and supply of higher education graduates with high-level knowledge and skills (Council of the European Union, 2009). The ambitious European goal of 40% of all young people (30–34 year olds) obtaining a tertiary or equivalent qualification in each of the 28 member countries by 2020 is still a distant goal (European Commission, 2010; Eurydice, 2013): the average share of the EU28 population aged 30–34 years who have successfully completed tertiary-level education was 37.9% in 2014 (32.3% in 2009) as compared to the benchmark of 40% (Eurostat, n.d.). The average share of the EU28's adult population (25–64 year olds) with high education attainment was 29.3% in 2014, while the Organisation for Economic Co-operation and Development (OECD) average was 33.3%. These attainment levels are, therefore, still outperformed by the Russian Federation (53%), Canada (53%), Japan (47%), or the USA (43%) (Eurostat, n.d.; OECD, 2014).

The *goals* of higher education are *changing* due to new labor market demands: forecasts indicate that in 2025 around 44% of total European job opportunities will require high-level qualifications and 46% medium-level qualifications (Cedefop, 2013). Hence, in order to enhance students' employability and to enable them to become lifelong learners, HEIs have to equip today's students with the subject-based know-how as well as with high-level transversal competences and skills such as joint problem solving, critical thinking, and self-regulated learning (SRL) (European Council & Commission, 2010). The "ultimate" goal of academic learning and instruction is "adaptive expertise" or "adaptive competence" in a domain, defined as the ability to apply knowledge and skills flexibly in different contexts (e.g., Bransford et al., 2006; Darling-Hammond, 2008; De Corte, 2012; National Research Council of the USA [NRC], 2000, 2005; Perkins, 1998, 2008).

In order to face these changing goals and societal challenges, HEIs in general, and educational managers, administrators, curriculum developers, instructors, and faculty developers in particular, have to take better advantage of educational research findings and successful educational practices to ensure that "European students have access to the best possible higher education learning environment" (EU-High Level Group on the Modernisation of Higher Education, 2013, p. 12).[2] *Research* conducted in the interdisciplinary field of the learning sciences[3] has made major *advancements* in recent decades with a growing understanding of how students learn: deep learning has become one of the hallmarks of the learning sciences. Deep learning focuses on sense making and involves both knowing and doing, with students acquiring the right kind of knowledge at hand and the capacity to use it flexibly in different contexts (Biggs, 2012; Engle, 2006; NRC, 2000; Sawyer, 2014a). There is broad consensus in the research literature that effective learning is a constructive, cumulative, self-regulated, goal-directed, situated, collaborative, and individually different process of meaning construction and knowledge building (De Corte, 2012). Students are required to use higher-order cognitive activities such as questioning, applying, and generating solutions as opposed to memorizing disconnected facts. Sociocultural and situative perspectives on cognition and learning place a strong emphasis on the co-constructive or social nature of teaching and learning processes to inform and guide the design of learning environments[4] in daily classroom practice. These learning environments share common epistemological foundations and assumptions focusing on knowledge construction rather than knowledge transmission, competences rather than declarative information, and social exchange rather than individual learning, in order to promote deep conceptual understanding (e.g., De Corte, 2004, 2012; Dubs, 1995, 2013; NRC, 2000, 2005; Reusser, 2001, 2006; Sawyer, 2014a; Sawyer & Greeno, 2009).

The current educational discussion about quality higher education in Europe has been reinforced by the *Bologna Process*.[5] After a decade of structural and ongoing curricular reforms, the Bologna Process has brought about dramatic changes. Progress has been made in all of the three original reform areas, although a systematic implementation within HEIs with adequate stakeholder involvement (e.g., instructors, students, employers) remains a key challenge (Crosier & Parveva, 2013): the three-cycle system (bachelor/master/doctorate) and higher quality standards are, meanwhile, the norm across Europe, while a smooth and fair recognition of qualifications and periods of study is implemented to varying degrees (see also Bologna Declaration, 1999; Eurydice, 2012).[6] For the second Bologna decade up to 2020, *student-centered learning* (*SCL*) and the *teaching mission of higher education* have been identified as higher education priority areas by the ministers responsible for higher education in the countries participating in the Bologna Process (Leuven/Louvain-la-Neuve Communiqué, 2009) in order to provide quality higher education for all, enhance graduate employability, and make the European system of higher education compete with some of the best performing education systems in the world such as the USA's and Canada's (ARWU, 2015; THES, 2014). So far, progress toward the implementation of the pedagogical concept of SCL has been rather slow because structural changes have to be implemented first in a systematic manner to pave the way (e.g., Eurydice, 2012). Apart from that, HEIs are confronted with diverse implementation obstacles that result from inadequate stakeholder involvement, insufficient funding, deteriorating working conditions for academics, rigid career structures, entrenched values and beliefs and academic traditions, as well as from students' teacher-centered expectations and conceptions of learning, among others (e.g., Bonwell & Eison, 1991; Education International [EI], 2010; European Students' Union [ESU] & Education International [EI], 2010a, 2010b; EUA, 2010; Jones, 2006; Lea, Stephenson, & Troy, 2003). Overall, the enormous potential of European HEIs to fulfill their crucial role in developing a collective knowledge base, equipping students for their professional life, fostering their personal development for a better life, and preparing them for active citizenship in democratic societies in the knowledge society and economy of the twenty-first century is not fully harnessed (Bergan, 2006).

## 1.2 Student-Centered Learning as a Promising Pedagogical Approach for Higher Education?

Despite its widespread use in the scientific literature and in policy statements there is a broad consensus that SCL is rooted in a constructivist view of learning and instruction that puts the student at the heart of the learning process and unfolds a broad spectrum of participation-oriented teaching and learning practices to support deep conceptual understanding (e.g., Dubs, 2013; EUA, 2010; Land, Hannafin, & Oliver, 2012; Lea et al., 2003; O'Neill & McMahon, 2005). However, there is considerable disagreement and confusion about what SCL entails and what constitutes SCLEs (ESU & EI, 2010a, 2010b; Lea et al., 2003). Different variants of SCLEs have emerged in the recent decades, emphasizing participation-oriented educational practices[7], such as problem-based learning (PBL) (Hmelo-Silver, 2004; Lu, Bridges, & Hmelo-Silver, 2014), anchored instruction (Cognition and Technology Group at Vanderbilt, 1993), cognitive apprenticeships (Collins & Kapur, 2014), project-based learning (Krajcik & Shin, 2014), learning communities (Bielaczyc & Collins, 1999; Bielaczyc, Kapur, & Collins, 2013), or computer-supported collaborative learning (Stahl, Koschmann, & Suthers, 2014). Nevertheless, despite differences in the various student-centered designs, the following core values and assumptions of SCLEs can be identified: centrality of the learner in defining meaning, scaffolded participation in authentic tasks and sociocultural practices, importance of prior and everyday experiences in meaning construction, and access to multiple perspectives, resources, and representations (Land et al., 2012).

In the light of the challenges and developments outlined earlier, I argue that SCL is a pedagogical concept that *can* foster deep learning, that is, student sense making in higher education classrooms. However, for European HEIs to become more SCLEs, a paradigm and culture shift from teacher-centered learning and instruction (input focus), in which faculty members transmit knowledge to students, to student-centered learning and instruction (outcome-based learning), in which universities produce learning through student discovery and the construction of knowledge, is necessary (Barr & Tagg, 1995). This stance is in line with the voices of an increasing number of policy makers, researchers, and educators who emphasize SCL as a promising pedagogical approach for higher education learning and instruction.

1. Higher education policy makers

In their policy reports and proposals higher education policy makers, such as the European Commission (2008, p. 4), submit that "traditional teaching approaches based on direct instruction or lecturing are no longer adequate" and that they have to be "replaced by more learner-focused models that are based on the learner's active involvement in the process of reflection and interpretation." The agenda for the modernization of Europe's higher education system also points to "a strong need for flexible, innovative learning approaches and delivery methods" in higher education to serve different kinds of learners (European Commission, 2011, p. 5). In their meeting in Bucharest in 2012, the ministers responsible for higher education in the countries participating in the Bologna Process recommitted to step up efforts already under way to "promote student-centred learning in higher education, characterised by innovative methods of teaching that involve students as active participants in their own learning" and they stressed their willingness to work together with institutions, students, and faculty to facilitate a supportive and inspiring working and learning environment (Bucharest Communiqué, 2012, p. 2). In addition, the Trends 2010 study proposed a set of future policy priorities for the European Higher Education Area (EHEA), launched in 2010, and suggested that the strategic orientations of HEIs as well as European and national higher education policies need to be

> framed within a broad vision of the society of the future and of its educated citizens. This would help institutions to exploit fully the link between the different elements of the Bologna Process and to engage in the required curricular and pedagogical renewal that the shift to student-centred learning entails—a renewal that must be cast within a lifelong learning perspective, and with the goals of widening and increasing access. (EUA, 2010, p. 10)

However, both the interest in and implementation of the Bologna Process seem to have stagnated for the past few years (e.g., European Students' Union [ESU] 2012, 2015); participants of the latest biannual meeting of the Bologna Follow-up Group in Athens in 2014 have underscored the need to rethink and improve the Bologna Process in order to adequately address the quantity and quality of higher education graduates. HEIs have to increase and widen participation and graduation rates (i.e., access and success in higher education) by attracting more students from both traditional and non-traditional backgrounds. And they have to continue to engage in curricular and pedagogical renewal to ensure that not only more graduates, but graduates with the right level of subject-based know-how and transversal competences and skills leave tertiary education.

2. Education research

Apart from policy proposals, education research provides a variety of innovative perspectives on learning and instruction: sociocultural and situative perspectives on cognition and learning study the social setting in the classroom as an activity system that contains learners, instructors, curriculum materials, technology, and the physical environment (Gresalfi, Martin, Hand, & Greeno, 2009). In this view, learning is considered as participation in an activity system and depends on the kinds of activity the learners get to participate in (e.g., the cognitive demands of the task) as well as on the ways students are positioned for participation in interactions. Hence, learning scientists study informational contents of interactions and dynamic aspects of interpersonal interaction coevally to analyze and explain knowledge construction in social situations (Greeno, 2011; Greeno & Engeström, 2014). In this context, Handelsman et al. (2004, p. 521; Biggs & Tang, 2011) refer to SCL as an effective educational practice that is well supported by research on higher education teaching and learning: "There is mounting evidence that supplementing or replacing lectures with active learning strategies and engaging students in discovery and scientific process improves learning and knowledge retention." In addition, current theoretical models of classroom learning and instruction, such as the European-developed "model of the provision and uptake of learning opportunities," suggest that students' actual learning outcomes depend not only on the quality of the education offered (e.g., teacher expertise and beliefs), but also on the extent to which students leverage the learning opportunities provided by the instructor (Fend, 1998; Helmke, 2009). The uptake of learning opportunities is thus influenced by various learner prerequisites such as approaches to learning, values, expectations, motivation, and prior knowledge (Lipowsky et al., 2009; Pauli & Reusser, 2011). Consequently, the learning process and its outcomes are influenced by what instructors and students bring to the table and it is of utmost importance that the instructor has the professional competence necessary to engage in adaptive instruction that offers different kinds of students a variety of high-quality learning opportunities and supports them throughout the learning process (Kunter et al., 2013; Terhart, 2014).

3. Higher education practice

Despite postulated changes in higher education goals and advances in classroom research, higher education practice is still centered on the instructor instead of the student and the envisioned educational paradigm and culture shift has not yet taken place. European higher education today is still characterized by the predominant use of traditional methods of teaching such as lectures, seminars, and examinations (e.g., De La Sablonnière, Taylor & Sadykova, 2009). The interaction between the instructor and students—if it occurs at all—often follows the "IRE pattern" with the instructor *initiating* a question to which s/he already knows the answer (I), followed by a short student *reply* (R), and an instructor *evaluation* of the student's response (E) (Cazden, 1988; Mehan, 1979). Weimer points to a practice that is all too common in the present higher education with the instructor as the "sage on the stage"

> What happens in the typical college classrooms? Who's delivering the content? Who's leading the discussions? Who's previewing and reviewing the material? Who offers the examples? Who asks and answers most of the questions? Who calls on the students? Who solves the problems, provides the graphs, and constructs the matrices? In most classrooms, it's the teacher. When it comes to who's working the hardest most days, teachers win hands down. Students are there, but too often education is being done unto them. (Weimer, 2013, p. 60)

In a comprehensive literature review on the effectiveness of lectures compared to other methods such as discussions, inquiry (e.g., projects), reading, and independent study, Bligh (2000) found that lecturing was as effective as any other method when the objective was learning of facts and general information, while the other methods (e.g., discussions, inquiry) were mostly superior when objectives centered on promoting thought, changing attitudes, or developing problem-solving skills and interest in the discipline (see also Middendorf & Kalish, 1996; Twigg, 2000). For the last decade, structural macro measures (Bologna tools), such as course credits, modularization, and learning outcomes, have been implemented to various degrees to promote the modernization of European HEIs toward becoming more SCLEs (EU-High Level Group, 2013). In this context, instructors have been encouraged to adopt student-centered forms of teaching that are considered good higher education practices that can improve the quality of the educational process (Kember, 2009). However, the growing pressures for HEIs and deteriorating working conditions have left little time for educational managers and faculty to thoughtfully reflect on how the pedagogical concept of SCL—as promoted, yet barely understood and only halfheartedly implemented by the Bologna Process—translates into powerful student-centered higher education classrooms (Geven & Attard, 2012). Moreover, all too often faculty are unaware of the potential of educational research to increase student learning (e.g., new knowledge about learning, new methods of instruction) and/or are fairly reluctant to engage in the scholarship of teaching and learning and change their teaching methods (Macke, Hanke, & Viehmann, 2012). Hence, high-quality higher education requires further reforms informed by education research and good practices, and promoted by educational policy efforts.

In the context of the multilayered discussion delineated above, teacher-centered approaches have increasingly been subject to criticism in higher education. However, little granular qualitative research has been done so far in student-centered higher education classrooms. Existing constructivist principles and frameworks offered by education research to guide the design of more SCLEs are often disjointed and not specific enough to effectively support educators in HEIs. So far, powerful learning environments have usually been linked with technology; however, technology is not essential. More empirical research is required, including identifying beacons of good practice, to get a better understanding of both the characteristics and quality features of powerful SCLEs, and the challenges that instructors and students may face in such classrooms (e.g., Lea et al., 2003). For HEIs to move from teacher-centered to powerful SCLEs, an educational shift on two levels is necessary.[8] (1) SCL begins in the *higher education classroom* and requires a change in the mindset and behavior on the part of the students and the instructors as key players with immediate implications for curriculum and syllabus design, assessment, and classroom interaction on a *curricular and pedagogical level*; (2) *HEIs* have to nurture a SCLE on an *institutional level* so that faculty and students can fulfill their respective new roles (e.g., ESU, 2012; ESU & EI, 2010a, 2010b; Kember, 2009). This research project concentrates on the micro level of classroom learning and instruction in order to draw productive implications for higher education policy and practice.

## 1.3 Research Objective and Research Questions

How can instructors design and bring to life powerful SCLEs that provide students with opportunities for deep learning? In order to answer this guiding question, the scientific objective of this research project is to develop a situative[9] educational model to guide the design and implementation of powerful SCLEs in higher education classrooms. This research project contributes to educational theory development and research on classroom teaching and instructional quality in the context of university-level (teacher) education. The onus is on the faculty to design and conduct courses in a way that encourages students to take responsibility for their learning by being actively involved in the learning process (Weimer, 2013). The model aims to support the faculty from different disciplines in making informed instructional decisions and is also of relevance to other formal and informal educational settings aside from higher education.

This research project synthesizes relevant education research and investigates concrete and successful ground-level examples from within the higher education classroom. These authentic instructional practices are crucial as they display how instructional expertise manifests itself in the quality of classroom teaching (e.g., Pauli & Reusser, 2011). Thereby, a systemic (instead of an elemental) approach to learning research is used to investigate two holistic research questions at the nexus of higher education policy, research, and practice (Sawyer, 2014b).

*Research Question 1*: What common design principles and instructional quality dimensions and features of SCLEs can be derived from learning sciences research in general, and empirical education research on the effectiveness and quality of learning and instruction in particular? (Chaps. 2 and 3)

SCLEs share common constructivist foundations on learning and instruction (e.g., Land et al., 2012; Schuh & Barab, 2008). Findings from different constructivist perspectives and education research strands are synthesized and aligned to derive common design principles and instructional quality dimensions and features of SCLEs. Recent classroom research indicates that instructors have to take greater account of *both* surface-level features of instruction referring to the observable "sight structures" describing teaching practices and the organization of learning activities in the classroom, and deeper-level instructional features referring to both the quality of the actual learning and teaching processes, and the teacher–student interactions in order to provide students with opportunities for deep learning (e.g., Greeno, 2011; Reusser, 2009; Reusser, Pauli, & Waldis, 2010; see also Chomsky, 1965; Lenzen, 1973).

As a result of the literature review, a *conceptual framework* is developed focusing on one higher education policy reform area—curriculum reform. The framework adopts a situative perspective that brings together common design principles and instructional quality dimensions and features of SCLEs to be considered when analyzing, designing, and implementing powerful SCLEs in educational settings (see Table 3.3, Sect. 3.5). The framework serves as a starting point and point of reference to structure the research context for the empirical study and to help navigate the empirical research (sub-) questions outlined below.

*Research Question 2*: How do expert instructors in the field of higher education design and bring to life SCLEs that provide students with opportunities for deep learning? (Chap. 5)

The empirical study explores in situ practices in student-centered higher education classrooms. The overall goal is to make visible and understand how learning and instruction are designed and enacted in these classrooms and to inform the theory-building process. More specifically, the analyses of three Harvard case studies uncover a small set of concrete course design elements and instructional quality dimensions/features embodied in the higher education classrooms under study. These design elements and quality dimensions/features inform the construction of a theoretically and conceptually coherent situative educational model. They can also help to account for each of the three purposefully selected, homogeneous cases (literal replication logic), while being general enough to be potentially useful for other cases and learning design efforts (e.g., Engle & Conant, 2002).

Three in-depth ethnographic case studies[10] investigating three different courses offered by expert instructors to prospective teachers enrolled in a Masters of Education program at the Harvard Graduate School of Education (HGSE Ed.M.), Harvard University, USA, were conducted over the course of one semester, respectively, between fall 2009 and spring 2012.[11] The graduate courses were designed as seminars and encompassed between 25 and 38 students who were expected to actively participate in class and collaborate with classmates. Exploring authentic student-centered classroom learning, teaching, and interaction practices provides rare and detailed glimpses into student-centered classrooms in order to carve out and systematize different recurring teaching patterns and specific practices in terms of instructional strategies for the successful facilitation of student sense making. The case analyses of the three cases provide integrated results with regard to four empirical research sub-questions (2a–2d, see Fig. 1.1) that refer to characteristic curricular design elements, instructional strategies (scaffolding processes of knowledge construction and cultivating a classroom community of learners), and teaching and learning challenges.

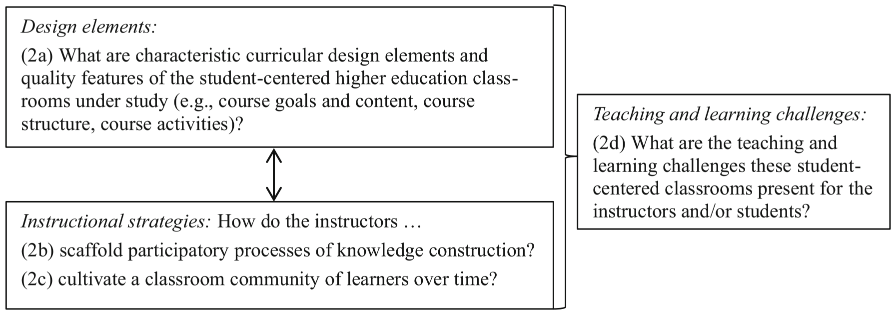


**Fig. 1.1:** Empirical research sub-questions

Finally, a *situative educational model* is presented (Chap. 6) that outlines design elements and instructional quality dimensions and features that are hypothesized to be embodied in powerful SCLEs creating learning opportunities that make it more likely for deep learning to occur. Implications for higher education policy and practice are drawn based on the findings. The overall objective of such learning environments is to develop students' deep conceptual understandings and self-regulation as contributions to their developing strong identities as learners and as increasingly effective participants in the meaningful social practices of their learning communities in higher education and elsewhere in their lives (e.g., Greeno, 1998, 2011).[12]

## Notes

1. The term "higher education institutions" (HEIs) is used as a generic term to cover the diverse establishments providing higher education. The terms higher and tertiary education as well as universities are used synonymously. Currently, the European higher education landscape spans around 4000 HEIs with over 19 million students and 1.5 million staff (European Commission, 2009, p. 22). See the Glossary for an alphabetical list of important educational terms with accompanying definitions used in this book.
2. The terms teacher and instructor, teaching and instruction, and student and learner are used synonymously in this work.
3. Learning sciences research studies learning as it happens in real-world situations and investigates how to better facilitate learning in designed environments (e.g., in schools, in the workplace, or online) and in informal environments (e.g., museums) (e.g., Sawyer, 2014a).
4. The learning environment "includes the people in the environment (teachers, learners, and others), the computers in the environment and the roles they play, the architecture and layout of the room and the physical objects in it, and the social and cultural environment" (Sawyer, 2014b, p. 8).
5. Largely inspired by the Erasmus Programme and the Sorbonne Joint Declaration on Harmonisation of the Architecture of the European Higher Education System (1998), the Bologna Process constitutes a voluntary, intergovernmental harmonization undertaking that was an important driver for higher education reforms in

the last decade and is based on a collective effort of public authorities, universities, teachers and students, together with stakeholder associations, employers, quality assurance agencies, and international organizations and institutions (European Communities, 2009). The Bologna Process aims to create an European Higher Education Area (EHEA), promote mobility and employability of students, and increase the compatibility, comparability, and competitiveness of European higher education systems (Crosier & Parveva, 2013). In March 2010, an Anniversary Conference that marked the end of the first decade of the Bologna Process took place to officially launch the EHEA with meanwhile 47 participating countries.

6. Challenges remain with regard to undertaking curriculum reviews as part of an internal quality assurance process and engaging employers and professional associations in a constructive dialogue to develop curricula, for example (Crosier & Parveva, 2013; EUA, 2010). For a comprehensive discussion of how the Bologna Process unfolded in Swiss higher education, see Müller (2012), for example.
7. Participation-oriented educational practices revolve around high levels of in-class student participation with participation defined broadly as verbal student contributions to class (e.g., asking questions, responding to questions, and making comments). Vocal contributions in small or large groups are seen as a way for students to show their knowledge and understanding (e.g., Dirk, 2010; Sutton-Brady, & Stegemann, 2010).
8. In this sense, this study focuses on the ways in which the individual components of an activity system, that is, of the higher education classroom, act and interact with each other, and it also takes the larger contextualizing systems that provide resources and constraints for those actions and interactions into account (e.g., policy reforms, HEIs) (Greeno & Engeström, 2014).
9. Following Sawyer and Greeno (2009), this work prefers the use of the term "situative" rather than "situated" as the former is less likely to invite the misconception that some cognition or learning is situated and some is not. Instead, it is assumed that learning is always embedded in a situation and knowledge is always stored in connection with the context in which it is constructed. Situativity

theory is used as an umbrella term for situative or situated approaches (e.g., Schuh & Barab, 2008).

10. In this research project, a *case* is defined as a university-level graduate course or in other words, a classroom of students with an instructor. The multiple ethnographic case study research conducted in the context of this research project is also referred to as *empirical study*.
11. The empirical study was carried out at the Graduate School of Education, Harvard University, Cambridge, Massachusetts, USA, under the auspices of both a Marie Curie scholarship awarded by the European Commission in 2009, and a courtesy appointment issued by the HGSE.
12. Practices are, thereby, understood as regular and recurring patterns of activity with the object of activity being the content of the knowledge to be learned (Greeno & Engeström, 2014; see also Sect. 2.1.3.4).

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CHAPTER 2

# Constructivist Foundations and Common Design Principles of Student-Centered Learning Environments

The constructivist perspectives outlined in this chapter contribute important insights about knowing, learning, and instruction, as well as epistemological and theoretical foundations for designing principles-based constructivist learning environments (research question 1, see Sect. 1.3). Section 2.1 differentiates various ways of constructivist thinking by presenting three constructivist perspectives—cognitive constructivism, social constructivism, and situativity theory—and selected learning and instruction models with relevance to teacher education that provide a theoretical foundation for the design of SCLEs. After that, several established design frameworks are discussed that submit well-founded principles for the design of constructivist learning environments proposed by learning sciences research (Sect. 2.2). Finally, common design principles of SCLEs are derived based on a situative constructivist view of learning and instruction (Sect. 2.3).

## 2.1 Constructivist Perspectives and Learning and Instruction Models

Salomon (1997, p. 2) extracts as a common denominator of constructivist perspectives, "Knowledge is believed to be actively constructed, tightly connected to the individual's cognitive repertoire and to the context within which this activity takes place, hence it is *situated*." To what extent, however, the knowledge construction is an individual or a social



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process is disputed in the literature (e.g., Anderson, Reder, & Simon, 1996, 1997; Anderson, Greeno, Reder, & Simon, 2000; Greeno, 1997; Sawyer, 2014a; Tobias & Duffy, 2009a). In this section, characteristics of two more traditional constructivist perspectives and selected learning and instruction models are presented and compared: cognitive constructivism (Sect. 2.1.1) and social constructivism (Sect. 2.1.2).[1] After that, a situative view on cognition and learning that tries to integrate these traditional perspectives with newer ecological and cultural perspectives is introduced (Sect. 2.1.3). In addition, current criticism of and misconceptions about constructivist perspectives are discussed (Sect. 2.1.4).

### *2.1.1 Cognitive Constructivism Focusing on the Individual Mind*

Cognitive constructivism is aligned with Swiss philosopher and developmental psychologist Jean Piaget's (1896–1980) work on cognitive development. Piaget is regarded as the founder of cognitive constructivism, which assumes that "to understand is to discover, or reconstruct by discovery" (Piaget, 1972, p. 20). This means that people learn through exploring the world around them and trying to make sense of the world by developing cognitive structures that reorganize what they know (Schuh & Barab, 2008). Discovery methods with the learner creating meaning and the instructor having a less directive and a more interactive role in designing rich learning environments are aligned with this perspective (e.g., Bruner, 1961). Common characteristics of a cognitive perspective on knowledge construction are outlined below.

#### *2.1.1.1 Common Characteristics*

A cognitive perspective on knowledge construction can be characterized by the following three components (see also Hoidn, 2007):

1. Learning as a cognitive knowledge construction process

Cognitive constructivists focus on the mental structures and processes in the mind of the individual—the perspective of the individual is in the foreground. Cognitive constructivism is a subjective and relativist perspective since knowing is understood as a cognitive activity (Piaget, 1976a, 1976b, 1985; Schuh & Barab, 2008). The individual organizes new experiences based on existing knowledge structures in the form of schemes, that is, mental models that are organized to ever-larger systems or entities.

Knowledge, thus, represents a part of the individual structures, mental representations that can be localized in an individual's head. Intellectual development is considered as an intrinsic process of equilibration—the motive for cognitive growth. The driver of cognitive development is the elimination of cognitive imbalances (perturbations), or in other words, the pursuit of cognitive stability at a higher level (adaptation). Discrepancies arise if the current cognitive structures and the environmental structures do not match. A cognitive conflict, thus, includes a disaccord between experiences and beliefs of the learner and the environmentally mediated experiences. Once the learner becomes aware of such a conflict, an imbalance evolves (disequilibrium) and s/he is made to question old beliefs and concepts, to reevaluate them, and to construct new ones (Duckworth, 1964; Schuh & Barab, 2008). The cognitive conflict is, therefore, a catalyst for initiating the interplay between assimilation and accommodation, two complementary construction processes that constitute the process of adaptation. Assimilation refers to the adaptation of new experiences to the individual's cognitive structure, that is, individuals tend to notice experiences that they can comprehend based on their existing schemes. Thereby, new experiences may be altered in such a way that they fit into existing structures. Accommodation is the process of adaptation of the existing cognitive structures and concepts to new experiences in interaction with the environment. If new experiences do not fit into existing structures, new patterns are formed or old ones are altered, respectively (Piaget, 1976b).

2. Learning and motivation

Motivation theories, such as social cognitive theories (e.g., self-efficacy, motivational self-regulation) and intrinsic motivation theories (e.g., self-determination, interest), focus on individuals and distinguish between learning and motivation. Ryan and Deci (2000, 2002) have developed a self-determination theory as an instrument that not only considers intrinsic and extrinsic motivation, but also distinguishes among different characteristics of extrinsic motivation. The authors emphasize the importance of three psychological needs: perceived competence, perceived autonomy, and perceived social relatedness for intrinsic motivation and self-determined forms of extrinsic motivation in learning environments. Since intrinsic motivation cannot always be assumed, it is the instructor's role to support students based on the different types of extrinsic motivation (e.g., foster competence and autonomy through constructive feedback). Cognitive theories of motivation treat the sociocultural context as one influence factor on an individual's motivation among others. Increased concern with classroom and cultural contexts and their influence on motivation and learning, however, have led to increased attention to contextual factors (Brophy, 1999; Weiner, 1990).

3. Importance of the social and cultural environment
Piaget (1973) sees the confrontation of the learner with his/her social environment as an essential element for the building of cognitive structures (i.e., acting on material things and doing things in social collaboration) (Duckworth, 1964). Piaget (1977/1995) suggests that relationships of cooperation are symmetrical and based on mutual respect. Participants attempt to explain their position on an issue, to understand each other's positions, and to coordinate their views in order to facilitate mutual understanding and knowledge development. Neo-Piagetians, among others, assume that the effectiveness of cooperative learning is due to socio-cognitive conflicts (Doise & Mugny, 1984; Perret-Clermont, 1980). These occur when individuals with more or less equal intellectual capabilities come together with different thoughts, theories, and opinions and have to reach a consensus to solve a problem situation. Different views can lead to perturbations of the cognitive equilibrium of the learners and socio-cognitive conflicts make them aware that there are other solutions than their own. Dealing with other perspectives stimulates intellectual activity because learners are encouraged to examine their own position, present their arguments, and discuss alternatives. Social interactions with peers can, therefore, be considered as a trigger for an individual's cognitive change processes. Nevertheless, the cognitive development of the individual is at the center—the individual is regarded as a potentially independent cognitive subsystem with the context as background for individual activities. The learning environment is considered as a reason and not as a cause for cognitive development (Duckworth, 1987/2006; Piaget, 1973).

The following two instruction models have been independently developed by two of Piaget's disciples to apply his influential ideas in the context of (teacher) education: Hans Aebli's (1980, 1981) model of problem-based construction developed in Switzerland (Sect. 2.1.1.2) and Eleanor Duckworth's (1987/2006, 2001, 2009) model of critical exploration developed in the USA (Sect. 2.1.1.3). The models start with the same philosophical assumptions deeply rooted in Piaget's ideas of learning and thinking as knowledge construction and operational thought and based on findings from cognitive science. Against this background, *learning knowledge deeply* (deep learning) requires learners to relate new ideas and concepts to previous knowledge and experience, integrate their knowledge into interrelated conceptual systems, look for patterns and underlying principles, evaluate new ideas and relate them to conclusions, understand the process of dialogue through which knowledge is created, and reflect on their own understanding and their own process of learning (Sawyer, 2014b). However, the two models draw unique instructional implications for supporting deep learning.

#### *2.1.1.2 Aebli's Model of Problem-Based Construction*

In Europe, Hans Aebli (1923–1990), the Swiss-German disciple of Jean Piaget, edited most of the German translations of Piaget's work. Aebli's foundational work in "psychological didactics" transformed Piaget's work in developmental psychology into an instructional theory and has been widely cited and adopted in teacher training programs in the German-speaking part of Switzerland and Europe (Pauli & Reusser, 2011).[2] Aebli's Piaget-based model of problem-based knowledge construction (1980, 1981) focuses on the nature of the knowledge to be constructed and on the learning functions necessary to develop a well-integrated and applicable knowledge base (Messner & Reusser, 2006; Pauli & Reusser, 2011). In the tradition of a cognitive-constructivist view of learning and instruction, Aebli's model is a teacher-guided, problem-solving approach, aiming at helping students to gain deep and flexible understandings. Hence, Aebli, unlike Piaget, attributed a central role to the guidance and mediation of learning through interaction with the instructor. For Aebli, teacher-guided instructional dialogue was a key element of cognitively guided instruction. The focus lies on the cognitive processes of (guided) individual knowledge construction—Aebli's instructional model is, in essence, individualistic (Pauli, Reusser, & Grob, 2007).

Aebli (1983) recommended the following sequence of four instructional subgoals in order to facilitate knowledge construction and operational thought. These different stages of the learning cycle can help curriculum designers to focus on the learning process, and instructors to focus their teaching practices on the underlying deep structure of students' learning processes (Stebler & Reusser, 2000, p. 3):

1. *introducing* new material by presenting and working on a challenging problem related to students' existing understanding of the subject matter,

2. *working through* the established cognitive structure by solving similar problems with fading teacher support or by fostering different representation formats or solution paths,
3. working on numerous practice problems as *practice to mastery*, and
4. *applying* the integrated knowledge structure or automatized procedure to solve new or different problems (*transfer*).

These instructional subgoals or dimensions of psychological-didactic reflection can be accomplished by combining a variety of teaching-learning methods (i.e., basic forms of teaching). Aebli (1983) suggested teacher-led dialogue and individual problem solving as the main methods. In a teacher-led dialogue, the instructor guides the process of constructing meaning in the whole class asking thinking questions, listening to student responses, and having students reflect on their answers without evaluating them. In phases of individual work, the instructor moves around the room and facilitates individual students' learning by providing tailored support (e.g., providing more challenging problems for individual students) (Stebler & Reusser, 2000).

Aebli suggests that it is less the surface-level features of instruction that are decisive for the quality of instruction. Rooted in cognitive psychology, Aebli's approach suggests instead that didactic decisions have to be based on the deeper level of the quality of students' learning processes (Baer, Fuchs, Füglister, Reusser, & Wyss, 2006). From Aebli's perspective, it is the extent to which instruction is successful in enabling the intended learning processes (deeper-level structures) and less the form of instruction and social interaction in the classroom (surface features of instruction) that is crucial for the quality of instruction. This "learning process orientation" is manifested in a pragmatic approach to different forms of instruction and social interaction in the classroom (both teacher-guided and student-centered instruction). In this perspective, teacher guidance and support of learning activities are compatible with a constructivist understanding of learning (Pauli & Reusser, 2011).

Based on Aebli's model of problem-based knowledge construction and on the cognitive apprenticeship model of learning and teaching, his disciple, Kurt Reusser (2012), has developed two corresponding models that differentiate between both the learning and the teaching process. Reusser argues for a complementary view of the deeper-level learning and teaching functions (Fig. 2.1).

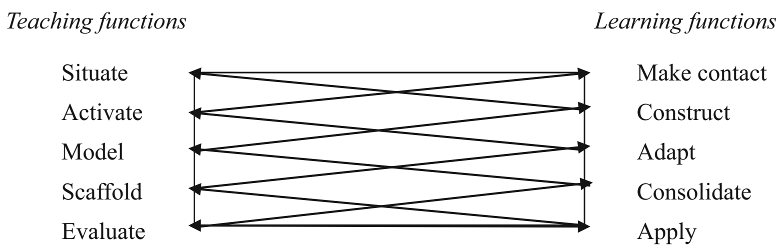



**Fig. 2.1** Learning and teaching functions intertwined (Reusser, 2012; see also Hugener, 2008)

The five *learning functions* are based on different cognitive-constructivist learning principles and conceptions of the learning process. They depict the full sequence of learning functions necessary to arrive at well-integrated and usable knowledge. Learning processes start with making contact ("make contact") with the subject matter and engaging with a problem. In the second step, the cognitive structures of the learner change due to the integration of external elements into evolving or completed structures (assimilation), or due to the transformation of already existing structures (accommodation) ("construct"). In the context of flexible adaptation ("adapt"), the learner works through the established structures, testing whether they can be flexibly integrated with prior knowledge about the subject matter, deepened and linked to existing schemes. Consolidation ("consolidate") of the newly gained knowledge structures occurs through repetition, exercise, and practice. Finally, application ("apply") means that the learner gets to know different ways to apply the integrated knowledge structures and is able to transfer the constructed knowledge to different contexts.

*Teaching functions* incorporate quality features of effective instruction and connect teaching practice with the theories of learning. The instructor creates a learning environment that situates learning goals, tasks, and activities and connects subject matter to students' everyday life ("situate"). The instructor steers students' attention toward subject matter and activates their prior knowledge. In recognizing a problem, students are motivated to engage in problem-solving activities ("activate"). Modeling ("model") refers to the instructor demonstrating a task explicitly (e.g., think aloud, point out challenging aspects) so that students can experience and build a conceptual model of the task at hand. Scaffolding marks the adaptive learning-focused support given by the instructor throughout the learning process. This support fades as the learner gains more competence ("scaffold"). Evaluation means articulating learning outcomes and critically reflecting on the learning process and outcome. Thereby, the instructor can promote metacognitive strategies for problem solving ("evaluate").

Teaching and learning functions are intertwined insofar as each of the five elements of the teaching process influences elements of the learning process and vice versa. Their concurrence describes complete integrative and reciprocal processes. In this way, didactic decisions, that is, adaptive instruction can be based on the deeper level of the quality of student learning processes (Hugener, 2008).

#### *2.1.1.3 Duckworth's Model of Critical Exploration*

Eleanor R. Duckworth, the Canadian-born disciple and leading translator and interpreter of Jean Piaget in the USA, also grounds her work in Jean Piaget and Bärbel Inhelder's insights into the nature and development of understanding and intelligence, and in their clinical research method. Duckworth, a cognitive psychologist, educational theorist, and constructivist educator, has developed the clinical interview method of the Genevan school into a teaching/research approach, called "Critical Exploration in the Classroom." Applied in an educational context, critical exploration as a scientific method can have two levels of meaning, according to Duckworth (1987/2006, p. 159),[3] (1) exploration of the subject matter by the student (instead of only words) and (2) exploration of the student's thoughts by the teacher, that is, striving to understand the meaning an experience holds for the student.

Critical Exploration in the Classroom is a constructivist approach to exploratory learning and teaching that challenges the traditional role of the teacher as the one who imparts knowledge. Duckworth (1987/2006, p. 1, 2001) considers the development of intelligence to be a creative affair and "the having of wonderful ideas" to be the essence of intellectual development. In order for these ideas to arise, it is necessary that teachers are willing to listen to students' ideas and that they provide educational settings suggesting different ideas for different students so that each student can work on a challenging intellectual problem. "Wonderful ideas" can only flourish in an environment where students can generate their own knowledge and where students and teachers are co-learners working alongside each other in the educational process.

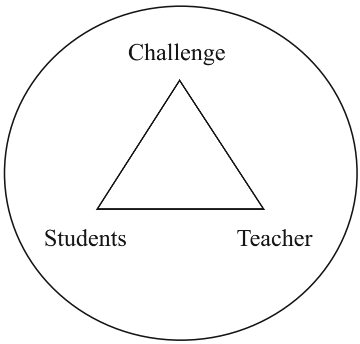
Duckworth's model constitutes a triangular, dynamic relation between three pedagogical core elements: the represented challenge, the teacher, and the students (see Fig. 2.2). These three elements create a dynamic that offers the teacher a window into the ways in which different students go about making sense of a challenge they face (see also Hoidn, 2014).

Below, these three educational components of the model are introduced in more detail.

1. Represented challenge
Students are given opportunities to be in contact with the phenomena related to the area to be studied. A specific intellectual challenge is represented in a concrete form (object), for example, a poem, a painting, a case in economics, materials embodying a problem in physics or mathematics. Thus, the students have something complex and authentic to look at and think about, instead of oversimplified, artificial materials or just spoken words. Interesting materials and activities can engage students' minds by providing occasions where surprise, puzzlement, excitement, patience, caution, confusion, honest attempts, and wrong outcomes are important elements of the learner's intellectual development. These concrete representations or objects can fulfill several educational functions (Duckworth, 1987/2006):

- Providing students with the subject matter itself instead of words allows them to act on material things so that they can discover the specifics of an object for themselves. They can make a connection to the world and assimilate new experiences in ways that make sense to them instead of being presented with the meaning somebody else is

**Fig. 2.2** Three educational components of critical exploration in the classroom



making, "You don't give them *words* about these things, you give them *these things*" (Duckworth in Meek, 1991, p. 32).

- Students have reliable materials at their hands (e.g., a poem) that are the proving ground against which they can develop and assess their own ideas or upon which students and teachers can collaboratively assess each other's ideas and claims to develop shared understandings. The subject matter is the source of authority—without the need for the teacher as an intermediary.
- Students are given opportunities to work on topics and projects that interest them and often construct their own objects. They come up with their own ideas and questions as they make sense out of the phenomena and also pass through confusions and emotions, as they cannot make sense out of the phenomena quite yet.
- Getting to know each other's ideas and seeing each other's confusions can help students and teachers to understand because they might have similar confusions and ideas. Nevertheless, sometimes they experience "how each other's ideas pass right over their heads, and they can't connect with them. Then six weeks later they hear exactly the same idea; and they notice, well, now they can connect with it" (Duckworth in Meek, 1991, p. 31).

2. The role of the students in the learning process

For students to connect to the world, they have to construct their own "wonderful ideas," move their ideas forward via exploration, discuss them with each other, and (collaboratively) evaluate them against materials which provide reliable grounds. In this process, students share with the teacher the responsibility of making sure they understand each other. Therefore, it is a valuable and important cognitive and emotional experience for students to come to their own understanding, not through being told answers, but through the power of their own minds—often in interaction with others. An exploratory learning environment "supports learners in constructing their understanding about a specific subject through learner-driven reflective inquiry" (Rick & Lamberty, 2005, p. 180). Exploratory learning has its roots in the works of John Dewey, Jean Piaget, Friedrich Fröbel, and Maria Montessori. Work relevant for exploratory learning environments has been done in educational theory (e.g., Bruner, 1966), educational technology (e.g., Papert, 1993; Resnick, Bruckman, & Martin, 1996), and educational psychology (Duckworth, 1987/2006).

Exploratory learning activities are more open in nature allowing students to explore the educational material available and, according to Duckworth (1987/2006, p. 67), can lead them to

- explore challenging questions and figure things out based on their own interests;
- bring their prior expectations and knowledge about a subject matter to the learning experience and then make a connection from the subject matter to what they already understand to reach an understanding of the subject matter and thus, expand their connection to the world;
- wrestle with their own ideas about a subject matter with confusions and conflicts being seen as valuable aspects of learning;
- try to make sense by testing ideas and posing questions, by thinking out loud and explaining what they think and why in a convincing fashion, and in the light of the phenomena they are trying to understand;
- have the courage to submit an idea of their own to someone else's scrutiny. Students form their own ideas, share what they think, see how their ideas relate to the ideas of others, and are open to the questioning of their peers; and
- have or develop a great sense of confidence in their own minds, when they get their minds around their own puzzling questions and ideas and see that their ideas can work out and can be of interest to other people.

3. The role of the teacher in the learning process
The student's learning is the focus of teaching and the teacher's role is to help students learn. Understanding requires searching thought about the nature of the subject matter on the part of the students and avoiding "technical words" to open a variety of connections to the subject matter. A teacher cannot assume that students have understood something because s/he has led them through it very carefully (Duckworth, 1999). Telling is not effective, especially when it comes to promoting higher-order thinking processes, as Duckworth (in Meek, 1991, p. 30) points out, "telling people what they ought to understand has very little impact on what they actually understand. You have to put them in a situation where they develop that understanding—it's not going to happen from your telling

them." Duckworth (1987/2006, 2009, see also Hoidn, 2014) emphasizes the following two important aspects with regard to the role of the teacher that are essential in helping students learn:

- The way teachers *use their own subject-matter knowledge*, as curriculum planners and as teachers: the teacher plans how to engage students' minds in exploring the subject matter, puts students in direct contact with the subject matter, and puts authentic materials in the students' hands. The teacher keeps them attending closely to the material—the real thing—related to the area to be studied and s/he gives them the space to explore what is interesting to them so they will continue to think and wonder about the subject matter. A good teacher knows how to get students interested in a subject matter/problem and keeps them interested in it (Duckworth in Meek, 1991).
- The way teachers *focus on the students' thoughts* rather than their own: the teacher has the students explain the sense they are making and provides them with the time to create their own meaning while s/he is observing and listening. S/He listens genuinely without trying to guide students' explorations by asking, for example, "What do you think?" S/He keeps trying to find out and understand what sense the students are making and helps them to develop their ideas further, offering new aspects for consideration while, at the same time, assessing and monitoring their progress. The teacher attends to them with the neutrality of a researcher by reacting to the substance of students' answers without judging them. S/He invites students to talk and establishes their feeling of self-confidence instead of explaining things to the students and imposing his/her knowledge.

#### *2.1.1.4 Summary*

Rooted in cognitive psychology, the two cognitive-constructivist models suggest that it is the quality of students' learning processes that is of utmost importance for instruction to enable the intended learning processes. Both focus on students' cognitive processes of individual knowledge construction with learners playing an active role in their learning processes. They also emphasize the importance of a deep quality of students' learning processes through independent problem solving and higher-order cognitive activity. Yet, despite similar views on the importance of the knowledge construction process, the models differ in terms of what kind and how much instructional guidance they propose to help students learn.

Aebli's model of problem-based knowledge construction provides four stages of the learning cycle—introduce, work through, practice to mastery, apply, and transfer—that can help to focus instructional practices on the underlying deep structure of students' learning processes. His disciple Kurt Reusser has developed these ideas further and differentiates between sequences of learning and teaching functions that are intertwined and crucial to arrive at well-integrated and applicable knowledge. Although Aebli's instructional theory is compatible with various instructional methods, Aebli—unlike Piaget—proposes a teacher-guided problem-solving approach in the form of either a teacher-guided instructional dialogue (whole class) or individual problem solving to foster students' learning processes, with a preference for the former. He emphasizes guidance and mediation of learning through teacher-led problem solving with the goal to facilitate deep and flexible conceptual understanding.

Duckworth's teaching/research approach, called "Critical Exploration in the Classroom," supports a move toward students' greater intellectual involvement by considering the learners to be active explorers building their own understanding, while the teacher acts as a facilitator to assist the learners' inquiries. The teacher's responsibility is to develop explorable curricula and to create a classroom environment where learners' thoughts generate the intellectual life of the classroom, while the teacher shows interest in what students are saying, and provides some direction through environmental resource selection (assignments, materials), activities, and genuine questions to further students' engagement. In short, in the course of the educational process, engaging learners in phenomena and keeping them engaged as well as inviting students to express their thoughts/ideas and working to understand the sense they are making are the main aspects of teaching.

### *2.1.2 Social Constructivism Focusing on Interactions among Individuals and Society*

Social constructivism[4] is closely linked to the Russian psychologist and philosopher Lev Vygotsky (1896–1934), who emphasized the influence of the physical, social, and cultural context on cognitive development. Learning is regarded as a discovery process in the context of social interactions, with the teacher playing an active role in scaffolding students' learning processes based on what they currently know (Schuh & Barab, 2008). Common characteristics of a social perspective on knowledge construction are outlined below.

#### *2.1.2.1 Common Characteristics*

A social perspective on knowledge construction can be characterized by the following three components (see also Hoidn, 2007):

1. Learning as a social knowledge construction process

Learning and cognitive development cannot be separated from their contexts, as cognitive and social processes are linked by the genetic law of development according to Vygotsky (1978, p. 57), "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, *between* people (*interpsychological*), and then *inside* the child (*intrapsychological*)." Accordingly, the construction of knowledge takes place in two stages: through socially-situated interaction with other people and tools and through the integration of knowledge construction processes implicit in the interactions and communications into the mental structure of the learner. Cognitive structures are therefore inextricably linked with the sociocultural environment and are socially constructed; knowledge is, thus, perceived as socially shared and distributed in tools and concepts (Salomon, 1993). Knowledge construction is not an individual but a shared experience based on social negotiations. Knowledge resides in the context of its use and learning involves meaningful participation in the practices that characterize a knowledge community (Hickey & Zuiker, 2005). The potential for cognitive development lies in the zone of proximal development (ZPD) that denotes those tasks that an individual cannot do alone but with the social and material support of the learning context.[5] The learner engages at the upper limit of his or her ZPD with the teacher who uses instructional scaffolding to increase the learner's competence (Vygotsky, 1929, 1978; see also Schuh & Barab, 2008). An individual extends his/her cognitive knowledge through ongoing participation in activities of collective knowledge construction and further development of external knowledge bases.[6]

2. Learning and motivation

Sociocultural theories of motivation focus strongly on the role of the sociocultural context, that is, on the relationships that students have with participants in the classroom and cultural context, instead of primarily on either the behavior or the cognition of individuals. These theories suggest that students' engagement in learning also depends on the different relationships that the students develop while negotiating and coordinating goals and norms among themselves or with the instructor. In order to support students' motivation, instructors need to help the classroom community to negotiate valuable goals providing them with opportunities to collectively create, monitor, and change these goals (Hickey & Zuiker, 2005; McCaslin, 1989). Learning, thus, relies on the interactions in which the person participates and the motivation to learn is both intrinsic (internal drive) and extrinsic (e.g., rewards by the learning community).

3. Importance of the social and cultural environment
The sociocultural environment and the social processes of interaction and participation, respectively, are sources of development and not just conditions. Culture provides the learner with the necessary psychological and physical tools or artifacts (such as language) developed in response to social, cultural, and historical construction processes to support his/her cognitive development. Thus, these tools also hold intelligence; they save knowledge and are carriers of knowledge so that knowledge is distributed in the physical, social, and cultural environment (Salomon, 1993). Learning that appears in the context of cooperative learning lies in the social problem-solving process that is internalized by the individual learner who, thus, reaches a level that slightly exceeds his/her current stage of development. This shifts the ZPD insofar as the learner can conduct steps alone in the future that s/he can currently only handle with the help of "more knowledgeable others" (Vygotsky, 1978). That is why social-constructivist learning theories emphasize the interaction with more competent partners. Learning using the support of more competent partners is also known as scaffolding meaning "the help given to a learner that is tailored to that learner's needs in achieving his or her goals of the moment" (Sawyer, 2014b, p. 9). If the support lies in the zone of proximal development, the amount of challenge is appropriate for students in order to learn (Dubs, 1999; Pea, 2004; Van de Pol, 2012; Wood, Bruner, & Ross, 1976). Learning is, thus, systematically encouraged by significant others and internalized in the course of development. The cognitive activity system consists of the individual as well as of the physical, social, and cultural learning environment and their reciprocal relationships (Schuh & Barab, 2008). As pedagogical (content) knowledge experts, instructors can elicit responses from students to support thinking and problem solving and are highly responsive to students' contributions by engaging in (a) modeling, scaffolding, and fading, that is, content-specific ways of providing hints, strategies, and situational forms of guidance tailored to the needs of the students, or (b) prompting, that is, a more content-neutral invitation by

the instructor to elicit elaborations, reflections, and self-explanations from students (Collins, Brown, & Newman, 1989; Reusser & Pauli, 2015).

The learning-community approach introduced below is supported by social-constructivist theories of learning as put forward by Dewey and Vygotsky. Communities of learners models propose quality dimensions of classrooms aiming to foster deep disciplinary understanding of both subject matter and ways the disciplinary community works with knowledge in a domain.

#### *2.1.2.2 Communities of Learners Models*

Community of learners models suggest that it helps students' learning if they tackle complex problems, figure out things for themselves, communicate and work together with people from diverse backgrounds, and share their knowledge with others.[7] These models present a radical departure from the traditional view of schooling insofar as they aim to instill a culture of learning in which everyone is involved in a collective effort of understanding, with students and instructors engaging in new modes of inquiry (Bielaczyc & Collins, 1999; Bielaczyc, Kapur, & Collins, 2013). According to Bielaczyc and Collins (1999), such a learning culture has four characteristics, diversity of expertise among its members, who are valued for their contributions and given support to develop, a shared objective of continually advancing the collective knowledge and skills, an emphasis on learning how to learn, and mechanisms for sharing what is learned.

Bielaczyc and Collins (1999; Bielaczyc et al., 2013) lay out several quality dimensions of classrooms that are organized as learning communities.

1. *Community goals*: the overall goal is to foster a culture of learning where students and the community as a whole are learning how to learn. Students see themselves as contributors to their own and the community's deeper understanding of a subject matter. They synthesize multiple perspectives, use a variety of ways to collaboratively solve problems, reflect on their learning and come to respect and value differences within the community.
2. *Learning activities*: the activities of learning communities allow students to gain content knowledge (CK) and are means of helping students learn how to learn so that they can become flexible problem solvers. These activities need to provide means for (1) individual development and collaborative knowledge construction, (2) sharing

knowledge and skills among community members, and (3) making learning processes visible and articulated. Hence, a variety of learning activities are applied in the classroom, such as class discussions or group work, to solve problems, with students creating artifacts or presentations that display both what is learned and the ways of learning.

3. *Teacher roles and power relations*: the teacher organizes and facilitates more student-directed activities, that is, activities that are driven by students' ideas, questions, and interests, or by certain students who have expertise in certain areas. In this way, students become more responsible for their own learning progress and the learning progress of others. Yet, there are also certain activities where the teacher or guest experts guide students more closely. Overall, the student–teacher power relationship shifts as the teacher's language is less directive and students are more involved in decision-making in the classroom and have more choices (e.g., open-ended assignments) (Weimer, 2013).
4. *Identity*: an individual's identity refers to how one sees oneself and how one is perceived by the community (Bielaczyc et al., 2013). Students' sense of identity is influenced by the degree to which they perceive themselves as central and respected members of the community (e.g., one's contribution is recognized, built upon, revoiced by the teacher). A learning-community approach aims to ensure that all students are making contributions to the community, supporting each other, and their contributions are valued (Lave & Wenger, 1991). Thereby, individual students can play a more central or peripheral role in contributing to the collective activities and knowledge of the community, depending on the learning situation. The class as a whole also develops a sense of a community identity working toward common goals, building a collective understanding and joint products, and becoming aware of the contributions that members make to support the community.
5. *Resources*: learning communities view both the members themselves and the collective knowledge and skills of the community (including the teacher) as legitimate resources. In addition, they use resources from outside of the classroom, such as disciplinary experts or the web, and they share both the content learned and the processes of learning with these resources to develop collective understanding.

6. *Discourse*: classroom-based learning communities develop a language for describing ideas and practices (e.g., learning processes, plans, goals, and assumptions) through interaction with different knowledge sources and through co-construction and negotiation among the members of the community. Discourse in class discussions functions as a medium for formulating, exchanging, and arguing about ideas to expand the learning-community's knowledge (e.g., raising questions, explaining, and making comments). Written discourse is another option to exchange ideas and critique each other's work by providing written comments.
7. *Knowledge*: learning communities develop a rich knowledge base centering around key principles and ideas in a domain generative for understanding broader topics. They emphasize the development of both diverse individual expertise and collective knowledge, including meta-knowledge about both the subject matter and students' learning processes. For example, students are encouraged to engage in a discourse about their own and the community's progress in understanding (e.g., what they have learned). Thereby, there is a circular growth of knowledge between individuals and the collective as discussions lead individuals to seek out further knowledge that they then share with the community.
8. *Products*: the students work together to produce artifacts or performances that further the community's understanding, leaving tangible records of shared, collective knowledge. In order for the envisioned learning products to focus the energy of the entire class on a joint effort which also helps to build community, students have to concentrate on meaningful learning and set subgoals. Students who adopt learning goals instead of (product-focused) performance goals learn more from their mistakes and pursue learning in the face of failure (Dweck, 1986).

Against this backdrop, cultivating a classroom community of learners requires changes in the following aspects of classroom life to support students engaging in peripheral participation in a community consistent with its disciplinary norms and practices (Bielaczyc et al., 2013).

*Curricular content*: although the instructor may frame the community inquiry, students' ideas, questions, and arguments drive the path of inquiry during subsequent explorations and class discussions, so that students can learn from the diverse investigation paths. Student work is kept and serves, then, as a resource to the community to further its understanding.

*What students do*: students are playing a discipline's "epistemic games" as a collective to build joint understanding and gain insights into the workings of the disciplinary community. Epistemic games intend for students to "develop a repertoire of disciplinary knowledge moves, and be able to engage in meta-discourse concerning the nature of these moves, along with the forms, goals, and rules of the knowledge work" (Bielaczyc et al., 2013, p. 7).

*What teachers do*: teachers have to become adept at engaging in pedagogical moves at both the individual and collective level to respond to student needs. This includes scaffolding participation so that students can develop agency and take responsibility for the community inquiry and for the progression of the collective's understanding. Strategies such as "accountable talk" can help to facilitate productive discourse (Michaels, O'Connor, & Resnick, 2008).

*The identity of the students and teachers—individual and community identity*: students learn through contributing their expertise to advance the work of the collective (individual identity) while the community works together to solve joint problems (community identity). Developing identity within a classroom takes time, as students need to be enculturated as participants in a disciplinary community. As they progress toward becoming more fully participating members in the practices of the community, they develop their identities further (Collins & Greeno, 2011; Lave & Wenger, 1991).

*The contextual landscape*: the contextual landscape is an integrated mutually reinforcing system that involves the social structures of the classroom, that is, norms and practices, means for participating in shared activities, and ways of accessing various technical elements. Physical artifacts and cultural practices embody a particular epistemology that biases different ways of knowing (e.g., more participatory ways of learning). Hence, the contextual landscape of the classroom has to be designed in a way so that its social infrastructure reinforces the epistemologies of a learning-community approach (e.g., Bielaczyc, 2006).

Overall, cognitive constructivism and social constructivism represent two traditional perspectives on learning and instruction that try to explain the relationship between context and cognitive development. The main features of these two perspectives are summarized below (see Table 2.1). Instruction models based on these two perspectives differ as they either use the processes of individual cognition as the basis and explain interactions with the environment in terms of individuals' perceptions, goals,

**Table 2.1** Cognitive versus social perspective on constructivist learning and instruction

| | *Cognitive perspective* | *Social perspective* |
|---|---|---|
| Knowledge | Cognitive structures are actively constructed by the learner based on his/her preexisting understandings (knowledge is located in the mind of the learner) | Knowledge is actively constructed in the context of social negotiation processes and is context-bound (knowledge is distributed among learner and environment) |
| Learning | Individual assimilation and accommodation (adaptation process); Self-regulated problem solving/ discovery | Collaborative assimilation and accommodation; Integration into an expert community (enculturation) |
| Motivation | Equilibrium as a driver; Socio-cognitive conflicts require an intrinsic desire of the learner to adapt | Motivation is both intrinsic (internal drive) and extrinsic (rewards by the knowledge/learning community) |
| Interaction | Peer interaction (intellectually equal); Socio-cognitive conflicts as stimuli, individuals as knowledge holders | Peer interaction (more competent persons); Social negotiation processes as sources, sociocultural environment as knowledge carrier |
| Instruction | Structured learning environment, challenging problems, taking the learner's preexisting knowledge into account | Support of the development of learning communities and collaborative learning, scaffolding, use of artifacts |
| Focus | Knowledge construction, competence, reflection, individual | Knowledge application (transfer), performance, interaction, context |

and inferences or they consider the processes of interaction as the basis (e.g., community of learners) and explain individual cognitions and other behaviors in terms of their contributions to interactive systems.

Controversies in 1990s led to the important finding that cognitive acquisition-orientated views of learning (Piaget, 1985) and interaction approaches (Dewey, 1938; Vygotsky, 1929, 1978) do not exclude, but instead *complement* each other. Hence, with the efforts by situativity theory to integrate these two lines of research having been under way for over a decade now, it is crucial to understand both of these more traditional constructivist perspectives (e.g., Anderson et al., 2000; Collins & Greeno, 2011; Greeno, 2011; Klauer, 2006; Salomon & Perkins, 1998).

### 2.1.3 Situativity Theory and Situated Models

Emerging from anthropology, sociology, and cognitive science, situative approaches see cognition, knowledge, and learning as situation-bound and underline the importance of the social and physical aspects of learning. The foundation for the Situated-Cognition-Movement was laid by an article written by Brown, Collins, and Duguid (1989, p. 32) who posit that, "*knowledge is situated*, *being in part a product of the activity*, *context*, *and culture in which it is developed and used*." Situative approaches assume that knowledge exists not only as an abstract unit in the head, but is also located in the relationship between the individual and the sociocultural environment and is reflected in products, tools, or resources such as worksheets, calculators, and books. One of the strengths of situative views on cognition is their capacity to integrate individually distributed and socially constructed knowledge by considering information processing as an aspect of interaction in activity systems (Greeno, 2011).

#### *2.1.3.1 Situative Views on Cognition and Learning*

The common goal of situative views of learning is to empower learners through social and contextualized learning to develop from novices to experts so that they can flexibly apply their knowledge in real-life situations. Knowing is, then, understood as "successful situated participation (…) a capability of the person to interact in the world" (Collins & Greeno, 2011, p. 64). The focus is on the expansion of opportunities for participation in a social context and on the development of an identity as competent and responsible learners that are shaped by the different practices in the classroom in which students learn (Greeno, 1997; Lave, 1988; Lave & Wenger, 1991). Learning is "a process through which individuals participate in the practices of a particular activity by interaction with resources (other members, artifacts, etc.) in the setting" (Gresalfi, Martin, Hand, & Greeno 2009, p. 68). In the classroom, learning manifests itself in more effective participation in practices of inquiry and discussion (Greeno, 1998).

In addition to cognitive acquisition-oriented views and interaction approaches, two more research traditions have contributed to shape the situative perspective on cognition, (1) Ecological perspectives emphasize the distributed nature of cognitive phenomena and the interaction between people and the resources in the environment (physical world). Cognition is viewed "as an integral part of the physical, social, and cultural contexts to which it belongs" (Derry, 1996, cited in Schuh & Barab, 2008, p. 75).[8]

(2) Cultural perspectives highlight the important role of cultural practices for learning (Cole & Wertsch, 1996; Nasir, Rosebery, Warren, & Lee, 2014; Rogoff, 2003). Individuals are involved in legitimate peripheral participation within the practices of a community in order to learn with knowing, identity, and context involving the whole person and constituting reciprocal relations (Lave & Wenger 1991).[9] Learning is understood as

> an evolving form of membership where the learner also reproduces and transforms the community of practice of which they seek membership (…) Becoming knowledgeably skillful involves appropriating the practices of the community, emphasizing community-defined practices of the community, emphasizing community-defined practices that wed individuals to a community, instead of cognitive processing. (Schuh & Barab, 2008, p. 79)

In stressing the importance of context and social interaction, situativity theory has also stimulated research on learning and instruction in real classrooms using a variety of quantitative as well as qualitative research methods (De Corte, 2010). Recent classroom research suggests that the design of learning environments based on a situative perspective entails both meaningful and challenging problems and socially supported constructive learning processes. These enhance students' cognitive, metacognitive, communicative, motivational, and emotional learning outcomes, including interests and beliefs that are important for SRL and independent problem solving (De Corte, 2003; Franke, Kazemi, & Battey, 2007; Pauli et al., 2007; Reusser, Pauli, & Waldis, 2010). Instructors are not only sensitive to what students know and understand but also to how students are able to participate in inquiry, discourse, and reasoning, and how they can facilitate a more effective participation in these practices. In such classrooms, instructors and students are collaborators in the construction of their shared understandings of a subject matter (Collins & Greeno, 2011; Greeno, 1998).

Situative views consider learning motivation as collective engagement in meaningful shared activity where students and instructors successfully negotiate a shared understanding of language, concepts, and methods of authentic domain knowledge practices. Through this collaborative process the standards, goals, and values that motivate individual learning are socially constructed and bound to the original context of the particular academic domain in which they were constructed. Motivation is, then, primarily understood as "the collective desire to participate meaningfully in the co-construction of understanding" (Hickey & Zuiker, 2005, p. 291).

For example, if the learning community does not value participation in the practices of the domain engaged, participation is less likely. Thus, motivation resides in activities that resemble the actual practices of the knowledge domain with the students striving to participate more meaningfully in the practices of those communities (Hickey & Zuiker, 2005).

Situative classroom studies that focus on engaged participation in classroom interaction have used concepts such as activity systems, participation structures, discourse practices, and conversational contributions to analyze patterns of interactions in different learning environments. Research results suggest that deep conceptual understanding requires trajectories of understandings building from knowledge and skills that students bring to the table and depends on the kinds of activity the learner gets to participate in (e.g., cognitive task demands, collective inquiry), as well as on the ways students are positioned for participation in interactions (e.g., Engle, 2006; Engle & Conant, 2002; Engle & Faux, 2006; see also Engle, 2011 for an overview of design-based research projects). In this view, for example, conceptual learning results in the capacity to formulate arguments that use concepts and principles of the domain and in changes in discourse practices during problem solving (Greeno, 2006).

The culture in these learning environments that are based on a situated perspective of learning and instruction differs from traditional instruction with regard to not only the instructor's behavior and the organization of the lesson, but even more so with regard to the kinds of teaching and learning activities, the quality of the learning tasks, the participation structures, the discourse practices, and the social norms that regulate behavior in the classroom and constitute the relationships between students and instructor (Pauli et al., 2007). Against this backdrop, *activity theory* provides a broader view on classrooms as activity systems in line with a situative view of learning and cognition, incorporating concepts of practices enacted in these systems that can support conceptual understanding (Engeström, 1987).

#### *2.1.3.2 Activity Theory: Classrooms as Activity Systems*

Situativity researchers within education have begun to investigate learning in complex social situations, such as in real classrooms, to learn more about the activities that take place in these learning environments as well as about the changes of the activity system as a whole. An activity is the basic unit of analysis within an activity system used to understand individual learners' actions. Building on Vygotsky's theorizing, Engeström (1987) has developed activity theory, a pragmatic framework that provides an lens to analyze and examine learning processes beyond the individual learner without losing sight of the individual (subject) as one component of the entire system (Greeno & Engeström, 2014).[10] More specifically, activity theory is a descriptive tool that offers a lens for a sociocultural analysis of activities focusing on the entire activity system. The framework is inherently a dynamic structure continuously undergoing change and can help to understand how its different components impact activity. This section characterizes classrooms as activity systems and introduces concepts of practices in activity systems that can be used to analyze and design learning and instruction in the classroom to foster understanding.[11]

At its core, the theoretical framework comprises three major components of an activity system (see Fig. 2.3)

- A *subject* (or the agency of the participants), referring to an individual or a group of individuals who participate as a part of the community.
- An *object*, referring to what the subject works on (e.g., learning product, experience).
- *Resources* (mediating instruments or tools), which the agent uses to transform the object toward a desired outcome. The *outcome* refers to intellectual tools and patterns of collaboration (e.g., technology, documents, language).

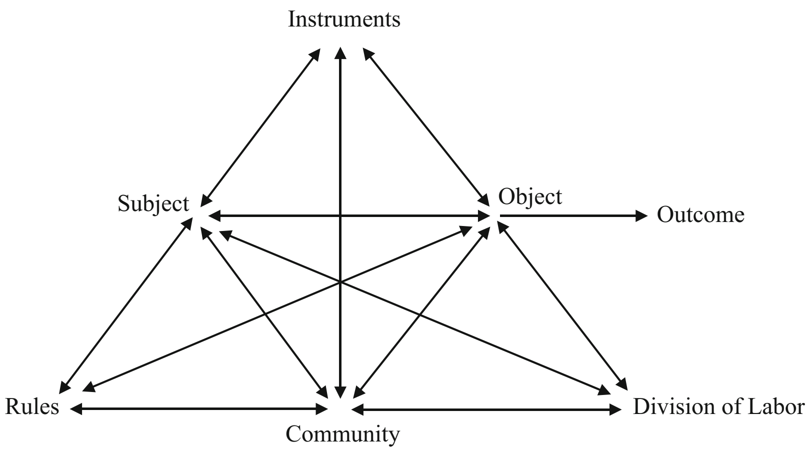



**Fig. 2.3** The structure of an activity system (Engeström, 1987, p. 78)

However, to fully explicate the social and collaborative nature of the actions of participants, the instructor has to create facilitating conditions such as useful discourse practices that position students in a way so that they have more productive agency in their learning processes. Hence, three more components are of importance

- *Rules* refer to a set of explicit guidelines, conditions, and implicit social norms that regulate activities in the system.
- *Community* comprises all participants in the activity system (the collective).
- *Division of labor* refers to the division of activities among actors in the community.

Activity systems are interrelated with the individual-level learning that participants undergo as they learn by participating in activity systems such as classrooms. The learning outcomes are the results of this participation (e.g., Bowers, Cobb, & McClain, 1999; Engle, 2006). In this view, reasoning and problem solving are carried out by activity systems which comprise people and resources so that both the individual and the collective learn. In addition, the activity system as a whole also changes over time and thus, learns, insofar as current patterns of joint activity (e.g., rules, routines) may change and new one's may evolve in problem-solving discourses (e.g., as suggested by the concept of distributed cognition; Hutchins, 1995; Salomon, 1993).

#### *2.1.3.3 Semantic Versus Systemic Principles of Interactions*

Overall, activity theory has the capacity to contribute to the development of a more integrated theory that includes information structures (content of interaction, the task) and interactional processes (process in which information structures are generated, social aspects of interaction) as suggested by Greeno (2011) and Greeno and Engeström (2014). Cognitive processing is considered as an aspect of interaction in activity systems and information is assumed to be constructed in processes of interaction in activity systems. Hence, constructive processes of understanding and reasoning occur in conversation through the joint actions of participants. In this view, an analysis of sequences or episodes of interaction has to consider both, *information structures* or "semantic principles of interaction" and *interactional processes* or "systemic principles of interaction."

Table 2.2 below presents an analytical scheme that provides a lens for understanding semantic principles of interaction involving ways of achieving coherence of information, and systemic principles involving ways in which students are positioned in interaction that function integrally (Greeno, 2006, 2011).[12] The left column depicts common topics for the analysis of cognition in activity with varying levels of aggregation in terms of the complexity and timescale of the activity that is analyzed (from 1 to 4). The right column depicts corresponding situative concepts used in current classroom research to analyze interactional processes that are hypothesized to occur at the level of activity systems (Greeno, 2011).

In student-centered classrooms, students are positioned with more productive agency in classroom activities in relation to the instructor,

**Table 2.2** Situative analysis—cognitive phenomena versus situative concepts (Greeno, 2011, p. 42)

| | *Cognitive phenomena studied* | *Situative concepts for analysis* |
|---|---|---|
| (1) | – Routine comprehension<br>– Conceptual understanding<br>– Problem solving, including performing procedures, search in problem spaces, reasoning, planning, skill acquisition | – Conversational contributions, mutual attention, understanding propositions, and reference<br>– Conceptual common ground, patterns of reasoning in practice<br>– Shared repertoire of schemata and procedures |
| (2) | – Emergent understanding | – Negotiating different interpretations for mutual understanding<br>– Problematizing, resolving, and positioning in interaction<br>– Explaining |
| (3) | – Adopting tasks<br>– Expending effort toward accomplishing goals | – Practices that encourage problematizing and resolving<br>– Practices that position students in disciplinary discourse with competence, authority, and accountability in participation structures |
| (4) | – Conceptual growth<br>– Commitment to learning goals<br>– Sustained, persistent participation in learning practices | – Changes in discourse practice; legitimate peripheral participation<br>– Intellective identities (e.g., academic learning, learning in specific subjects) and positional identities in classrooms (e.g., mutual engagement and productive agency in relation to a community's joint learning enterprise) |

each other, and to the subject matter being discussed as compared to more traditional classrooms with an elicitation pattern known as IRE: the instructor initiates a question to which s/he already knows the answer (I), followed by a short student reply (R), and an instructor evaluation of the student's response (E) (Cazden, 1988; Mehan, 1979). Gresalfi et al. (2009; Greeno, 2011) distinguish two general aspects of students' positioning (or framing)

- *Semantic positioning* refers to the distribution of agency. There are two different types of agency: *conceptual agency*, in which the individual makes choices and judgments involving meanings and appropriateness of methods and interpretations (e.g., questioning concepts, using methods in new ways), or *disciplinary agency*, in which students are only involved in the performance of procedures that are already established in the practices of the discipline (Pickering, 1995). Conceptual agency requires students to engage in an effort to construct mutual understanding in their common ground.
- *Systemic positioning* in relation to other students and the instructor in the class involves the degree to which a student is entitled and expected to initiate contributions, to question or challenge proposals that are made by others, and to be given satisfactory explanations of meanings and methods involved in instructional tasks. The instructor engages with students in talk which has "dialogic" features (e.g., students have opportunities to express their ideas; Alexander, 2008; Mercer, Dawes, & Kleine Staarman, 2009). The way in which students are positioned in the participant structures of learning activities is also an important aspect of their identities and thus, central to deep learning (Collins & Greeno, 2011; Philips, 1972).

#### *2.1.3.4 Concepts of Practices in Activity Systems*

A situative analysis makes use of concepts of practices in activity systems. Concepts can be defined as a "family of interrelated constraints and affordances that functions in organizing some aspect of the community's activities" (Greeno & Van de Sande, 2007, p. 12). These more or less explicit concepts of practices characterize the patterns of activity that a community of learners engages in and that new participants have to learn in order to move toward fuller participation in the community's practices.

The following concepts uncover regularities in activity rooted in a situative view on cognition and learning that are of particular interest to student-centered classrooms that engage students in participation-oriented activities: dialogic discourse practices, norms of interaction, and affordances of the learning task.

1. Dialogic discourse practices
Dialogic discourse practices of co-constructive learning in a classroom community can be characterized as teacher–student talk or student–student talk (Mercer & Hodgkinson, 2008; Mercer & Howe, 2012; Reusser & Pauli, 2015).

*Teacher–Student Talk*: Dialogue-oriented forms of classroom interaction in the context of whole class teaching aim to foster students' deep understanding of concepts and practices of a discipline. Evidence indicates that discussion-based classroom practices that carefully orchestrate tasks with high-level cognitive demands (e.g., problems that support multiple positions or solution paths) and teacher-guided discussions can support the acquisition of both disciplinary knowledge and students' capacity to engage in reasoned discussions (Resnick, Michaels, & O'Connor, 2010). In order to implement more dialogic structures, instructors can utilize theoretically substantiated concepts and related tools. Concepts of practices such as "problematizing" (Engle & Conant, 2002) "dialogic teaching" (Alexander, 2008), "accountable talk" (Michaels et al., 2008; Resnick et al., 2010), or "academically productive talk" (Chapin, O'Connor, & Anderson, 2009) provide instructors with strategies to foster a more dialogic culture of interaction in their classrooms. The concept of "accountable talk," for example, grew out of a Vygotskian theoretical framework that emphasizes the importance of social interaction for students' learning. A teacher poses a question and subsequently presses students to develop explanations, challenges, counterexamples, and further questions in order to socialize students into communities of practice in which respectful and grounded discussions are the norm (Michaels et al., 2008; Resnick et al., 2010). *Accountable talk* is a structured talk that combines accountability to disciplinary knowledge (e.g., students make references to readings or earlier contributions, use and explain disciplinary terms appropriately, ask for factual information, elaboration, rephrasing, or examples) with accountability to reasoning (e.g., students use reasons, examples, and analogies to support claims and challenge each other's reasoning) and accountability to the community (e.g., high amount of student talk and attentive listening, students build upon each other's contributions, or ask each other questions). Various conversational teacher moves, such as challenging students ("What do you think?"), verifying and clarifying ("So, are you saying...?"), or pressing for reasoning ("Why do you think that?") can promote accountability to community, knowledge, and rigorous thinking (Michaels, O'Connor, Hall, & Resnick, 2010). In the context of classroom interaction, accountability can also be distinguished referring to both what students are supposed to know (be accountable for) and whom students are expected to convince (be accountable to) (Gresalfi et al., 2009). Classrooms, in which students are accountable to their classmates as well as their teachers, require the students to convince both the instructor and their peers that their ideas make sense. Accountability requires the teacher to frame students' contributions in ways that attribute authorship to them rather than to other sources (i.e., to distribute authority) and that position students with agency so that they can perceive themselves as competent.

*Student–Student Talk*: Productive talk between students refers to collaborative learning activities that are characterized by rather symmetrical relationships between students working in groups in a "teacher-free" dialogic context. An elaborate discourse practice that guides such co-constructive talk is "exploratory talk"—as opposed to disputational and cumulative talk (Barnes, 2008; Barnes & Todd, 1977; Mercer, 1995; Mercer & Dawes, 2008). The concept of *exploratory talk* represents "a joint, co-ordinated form of co-reasoning in language, with speakers sharing knowledge, challenging ideas, evaluating evidence and considering options in a reasoned and equitable way" (Mercer & Howe, 2012, p. 16).[13] Exploratory talk can help to create a situation where the tentative expression and evaluation of ideas is a collective enterprise of students co-constructing the reasoning process. Exploratory talk refers to cooperative interactions, including questioning of one's own and others' assumptions, outlining reasons for claims, making explicit evaluations and critiques, and engaging in persuasion (Atwood, Turnbull, & Carpendale, 2010). In order for exploratory talk to effectively happen in the classroom, a sense of trust and common endeavor as well as supporting ground rules are necessary. The following ground rules can enable exploratory talk (Mercer & Dawes, 2008; Mercer & Littleton, 2007): the partners engage critically, but constructively, with each other's ideas; everyone participates; tentative ideas are explored and treated with respect; ideas offered for joint consideration may be challenged; challenges are justified and alternative ideas or understandings are offered; opinions are sought and considered before decisions are jointly made; and knowledge is made publicly accountable (i.e., contributions are open to scrutiny and evaluations in light of publicly available bodies of knowledge). *Cumulative talk*, by contrast, refers to the accumulation of uncritically and mutually agreed-upon and valued pieces of knowledge, with students being accountable only to one another—cumulative talk is positive and supportive. *Disputational talk* is a rather competitive form of social interaction oriented to making views heard with students actively seeking to protect and maintain their respective individual identities as opposed to forming a collective identity—disputational talk is rather defensive and oppositional (Atwood et al., 2010).

2. Norms of interaction
Norms of interaction constitute (written) expectations for behavior governing what constitutes acceptable and unacceptable behaviors in a classroom. Norms include general social norms (e.g., attending to others' solutions and explanations) and socio-disciplinary norms (e.g., using disciplinary terms in explanations) that are established in the classroom and to which the teacher and students attend (e.g., Bowers et al., 1999). Norms can have different functions in an activity system: they function as *rules* of practice that constrain the classroom's discourse activity; they also function as *resources*, which facilitate participation shaping ways in which members of the system interact with each other as they collaborate in activity; and they also relate to the way in which responsibility for different aspects of activity is distributed among the participants (the *division of labor*) (Greeno & Engeström, 2014). In contrast to the IRE pattern, the concept of "revoicing" (O'Connor & Michaels, 1996, 2007) exemplifies how the teacher can establish students as legitimate participants in activities, and credit them for their contributions so that they learn how to externalize reasoning, compare views, and articulate a position. By using the practice of revoicing, a person essentially tries to re-utter some or all of what has been said by another participant in a preceding turn. Norms of interaction can also contribute to the development of a productive discourse and thinking culture of trust and respect. Such a culture values students as responsible co-constructors of knowledge and as accountable members of a learning community who are expected to contribute ideas and meaningful disciplinary explanations. The instructor models these norms and behaviors and ensures that they are enacted in the classroom. Participation structures that allow for student collaboration to work on problems and develop mutual understanding also contribute to the development of students' identities. Solving problems in groups affords stu-

dents to make themselves clear so that others can follow their sense making and provides them with the opportunity to experience validation of their contributions by peers and by the instructor (Greeno, 2011).

3. Affordances of the learning task
Affordances of the learning task (problem), including how the teacher frames the task (e.g., expectations, requirements for successful completion) influence the opportunities that students have to experience and develop agency, accountability, and competence. Tasks create affordances for the activity of the class by structuring the kinds of disciplinary knowledge that students have opportunities to use and build (content) and how the knowledge gets constructed (process, e.g., social form, methods) (Gresalfi et al., 2009). Problems and tasks that are challenging for students and prompt high levels of cognitive processing are essential for developing conceptual understanding—that is, tasks that have relevance to practical applications or to students' everyday lives and that require students to explore, discuss, and evaluate multiple solutions, for example. Bloom's revised taxonomy classifies thinking according to *six cognitive levels of complexity* (cognitive process dimension)—remember, understand, apply, analyze, evaluate, and create—in order to build CK that provides a useful foundation for developing learning objectives, course activities, and assessment tasks. Moreover, the taxonomy differentiates between *four levels of knowledge* (knowledge dimension)—factual (e.g., terminology), conceptual (e.g., theories, models, and principles), procedural (e.g., subject-specific skills, procedures, and usage criteria), and metacognitive (e.g., self-awareness, self-knowledge) knowledge (Anderson & Krathwohl, 2001). Tasks that require students to remember definitions or models have the potential to promote *disciplinary agency*. Open-ended tasks with higher levels of cognitive demand (e.g., making judgments based on disciplinary criteria, finding solutions for complex problems) involve *conceptual agency* with students being positioned as competent and accountable (Pickering, 1995).

Overall, classroom research shows that students' knowledge and skills with regard to engaging in whole class discussions and collaborative learning; the establishment of a culture of dialogue and of PBL; group characteristics, such as size and ability; the goal and incentive structure of the task; and the structuring of group interactions (e.g., posing questions with generic prompts, introducing procedures and techniques) are important features that impact the quality of classroom interaction (Chi, 2009; Reusser & Pauli, 2015).

### 2.1.4 *Criticism of and Misconceptions about Constructivist Perspectives*

Until now, there has been considerable stimulating rhetoric for the constructivist position, but a rather slim or contradictory empirical research base supporting constructivist instruction as compared to research in the behaviorist or cognitivist tradition (e.g., Fenstermacher & Richardson, 2000; Tobias & Duffy, 2009a). Mandl, Kopp, and Dvorak (2004); and Renkl, Gruber, and Mandl (1999) identified the following weak spots of a situative view on cognition and learning that tries to combine cognitive and social-constructivist ideas: (a) there are only few undifferentiated research results (deficient empirical foundation), (b) the positive effects that result from merely dealing with complex problems are overestimated, (c) the learning activities of students necessary for successful learning are insufficiently differentiated, (d) the instructional support is not specified enough, (e) motivational-emotional processes are not adequately accounted for and the individual is only randomly considered, and (f) the individual-cognitive knowledge construction processes are not systematically related to the social-collective knowledge construction processes. Finally, it is not specified how collective knowledge becomes individual knowledge that the individual can apply in new contexts (Fischer, 2001). This section discusses current criticism of and misconceptions about constructivist perspectives (e.g., De Corte, 2012; Kirschner, Sweller, & Clark, 2006; Mayer, 2004, 2009; Tobias & Duffy, 2009a) that led learning scientists to continue to search for more effective combinations of learning processes and environmental support.

#### 2.1.4.1 *Criticism of Constructivist Ideas on Learning and Instruction*

Criticism of constructivist ideas on learning and instruction mainly revolves around research comparing guided and unguided forms of instruction, and research differentiating between cognitive activity during learning and behavioral activity as discussed below.

*Guided Versus Unguided Instruction*: Research comparing guided (instructionism) and unguided instruction/pure discovery learning (constructivism) in different educational contexts from elementary to higher education tends to produce empirical results in favor of guided instruction. McCray, DeHaan, and Schuck (2003) reviewed studies and practical experiences in the education of college undergraduates in engineering, technology, science, and mathematics, suggesting that more strongly guided instruction is more effective than unguided approaches. Kirschner et al. (2006) submit that constructivist-based instructional approaches that rely heavily on discovery-based practices and provide minimal guidance to students (e.g., inquiry-based learning, SRL) are incompatible with human cognitive architecture and can result in cognitive overload of working memory. According to the authors, constructivist pedagogies, such as PBL, are placing a huge burden on the limited working memory. For instance, they argue that a student who searches for problem-relevant information or discovers new knowledge uses working memory, but does not necessarily accumulate knowledge in his/her long-term memory. They cite controlled experimental studies supporting instructional guidance, especially in science learning (e.g., Brown & Campione, 1994; Moreno, 2004) and refer to worked examples and process worksheets as evidence-based possibilities for effective guided instruction (see also Clark & Hannafin, 2011; Hattie, 2009). De Corte (2012), however, notes that constructivist learning cannot be equated with unguided discovery learning and Hmelo-Silver, Duncan and Chinn (2007) submit that PBL and inquiry learning are not minimally guided instructional approaches, but provide rather diverse scaffolds to facilitate student learning. De Corte (2012, p. 36) points out that a powerful innovative learning environment "is characterized by an effective balance between discovery and personal exploration, and systematic instruction and guidance, while being sensitive to learners' individual differences in abilities, needs, and motivation." He refers to a recent meta-analysis conducted by Alfieri, Brooks, Aldrich, and Tenenbaum (2011) stating that direct instruction is better than unguided discovery; however, the meta-analysis also submits that guided discovery is superior to direct or explicit instruction. Mayer reviewed studies conducted from 1950 to the late 1980s comparing unguided with guided discovery and also concludes that in each case guided discovery has been more effective than pure discovery in helping students learn and transfer:

> Guided discovery is effective because it helps students meet two important criteria for active learning: (a) activating or constructing appropriate knowledge to be used for making sense of new incoming information and (b) integrating new incoming information with an appropriate knowledge base. (Mayer, 2004, p. 15)

Mayer (2004, p. 16) concludes that students "need enough freedom to become cognitively active in the process of sense making, and students need enough guidance so that their cognitive activity results in the construction of useful knowledge." He submits that guided discovery, that is, knowing how much and what kind of guidance to provide and how to specify the desired learning outcome, appears to be the "best method" to facilitate learning.

*Cognitive Versus Behavioral Activity*: Mayer (2004, 2009) distinguishes between cognitive activity during learning and behavioral activity during learning and points to the "constructivist teaching fallacy" assuming that active learning is caused by active instructional methods and passive learning is caused by passive methods of instruction. Mayer emphasizes that behavioral activity, that is, active instructional methods such as discovery learning or so-called hands-on activities do not "guarantee" that the learner will engage in appropriate cognitive processing during learning (active learning). Accordingly, passive methods of instruction, such as lecturing, do not necessarily lead to passive learning. He notes that a variety of instructional methods can lead to constructivist learning because it is not the amount of "doing" or discussing or group work in the classroom, but rather the quality of the knowledge construction processes these methods promote in learners is essential (Mayer, 2004). Meaningful learning occurs when the learner strives to make sense of the "to-be-learned material" by selecting relevant information, organizing it into a coherent structure, and integrating it with prior knowledge. In addition, Jonassen submits that a cognitive architecture must "account for the context, the learner, and the processes of cognition (social and cognitive) in order to explain or predict cognitive activities" (2009, p. 13). This broader, multidimensional view of human cognition is not only concerned with storage in and retrieval from long-term memory, but also with questions like the following: what is stored in long-term memory?, how does it get there?, what can the learner do with it?, and how, with what, and for what purpose does long-term memory change? In line with a situative perspective, Jonassen (2009) argues that the ability to solve problems relies only partly on the contents of long-term memory that are only one component or mechanism of cognition.

The above criticism of constructivist pedagogies stems also partly from misconceptions between information-processing perspectives and constructivist perspectives on learning and instruction—especially when it comes to guided versus unguided learning. The following section points to some of the main misconceptions and differences between the acquisition (information processing) and participation (constructivism) metaphor (Tobias & Duffy, 2009a).

#### *2.1.4.2 Misconceptions about Constructivist Perspectives*

Researchers examining the effectiveness of direct instruction begin with fundamentally different assumptions and use different research methods as compared to researchers examining informal or inquiry learning (Jonassen, 2009). The traditional information-processing model based on a computer metaphor sees learning as a process of knowledge acquisition. Knowledge is the object (e.g., concepts stored in the head) that is acquired and then applied with the support of direct instruction (e.g., to reduce cognitive load). The constructivist/sociocultural perspective sees learning as "doing," that is, as discourse practices where concepts are societally constructed and situated. Learning is considered as participation in various aspects of society as well as identity development as a member of the community (Tobias & Duffy, 2009a). These differences between the acquisition (direct/explicit instruction) and participation (constructivist instruction) metaphor have resulted in several misconceptions with regard to learner goals, instructional support, and goals of education that are discussed below.

*Learner Goals*: From a constructivist perspective, it is central that the learner is stimulated to make sense of the world and to be an active participant because student-generated goals for learning derived from the learners' interests determine what is learned from a given experience. Learning is in the student's inquiry process that is initiated and maintained by the student who also takes ownership of her/his own goals. In that sense, the learning environment is a resource to support the student's inquiry as it is the case in informal and lifelong learning, for example. Guidance comes in support of the learners' goals as they are engaged in learning activities. In contrast, direct-instruction researchers mainly seek to help the student acquire relevant knowledge chosen by the instructor (i.e., objectification of the concepts to be learned). However, traditional schooling cannot solely rely on student goals for directing learning. Therefore, constructivist instruction also focuses on engaging students in real-world projects and authentic problems designed for use in instruction. The stimulus for learning—the problem or project or student interest—and the students' ownership of that stimulus are critical determiners of the learning process (Duffy, 2009). In this view, direct instruction can take place when the learner has a need for learning and when it is relevant for and supports students' sense making: "There is a time for telling, but if there is not a need (it is not the time), little will be learned from that telling." (Duffy, 2009, p. 358)

*Instructional Support*: Because a well-specified constructivist instruction theory does not exist, Tobias and Duffy (2009b) point out a major misconception, that is, constructivist teachers do not provide guidance. They refer to the constructivist concept of scaffolding which is central to the design of effective learning environments. Scaffolding was first introduced by Wood et al. (1976) and differs from the broader use of guidance in two ways: (a) guidance is only provided when the learner is unable to proceed by himself/herself and (b) guidance is gradually withdrawn as the learner develops competence (Pea, 2004). Consequently, there is general agreement—also from constructivists—that some guidance is required for effective instruction and learning to occur, though there remains disagreement about what amount and kind of guidance should be provided to help students learn deeply (e.g., what forms/types of instructional support) (Duffy, 2009; Tobias, 2009). Some researchers suggest that constructivist-oriented educators have to focus more on scaffolds that facilitate students' cognitive processing during learning so that specified educational goals can be achieved. If scaffolding is understood as helping learners to manage information, information-processing theory (including cognitive load) can contribute to the understanding of scaffolding, asking what impact the instructional design has on the information-processing demands within the larger context in which students learn and why (e.g., in terms of reducing memory load, directing attention, aiding visualization and building linkages between concepts) (Duffy, 2009).

*Goals of Education*: The goals of education include not only subject-matter content that is measured on achievement tests, but also the learning of "softer skills" such as SRL, collaboration, inquiry methods, and cultural practices that are important for lifelong learners and informed citizens in a knowledge society and economy. Schwartz, Lindgren, and Lewis (2009, p. 35) submit that "a constructivist-tailored assessment should examine students' abilities and dispositions to construct new knowledge, not just execute old knowledge." One style of instruction does not fit all outcomes as the relation between instruction and outcomes is mediated by the specific learning processes that are engaged. Schwartz et al. (2009) suggest that the different approaches of constructivist and explicit instruction may be useful for different purposes, that is, immediate and longer-term outcomes:

> constructivist instruction may be ideal for preparing people for future learning that becomes evident long after instruction has ended, whereas explicit instruction may be optimal for sequestered problem solving. (Schwartz et al., 2009, cited in Tobias, 2009, p. 345)

Hence, it is important to differentiate between different outcomes/purposes and to investigate how certain actions or activities may or may not affect different kinds of cognitions.

## 2.2 Design Frameworks for Student-centered Learning Environments

This section introduces five design frameworks and their underlying teaching and learning principles to extract common design principles of SCLEs (see Table 2.3 for an overview). These frameworks reflect broad representations of a situative constructivist view of learning and instruction aiming to combine individual and social aspects of learning to support students' conceptual understanding.

- *Four perspectives on effective learning environments* (Sect. 2.2.1) submitted by the editors of "How people learn" (NRC, 2000, 2005) who synthesized volumes of research from areas such as cognitive, social, and developmental psychology and neuroscience;
- *The Teaching for Understanding (TfU) Framework* (Sect. 2.2.2) developed by teachers and researchers at HGSE based on a five-year-long project at Project Zero (Blythe & Associates, 1998; Wiske, Rennebohm Franz, & Breit, 2005);
- *A framework for designing cognitive apprenticeship learning environments* (Sect. 2.2.3) based on the cognitive apprenticeship approach (Brown et al., 1989; Collins, Brown, & Holum, 1991; Collins et al., 1989);
- *Constructively aligned learning environments* (Sect. 2.2.4) based on findings with regard to deep versus surface learning (Biggs, 1999, 2012);

**Table 2.3** Common design principles: Contrasting student-centered design frameworks

| *Common design principles* | *Framework* | | | | |
|---|---|---|---|---|---|
| | *Four perspectives on effective learning environments* | *The Teaching for Understanding (TfU) framework* | *A framework for designing cognitive apprenticeship learning environments* | *Constructively aligned learning environments* | *A framework for designing powerful learning environments* |
| | NRC, 2000, 2005; Sawyer, 2008, 2014a | Blythe & Associates, 1998; Wiske, Rennebohm Franz, & Breit, 2005 | Brown, Collins & Duguid, 1989; Collins, Brown & Holum, 1991; Collins, Brown & Newman, 1989 | Biggs, 1999, 2012; Whetten, 2007; Whetten, Johnson, & Sorenson, 2009 | De Corte, 1996; De Corte & Masui, 2009; De Corte, Verschaffel & Masui, 2004 |
| Curriculum for understanding (deep conceptual understanding) | *Knowledge-centered environment*<br>• Fosters the development of flexible, integrated knowledge structures (sense making) to help students to organize knowledge in ways so that it can be retrieved, applied, and transferred to the real-world settings<br>• Helps to create skills to enable students to learn more about their own learning and take control of their learning processes (metacognitive skills) | *Generative topics* are central to one or more disciplines, interesting to students and teachers, accessible to students, and provide opportunities for multiple connections<br>*Understanding goals* are statements or questions that express what is most important for students to understand (concepts, processes, and skills) and that take prior knowledge/experience into account | *Content*—Types of knowledge required for expertise<br>• Domain knowledge: subject-matter-specific concepts, facts, and procedures<br>• Heuristic strategies: generally applicable techniques for accomplishing tasks<br>• Control strategies: general approaches for directing one's solution process<br>• Learning strategies: knowledge about how to learn new concepts, facts, and procedures | *Learning outcomes*, that is, what students can do as well as the levels of performance have to be specified | *Competence*—Acquiring competence in a domain<br>• Well-organized and flexibly accessible domain-specific knowledge base<br>• Heuristic methods<br>• Meta-knowledge<br>• Self-regulatory skills<br>• Positive beliefs |

| | | | | | |
|---|---|---|---|---|---|
| Customized learning (individualized learning experiences) | *Learner-centered environment*<br>• Provides situations and assignments in which students can apply their preconceptions and current knowledge and build on them to construct deep understandings<br>• Presents problems that engage students in socio-cognitive conflicts that lead to the discussion of different viewpoints and finally result in changing cognitive and participation structures | *Understanding performances* are learning activities that are closely linked to understanding goals: students demonstrate their different understandings (flexible performance capacity) and explore them more and more deeply | *Sequencing*—Keys to ordering learning activities<br>• Global before local skills: focus on conceptualizing the whole task before executing the parts<br>• Increasing complexity: meaningful tasks gradually increasing in difficulty<br>• Increasing diversity: practice in a variety of situations to emphasize broad application | | *Learning*—Effective learning processes are<br>• Active/ constructive<br>• Cumulative<br>• Self-regulated<br>• Goal-oriented<br>• Situated and collaborative<br>• Individually different |

(*continued*)

**Table 2.3** (continued)

| *Common design principles* | *Framework* | | | | |
|---|---|---|---|---|---|
| | *Four perspectives on effective learning environments* | *The Teaching for Understanding (TfU) framework* | *A framework for designing cognitive apprenticeship learning environments* | *Constructively aligned learning environments* | *A framework for designing powerful learning environments* |
| Supportive community of learners (working together) | *Community-centered environment*<br>• Facilitates norms that value the search for understanding, encourage different modes of participation and allow the freedom to make mistakes and to explore, articulate, and reflect on one's understanding<br>• Facilitates connections to other people or experts outside the classroom (e.g., creating a "community of practice") | *Reflective collaborative communities* that promote shared knowledge construction, dialogue, and reflection—often with the use of new technologies | *Sociology*—Social characteristics of learning environments<br>Situated learning: students learn in the context of working on realistic tasks<br>Community of practice: communication about different ways to accomplish meaningful tasks<br>Intrinsic motivation: students set personal goals to seek skills and solutions<br>Cooperation: students work together to accomplish their goals | | |

| | | | | | |
|---|---|---|---|---|---|
| Ongoing assessment and feedback | *Assessment-centered environment*<br>• Measures deep understanding by making students' thinking visible<br>• Makes sure that what is assessed is congruent with what should be learned<br>• Provides many opportunities for formative and summative feedback as well as self- and peer assessment and subsequent revision, reflection, and improvement to enhance the quality of student learning | *Ongoing assessment*<br>• Integrated with performances of understanding aiming to help students to reflect and revise their work to develop their ideas further<br>• Informs students and teachers about what students currently understand, how to proceed with subsequent teaching and learning (e.g., in terms of activities)<br>• Examines and reshapes the current curriculum and teaching practice | | *Assessment* has to be aligned to the curriculum so that the assessment tasks are criterion-referenced to the learning outcomes, that is, the students' acquired levels of understanding and skills | *Assessment*—Monitoring and improving learning and teaching<br>• Monitor students' progress<br>• Provide diagnostic feedback<br>• Meaningful assignments<br>• Develop skills in individual and group self-assessment |

(*continued*)

**Table 2.3** (continued)

| *Common design principles* | *Framework* | | | | |
|---|---|---|---|---|---|
| | *Four perspectives on effective learning environments* | *The Teaching for Understanding (TfU) framework* | *A framework for designing cognitive apprenticeship learning environments* | *Constructively aligned learning environments* | *A framework for designing powerful learning environments* |
| Adaptive instruction | *Teacher helps students learn*<br>• Actively inquiries students' thinking and builds on the knowledge and skills as well as the interests students bring to the learning situation<br>• Teaches some subject matter in depth and provides many examples so that students can develop an organized understanding of important concepts of their discipline<br>• Tailors help so that students can make sense themselves, providing prompts and hints that help the students to figure something out and develop their thinking further<br>• Incorporates the teaching of metacognitive strategies into the subject (e.g., by modeling) | *Pedagogy of understanding*: Instructor as a "floating coach," who keeps an eye on students' learning processes, listens for common questions, confusions, and issues that should be addressed in subsequent lectures or whole group discussions<br>Instructor probes students' answers and asks them to give reasons for their answers and to offer supporting evidence and reflect on their understandings<br>"Instructor assesses" students all the time, asking probing questions and observing their performances of understanding to figure out what they understand | *Method*—Ways to promote the development of expertise<br>• Modeling: instructor performs a task so students can observe<br>• Coaching: instructor observes and facilitates while students perform a task<br>• Scaffolding: instructor provides supports to help the students perform a task<br>• Articulation: instructor encourages students to verbalize their knowledge and thinking<br>• Reflection: instructor enables students to compare their performance with others<br>• Exploration: instructor invites students to pose and solve their own problems | *Learning and teaching activities* have to provide opportunities for students to demonstrate their understanding in different situations | *Intervention*—Guiding principles for the design of powerful learning environments<br>• Active, constructive acquisition processes<br>• Development of self-regulation strategies<br>• Activities embedded in real-life situations<br>• Acquisition of general learning and thinking skills<br>• Flexible adaptation of instructional support |

- *A framework for designing powerful learning environments* (Sect. 2.2.5) based on theoretical studies such as the cognitive apprenticeship model and on empirical classroom studies (De Corte, 1996; De Corte & Masui, 2009; De Corte, Verschaffel, & Masui, 2004).

### *2.2.1 "How People Learn": Four Perspectives on Effective Learning Environments*

Focusing on how people come to know, that is, focusing on their learning processes, can help the teacher to purposefully select tasks and materials to unfold the learners' potential. While a rich body of knowledge about the subject matter is important to support understanding and transfer, this knowledge has to be connected and organized around important concepts and conditionalized to specify the contexts in which it is applicable. This also leads to a focus on the processes of knowing, with learners bringing their prior knowledge to the learning setting and actively constructing knowledge based on what they already know and believe, including misconceptions. The framework takes three fundamental learning principles into account that can improve student achievement when they are incorporated into the design of learning environments (NRC, 2000, 2005; Sawyer, 2008, 2014a).

- *Existing knowledge*: students are not blank slates; they come to the university with cultural practices, interests, prior knowledge, skills, misconceptions, expectations, interests, and attitudes. Effective teaching has to build on students' preexisting understandings by actively inquiring students' thinking and creating tasks and conditions under which student thinking is engaged, revealed, and can be built on.
- *Deep conceptual understanding*: students need to develop a deep foundation of factual knowledge and understand facts and ideas in the context of a conceptual framework to help them to organize knowledge in ways so that it can be retrieved, applied, and transferred to the real-world settings. Instructors have to teach some subject matter in depth and provide many examples so that students can understand key concepts. Assessment has to test for deep understanding.
- *Reflection and metacognition*: students have to acquire and use metacognitive strategies in a variety of subject areas to define learning goals, analyze, monitor, and reflect upon their own understanding

and thus, take control of their own learning processes. Instructors can incorporate the teaching of these strategies into the subject matter that students are learning about and model them in the classroom environment.

The framework depicted in Fig. 2.4 is based on these fundamental learning principles and can help to guide the design and evaluation of student-centered classroom environments. The framework suggests that effective learning environments depend on the degree to which they are learner-centered, knowledge-centered, assessment-centered, and community-centered (NRC, 2000, Chap. 6). These four perspectives are outlined below (see also Hoidn & Gilbert, 2007).

1. Learner-centered perspective

> If teaching is conceived as constructing a bridge between the subject matter and the student, learner-centered teachers keep a constant eye on both ends of the bridge. The teachers attempt to get a sense of what students know and can do as well as their interests and passions—what each student knows, cares about, is able to do, and wants to do. (NRC, 2000, p. 136)

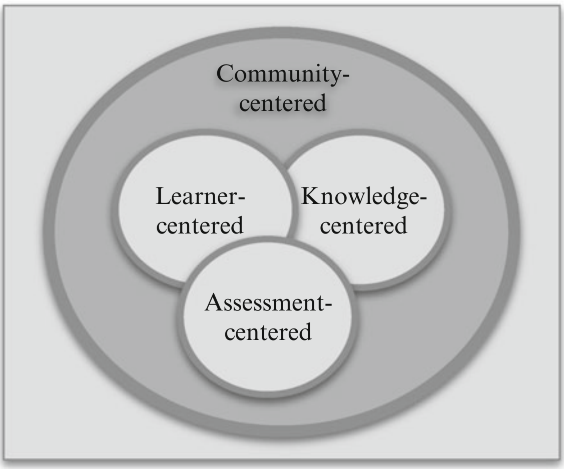



**Fig. 2.4** Perspectives on effective learning environments (NRC, 2000, p. 134)

Starting from the structure of students' knowledge, that is their preconceptions about the subject matter, a learner-centered environment provides situations and assignments in which students can apply their preconceptions and current knowledge and build on them to construct deep understanding. Moreover, it presents problems that engage students in socio-cognitive conflicts that lead to the discussion of different viewpoints and finally, result in changing cognitive and participation structures. Teachers build on the knowledge students bring to the learning situation, they are aware of what students think in relation to the problems at hand, what sense they are making, including misconceptions, and provide them with situations to help them to make connections and to develop their thinking further.

2. Knowledge-centered perspective

> A challenge for the design of knowledge-centered environments is to strike the appropriate balance between activities designed to promote understanding and those designed to promote the automaticity of skills necessary to function effectively without being overwhelmed by attentional requirements. (NRC, 2000, p. 139)

Knowledge-centered environments emphasize sense making and activities that promote learning with understanding leading to transfer of this knowledge into other contexts based on the learners' current knowledge. Learners develop well-organized knowledge and come to understand the overall picture; that is, they develop integrated knowledge structures rather than just memorizing isolated facts. Thus, these environments also help to create "conditionalized" knowledge, that is information about the conditions of applicability, as well as skills to enable students to learn more about their own learning (metacognitive skills). Teachers support students in developing an organized understanding of important concepts of their discipline.

3. Assessment-centered perspective

> The key principles of assessment are that they should provide opportunities for feedback and revision and that what is assessed must be congruent with one's learning goals. (NRC, 2000, pp. 139–140)

An assessment-centered environment measures understanding rather than memorizing isolated facts and procedures. What is assessed is connected with what should be learned (learning goals). The teacher helps students to make their thinking visible so that their ideas can be clarified, for example, by presenting their arguments in discussions. There are many opportunities for continuous formative and summative feedback as well as self- and peer assessment, and for subsequent revision, reflection, and improvement in order to enhance the quality of student learning. Portfolio assessment is one method of providing formative assessment; as a result, in the process of discussing the students' work, learners also gain valuable information about their learning process over time.

4. Community-centered perspective

> Ideally, students, teachers, and other interested participants share norms that value learning and high standards. Norms such as these increase people's opportunities to interact, receive feedback, and learn. (NRC, 2000, p. 154)

A community-centered environment facilitates norms that value the search for understanding, encourage different modes of participation and allow the freedom to make mistakes, and to explore in order to learn. For example, asking students to share and discuss their thinking with the class, even if the ideas are "wrong," can deepen everyone's understanding. Connections to other people outside of the classroom in the form of guest visits and field trips can provide students with valuable opportunities to interact with experts and connect what they learn in the classroom with real-word examples and practices. One way to embrace the idea of community-centered learning environments is the creation of "communities of practice" (Lave & Wenger, 1991).

In summary, the above four perspectives form a system of interrelated attributes that have to be balanced and aligned with the learning goals, assignment and assessment tasks, and with the course activities to allow students to develop well-organized knowledge and transfer it to different contexts. Instructors have to actively inquire students' thinking and create tasks and conditions under which students' thinking is engaged and revealed and can be built on. Making thinking visible, providing opportunities for feedback and reflection, and installing norms of behavior that value deep understanding, exploration, participation, and collaboration are all important features of effective learning environments. This social-constructivist view that learning occurs through active student engagement and participation is also at the root of the TfU framework that is introduced next.

### 2.2.2 The Teaching for Understanding Framework

The TfU framework is a tool for designing, conducting, and reflecting on classroom practices that facilitate student understanding at all grade levels, even through higher education. In the course of a five-year-long research project, curricula were developed, applied, and tested in the classroom and a "pedagogy of understanding" was introduced.[14] Understanding is defined as a "flexible performance capacity" that shows its face when students do something that puts their understanding to work so that they can demonstrate their (advanced) understandings—"using old knowledge in new situations to solve novel problems" (Blythe & Associates, 1998, p. 17). Hence, the framework is based on a performance perspective on understanding and goes beyond reproducing facts or executing routine performances. Understanding "is a matter of being able to do a variety of thought-provoking things with a topic, such as explaining, finding evidence and examples, generalizing, applying, analogizing, and representing the topic in new ways" (Blythe & Associates, 1998, p. 12). Students have to understand factual knowledge in the context of a conceptual framework and organize it in ways that facilitate retrieval and application in new situations (NRC, 2000). That is why they take part in different learning activities that build and demonstrate understanding and they receive feedback to further develop their understandings and reflect on their learning processes.

The framework highlights five key elements of planning and TfU that support student understanding (Blythe & Associates, 1998, pp. 17–88; Wiske, 1998): generative topics, understanding goals, understanding performances, ongoing assessment, and reflective collaborative communities which will be discussed below (see Fig. 2.5).

1. Generative topics

Generative topics form the core of the curriculum and have an inexhaustible quality insofar as they provide students with the opportunity to develop many different understandings and to explore these topics more and more deeply. Generative topics are central to one or more disciplines or domains, interesting to teachers and students, accessible to students (e.g., lots of resources are available for students to investigate a topic), and

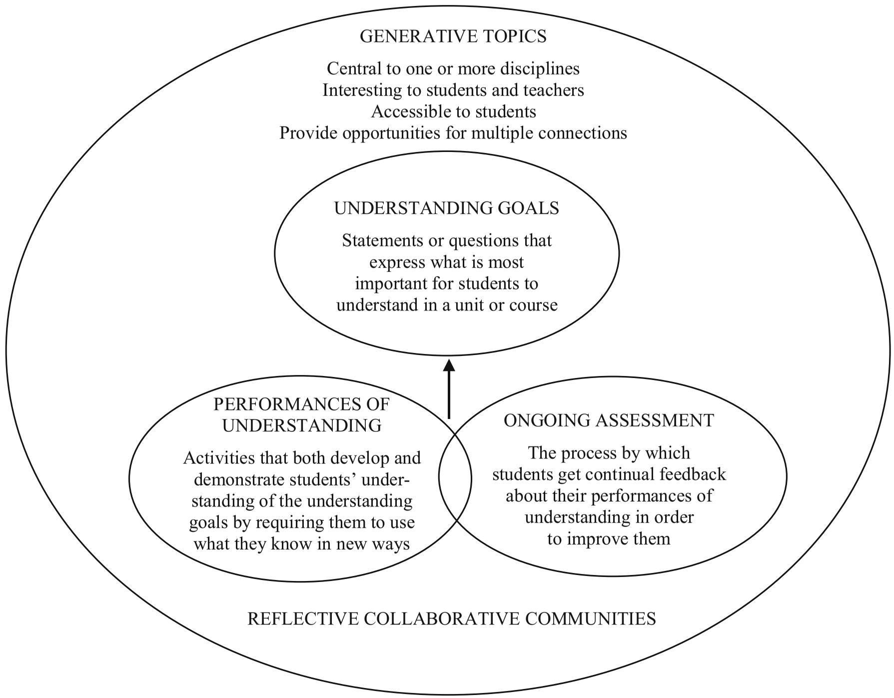



**Fig. 2.5** The Teaching for Understanding Framework (adaptation from Blythe & Associates, 1998, p. 19)

they offer many opportunities for students to connect them to their own experiences, "Generative topics are issues, themes, concepts, ideas, and so on that provide enough depth, significance, connections, and variety of perspective to support students' development of powerful understandings" (Blythe & Associates, 1998, p. 25). In order to integrate generative topics the teacher has to know his/her students and think about what topics are worth understanding. Generative topics usually involve a group of lessons delivering related facts, concepts, and principles. Examples for generative topics are: representations in signs and symbols or size and scale in mathematics, and the definition of life or global warming in biology (Blythe & Associates, 1998).

2. Understanding goals
Understanding goals "are the concepts, processes, and skills that we most want our students to understand. They help to create focus by stating where students are going." (Blythe & Associates, 1998, p. 36) To ensure that students stay focused on developing the most essential understandings teachers have to identify both (1) specific, *unit-long* goals (involving a group of lessons) that focus on particular generative topics, and (2) broader, *course-long* understanding goals (overarching understanding goals called throughlines) that capture the learning outcomes of a whole course that the teacher wants students to take away when they leave the course. Understanding goals are also the starting points for developing assessment criteria for figuring out what students understand and for evaluating their work. They can be phrased as statements like, "Students will understand" or "Students will appreciate" and as open-ended questions like "What are the important similarities and differences among different genres of literature?" The following is an example of a unit-long understanding goal for a biology unit with the generative topic "'The Meaning of Life': students will understand how a biologist distinguishes between living and nonliving things" (Blythe & Associates, 1998).

3. Understanding performances
Understanding performances (or performances of understanding) are learning activities that are closely linked to understanding goals and are at the heart of developing and demonstrating what students understand. Students need to have opportunities to apply their knowledge, skills, and prior experiences in a variety of situations with the help of peers, teachers,

and diverse resources: "Performances of understanding require students to go beyond the information given to create something new by reshaping, expanding, extrapolating from, applying, and building on what they already know" (Blythe & Associates, 1998, p. 56). Understanding performances make publicly visible what students know and think—they treat understanding as a performance rather than a mental state. Performances of understanding also provide evidence for assessment (Ritchhart & Perkins, 2008).

4. Ongoing assessment

Ongoing assessment provides students with frequent feedback from a variety of perspectives (e.g., instructors, peers, self-evaluations) and in various forms (e.g., verbal, written). Ongoing assessment is integrated with performances of understanding and formal or informal feedback (e.g., feedback on a presentation in class versus a response to a student comment in class) and aims to help students improve their performances by providing opportunities for reflections throughout the learning process. Thereby, students can also participate in the process of constructing rubrics for the understanding performances they have to demonstrate and apply public and clearly articulated criteria in the context of self- and peer feedback to self-regulate their learning. Ongoing assessment asks the teacher to look closely at student work and informs students about how well they are doing and how they can improve; thus, it contributes substantially to deepen students' understanding. It informs teachers about what students currently understand and how to proceed in terms of activities, for example, or how to reshape the current curriculum and teaching practice (Blythe & Associates, 1998).

5. Reflective collaborative communities

A fifth element was added to the framework a few years after the model was first proposed: reflective collaborative communities acknowledge that generative topics can be taught in a way so that they promote collaboration and supportive learning communities—often with the use of new technologies (Wiske et al., 2005). Learning in a community can foster dialogue and reflection based on shared goals, joint experiences, and a common language. Collaborative communities expose students to diverse ideas and opinions and promote shared knowledge construction, listening skills, and respect. Moreover, utilizing technology can support the collaborative process by illustrating and deepening understanding of the subject matter, enabling discussions outside of class, and facilitating communication between students and instructors.

To sum up, the TfU framework supports a pedagogy of understanding which provides students with opportunities for multiple connections to develop different understandings about important topics and explore them more deeply. Performances of understanding are of particular importance as they refer to what students do to build and demonstrate those understandings and make them visible. A collaborative class community and ongoing assessment facilitate the process of reflecting on performances to gauge progress toward understanding goals.

### *2.2.3 A Framework for Designing Cognitive Apprenticeship Learning Environments*

The design of cognitive apprenticeship learning environments is based on theories of situated cognition and is strongly linked to the traditional learning in trades where the master models activities in real-world situations. The framework is supported by Albert Bandura's (1997) theory of modeling and rooted in Brown et al. (1989) idea that learning and cognition are fundamentally situated and that learning occurs through participation. Cognitive apprenticeship takes account of the distribution of knowledge through participation and focuses on the negotiation of understanding to establish intersubjectivity within a group of learners. The theory makes the processes of thinking visible and is useful when students have to learn about a fairly complex task (Collins et al., 1991).

Collins et al. (1989) suggest that instructors should create learning environments that provide students with opportunities to not only listen to elaborated explanations and observe models carrying out tasks, but also to allow for articulation, reflection, and exploration of subject matter to stimulate and structure the inner activity of learning and problem solving. They developed six teaching methods that are rooted in cognitive apprenticeship theory and are of interest for the design of SCLEs.

- *Modeling* refers to an instructor demonstrating a task within the cognitive domain or subject area so that a student can observe, experience, and build a conceptual model of the task at hand and the processes required to solve the task.
- *Coaching* spans the entire process of overseeing the student's learning through the apprenticeship experience. It refers to an

instructor observing the student's task performance and offering feedback and hints to sculpt the student's performance to that of an expert's.

- *Scaffolding* refers to the supports the instructor gives to help the student carry out the task. These supports can, for example, take the form of teaching manipulatives, activities, suggestions, and group work. The instructor may have to execute parts of the task that the student cannot yet manage. This requires the instructor to analyze and assess student abilities in the moment and give occasional hints, at the appropriate level of difficulty, as to what to do next in order to carry out the target activity. As the student becomes more skilled through the repetition of this process, the provided feedback and instruction "fade" and the learner takes on more and more responsibility for carrying out the task.
- *Articulation* includes "any method of getting students to articulate their knowledge, reasoning, or problem-solving process in a domain" (Collins et al., 1989, p. 482). Sociocultural views argue that understanding is fostered through co-construction and negotiation among instructors and students in classroom discourse and small-group activities that require students to formulate and articulate their ideas to other students (Stebler & Reusser, 2000). Students think aloud, for example, to articulate their thoughts while solving problems, or the instructor asks questions that allow students to refine their understandings and to form explicit conceptual models (inquiry teaching).
- *Reflection* allows students to "compare their own problem-solving processes with those of an expert, another student, and ultimately, an internal cognitive model of expertise" (Collins et al., 1989, p. 483). Students become metacognitively active and responsible participants in their own learning and problem-solving processes through planning, monitoring, and evaluating their goal-directed behavior (Stebler & Reusser, 2000). For example, students look back and analyze the instructor's and each other's performances to highlight similarities and differences with the aim to understand and improve their performance toward expertise.
- *Exploration* provides facilities for students to self-regulate their learning and to productively problem solve on their own by manipulating objects, creating models, and performing experiments (Stebler & Reusser, 2000). Students, thus, learn how to frame

questions or problems that are interesting to them and that they can solve applying exploration strategies taught by the instructor. The latter slowly withdraws the use of supports and scaffolds and allows students to frame interesting problems within the domain for themselves and then take the initiative to figure out ways to solve these problems.

In practicing the ideas of cognitive apprenticeship, the instructor has to identify ways in which students can become the experts in a domain with the ability to learn throughout life. This includes exploring questions the instructor cannot answer and challenging solutions the "experts" have found (Collins et al., 1991). Collins, Brown and Holum (1991) have developed a general framework for the design of cognitive apprenticeship learning environments that includes four dimensions: the content taught, the pedagogical methods employed, the sequencing of learning activities, and the sociology of learning. Each of these dimensions comprises a set of characteristics that should be considered in constructing or evaluating SCLEs.[15]

1. Content: types of knowledge required for expertise
Cognitive research differentiates between four types of knowledge required for expertise. Domain knowledge, that is concepts, facts, and procedures explicitly identified with a particular subject matter. This is followed by three types of strategic knowledge, that is, tacit knowledge that underlies an expert's ability to make use of concepts, facts, and procedures as necessary to solve problems and accomplish tasks

- Problem-solving heuristics (techniques and approaches regarded as "tricks of the trade");
- Strategies that control the problem-solving process (metacognitive strategies, e.g., monitoring, diagnostic, and remedial components);
- Learning strategies (general strategies for exploring a new domain or more specific strategies such as extending or reconfiguring knowledge in solving problems) (Collins et al., 1991).

2. Method: ways to promote the development of expertise
The model advocates six teaching methods based on the cognitive apprenticeship approach introduced above: modeling, coaching, and scaffolding are at the core of cognitive apprenticeship and help with cognitive

and metacognitive development (i.e., processes of observation and guided practice). Articulation and reflection are designed to help novices with the awareness of problem-solving strategies, execution, and control similar to that of an expert. Exploration intends to guide novices toward independence and develop their ability to identify and solve problems within the domain on their own.

3. Sequencing: keys to ordering learning activities
Sequencing activities means that students are given tasks that structure their learning while at the same time preserving the meaningfulness of what they are doing. Thereby, three balancing principles have to be considered, (a) global before local, that is, students build a conceptual model of the target skill or process first, helping them to make sense of the portion that they are carrying out and acting as a guide for the learner's performance; (b) increasing complexity, that is, sequencing meaningful tasks that gradually increase in difficulty so that students can control task complexity and are able to accomplish the task with the fading help of the instructor or other people; (c) increasing diversity, that is, constructing tasks that require an increasing variety of strategies or skills so that students learn to distinguish the conditions under which certain skills and strategies do (and do not) apply and have them available for use with unfamiliar or novel problems.

4. Sociology: social characteristics of learning environments
The sociology of the learning environment refers to four critical characteristics: (a) situated learning, that is, the environment reflects the multiple uses to which students' knowledge will be put in the future to foster its transfer to new problems and new domains (e.g., purposes and different conditions for the use of the newly gained knowledge, learning by actively using knowledge); (b) community of practice, that is, the participants actively communicate about and engage in the knowledge and skills involved in solving problems in a domain and whereby develop a sense of ownership through common projects and shared experiences; (c) the need to promote intrinsic motivation is emphasized, that is, students perform tasks because they are intrinsically related to an interesting goal rather than extrinsically motivated; and (d) exploiting cooperation means that students work together to solve problems and whereby are more motivated and have more learning resources.

To summarize, cognitive apprenticeship learning environments build on the cognitive apprenticeship approach with its six teaching methods and extend it to include the different types of knowledge required for expertise (i.e., domain knowledge as well as heuristic, control and learning strategies), the ways to sequence learning activities to foster expertise (e.g., practice in a variety of situations, increasing complexity of tasks), and the social characteristics of the learning environment (e.g., students work together and work on realistic tasks).

### *2.2.4 Constructively Aligned Learning Environments*

A review of research on students' approaches to learning suggests that it is one's approach to learning that effects how well one learns (Biggs, 1999; Ramsden, 2003). Approaches to learning describe the level of students' cognitive engagement through which meaning is created by the students' learning activities. 'Deep' learning—in contrast to 'surface' learning—leads to high levels of cognitive activity that facilitate conceptual change and thus deep, conceptual understanding that allows students to transfer their knowledge and skills to real-world settings to solve authentic problems. Students who apply a deep approach to learning intend to understand and seek meaning referring to activities that are appropriate to handle the task and to achieve an appropriate outcome. Students who intend to complete a task and memorize information apply a surface approach to learning referring to activities of an inappropriately low cognitive level with fragmented outcomes that do not convey the meaning of the encounter (Biggs, 1987, 1989; Marton & Säljö, 1976a, 1976b).[16]

Empirical research indicates that students who use deep approaches to learning tend to earn higher grades, and retain, integrate, and transfer information at higher rates. Students enjoy learning more, read widely, draw on a variety of resources, discuss ideas, reflect on how individual pieces of information relate to larger patterns, and apply knowledge in real-world situations as compared to students who use surface approaches to learning (e.g., Biggs, 1999; Nelson Laird, Seifert, Pascarella, Mayhew, & Blaich, 2011; Ramsden, 2003). Research studies on approaches to learning also suggest that student engagement plays a crucial role in terms of college impact and persistence, for example (see also Nelson Laird, Chen, & Kuh, 2008; Pascarella & Terenzini, 1991, 2005).

Biggs (2012, p. 40) points out that "'[a]cademic' students will adopt a deep approach to learning in their major subjects, often despite their teaching, while non-academic students are likely to adopt a deep approach only under the most favorable teaching conditions." The teaching challenge is, then, to teach in a way so that most students apply a deep approach to learning using the higher cognitive level process that the more academic students use spontaneously. Instructors can promote deep approaches to learning by constructively aligning their teaching, curriculum design, and the assessment (e.g., students' prior knowledge and interests, learning objectives, activities, assessment; Biggs, 2012; Fry, Ketteridge & Marshall, 2009).

For learning situations, Biggs (2012) suggests that conceptual change—and not only the passing acquisition of information—can take place, when students (1) know what the objectives are and how they are related to the assessment tasks; (2) experience the felt need to get there; (3) feel free to focus on the learning task and engage deeply; and (4) can work collaboratively and in dialogue with their peers and the instructor to deepen their understanding. A lack of alignment can lead students to adopt a surface approach to learning. Focusing on the learner and on learning, therefore, implies that learning outcomes, activities, and assessment tasks are constructively aligned (Biggs, 2012; Whetten, 2007; Whetten, Johnson, & Sorenson, 2009; see Fig. 2.6):

- The expected *learning outcomes*, that is, what students can do as well as the levels of performance, have to be specified (e.g., Anderson & Krathwohl, 2001);
- *Assessment* has to be aligned to the curriculum so that the assessment tasks are criterion-referenced to the learning outcomes, that is, the students' acquired levels of understanding and skills;
- Learning and teaching *activities* have to provide opportunities for students to demonstrate their understanding in different situations.

Instructors are concerned with what students do in order to understand and with the kinds of teaching and learning activities and assessment tasks required to reach certain understandings (focus on student intellectual development). Learning and teaching methods that require students to use higher-order cognitive activities, such as questioning, applying, and generating solutions facilitate the adoption of deep approaches to learning (Biggs, 2012). Furthermore, a "backward design" determining what students need to be able to do when they have finished a course and after that deciding what students should do in the course to be able to achieve these expected learning outcomes is important (Wiggins & McTighe, 2005).

Institutional policies can contribute to poor alignment when they require instructors to construct tests to discriminate between students

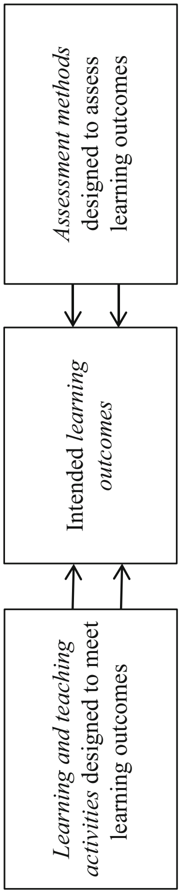



**Fig. 2.6** Model of constructive alignment (adapted from Biggs, 1999)

and get a "good spread" in grade distributions or marks distributed along a predetermined curve. In contrast, in a constructive aligned learning environment, the objectives are embedded in the assessment tasks so that both elicit certain levels of cognitive engagement. Students who focus on assessment will then be learning the objectives the teaching and learning activities elicit and the course set out for them to learn. This increases the chance that students engage in appropriate learning activities and thus, in a deep approach to learning as compared to a surface approach (Biggs, 2012). In learning environments that focus on learning instead of teaching, less time is devoted to lecturing and more time to activities that increase the level of student engagement and participation. SCL allows students to actively participate in "messy" discovery learning processes and students are encouraged to participate in the learning process at all times. Students come to class better prepared and the class time can be more effectively used for active learning through a variety of hands-on activities, discussions, and reflections administered to promote deep learning.

Overall, the encouragement of deep-level learning (i.e., students adopting a deep approach to learning instead of a surface approach) depends on both a learning-centered course design and the constructive alignment of learning outcomes, activities, and assessment tasks.

### *2.2.5 A Framework for Designing Powerful Learning Environments*

De Corte et al. (2004, p. 366) present the CLIA model (Competence, Learning, Intervention, Assessment) as a framework that aims "to be powerful in eliciting in students learning processes that facilitate the acquisition of productive knowledge and competent learning and thinking skills." Based on theoretical studies, such as the cognitive apprenticeship model and their own empirical studies, the authors point to the importance of both beliefs and affective aspects for learning and new classroom cultures (De Corte et al., 2004). The framework builds on prior work concerning the core elements of a theory of learning from instruction (Glaser, 1976; Resnick, 1983; Snow & Swanson, 1992). Various studies provide empirical support for the positive effects of powerful learning environments based on the CLIA model for students' problem-solving competence, adaptive competence, self-regulation activities, and academic performance (e.g., De Corte, 2012; De Corte et al., 2004). The framework identifies several major guiding design principles and encompasses four interconnected components (De Corte, 2003; De Corte & Masui, 2009).

1. Competence
Acquiring competence in a domain requires the acquisition of five categories of components: (1) a well-organized and flexibly accessible domain-specific knowledge base involving the facts, symbols, concepts, and rules that constitute the contents of a subject-matter field; (2) heuristic methods, that is, search strategies for problem analysis and transformation that induce a systematic approach to the task; (3) meta-knowledge, involving knowledge about one's cognitive functioning, motivation, and emotions; (4) self-regulatory skills relating to regulating one's cognitive processes/activities, as well as affective and motivational processes/activities; and (5) positive beliefs about oneself as a learner in a domain, and about the content domain.

2. Productive learning processes
Productive learning is a process of meaning construction and knowledge building encompassing six features that are well documented by a substantial amount of research and can inform the design of powerful learning environments (De Corte, 1996). Productive learning is

- active/constructive: students engage in an effortful and mindful process in which they actively construct their knowledge and skills through reorganization of their mental structures in interaction with the environment;
- cumulative: students' prior formal and informal knowledge impact subsequent learning;
- self-regulated: students manage and monitor their own processes of knowledge building and skill acquisition and assume more and more control and agency over their own learning (metacognition);
- goal-oriented: students engage in goal-setting activities, choosing and determining their own objectives with support of the instructor;
- situated and collaborative: the learning effort is distributed over the individual student, his/her partners in the learning environment, and the resources and (technological) tools that are available. In other words, learning is conceived as an interactive activity between the individual and the physical, social, and cultural context and artifacts; and

- individually different: the processes and outcomes of learning vary among students due to differences in prior knowledge, conceptions of learning, learning styles and strategies, interest, motivation, self-efficacy beliefs, and emotions.

3. Intervention
Taking the literature as well as the present conception of competence (first component of CLIA) and the characteristics of productive learning (second component of CLIA) into account, powerful learning environments should:

- Initiate and support *active*, *constructive acquisition processes* in all students. Thereby, powerful learning environments are characterized by a good balance between discovery, on the one hand, and systematic instruction and guidance, on the other, while taking into account individual differences among learners.
- Foster the development of *self-regulation strategies* in students, balancing external and internal regulation insofar as the share of self-regulation grows with time while explicit instructional support fades out.
- Embed students' constructive acquisition activities—preferably *in real-life situations*—that have personal meaning for the learners, that offer ample opportunities for distributed learning through social interaction, and that are representative of the tasks and problems to which students will have to apply their knowledge and skills in the future.
- Create opportunities to acquire *general learning and thinking skills* embedded in the subject-matter fields.
- Create a *classroom climate and culture* that induces in students explication of and reflection on their learning activities and problem-solving strategies (e.g., develop students' conceptual metacognitive understanding about learning through reflective practices and dialogues with peers in small groups).
- Allow for the *flexible adaptation of instructional support* to individual differences in aptitudes among learners, including emotional support.

4. Assessment
Forms of assessment for monitoring and improving learning and teaching need to be aligned with the preceding components of the CLIA frame-

work: assessment instruments should monitor students' progress toward the acquisition of the full range of aspects of the competence component outlined above. They should also provide diagnostic feedback about students' deep understanding of content and their mastery and productive use of learning and thinking skills (i.e., address learning outcomes, but also trace students' learning processes and strategies). Alternative assessment forms should contain meaningful assignments that offer opportunities for individual, self-regulated, and collaborative approaches to tasks and problems as well as for developing skills in individual and group self-assessment.

To sum up, powerful learning environments consist of four interconnected components that are theoretically and empirically well-founded: De Corte et al. (2004) provide a holistic framework that refers to competence development, learning processes, guiding design principles, and forms of assessment. The holistic model stresses the importance of promoting active knowledge construction, social interaction among students, and the development of self-regulatory skills and learning embedded in authentic situations to foster transfer.

## 2.3 Summary and Conclusions: Common Design Principles of Student-Centered Learning Environments

This section synthesizes the main principles and guidelines derived from the established design frameworks discussed earlier. The five common design principles are grounded in a situative perspective on learning and instruction and are elucidated below: curriculum for understanding (Sect. 2.3.1), customized learning (Sect. 2.3.2), supportive community of learners (Sect. 2.3.3), ongoing assessment and feedback (Sect. 2.3.4), and adaptive instruction (Sect. 2.3.5).

### *2.3.1 Curriculum for Understanding*

From a constructivist point of view, deep conceptual understanding or deep learning is the goal of all learning processes and can be defined as "an active, constructive, self-regulated, cumulative, goal-oriented, collaborative and individual process of knowledge-building and construction of meaning based on prior knowledge and placed in a specific context"

(Hugener et al., 2009, p. 66; see also De Corte, 2003). A curriculum for understanding focuses on the acquisition of strong subject-based know-how central to one or more disciplines as well as transversal higher-order skills, such as problem solving and self-directed learning, that enable students to think and act flexibly and creatively with what they know in an ever-changing environment (e.g., Perkins, 1998, 2008). Curricular understanding goals concentrate on what is most important for students to understand (concepts, processes, and skills) and take prior knowledge/experience into account. Learning activities are closely linked to understanding goals and assessment tasks insofar as they emphasize sense making and allow students to demonstrate their different understandings (flexible performance capacity). Students explore their understandings more and more deeply and acquire knowledge about the conditions of applicability as well as metacognitive knowledge and skills so that they can assess their own progress and take control of it. A curriculum for understanding helps students to become more aware of what they are doing and why they are doing it (e.g., O'Neill & McMahon, 2005).

A curriculum for understanding also provides opportunities for students to negotiate learning outcomes and choose learning objectives based on their prior knowledge, interests, and experience (e.g., authentic problems of relevance for their personal and/or professional life). While the instructor identifies core learning (what is non-negotiable) and informs students about the rationale behind curricular decisions and instructional behaviors, the content and learning paths are also largely influenced by students' thoughts and questions. The co-construction of the curriculum requires instructors to expose their teaching methods for students to reflect on the whole learning experience, to discuss how the learning environment is perceived, and to make suggestions for improvement. In this way, curricular adjustments can be made depending on the learning experiences of the diverse individuals in the class. Continuous student feedback and constructive criticism on course curriculum and classroom instruction can help instructors to institute changes that take students' needs into account and can boost students' confidence and responsibility for their own learning.

### *2.3.2 Customized Learning*

Effective learning environments have to be sensitive to students' different interests, preexisting understandings (preconceptions), misconceptions, and perceptions to allow for individualized learning experiences. Through soliciting student background knowledge by asking questions and taking students' ideas, questions, and confusions seriously, the instructor can help students to connect background knowledge to new content. At the same time, instructors also become aware of the diverse backgrounds of their learners and they learn who their students are so that they can better address the needs of students who may be at different starting points and design course activities with the students' needs in mind. The EU-High Level Group on the Modernisation of Higher Education (2013, p. 18) submits that the

> best teaching helps students to question their preconceptions, and motivates them to learn, by putting them in a situation in which their existing model does not work—and in which it matters to them that it does not work and in which they come to see themselves as authors of answers, as agents of responsibility for change.

Effective instructors devote less time to lecturing and more time to activities that increase the level of students' cognitive engagement and participation. A range of optional activities and assignments can give students some choice in subject matter so that they occur in ways that students find relevant, engaging, and suitably challenging. Assignments provide structure but also leave room for negotiation to develop student choice in content so that they can devise a personal content area to explore and think for themselves. This way, learning activities and assignments provide students with opportunities to apply their preconceptions and current knowledge, engage in socio-cognitive conflicts that lead to the discussion of different viewpoints, and build on them to construct deep understandings and demonstrate their understandings. Learning-focused activities facilitate interactive dynamic processes that have the potential to get students to think for themselves, share and discuss their thoughts, practice what they have learned and thus, facilitate retention and transfer.

### *2.3.3 Supportive Community of Learners*

Communities of learners provide opportunities for students to gain expertise from jointly organizing their learning process so that distributed knowledge can be used to solve challenging problems together (e.g., Sawyer, 2008). Students engage in a collective effort of understanding to learn about the subject matter and about ways in which a disciplinary community works with knowledge in a domain. Students work together with people from diverse backgrounds (including experts outside of the classroom), get to know different ways to solve a task, engage in peer support (such as formal or informal tutor groups), and reflect on their shared knowledge construction process. However, students do not always have the knowledge and skills to work effectively in groups or to engage productively in classroom discourse. A safe and supportive classroom environment encourages students to take risks, explore, share, and reflect on one's understanding, promotes norms of behavior that value the search for understanding as well as different modes of participation, and the freedom to make mistakes. Course activities that require cooperation, such as discussions or group work, can promote students' long-term retention of information, motivate them for further learning, allow them to consider different perspectives, and develop a common language or develop their thinking and listening skills further (e.g., Bonwell & Eison, 1991; Cornelius-White, 2007).

### *2.3.4 Ongoing Assessment and Feedback*

A constructive aligned curriculum starts with the intended learning outcomes and considers how these outcomes will be assessed to determine whether students have achieved them—whereby taking into account that many students are 'assessment-led' in their orientation to study and that assessment is a source of extrinsic motivation for students (e.g., Biggs, 1999, 2012). Ongoing (formative) assessment can tap understanding by helping to make students' thinking visible and by providing tailored feedback that can help students to take their existing understandings further (e.g., Hattie, 2009, 2012). By developing various forms of formative course assessments, instructors can help students to pursue their interest in the subject matter, identify their learning gaps, and help them to reflect on and revise their work to develop their ideas further.

Assessment methods and criteria have to be explained to students and negotiated, where appropriate, so that students develop greater responsibility for their own and each other's learning. Clear assessment criteria indicate to students when they have reached the goals of the course and allow them to experience ownership and a greater sense of control over their learning processes. Opportunities for feedback from the instructor, from peers, as well as self-assessment can help to develop students' self- and peer assessment skills. Instructors can give students some autonomy and involve them in decision-making by letting them choose assessment tasks, discuss assessment criteria, make self-assessment and peer assessment comments, and suggest and negotiate grades, for example (e.g., Brown, Rust, & Gibbs, 1994; Gibbs, 1992a, 1992b).

### 2.3.5 Adaptive Instruction

Adaptive instructors are highly-trained professionals who make their expectations clear, are attuned to the learners' motivation, comfortable with technology, with a deep pedagogical understanding of the subject matter, an awareness of the key role of emotion in achievement, and are able to respond to the uniquely emerging flow of each classroom. The learning environment is designed in a way so that the instructor is moving around the classroom rather than in front of it, which also signifies a shift in power and a cooperative instructor–student relationship with a mutual ownership of the educational process (e.g., ESU & EI, 2010a, 2010b; Piaget, 1977/1995). Instructors who are adaptive experts "are able to approach new situations flexibly and to learn throughout their lifetimes. They not only use what they have learned, they are metacognitive and continually question their current levels of expertise and attempt to move beyond them" (NRC, 2000, p. 48).

In constructive aligned learning environments, the course objectives are embedded in learning-focused activities to elicit certain levels of students' cognitive engagement and participation. In this context, adaptive instruction refers to a tailored individual or group learning support that stimulates further thought. The question is what kinds of teaching and learning activities are required for students to reach certain performances of understandings. The instructor's focus is on what the student thinks and does in order to understand. S/He provides prompts and hints that help the student to figure something out. The notion of adaptive instruction is aligned with the concept of scaffolding that is adapted to or contingent upon students' understanding in order to promote deep learning (Pea, 2004; Sawyer, 2014b; Van de Pol, 2012; Wood et al., 1976). According to Van de Pol and Elbers (2013), scaffolding support is contingent, fades over time, and is aimed at transferring responsibility to the student. Thereby, contingency is the most central characteristic as it represents the adaptive nature of scaffolding that is also crucial for adaptive instruction.

Table 2.4 summarizes the common design principles of SCLEs that support the development of deep conceptual understanding based on the above literature review (research question 1, see Sect. 1.3).

**Table 2.4** Common design principles of student-centered learning environments

| *Design principle* | *Specification* |
|---|---|
| Curriculum for deep conceptual understanding | – Subject-based know-how and transversal higher-order skills (e.g., problem solving, metacognitive strategies)<br>– Alignment between understanding goals, prior knowledge, learning activities, and assessment<br>– Metacognitive student awareness of what they are doing and why<br>– Co-construction of the curriculum (e.g., student choices, feedback) |
| Customized learning (individualized learning experiences) | – Taking students' interests and preexisting cognitive structures into account<br>– Assignments and learning activities that promote active student engagement and participation<br>– Opportunities for students to demonstrate their different understandings |
| Supportive community of learners (working together) | – Collective effort of understanding with course activities that require cooperation and participation<br>– Supportive environment that promotes facilitating norms of behavior, joint exploration, and reflective practices |
| Ongoing assessment and tailored feedback | – Tracking students' understandings by making their thinking visible to students and teachers<br>– Continuous and tailored cycle of feedback aligned with intended learning goals to take students' understandings further<br>– Clear assessment criteria that allow for negotiation, student choice, and foster students' self- and peer assessment skills |
| Adaptive instruction | – Instructors as highly-trained professionals who approach new situations flexibly and learn throughout their lifetimes<br>– Cooperative instructor–student relationship with a mutual ownership of the educational process<br>– Tailored individual or group learning support (e.g., prompts) that stimulates further thought |

This chapter focused on constructivist foundations and common design principles of SCLEs. However, focusing on rather abstract design principles can easily result in superficial changes in the higher education classroom such as an increase in hands-on classroom activities that merely aim to provide students with opportunities for autonomous learning. Guiding principles based on established design frameworks are necessary, but not sufficient, to foster deep learning since the latter requires both a student-centered orientation *and* cognitive activation (sense making) that need to be brought to life in the classroom (e.g., Greeno, 2011; Gresalfi et al., 2009; Pauli, 2010). Hence, the next chapter is concerned with reviewing empirical education research that takes the effectiveness and quality of learning and instruction into account.

## Notes

1. Cognitive constructivism takes cognitive theory as the basis (i.e., individual information processing) and extends it by including interactions between individuals. Social constructivism takes interactional theories of activity as the basis (i.e., activity systems and joint participation in communities of practice) and incorporates information structures (Greeno, 2011).
2. His book entitled "Basic methods of teaching: A didactics on cognitive-psychological foundation" published in 1961 had a significant impact on teacher education in Switzerland, for example (Stebler & Reusser, 2000).
3. Bärbel Inhelder first introduced the term "Critical Exploration" for Piaget's clinical interviewing method as she applied it to pedagogical contexts that included observing children as well as interviewing and interacting with children who were experimenting and investigating a problem set by the researcher.
4. Other names used for this perspective are socioconstructivism, socioculturallism, sociocultural constructivism, or sociohistoricism (Schuh & Barab, 2008).
5. The ZPD is defined by Vygotsky (1978, p. 86) as: "*the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers.*"
6. Thereby, the individual changes through the processes of internalization, developing cognitively as the external social processes become internal cognitive processes. In return, the individual changes his/her sociocultural learning environment (externalization).
7. Prominent research on learning communities and ways to organize them comes from American educational researchers (e.g., Brown & Campione, 1994; Lampert, 2001; Rogoff, 1994; Scardamalia & Bereiter, 1994).

8. Scholars who take on an ecological perspective often research learning outside of formal educational settings, such as in the workplace, at homes or in museums, where learning depends to a great extent on the use of artifacts (e.g., Harnad & Dror, 2006; Hutchins, 1995; Lave & Wenger, 1991; Pea, 1993).
9. Anchored instruction is one instructional theory that builds on anchoring stories. The learners are presented with complex authentic problems to solve, with the learning being a part of this rich macro-context in which the problem solving takes place (e.g., the Jasper series, Cognition and Technology Group at Vanderbilt, 1993).
10. Activity theory is rooted in the classical German philosophy of Kant and Hegel, the ideas of pragmatism by Dewey and Mead, the dialectical materialism of Marx, and the sociocultural and sociohistorical tradition of Russian psychologists such as Vygotsky, Leont'ev, and Luria (Jonassen, 2000).
11. Jonassen (2000, p. 89) underlines the theory's analytic value for designing learning environments stating: "I continue to believe that activity theory offers a powerful framework for analyzing activity systems for the purpose of designing SCLEs and for understanding the activities of an instructional design community engaged in designing such learning environments." He presents an example from a third-year university course in operations management that was designed as a SCLE informed by activity theory.
12. *Semantic principles* refer to achieving a coherent network of information (e.g., alignment of meanings and propositions with accepted concepts and principles in conceptual domains that students have access to) including problematizing inconsistencies in the current information structure by taking them up as discourse topics. *Systemic principles* refer to the ways students are positioned in the learning activity with regard to conceptual agency/authority, commitments and accountability to each other and to the conceptual domain of their activity (e.g., as members of a learning community jointly responsible for developing the shared understanding of the class) (Greeno, 2011).
13. According to Barnes (2008), *exploratory talk* is typical for the early stages of approaching new ideas, with the speakers being concerned about sorting out their thoughts, while *presentational talk* refers to a rather well-shaped presentation, such as a lecture. Exploratory talk "is hesitant and incomplete because it enables the

speaker to try out ideas, to hear how they sound, to see what others make of them, to arrange information and ideas into different patterns" (ibid., p. 5).

14. The framework was developed by teachers and researchers in the context of a research project at Project Zero, Harvard Graduate School of Education and funded by the Spencer Foundation during the early 1990s (Blythe & Associates, 1998).
15. A representative and research-based example of creating a learning environment in line with this framework is the "Fostering Communities of Learners" project that found substantial learning and transfer results based on design experiments (Brown & Campione, 1994).
16. This original series of student learning research struck a chord with work done by Entwistle and Ramsden (1983) and Biggs (1979, 1987, 2012) that was highly influential in the context of learning and instruction in higher education.

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CHAPTER 3

# Empirical Education Research on the Effectiveness and Quality of Learning and Instruction

This chapter aims to derive deeper-level instructional quality dimensions and features of SCLEs based on empirical education research (research question 1, see Sect. 1.3). Section 3.1 reviews major findings of process-outcome research on teaching quality and its effects on student outcome measures conducted in HEIs. Section 3.2 discusses effectiveness research on SRL and instruction to look more closely at students' learning processes and outline effective ways to promote students' self-regulation. Section 3.3 discusses PBL in higher education and empirical research findings with regard to its effectiveness. Section 3.4 refers to complex models of learning opportunities and instructional quality based on social-constructivist and situated perspectives. Research on everyday classroom instruction, mainly conducted in schools with teachers and students, is discussed to distill deeper-level quality features of effective instruction. Finally, in drawing on the literature review conducted in Chaps. 2 and 3, a conceptual framework is introduced comprising common design principles and instructional quality dimensions and features that have to be considered when designing powerful SCLEs (Sect. 3.5). The conceptual framework serves as a starting point and point of reference for the subsequent empirical study (multiple ethnographic case study research in naturalistic higher education classrooms)



S. Hoidn, *Student-Centered Learning Environments in Higher Education Classrooms*, DOI 10.1057/978-1-349-94941-0_3

## 3.1 Process-Outcome Research on Instructional Effectiveness in Higher Education

In the 1970s, studies on teacher effectiveness or process-outcome research became influential and researchers tried to determine teaching behaviors that promote important educational outcomes. Process-outcome research is "the study of relationships between instructional activities of teachers (the processes of teaching), and educational changes that occur in students (the outcomes of teaching)" (Murray, 1997, p. 171). This linear approach is based on a positivistic, behaviorist view on learning and teaching and on the belief that certain instructional behaviors are more effective than others (Fenstermacher & Richardson, 2000). However, there is no commonly accepted concrete definition of effective university teaching and there is no agreement on the characteristics of effective teaching (e.g., Trigwell, 2001). In summing up reviews of the literature on effective teaching, Hativa, Barak, and Simhi (2001, pp. 701–702) submit that exemplary university teachers

> are well prepared and organized, present the material clearly, stimulate students' interest, engagement, and motivation in studying the material through their enthusiasm/expressiveness, have positive rapport with students, show high expectations of them, encourage them, and generally maintain a positive classroom environment.[1]

After outlining the research context and methods used in process-outcome research in higher education (Sect. 3.1.1), effective instructor behaviors are distilled that have emerged consistently as strong predictors of diverse student outcome measures (Sect. 3.1.2).

### *3.1.1 Research Context and Methods*

Process-outcome research in higher education was primarily carried out in teacher-centered learning environments that focus on knowledge transmission, that is, in the context of either a lecture or lecture-discussion method of teaching. Process-product research suggests that successful teachers use a pattern called "direct instruction" or "explicit teaching" or "systematic teaching" (Rosenshine, 2009, p. 203). As compared to less effective teachers, effective teachers show behaviors such as beginning their lesson with a 5–8 minute review, spending more time presenting new material and guiding student practice, helping students by simplifying questions, and providing hints or reteaching the material. However, as students exhibit more mastery these instructors decrease control to provide opportunities for independent and fluent performance by the students themselves (McDonald & Elias, 1976; Rosenshine, 2009; Stanovich, 1980).

Instructional effectiveness research is mostly based on two indicators: student ratings measuring student satisfaction and student achievement as usually measured by their success in the course's tests (see Cashin, 1995; Marsh, 1987; McKeachie, 2007, for reviews of the student rating literature). Consistently high positive correlations have been found in meta-analyses between students' ratings of the amount learned in a course (with student learning being a measure of good teaching) and their course evaluations (e.g., Cohen, 1981; Feldman, 1989, 2007; Greenwald & Gillmore, 1997; Marsh, 2007). Research findings indicate that courses with higher exam averages are taught by teachers with higher student rating scores—meaning that students learn more as measured by exam scores when instructor evaluations are high.

Evaluation instruments, such as student ratings, are considered to be very reliable outcome measures capturing the data they set out to capture. Students' ratings measure perceived instructor effectiveness—they are primarily a function of the instructor who teaches the course and not of the course that is taught (Marsh, 2007). Knowledge about the quality of teaching is important because teaching quality affects what teachers do and think, and what students learn. Student evaluations make instruction visible from the students' perspective and provide crucial sources of information for teachers to learn from. Thereby, global student ratings—such as overall instructor rating, overall course rating, and course materials—are especially suitable for summative evaluation purposes while more specific, multidimensional student ratings—such as ratings of course difficulty, feedback, interest/motivation, intellectual challenge, and concern for students—are more suitable for formative purposes to facilitate instructional changes and improve teaching (Abrami, d'Apollonia, & Rosenfield, 2007; Hattie, 2009, 2012; Weimer, 1997, pp. 418–419). In distilling the extensive body of research, Pascarella (2006) draws three general conclusions regarding student perceptions of teacher classroom behaviors or instructional practices: these perceptions are multidimensional, they are reasonably reliable and stable, and they have moderate positive correlations, for example, 0.30–0.50, with various measures of course learning, such as course grade and final examination.

However, there is a broad consensus that student evaluations should not be the only measure of teaching effectiveness (Marsh, 2007).[2] As to methodologies, process-outcome research can rely on both correlational investigations based on systematic observations under natural conditions and/or student ratings, and laboratory designs where students are randomly assigned to instructional treatment conditions. In the last decades, instructional effectiveness research has accumulated an extensive body of correlational and experimental evidence on what constitutes effective college and university teaching. This voluminous research base has demonstrated the positive empirical link between different dimensions of effective postsecondary classroom instruction and both course-level learning outcomes and more general cognitive growth. Nevertheless, different teaching behavior dimensions vary substantially in the strength of their relationship with course achievement (for comprehensive, state-of-the-art reviews, see Pascarella & Terenzini, 1991, 2005; Perry & Smart, 1997, 2007).

### *3.1.2 Effective Instructor Behavior and Students' Learning Outcomes*

Considering which dimensions emerge consistently as strong predictors of diverse cognitive and motivational outcomes in higher education research, observational studies found that the following three dimensions have the highest effects: (1) teacher clarity/organization, (2) teacher enthusiasm/expressiveness, and (3) teacher–student rapport/interaction. Overall, Murray (2007a) found that interaction factors together with clarity and expressiveness accounted for 50–70% of the variance in student ratings of teaching behaviors. Teaching behavior factors correlated higher with student ratings (student satisfaction) as compared to student learning or motivation. This section refers to correlational studies that explore links between instructional behaviors and different instructional outcomes based on student ratings and/or nonparticipant observations (Abrami et al., 2007; Feldman, 1989, 1997, 2007; Murray, 1983, 1985, 1997, 2007a, 2007b). Experimental research also indicates that expressive, enthusiastic teaching behaviors (e.g., speaks emphatically) as well as organization/preparation (e.g., effective use of class time), and teacher clarity (e.g., clear explanations) are the dimensions that consistently stand out and are most strongly linked to instructional outcome measures such as achievement tests on the course level (Hines, Cruickshank, & Kennedy, 1985; Schonwetter, Perry, & Struthers, 1994).

1. Teacher clarity and organization
Feldman (1989, 1997, 2007) found correlations between 28 specific instructional dimensions and student achievement in the common final exams.[3] The two highest correlations explaining variance of over 30% were the dimensions "teacher's preparation and course organization" with 0.57 and "teacher's clarity and understandableness" with 0.56. These were followed by "teacher's pursuit and/or meeting of course objective" (0.49) and "student-perceived outcome or impact of the course" (0.46), indicating between roughly 20% and 30% of explained variance. Based on Feldman's coding scheme, Abrami et al. (2007) quantitatively integrated the results from 17 correlation matrices. All multidimensional student rating forms that were analyzed included global items measuring effective teaching. Global clarity/organization factors such as "relevance of instruction," "clarity of instruction," "preparation and management style," "high-level cognitive outcomes," "monitoring learning," and "choice of supplementary materials" were highly correlated with instructional effectiveness. Murray (1985, 2007a, 2007b) measured teaching effectiveness by end-of-term student ratings and low-inference teaching behaviors[4] that were independently recorded by trained observers and found that teacher clarity and organization associated with specific classroom behaviors such as "uses concrete examples," "stresses most important points," "task orientation" (e.g., states teaching objectives, sticks to point in answering questions), or "summarizes periodically" correlated highly with student ratings of overall teacher effectiveness. Murray (1997, 2007a, 2007b) also found that conceptual clarity and speech clarity correlated highly with student ratings (teacher and course ratings) and student motivation for further courses (only conceptual clarity), but not with student studying, examination performance, or amount learned rating. Moreover, "task orientation" correlated with five out of these six measures (Murray, 1997). In a recent empirical study using data from the 2010 administration of the National Survey of Student Engagement (NSSE) as well as items from the core NSSE survey, BrckaLorenz, Cole, Kinzie, and Ribera (2011) researched teacher clarity behaviors related to student engagement, deep learning, and self-reported gains in college using regression analysis. First-year as well as senior data were analyzed. The authors found that students' perception of instructional clarity can promote deep learning. Clear and challenging learning goals (0.50) that describe the attitudes, knowledge, and skills that the students need to learn and, particularly, teacher clarity (0.75) were found to have a large effect on student achievement (Hattie, 2009, 2012).

Scientific evidence further suggests that instructional organization/preparation might have implications beyond the facilitation of knowledge acquisition in a specific course. Exposure to organized and clear classroom instruction may also have positive net effects on student decisions to persist at, or depart from, a particular college or university. Findings from a longitudinal study of first-year students at a large research university, controlling for an extensive battery of confounding influences, show that exposure to organized and clear instruction had a significant positive total effect ($p < 0.001$) on actual reenrollment at the institution for the second year of college with most of the causal influence on reenrollment decisions being mediated by level of satisfaction with the first-year education experience

> Exposure to instructional behaviours that enhance learning (organization and clarity) might also increase the probability of a student's persistence at an institution by increasing his or her sense of overall satisfaction with the education being received. (Pascarella, Seifert, & Whitt, 2008, p. 67)

The above findings were replicated in a longitudinal and multi-institutional study (Pascarella, Salisbury, & Blaich, 2011) involving 19 four-year and two-year colleges and universities such as research universities, regional institutions, or community colleges. The authors emphasize the importance of classroom instructional practices and teacher behaviors in student persistence at an institution—irrespective of the type of institution attended and despite different levels of precollege academic preparation (Pascarella et al., 2008).

2. Teacher enthusiasm and expressiveness
Teacher enthusiasm is regarded as an important teacher behavior to engage students (Brophy & Good, 1986). The instructional dimension enthusiasm/expressiveness, involving "teacher motivates students to do their best," "teacher's enthusiasm for the subject," and "teacher's elocutionary skills," for instance, was found to be of high or moderate importance to student achievement in common final exams (Feldman, 1989, 1997). Abrami et al. (2007) and Murray (2007a, 2007b) also found that teacher enthusiasm/expressiveness factors, such as "enthusiasm for teaching," "motivating students to greater effort," "stimulation of interest" (relates subject to student interests), "enthusiasm for subject," "shows facial

expressions," "gestures with hands and arms," or "describes relevant personal experience," were highly correlated with student ratings of overall teaching effectiveness. In a five-year project to investigate whether low-inference teaching behaviors are related to outcomes other than student ratings, enthusiasm/expressiveness correlated not only with student satisfaction (teacher and course ratings) but also with students' motivation for further courses and final exam performance (Murray, 1997). A lack of teacher enthusiasm can easily lead to student boredom which research has been shown to have consistently negative effects on subsequent student performance and vice versa (Pekrun, Hall, Goetz, & Perry, 2014).

3. Teacher-student rapport/interaction

Feldman (1989, 1997, 2007) also found that rapport/interaction was of moderate importance to student achievement in common final exams. This dimension involves social teaching behaviors, such as "intellectual encouragement and encouragement of independent thought," "teacher's concern and respect for students," and "teacher's sensitivity to, and concern with, class level and individual progress." The factor analysis conducted by Abrami et al. (2007) based on student ratings also showed that rapport/interaction factors such as "concern for students," "tolerance of diversity," "availability," "interaction and discussion," "feedback," "respect for others," and "friendly classroom climate" correlate highly with instructional effectiveness. Murray's (1997, 2007a) correlational research indicates that teaching behaviors related to rapport/interaction factors including behaviors such as "addresses students by name," "asks questions of class as a whole," and "shows concern for student progress" were among the dimensions that emerged consistently as strong predictors of instructional outcomes (student satisfaction and motivation). Frisby and Martin (2010) assessed the relationship between instructor–student rapport and student outcomes and found that rapport building behavior predicts cognitive learning (e.g., knowledge, understanding, development of skills), affective learning (affect toward instructor, course content, and enrolling in a similar content course), and participation in class (e.g., making comments during class) (see also Webb & Obrycki Barrett, 2014; Wilson & Ryan, 2013).

Instructors are playing an important role in shaping classroom interaction and, thus, contributing to students' levels of participation (e.g., Karp & Yoels, 1976; Mustapha, 2010). Instructors can create a classroom climate conducive to participation by showing enthusiasm, patience and respect, listening to students' comments and questions without judging them, presenting participation as a collective responsibility of the class, and by being a good discussion facilitator, for example (Karp & Yoels, 1976; Rocca, 2010). In terms of classroom interaction, there is consensus in the education research literature that increased class participation has twofold benefits: more enjoyable classes for teachers and students and improved learning outcomes for students (Kenney & Banerjee, 2011; Marzano, Pickering, & Heflebower, 2011; Nunn, 1996; Sutton-Brady & Stegemann, 2010; Weaver & Qi, 2005). Research shows that students in lecture courses that substitute part of the lecturing during class time with in-class activities that actively engage students (e.g., student-generated questions, having students explain their own ideas, paired discussions of a problem, and buzz groups or debriefs) substantially outperform those attending traditional courses (Gerbig-Calcagni, 2009; Hake, 1998; Lo, 2010; Roehling, Vander Kooi, Dykema, Quisenberry, & Vandlen, 2011). In order to make classrooms more interactive, whole class discussions, wherein the instructor poses open-ended questions attempting to draw all class members into conversation, have proven to be effective (Hattie, 2009, 2012). Collaborative learning, with students working in small groups reconciling opposing ideas, accommodating others' perspectives, and sharing their reasoning and resolving conflicts while developing understanding, is another effective way to increase student learning (Kyndt, Raes, Lismont, Timmers, Cascallar, & Dochy, 2013; Lo, 2010; Slavin, 2009). Self-verbalization, self-questioning, and more dialogic classrooms where students generate their own questions and comment on ideas are also effective ways to improve student involvement and learning (Alexander, 2008; Campbell & Mayer, 2009; Hattie, 2009, 2012).

In summary, the above process-outcome research based on student ratings, observational studies, and partly experimental research, mostly conducted in more teacher-centered learning environments, differentiates effective teachers from less effective teachers for both cognitive and noncognitive outcomes. Three effective instructional behavior dimensions emerge consistently as strong predictors of student satisfaction, motivation, learning, and student persistence at an institution: teacher clarity/organization, teacher enthusiasm/expressiveness, rapport/interaction. The above classroom behaviors were found to influence not only how well or poorly students do on final examinations or the amount they learned but also—with some variation—to which extent students enjoy the course, study a lot or a little, are motivated to enroll in further courses in the same subject area, or persist at a particular university. The low-inference behaviors related to the three instructional behavior dimensions outlined above are trainable and, thus, have the potential to produce significant changes with regard to student ratings of effectiveness and other cognitive and noncognitive outcome measures.

## 3.2 Effectiveness Research on Self-Regulated Learning and Instruction

If students are to become successful independent learners who can access and effectively engage with learning opportunities throughout their lives, they must develop and refine the capacity to regulate their own learning by developing skills as they progress through education. During the 1970s and 1980s, researchers found that individual differences in learning could be attributed to students' lack of self-regulation which requires the active participation of individuals in their own learning (Zimmerman, 2002). Research in the recent decades has, thus, focused on identifying general and domain-specific components of self-regulation, including cognitive, metacognitive, motivational, and behavioral strategies that are used by students to autonomously plan, execute, monitor, and evaluate their learning processes in order to achieve desired academic outcomes. Findings show that SCLEs and instructional practices (context) that are designed to promote students' (intrinsic) motivation and self-regulation processes can support deep learning and improve retention rates in higher education. Self-regulatory processes or beliefs, such as sustaining motivation, setting goals, using strategies, engaging in self-evaluation, and self-reflection can be learned from instruction and from modeling by instructors or peers (e.g., Boekaerts, Pintrich, & Zeidner, 2000; Schunk & Zimmerman, 2007; Zimmerman, 2013; Zimmerman & Schunk, 2001, 2011).

This section defines what it means to be a self-regulated learner (Sect. 3.2.1) and refers to the shift of instructors' conceptions of teaching necessary to create opportunities for students' self-regulation (Sect. 3.2.2). After that, Zimmerman's cyclical phase model of self-regulation, which is grounded in social-cognitive theory and uncovers the phases and subprocesses of self-regulation, is introduced (Sect. 3.2.3) and the importance of context for self-regulation and motivation of learning is emphasized (Sect. 3.2.4). The last section delineates effective ways to promote self-regulation among students based on empirical research findings (Sect. 3.2.5).

### *3.2.1 The Self-Regulated Learner*

Self-regulation refers to the degree to which students can actively regulate aspects of their thinking, motivation, and behavior oriented to attaining goals. SRL manifests itself in students' active monitoring and regulation of learning processes (Pintrich & Zusho, 2002). Empirical research shows that self-regulated learners are more effective learners in terms of their persistence, resourcefulness, confidence, and level of academic achievement (e.g., Bembenutty, Cleary, & Kitsantas, 2013; Zimmerman, 2008; Zimmerman & Schunk, 2001, 2011). Self-regulated learners are self-motivated agents of their own behavior who use adequate strategies to achieve desired academic outcomes. Thereby, students' motivational feelings and beliefs regarding initiating and sustaining changes in their self-regulation of learning are closely related with key SRL processes (Zimmerman, 2008). Their self-regulated competences and skills include the following key self-regulatory processes:

- setting specific proximal *goals* for oneself,
- adopting powerful *strategies* for attaining the goals (e.g., cognitive strategies such as repetition, elaboration, and organization),
- *monitoring* one's performance selectively for signs of progress,
- *restructuring* one's physical and social context to make it compatible with one's goals (e.g., help-seeking from peers),
- managing one's *time* use efficiently,
- *self-evaluating* one's methods,
- *attributing* causation to results, and
- *adapting* future methods (Zimmerman, 2008, p. 66).

In comparing the self-regulation profiles of novices with those of experts, researchers found that experts display high levels of self-motivation, set process goals, use powerful strategies and self-observe their effects, self-evaluate their performance against their personal goals, and make strategy attributions. Such behaviors lead to greater personal satisfaction with one's progress and further efforts to improve one's performance together with favorable self-motivational beliefs (e.g., intrinsic interest) (Zimmerman, 2002). Self-regulated learners have not only knowledge of a skill but also "the self-awareness, self-motivation, and behavioral skill to implement that knowledge appropriately" together with the ability to selectively use and adapt specific processes to the learning task (Zimmerman, 2002, p. 66).

They can also change and modify their learning environment in order to promote productive learning.

Currently, higher education is confronted with increasing numbers of students from diverse backgrounds entering tertiary education who might not be prepared to benefit fully from their studies and/or drop out due to a lack in self-regulatory skills (Bembenutty, 2011; Pintrich & Zusho, 2007). Consequently, SCLEs in higher education aim to empower students to engage in SRL to actively construct knowledge and become masters of their own learning processes (OECD, 2013; Zimmerman, 2008).

### *3.2.2 Instructors' Conceptions of Teaching*

In the course of their professional development, instructors generate specific beliefs on the subject matter they teach and on the nature of student learning. In higher education, there has been considerable interest in conceptions of teaching because they influence instructors' decisions and behaviors in the classrooms and have, thus, implications for student learning.[5] Hence, in determining what good teaching is and how to teach and learn effectively, conceptions of teaching that instructors hold have to be taken into account. Research on conceptions of teaching suggests two basic strategies (Kember, 1997; Prosser & Trigwell, 1998): teacher-focused (content oriented) strategies referring to the transmission of knowledge from expert teacher to novice learner as is the case in traditional lectures. Student-focused (learning oriented) strategies referring to conceptual changes in students' understanding of the world focusing on what students do in order to understand. Prosser and Trigwell (1999) and Ramsden (2003) argue that becoming an effective instructor involves developmental stages. These stages generally are characterized by approaches that move from viewing teaching as information transmission (content focus), to a focus on instructional strategies (teacher focus), to, finally, a focus on students' intellectual development (learner focus) (Chism, 2004).

Biggs (1999, 2012) differentiates three common theories of teaching and suggests that these three conceptions are developmental in that they seem to follow the growth of teacher competence: (a) learning is primarily a result of individual differences between students regarding ability, attitude, motivation, and study skills (teacher-focused conception, Prosser & Trigwell, 1998); (b) learning is primarily the result of appropriate teaching, meaning the effective transmission of information and understanding of important concepts of a certain discipline to students (e.g., process-outcome research); and (c) learning is the result of students' learning-focused activities with a focus on what the student does and on whether student activities that lead to appropriate learning are supported by the teacher. The first two understandings rely on a "deficit model," blaming either the student or the teacher for the outcome and many academics seem to follow traditional transmission theories of teaching similar to the first two understandings. The third conception provides a systemic view that takes into account what it means to understand something at the desired levels, and what kinds of teaching and learning activities are required to reach certain understandings (Biggs, 2012).

The current shift from a focus on the teacher to a focus on the learner and on learning in education de-emphasizes teaching as "telling"—lecture-based instruction—that was often the basis for previous studies on instructional effectiveness.[6] Compared to traditional teacher-centered methods mainly focusing on rote learning, memorization, and on testing standards, student-oriented views brought fresh pedagogical ideas to help learners to become autonomous human beings and lifelong learners by emphasizing individualized learning, student orientation, and learner autonomy. Student-oriented instruction conveys the notion of students as active participants with a high level of personal responsibility for their learning processes and outcomes (e.g., EUA, 2010). Student-oriented instructors seek to provide students with opportunities for SRL by using more open forms of education such as active learning, cooperative learning, and by designing more student-centered classrooms, with the latter involving students in decisions on what is learned, how it is learned, and when it is learned (Gibbs, 1992a, 1992b; Pauli, Reusser, & Grob, 2007). However, student-oriented models of instruction often tend to focus one-sidedly on the surface-level organization of learning activities—at the cost of the quality of subject-based learning processes (Mayer, 2004, 2009; Pauli & Reusser, 2011). Empirical research shows that the use of self-regulation processes is fundamentally domain-specific (e.g., Leutwyler & Maag Merki, 2009). In order to be most effective, such self-regulation strategies need to be integrated within the different subjects of the curriculum so that students can apply these strategies in different learning situations and transfer them to other contexts later on (e.g., Dubs, 2007; Mandl & Friedrich, 2006).[7] Overall, SRL is both a desired product of classroom instruction and, to a substantial degree, the precondition for successful and productive classroom learning (Leutwyler & Maag Merki, 2009).

### *3.2.3 Zimmerman's Social-Cognitive Model of Self-Regulated Learning*

The pedagogical and psychological literature offers a broad array of SRL models for higher education learning and instruction (see Hoidn, 2010 for an overview). Prominent models of SRL cycles that are grounded in social-cognitive theory aim to explain the various processes students engage in to regulate their learning, emphasizing the interaction of personal, behavioral, and environmental factors (e.g., Boekaerts, 1999; Pintrich, 2000; Zimmerman, 2000).[8] These models underscore the role of context in cognition and academic motivation. According to Zimmerman (1989, p. 329), students learn self-regulated "to the degree that they are metacognitively, motivationally, and behaviorally active participants in their own learning process." Thus, self-regulation is concerned not only with thinking skills, but also with the role of emotion, motivation, self-concept, and self-efficacy, and with related behavioral processes in learning (e.g., active participation). Zimmerman (2000, 2002, 2008) has developed a cyclical phase model of self-regulation (see Fig. 3.1) that depicts learning processes and motivational beliefs in three phases: forethought (pre-action), performance (action), and self-reflection (post-action).

- The *forethought phase* sets the stage for learning and includes two key self-regulatory processes: *task analysis* involving goal setting and strategic planning, and *self-motivation beliefs* to self-regulate involving self-efficacy, outcome expectations, task interest or value, and goal orientation (i.e., valuing the process of learning for its own merits).
- The *performance phase* refers to processes that occur during learning: *self-control* involves the deployment of specific methods or strategies that were selected during the forethought phase (e.g., imagery, self-instruction, attention focusing, and task strategies). *Self-observation* refers to self-recording personal events (e.g., time use), self-experimentation (testing hypotheses to improve one's learning), or self-monitoring (i.e., one's cognitive tracking of personal functioning).
- The *self-reflection phase* occurs when learners respond to their efforts with *self-judgment* involving two self-regulatory processes: self-evaluation (against some standard) and causal attribution with the latter referring to beliefs about what caused the outcome. *Self-reaction* refers to whether the student is satisfied with the performance and

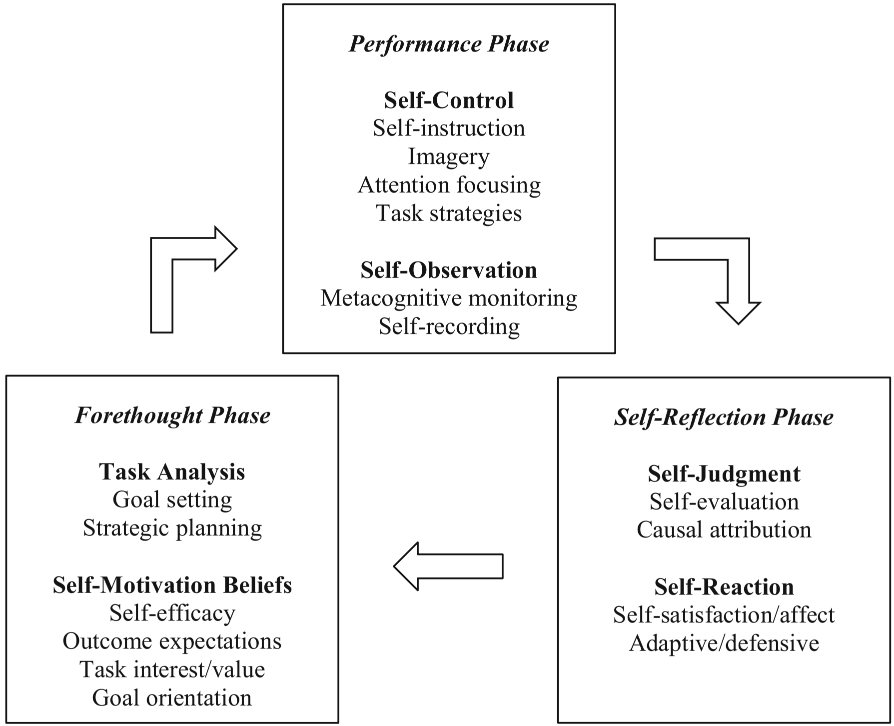


**Fig. 3.1** Phases and subprocesses of self-regulation (Zimmerman, 2008, p. 178)

experiences positive affect regarding his/her performance. Defensive reactions aim to protect the student's self-image (e.g., by avoiding opportunities to perform), while adaptive reactions lead to adjustments in order to increase the effectiveness of his/her learning strategies.

Self-reflections from prior efforts to learn (e.g., feedback) affect subsequent forethought processes in a "self-regulatory cycle" so that self-regulated learners continually adjust their goals and strategy choices. This implies that self-regulation can improve with practice because successful self-regulators draw on their previous learning experiences to build a growing repertoire of beliefs and strategies to enhance their learning.

#### *3.2.4 The Importance of Context for Self-Regulation of Learning and Motivation*

The consideration of contextual factors indicates that students' perceptions of their learning environment are an important aspect of their learning processes. Self-determination theory highlights the importance of students' perceived competence, autonomy, and social relatedness for students' autonomous self-regulation for learning, academic performance, and well-being. These perceptions relate to basic psychological human needs (Deci & Ryan, 2002; Niemiec & Ryan, 2009):

- the *need for competence* refers to the human desire to effectively interact with the environment so as to feel competent in producing desired outcomes;
- the *need for autonomy* refers to the human desire to be the origin of one's behaviors; and
- the *need for social relatedness* refers to the human desire to feel connected to significant others.

The facilitation of more self-determined learning requires learning environments that allow satisfaction of these three basic human needs. To the extent that these needs are satisfied, both intrinsic motivation and autonomous forms of extrinsic motivation that emanate from and are congruent with the self and are conducive to deep learning will be enhanced and nonself-determined forms of motivation will be diminished (Vallerand & Ratelle, 2002).

SRL research also emphasizes the role of students' perceptions of self-efficacy and achievement goals as important aspects of motivation that influence control and regulation of their learning.

- *Academic self-efficacy* is the belief in one's capability to organize and carry out the actions required to achieve one's goals. Self-efficacy beliefs were found to have a positive effect in the process of self-regulation and learning (Hattie, 2009; Schunk & Zimmerman, 2007). Students with high self-efficacy tend to set higher goals for themselves, see challenging tasks as opportunities to learn, and continue to persist even when confronted with difficulties (Bandura, 1997). Self-regulated students exhibit a strong sense of efficacy in their capabilities which also influences their choice of particular self-regulatory learning strategies (e.g., rehearsal strategies versus elaboration).
- *Achievement goals* (*reasons for performing the task*): research on achievement goals has emerged as one of the dominant theories of academic motivation (Zusho & Edwards, 2011). Achievement goal theory focuses on *why* students are engaging in a task (e.g., to proceed to more advanced studies) in order to achieve certain objectives (e.g., a passing grade) and differentiates between two types of goals: (1) mastery goals (or learning goals), with the students focusing on the learning process in order to deepen their understandings (development of competence); and (2) performance goals, with students oriented toward demonstrating competence and trying to be better than others. SRL research over the past decades found that mastery goal orientation (e.g., students who have opportunities to pursue goals that they find meaningful and interesting) promotes adaptive self-regulation (Hattie, 2009; Pintrich & Zusho, 2007; Zimmerman, 2002).

### *3.2.5 Effective Ways to Promote Self-Regulation among Students*

The goal of constructivist instruction is to not only foster "thoroughly understood and flexible knowledge" but also "the enhancing of cognitive, metacognitive, communicative and volitional abilities and of interests and beliefs that are important for self-regulated learning and problem-solving" (Pauli et al., 2007, p. 296). What can instructors do to foster SRL in their students? The literature on self-regulation distinguishes between direct and indirect ways to promote SRL (Dubs, 2009; Hoidn, 2010; Kistner, Rakoczy, Otto, Dignath-van Ewijk, Büttner, & Klieme, 2010).

Instructors can promote SRL by *directly* teaching learning strategies—through either implicit or explicit instruction:

- *Implicit instruction*: instructors engage their students in self-regulated behaviors by asking questions to facilitate the process, or they model self-regulating behaviors (e.g., strategy use while thinking aloud) so that students can observe the instructor or other experts without being made aware that they are taught learning strategies.
- *Explicit instruction*: instructors explicitly explain the use of SRL activities (e.g., goal setting, learning strategies) and students have opportunities to practice these strategies. "Study skills" courses are prevalent SRL interventions in tertiary education that aim to improve students' strategic knowledge, goal setting, learning strategies, and time management skills, for example (e.g., Zusho & Edwards, 2011).

Instructors can promote SRL *indirectly* by arranging a supportive learning environment that enables and encourages students to learn in a self-determined way. Self-regulatory processes can develop gradually within learning environments that balance structure with opportunity for autonomy (English & Kitsantas, 2013). Such environments provide students with opportunities to practice self-regulation (e.g., strategic planning, self-evaluation) and to get feedback on their performance with the instructor gradually removing scaffolds to help students to assume more control over their learning. Instructors can design learning environments that help promote higher levels of understanding by fostering the adoption of understanding-oriented goals (mastery goals) and high self-efficacy expectations of students. The instructor and peers can facilitate student confidence by providing quality feedback and appropriate learning support. In order to be successful in academia, students often need to manage to pursue multiple goals and strategies at the same time, including both intrinsic goals (e.g., mastering a task) and extrinsic goals (getting a good grade) as well as deep and surface approaches to learning (e.g., Hattie, 2012).

Research results show that self-regulation of learning is a dynamic process where both the student and the learning context play reciprocal roles in cognition and academic motivation (Bembenutty, 2011). The importance of context in terms of the instructional setting has been highlighted in a recent empirical study conducted in schools. This study considered the influence of different instructional designs on dimensions of SRL (i.e., motivational, cognitive, and metacognitive self-regulation) (Leutwyler & Maag Merki, 2009). Students' subjective evaluation of personal achievement ability, students' perceived social integration, and the instructor's ability to motivate students were found to play an important role in the development of motivational self-regulation. The degree of transfer orientation (measured by the use of elaboration strategies) was found to be positively related to the development of cognitive and metacognitive self-regulation.

In another empirical study investigating 20 German mathematics teachers and their overall 538 secondary school students (grade 9), Kistner et al. (2010) found that the promotion of SRL occurred mainly by implicit instruction of strategies (especially cognitive strategies such as elaboration and organization), while explicit strategy teaching was rare. Yet, students seemed to benefit most from explicit strategy instruction. Moreover, teachers hardly created a learning environment that fostered SRL in regular lessons. In the rare occasions when students were learning in a more constructivist and transfer-activating learning environment, results showed a higher increase in their understanding over time as compared to an environment without supportive features for the promotion of SRL.

In summary, SRL requires the active participation of students in their own learning and manifests itself in students' active monitoring and regulation of the learning process in order to attain desired goals. Empirical research has generated ample evidence that SRL can contribute to student learning, motivation, and academic success, and that instructors can employ specific classroom structures and teaching methods to develop students' SRL skills. Students' self-regulation can improve with practice since self-reflective processes based on prior efforts create learning experiences students can draw and learn from and, thus, build a growing repertoire of beliefs and strategies to enhance their learning. The literature also shows that self-regulation strategies need to be integrated within the different subjects of the curriculum in order to be most effective.

Instructors can implicitly foster students' SRL skills by asking questions to facilitate the learning process and by modeling self-regulating behaviors, or they can explicitly explain the use of certain SRL strategies and provide students with opportunities to practice those skills within a subject they are learning about. Instructors can further design a supportive learning environment that provides students with increasing opportunities to practice self-regulation and receive quality feedback on their performance as well as adaptive learning support to help students to assume more control over their learning. Such environments foster the adoption of understanding-oriented goals to promote higher levels of understanding (mastery goals), high self-efficacy beliefs (i.e., how confident students are about performing specific tasks), and students' perceptions of their learning environment regarding competency support, autonomy support, and social relatedness to promote students' self-regulation of learning and motivation.

## 3.3 Effectiveness of Problem-Based Learning in Higher Education

### *3.3.1 The Concept of Problem-Based Learning*

PBL surfaced over 40 years ago as a reaction to the problems and shortcomings of conventional educational approaches, such as direct instruction, and has since had a significant impact on medical and nonmedical (e.g., science, engineering) education domains (Barrows, 2002; Xian & Madhavan, 2013). Inquiry-based PBL approaches draw upon adult learning theory as well as cognitive and social constructivism. Learning is seen as an active, self-regulated process with students working together in groups to solve complex real-world problems that facilitate the acquisition of discipline-specific knowledge and attitudes as well as transversal skills, such as problem solving, critical and creative thinking, and collaborative learning skills which students can use in their personal life and careers (Barrows & Tamblyn, 1980). In a classical definition stemming from medical education, PBL "is the learning that results from the process of working towards the understanding of a resolution of a problem […] encountered first in the learning process" (Barrows & Tamblyn, 1980, p. 1). More recently, Barrows (2002; Walker & Leary, 2009) has identified four key components of PBL:

- *Ill-structured problems* are presented so that students will generate not just multiple thoughts about the case of the problem, but engage in the exploration of multiple solution paths;

- A *student-centered approach* that consists of students determining what they need to learn, that is, students derive the key issues of the problems they face, define their knowledge gaps, and pursue and acquire the missing knowledge;
- *Teachers act as facilitators or tutors* in the learning process who initially prompt students with genuine and metacognitive questions, model the kinds of learning processes that lead to success in PBL settings, and, in subsequent sessions, fade that guidance;
- *Authenticity* forms the basis of problem selection, embodied by alignment to professional or real-world practice. As such, the problems are inherently cross-disciplinary and require students to investigate multiple subjects in order to generate a workable solution.

PBL is an instructional approach with elements that allow for flexible adaptation of guidance compatible with humans' cognitive architecture in order to foster deep conceptual understanding and SRL. Specifically, it is characterized by the use of problems that actualize important scientific ideas as the starting point, small-group collaboration of 6–10 students, flexible guidance, a limited number of lectures, student-initiated learning, and ample time for self-study (Schmidt, Loyens, Van Gog, & Paas, 2007; Schmidt, Van der Molen, Te Winkel, & Wijnen, 2009). Consequently, successful constructivist curricula that promote PBL have four conditions:

> First, problems or assignments used as the starting point of small-group discussion and self-directed learning should be promoting epistemic curiosity and should be perceived by students as relevant to their personal strivings. Second, small group work should enable the activation of prior knowledge and elaboration on what is learned. Third, tutors should engage themselves actively in didactic conversations with the learners and provide appropriate scaffolds. Fourth, students need ample time for self-directed learning using resources that (to some extent) represent their own interests and preferences. (Schmidt, Van der Molen et al., 2009, p. 240)[9]

Section 3.3.2 reviews empirical studies on the effectiveness of PBL environments representing a rare student-centered approach that has been well researched over the past decades. Most empirical studies describe and evaluate PBL innovations, comparing them with more conventional education based on knowledge tests involving large samples of students or graduates from two schools. The research findings cover studies of PBL mainly conducted in the training of professionals in the field of medicine in higher education over the last 30 years. These earlier results are blended with more recent meta-analyses and meta-syntheses that also expanded the disciplines covered (Schmidt, Rotgans, & Yew, 2011).

### *3.3.2 Research Findings on the Effectiveness of Problem-Based Learning*

Does empirical evidence exist that PBL is an effective instructional approach, especially in comparison with more traditional, commonly practiced methods of instruction?[10] The results of the meta-analyses, meta-syntheses, and studies that were analyzed and synthesized were categorized into six pragmatic categories: knowledge acquisition and retention, reasoning skills, knowledge application, social and behavioral skills, student satisfaction and motivation, and study progress and success. Overall, PBL appears to fare very well against the more traditional teaching—regarding a variety of objectives and in a variety of disciplines—with newer studies tending to favor PBL more than the older studies (see also Hoidn & Kärkkäinen, 2014; Loyens, Kirschner, & Paas, 2012).

1. Knowledge acquisition and retention

The performance of medical students participating in PBL was not found to be statistically different from the performance of students in more traditional medical education on tests of basic science by Vernon and Blake (1993), who analyzed five meta-analyses covering 35 studies from 19 institutions dating from 1970 to 1992 (see also Mennin, Gordan, Majoor, & Al Shazali Osman, 2003).[11] A narrative meta-analysis by Berkson (1993) on medical education, including PBL literature, through 1992 also concluded that, “the graduate of PBL is not distinguishable from his or her traditional counterpart.” Along these lines, Albanese and Mitchell’s (1993) meta-analysis-type review covering 20 years (1972–1992) of research relying on a narrative integration found that PBL graduates performed as well and, sometimes, better on clinical examinations and faculty evaluations than their traditional counterparts. PBL students showed patterns of higher resource utilization per patient and had more study hours each day. In a few instances, PBL students scored lower on basic sciences examinations and viewed themselves as less well prepared in the basic sciences.

Colliver (2000) conducted a review of the medical education literature, including the three above meta-analyses as well as research published from 1992 to 1998. He analyzed the effects of PBL on educational outcomes and concluded that there is no significant evidence for the superiority of PBL regarding performance on standardized tests or instructor-designed tests during the first two years of medical school, although it might be more motivating, satisfying, and enjoyable for medical students. However, a more recent study comparing students' motivation in a PBL curriculum versus a traditional curriculum submits that PBL does not always seem to foster higher intrinsic motivation (Wijna, Loyens, & Derous, 2011). Smits, Verbeek, and De Buisonjé (2002) reached similar conclusions by researching the effects of PBL in continuing medical education on the basis of controlled evaluation studies conducted from 1974 to 2000.

Dochy, Segers, Van den Bossche, and Gijbels (2003) conducted a quantitative meta-analysis, including 43 quasi-experimental field studies of PBL in higher education. They report that no robust effect of PBL was found on declarative knowledge tests, at least for the time the study was conducted, and the nonsignificant advantage of conventional instruction disappeared after the second year of medical education. The benefits of PBL over traditional approaches seem to become more visible when examining higher education students' long-term retention of knowledge. While PBL students may be slightly inferior to traditional students in overall knowledge and competence, they appear to be superior in long-term recall and retention (see also Gijbels, Dochy, Van den Bossche, & Segers, 2005; Norman & Schmidt, 2000; Schmidt & Moust, 2000). Strobel and Van Barneveld (2009) compared and contrasted the assumptions and findings of meta-analytical research on the effectiveness of PBL for the workplace. Their qualitative meta-synthesis approach drew on eight meta-analyses and systematic reviews (1993–2005) in medicine and other disciplines such as economics and computer science. Strobel and Van Barneveld's (2009) analysis showed mixed results with regard to the knowledge assessment category tending to favor traditional learning approaches for short-term knowledge acquisition, but PBL was more effective for long-term knowledge acquisition.

In another meta-analysis, Schmidt, Van der Molen, et al. (2009) found that constructivist curricula with less direct instruction had positive effects compared to various conventional Dutch medical schools. Their analysis is based on computing effect sizes for most of the 270 comparisons in the context of a single, well-established, problem-based curriculum involving the medical school of the Maastricht University in the Netherlands. Acquisition of medical knowledge was examined through a "progress test" consisting of 200–300 questions that students routinely take four times a year covering medicine as a whole. Comparing the performance of students and graduates of the problem-based medical curriculum under study and conventional medical schools, an overall weighted effect size averaged over 90 comparisons was equal to $d = 0.07$, signifying a small positive effect for PBL over the conventional medical programs. The effects found with regard to medical knowledge acquired showed 3% in gains over the average student in a conventional curriculum.

2. Reasoning skills

As to reasoning and application of knowledge into *new* situations, research results indicate a small but significantly positive effect of PBL on measures of medical student diagnostic ability. Patel, Groen, and Norman (1993) compared students from two different medical schools with basic science taught in the context of a conventional curriculum versus PBL curriculum. In the study, students were asked to provide diagnostic explanations of a clinical case. Patel et al. (1993) found that PBL students applied a backward- or hypothesis-driven reasoning strategy using a hypothesis to explain the data as opposed to a forward- or data-driven reasoning strategy, reasoning from the data to a hypothesis. Experts go back to basic principles and effectively use hypothesis-driven reasoning rather than data-driven reasoning when faced with complex or unfamiliar problems. PBL students, who engaged in a far more hypothesis-driven reasoning, created more elaborated and coherent explanations based on detailed biomedical information compared to the sparse explanations of students in the traditional curriculum. It was also suggested that a backward-reasoning strategy should lead to more flexible knowledge and problem solving (e.g., Albanese & Mitchell, 1993; Hmelo-Silver, Gotterer, & Bransford, 1997; Schmidt, Van der Molen, et al. 2009).

Nevertheless, it is less clear that PBL students outperform students of traditional programs in terms of applying knowledge accurately to *familiar* instead of new situations. Forward or data-driven reasoning can be seen as essential when presented with familiar problems as it "relies on having a well-defined cognitive structure or schema from which a diagnosis can be achieved almost simultaneously with recognition of symptoms" (Walker & Leary, 2009, p. 15). Patel et al. (1993) concluded that PBL impedes the development of expert data-driven/forward-directed reasoning strategies that are at the core of expertise in terms of familiar problems. In applying hypothesis-driven reasoning, PBL students were more likely to make errors and needed more time while at the same time generating less coherent explanations and using flawed patterns of explanation than their peers in traditional programs. In contrast, in a later longitudinal, quasi-experimental study with first-year medical students, Hmelo (1998) found that PBL students generated more coherent and accurate problem solutions compared to traditional medical students despite their hypothesis-driven reasoning (see also Patel et al., 1993). Schmidt, Van der Molen, et al. (2009) also researched diagnostic reasoning by presenting to the students a number of cases requiring them to produce a diagnosis. PBL had a small positive impact ($d$ = 0.11) over conventional programs. Gains over the average student in a conventional curriculum were 5%.

3. Knowledge application
PBL also helps medical students remember knowledge acquired for purposes of applying it in clinical practice. For example, in a quantitative meta-analysis including 43 quasi-experimental field studies, Dochy et al. (2003) report robust positive effects of PBL as compared to traditional instruction in terms of higher education students' ability to apply knowledge. The findings in medical education revealed a moderate effect size of measures of knowledge application (ES = 0.46). Several other meta-analyses also found that PBL students performed better on tests of clinical performance and skills compared to traditional medical students (e.g., Albanese & Mitchell, 1993; Gijbels et al., 2005; Vernon & Blake, 1993). Recent meta-analyses and syntheses including studies in diverse disciplines—although mainly from the field of medicine—found that performance or skill-based assessments clearly and consistently favor PBL with modest to high effect sizes (e.g., Schmidt, Van der Molen, et al. 2009; Strobel & Van Barnefeld, 2009; Walker & Leary, 2009). For example, in the area of the more domain-specific practical medical skills such as blood pressure measurement or abdominal examination, the overall weighted effect size for the level of mastery of these skills was equal to 0.83. The average PBL student surpassed 79% of the students from conventional medical schools (Schmidt, Van der Molen, et al. 2009b). Strobel and Van Barneveld (2009, p. 55) conclude, based on their meta-analytical research findings, "PBL is significantly more effective than traditional instruction to train competent and skilled practitioners and to promote long-term retention of knowledge and skills acquired during the learning experience

or training session." In addition, Ravitz points out that PBL is especially promising outside of medical education such as "in studies of teacher education, social science, business, allied health" (2009, p. 5; Walker & Leary, 2009). Overall, almost all of the analyses run found that "PBL students either did as well as or better than their lecture-based counterparts, and they tended to do better when the subject matter was outside of medical education" (Walker & Leary, 2009, p. 24).[12]

4. Social and behavioral skills

Overall, PBL students appear to employ more productive approaches to study, have better interpersonal skills, and seem to be more satisfied and motivated than students in more traditional higher education programs. PBL can promote medical students' confidence in their problem-solving skills, it gives them a sense of ownership over their learning, and helps them to feel prepared for their careers and become lifelong self-directed learners. This can put them at an advantage in future courses and in their careers as (medical) practitioners (Albanese & Mitchell, 1993; Colliver, 2000; MacKinnon, 1999). For example, medical graduates of McMaster University and the University of New Mexico School of Medicine report being as prepared or more prepared for postgraduate study and practice as compared to graduates of traditional programs. Clinical ratings by postgraduate supervisors also found graduates from these PBL programs to be more likely to spend more time in direct patient care and to pay attention to psychosocial issues (Mennin et al., 2003). In their recent qualitative meta-synthesis, Strobel and Van Barneveld (2009) found that PBL students in various disciplines rate the quality of the problem-based instruction as higher in terms of independent study and critical thinking (Schmidt, Van der Molen et al. 2009). PBL students felt better prepared in self-directed learning and problem-solving skills. Along these lines, PBL students have also been found to use the library more often, and choose and utilize a wider variety of learning resources on their own (Mennin et al., 2003; Newman, 2003).

Recent studies have found PBL to also benefit communication and teamwork skills. In conducting a Medline literature research (1980–1999) comparing studies and meta-analyses researching PBL versus conventional lecture-based teaching in medical undergraduate education, Nandi, Chan, J.N.F., Chan, C.P.K., Chan, P., and Chan L.P.K (2000) found that medical students engaged in PBL seem to have superior interpersonal skills necessary in effectively interacting with patients and showed better psychosocial knowledge and attitudes toward patients (see also Sanson-Fisher & Lynagh, 2005). Schmidt, Van der Molen, et al. (2009) also found that PBL students performed much better, particularly in terms of communication skills and other work-supporting competences such as the ability to work efficiently and in teams. PBL students and graduates performed much better in the area of interpersonal skills compared to those in conventional programs, with the former leaving behind about 92% of the latter. It is suggested that the small-group collaborations essential to PBL facilitate the acquisition of such skills. Koh, Khoo, Wong, and Koh (2008) searched medical databases and selected journals through 2006 to investigate the effects of PBL in medical school on the performance of doctors after graduation.[13] Research results indicate that PBL during medical school has particularly positive effects on physicians' social competences. These social competences include teamwork skills, appreciation of legal and ethical aspects as well as of social and emotional aspects of health care, and appropriate attitudes toward personal health and well-being. Moreover, moderate to strong evidence was found for coping with uncertainty (strong), communication skills such as communication with patients (moderate effects), and self-directed learning (moderate) (Koh et al., 2008).

5. Student satisfaction and motivation
Moreover, PBL in medical education seems to have a positive impact on student satisfaction and motivation. Vernon and Blake (1993) found that attitudes, class attendance, and mood of PBL students were better as compared to students taught by traditional curricula (see also Albanese & Mitchell, 1993; Moore, Block, Style & Mitchell, 1994; Newman, 2003; Norman & Schmidt, 2000; Sanson-Fisher & Lynagh, 2005; Smits et al., 2002). PBL students found their experience more nurturing, motivating, and enjoyable (e.g., Albanese & Mitchell, 1993; Smits et al., 2002; Vernon & Blake, 1993). Medical students in PBL tracks were also more likely to report that their early medical school years were challenging, engaging, and satisfying as compared to students from traditional programs, who report their experience as being rather irrelevant, passive, and boring (Mennin et al., 2003; Nandi et al., 2000). PBL allows student groups to solve authentic problems based on students' prior knowledge and to self-direct and reflect upon their learning, promoting increased motivation and deep learning as opposed to surface learning (NRC, 2000; Ramsden, 2003; Schmidt & Moust, 2000). Other motivating factors in

PBL are the relevance of the course content and the degree to which it is empowering for students in terms of gaining a sense of mastery and autonomy (MacKinnon, 1999; Ryan & Deci, 2002). A positive impact of PBL has also been found with regard to students' attitudes toward learning (e.g., enjoyment of the learning process) and student engagement (e.g., fewer dropouts, faster graduation, and higher graduation rates) in medical education (e.g., Albanese & Mitchell, 1993; Barrows, 1996; Colliver, 2000; MacKinnon, 1999; Schmidt, Van der Molen, et al. 2009b; Vernon & Blake, 1993).

6. Study progress and success

Finally, the positive impact of PBL in comparison to more conventional programs can become more visible when using different measures with regard to study progress and success. Research suggests that the engaged time students spend on curricular materials (time on task) is a major contributor to learning (Schwartz, Lindgren, & Lewis, 2009). In a four-year study of 8643 students related to 60 university courses in four Dutch universities that focused on the factors that determine study progress and numerical success rate in higher education, Van den Berg and Hofman (2005) found that the time devoted to study had a positive effect on study success. Offering few parallel study units was positively correlated with the study progress achieved. Therefore, the authors suggest introducing more problem-based instruction to facilitate student engagement and, thus, intensify the educational process. Of all students that entered Dutch medical education between 1989 and 1998, fewer students dropped out from PBL programs than from conventional programs and students received their degree faster as well. PBL had a medium positive effect on both graduation rate (overall $d = 0.33$) and time needed to graduate ($d = -0.68$) (Schmidt, Cohen-Schotanus, & Arends, 2009). The average PBL student graduates more quickly than 70% of the students in a conventional medical school and the problem-based school retained 12% more students as compared to the conventional schools (Schmidt, Van der Molen et al. 2009). In their recent qualitative meta-synthesis, Strobel and Van Barneveld (2009) found that PBL students were more often accepted to their first choice of residencies.

To sum up, inquiry-based PBL approaches see learning as an active, self-regulated process, with students working together in groups to solve complex real-world problems. PBL encompasses four key components: ill-structured problems that allow for multiple solution paths, a student-centered approach with students defining and closing their knowledge gaps to solve problems, teachers as facilitators or tutors who provide prompts, model learning processes and gradually fade out the level of support, and, finally, authentic problems aligned to real-world practice.

Meta-analyses and meta-syntheses that analyzed the effectiveness of PBL covering studies as far back as 1970 show consistent positive effects on encouraging student motivation to learn and on cognitive skills, although they show non-robust effects for declarative knowledge. PBL students retain knowledge longer and are more effective in integrating and explaining concepts than students who are taught traditionally. PBL has also small, but significantly positive, effects on students' diagnostic abilities and clinical reasoning skills—especially when students engage with unfamiliar problems. PBL students also seem to be better prepared to apply their learning to real-world situations. Performance or skill-based assessments clearly and consistently favor PBL with modest to high effect sizes.

PBL seems to have a positive impact on students' satisfaction, motivation, and attitudes toward learning. PBL students employ more productive approaches to study, such as self-directed learning, find their experience more nurturing, enjoyable, engaging, and challenging, and feel equally prepared or more prepared for postgraduate study and practice as compared to traditionally taught students. PBL students and graduates also perform better in the area of work-supporting interpersonal skills, like communication skills and teamwork skills. PBL is especially promising outside of medical education, such as in teacher education, social science, and business studies. PBL students were also less likely to drop out, graduated sooner, and were more often accepted to their first choice of residencies as compared to students in more traditional programs.

## 3.4 Empirical Instructional Research on Quality Features of Teaching and Learning

Complex theoretical models of classroom learning and instruction, such as the European-developed "model of the provision and uptake of learning opportunities" propose that instructional quality is influenced by multiple factors at different levels of the education system (Fend, 1998; Helmke, 2009; Pauli & Reusser, 2006, 2011). These models incorporate multiple educational goals (cognitive and motivational learning outcomes) and submit that classroom instruction provides learning opportunities that teachers put in place for learners. Learning opportunities are understood broadly as the full range of instructional activities offered to students by the teacher. A teacher's professional competence (knowledge, skills, beliefs, motivation) is, therefore, crucial as it manifests itself in the quality of classroom teaching practice. Yet, the students are responsible for the active uptake of those opportunities, that is, the extent to which they leverage the learning opportunities provided by the instructor. This means that instructional quality also depends on various learner prerequisites, such as approaches to learning, values, expectations, motivation, and prior knowledge. Empirical research shows that students' estimates of their own performance (expectations), self-concept, motivation, and prior achievement are student attributes that have a major influence on the outcomes of schooling (Hattie, 2009, 2012). High-quality instruction is, thus, the result of constructive interactions between teachers and students and is influenced by the teachers' and students' cognitive, motivational, and social characteristics (Kunter & Voss, 2013; Lipowsky, Rakoczy, Pauli, Drollinger-Vetter, Klieme, & Reusser 2009; Pauli & Reusser, 2011; Reusser & Pauli, 2013).

This section reviews effective surface-level and deeper-level features of learning and instruction based on empirical research on everyday classroom instruction, mainly conducted in schools (Sect. 3.4.1). After that, the basic dimensions of deeper-level features of instructional quality and their influence on students' cognitive and noncognitive development are discussed (Sect. 3.4.2). In Sect. 3.4.3, empirical education research on teachers' professional competence and high-quality instruction is reviewed.

### *3.4.1 Effective Surface-Level and Deeper-Level Features of Learning and Instruction*

Research on everyday classroom instruction, mainly conducted in schools, has shown that it is the deeper-level aspects of instructional quality, less the surface-level aspects, that determine students' learning outcomes. Moreover, the presence of certain surface-level aspects and the quality of the deeper-level features vary largely independently of each other (e.g., Aebli, 1983; Brophy, 2006; Helmke, 2009; Klieme & Rakoczy, 2008; Kunter & Voss, 2013; Pauli & Reusser, 2011). Deeper-level quality features refer to the extent to which learners are involved in higher-order thinking and demanding problem-solving processes. Major aspects of instructional quality are, thereby, the quality of teaching and learning processes and the quality of teacher–student interactions in the classroom.

Previous meta-analyses and meta-syntheses have produced comprehensive overviews of quality features of effective instruction in school environments (e.g., Anderson, 2004; Hattie, 2009, 2012; Scheerens & Bosker, 1997; Seidel & Shavelson, 2007; Wang, Haertel, & Walberg, 1993). Based on empirical findings and informed by cognitive and constructivist conceptions of learning and teaching, theoretical and conceptual frameworks have also been developed in the recent years in order to provide a systematic structure for the study of instructional quality (e.g., De Corte, 2004; Greeno, 2006; Klieme, Pauli, & Reusser, 2009).

A recent, large-scale synthesis involving the findings of more than 800 meta-analyses about influences on learning shows that teachers are among the most powerful influences in learning and has identified high- and low-impact factors related to student achievement (Hattie, 2009, 2012).[14] Terhart (2014) reorganized Hattie's 150 variables, distinguishing between surface-level and deeper-level features of learning and instruction (see Table 3.1).

The findings show that surface-level features, such as class size, ability grouping, or individualized instruction are considerably less effective with regard to student achievement than deeper-level features (see also Hattie, 2012, pp. 251–252; Seidel & Shavelson, 2007). The notion that there is no one "best" teaching method is substantiated by Hattie's (2012) synthesis that found that *problem-solving teaching* (e.g., defining the cause

**Table 3.1** Effective surface-level and deeper-level features of learning and instruction (adapted from Terhart, 2014, pp. 125–126)

| *Surface-level features* | | *Deeper-level features* | |
|---|---|---|---|
| *Influence* | *Effect size* | *Influence* | *Effect size* |
| Problem-solving teaching | 0.61 | Providing formative evaluation | 0.90 |
| Direct instruction | 0.59 | Classroom discussion | 0.82 |
| Cooperative versus individualistic learning | 0.59 | Teacher clarity | 0.75 |
| Student-centered teaching | 0.54 | Feedback | 0.75 |
| Classroom management | 0.52 | Reciprocal teaching | 0.74 |
| Small-group learning | 0.49 | Teacher–student relationships | 0.72 |
| Ability grouping | 0.30 | Metacognitive strategies | 0.69 |
| Individualized instruction | 0.22 | Peer tutoring | 0.55 |
| Class size | 0.21 | Cooperative versus competitive learning | 0.54 |
| | | Setting (challenging) goals | 0.50 |

of the problem, letting students select alternative solution paths, evaluate the outcome; 0.61), *direct instruction* (modeling and guiding learning, meaningful feedback; 0.59), *cooperative learning* (0.59), *student-centered teaching* (0.54) and *small-group learning* (0.49) had the highest effect on student achievement in schools. A *well-managed classroom* is another important surface-level feature to ensure effective learning for all students (0.52; e.g., reacting quickly and in an emotionally objective manner to potential disruptions). The task for educators is, then, to design an effective combination of learning processes and environmental support to yield the desired learning outcomes. This also involves altering instruction "on the fly" depending on the feedback about the effects they are having on their students (Hattie, 2009, 2012; Tobias & Duffy, 2009a, 2009b).

Hattie's research emphasizes that teachers need to have clear (and challenging) learning intentions (0.50) and take a caring and active role in driving their students' construction of knowledge forward toward the success criteria of their lesson. The latter does not necessarily contradict student-centered forms of teaching and learning, but emphasizes that teachers play an active role in the learning and teaching that goes on in the classroom (provision of learning opportunities). Hence, a deeper analysis of the inner workings and consequences of constructivist learning and instruction is necessary (e.g., Mayer, 2009; Pauli, 2010). The deeper-level instructional quality features singled out below show large effects on student learning based on empirical research (Hattie, 2009, 2012).

1. Quality teaching strategies
*Teacher clarity* (0.75; e.g., clarity of speech, organization, explanation, and examples), involving the teacher clearly communicating the intentions of the lessons and the success criteria, and *reciprocal teaching* (0.74) are major influences on students' learning outcomes. The latter means teaching students cognitive strategies, such as questioning and clarifying, aligned with the learning intentions. The effects were highest when instruction in the use of these strategies was given (e.g., explicit teaching, modeling) close to the time students used them (see also Tricot & Sweller, 2014; Tuckman & Kennedy, 2011). *Metacognitive strategies* (0.69) involve "thinking about thinking" and refer to students' self-regulation strategies (learning-to-learn skills) necessary for them to become lifelong learners (e.g., planning, evaluating, monitoring, and regulating student behaviors). Strategies that have been found to have the highest effects on learning are goal setting and planning, self-instruction and self-evaluation. Research also shows

that these strategies need to be taught within the content domain (Hattie, 2012; see also Sect. 3.2).

2. Teacher feedback and formative evaluations
*Feedback* (0.75) that students receive from the teacher and *formative evaluations* (0.90) that the teacher receives from the students are one of the most significant influences on student learning. The former is effective when it helps reduce the gap between where students are and where they are meant to be, enabling them to progress toward challenging learning intentions and goals. Formative evaluations refer to activities used by the teacher to assess learning progress during the learning process. It requires teachers to monitor student understanding—what they can and cannot do (e.g., observe, listen, and gather student feedback)—and enables them to adapt the next steps in light of the gap between students' current knowledge and understanding and the intended learning outcomes (see also Kluger & DeNisi, 1996). Apart from that, "in-the-moment" formative assessments that are woven into class activities and that provide immediate feedback to teachers and students during the process of learning were also shown to contribute to student learning. However, feedback should not be mixed with praise, since feedback without praise has proved to have a greater effect on achievement (Hattie, 2012).

3. Supportive and positive classroom climate
A supportive and positive classroom climate welcomes "not knowing" and errors as learning opportunities; students feel invited to learn and safe to explore knowledge and understanding and to make and learn from mistakes (see also Keith & Frese, 2008). In this context, creating *positive teacher–student relationships* (e.g., being able to listen, show empathy and respect, trust and care) (0.72) and fostering a climate of *high cooperation* instead of competition (0.54) are important precursors to student learning. A meta-analysis synthesizing 119 studies from 1948 to 2004 (grade levels included pre-K through 12) concludes that learner-centered teacher variables such as positive relationships, trust, nondirectivity (student-initiated and student-regulated activities), empathy, warmth, and encouraging thinking and learning have above-average associations with positive cognitive, affective, and behavioral student outcomes. Correlations for participation, critical thinking, satisfaction, math achievement, dropout prevention, self-esteem, verbal achievement, positive motivation, social connection, IQ, grades, reduction in disruptive

behavior, attendance, and perceived achievement were all above average (Cornelius-White, 2007).

4. Classroom talk

The proportion of student talk to teacher talk is also an important factor that contributes to student learning. The current imbalance in most classrooms in which teachers talk 70–80% of the time produces low student engagement and fosters rather lower-order learning. Using class time to promote dialogic teacher–student interactions and *classroom discussions* (0.82) involving the entire class in meaningful discussions about students' ideas, for example, can contribute to challenge and engage students while the teacher listens to their questions, ideas, struggles, and interactions in order to learn more about what students understand and how to help them further their understandings. Discussions allow students to voice their thoughts and learn from each other, while the teachers can see if students have learnt the concepts that are being taught (see, e.g., Alexander, 2008). Devoting more time to *peer tutoring* has considerable effects on learning for both those tutoring and those being tutored (0.55). Peer tutoring refers to peers as co-teachers who exercise self-regulation and control over their own learning and become their own teachers by helping and giving feedback to their peers (see also Wimshurst & Manning, 2013).

Overall, Hattie (2009, 2012) submits that the key to improve student learning is making teaching visible to the student (e.g., making learning the explicit goal, being clear about the success criteria for learning, seeking and giving feedback) and making learning visible to the teacher (e.g., students being committed and open to learning, being involved in setting challenging learning intentions, and seeking feedback for learning). Classroom research shows that deeper-level quality features referring to both the quality of teaching and learning processes and the quality of teacher–student interactions are considerably more effective with regard to students' learning outcomes than surface-level features (e.g., classroom management). The findings indicate that a well-managed classroom is important to ensure learning and that there is no one "best" teaching method. Teachers play a caring and active role in the learning that goes on in the classroom with the following deeper-level instructional quality features being particularly effective when it comes to student achievement: setting challenging goals, quality teaching strategies (e.g., teacher clarity, reciprocal teaching, metacognitive strategies), teacher feedback and formative evaluations, a supportive and positive classroom climate (positive teacher–student relationships, high cooperation), and class discussions and peer tutoring.

### *3.4.2 Basic Dimensions of Deeper-Level Features of Instructional Quality and Students' Cognitive and Noncognitive Development*

Quality instruction provides learning opportunities that can be used effectively by students (Kunter & Voss, 2013). Building on both classical process-product research and (socio-) constructivist research paradigms and taking cognitive as well as motivational theories into account, empirical education research—especially in the area of mathematics instruction—has repeatedly demonstrated the predictive validity of three basic dimensions of instructional quality on students' learning outcomes (Klieme et al., 2009; Kunter, Klusmann, Baumert, Richter, Voss, & Hachfeld, 2013; Lipowsky et al., 2009; Praetorius, Pauli, Reusser, Rakoczy, & Klieme, 2014; Reyes, Brackett, Rivers, White, & Salovey, 2012): cognitive activation, supportive climate, and classroom management (see Fig. 3.2).[15] These three deep structure quality dimensions constitute basic qualities of the learning environment on the classroom level likely to offer students more opportunities to learn and to promote deep conceptual understanding. The model can also contribute to bridge the gap between constructivism and explicit instruction insofar as hands-on activities are geared toward cognitive activation and the impor-

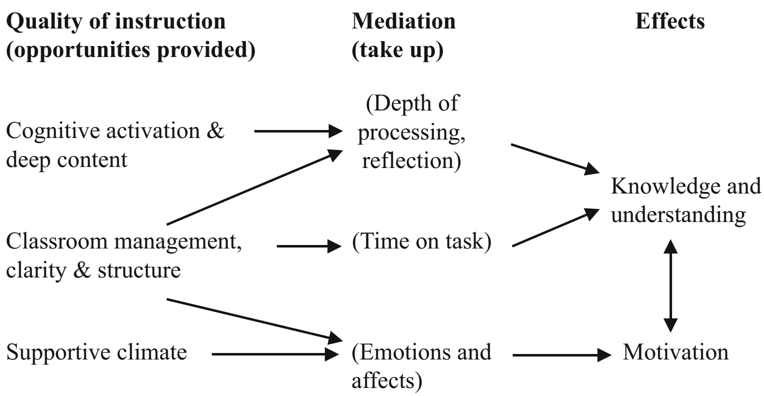


**Fig. 3.2** Triarchic model of basic dimensions of instructional quality and their effects on student learning and motivation (Klieme et al., 2009, p. 140)

tance of structure and clarity for deep understanding is stressed (Klieme et al., 2009; Tobias & Duffy, 2009a). Moreover, this generic model represents a multicriteria approach that measures the effects of specific methods or strategies on students' cognitive and noncognitive development.

*Cognitive activation* is a key dimension of the instructional quality of classroom learning, and relates to "any observable pedagogical practice and pattern on the surface level of instruction that encourages students to engage in (co-) constructive and reflective higher-level thinking and thus to develop an elaborated, content-related knowledge base" (Klieme et al., 2009, pp. 140–141). The concept of cognitive activation assesses the depth of the student's engagement with the learning content and the demands of the cognitive activities. Learning situations can be described in terms of their potential to stimulate goal-oriented cognitive activities in learners. Instruction is cognitively activating

> when the teacher calls students' attention to connections between different concepts and ideas, when students reflect on their learning and the underlying ideas, and when the teacher links new content with prior knowledge. (Lipowsky et al., 2009, p. 529)

The concept of cognitive activation integrates key components such as challenging tasks, activation of prior knowledge, and content-related discourse and participation practices (e.g., students disclose, explain, share and compare their thoughts, concepts, and solution paths) that prompt higher levels of cognitive functioning and processing (Klieme et al., 2009). Empirical research shows that tasks with high potential for cognitive activation increase students' learning gains (e.g., Kunter & Voss, 2013; Lipowsky et al., 2009).

*Classroom management* has been intensely studied within the process-product paradigm (see also Sect. 3.1) and can be seen as a critical prerequisite for students' cognitive engagement. By coordinating and managing the complex occurrences in the classroom, the instructor aims to provide students with sufficient quality learning time (time on task) for them to engage in content-related activities. Managing a productive atmosphere in the classroom and making optimal use of the learning time available require the instructor to show constant attentiveness to what is going on in the classroom at all times (Kounin, 1970) and to establish structure and clarity both with regard to content and to social norms (e.g., clear expectations and guidelines, routines, and strategies for preventing disruptions) (Klieme et al., 2009). Empirical research shows that the more effective learning time is available in the classroom, the higher students' learning outcomes (e.g., Seidel & Shavelson, 2007).

The degree to which students are motivated to learn and to engage with learning content also depends on the creation of a *supportive classroom climate* (e.g., Brophy, 2000; Cornelius-White, 2007) comprising observable features of teacher–learner interaction, such as supportive teacher–student relationships, positive and constructive teacher feedback, a positive approach to student errors and misconceptions, individual learner support, and caring teacher behavior. Studies often refer to self-determination theory in order to identify key components of a supportive classroom climate that powerful learning environments should provide, such as autonomy, competence, and social relatedness (Deci & Ryan, 2002; Klieme et al., 2009). In the context of the TIMSS Video Study and COACTIV Study,[16] *individual learning support provided to learners by the teacher* (instead of supportive classroom climate) has emerged as a third core dimension of instructional quality (Cornelius-White, 2007; Kunter & Voss, 2013). Individual learning support aims to ensure effective learning opportunities for all students by monitoring students' learning processes and providing adaptive learning support and feedback while respecting students' autonomy. The concept of individual learning support, thereby, comprises structuring measures, such as breaking complex tasks down into manageable steps, guiding the learning process as outlined in the literature on scaffolding, (Pea, 2004; Van de Pol, 2012) and aspects of the quality of the student–teacher relationship as outlined in the context of research on the instructional climate above.

Table 3.2 below summarizes and specifies the basic dimensions and features of instructional quality. Each of these three dimensions can further be described in terms of the instructional quality features that constitute them. Lipowsky et al. (2009; Hugener, Pauli, Reusser, Lipowsky, Rakoczy, & Klieme, 2009) have identified high-inference rating features that can be adapted to investigate the three basic dimensions of instructional quality in the higher education classroom.[17]

Overall, instructional research (e.g., COACTIV Study) has shown that effective classroom management and high potential for cognitive activation statistically significantly predict students' mathematics achievement (cognitive development). Individual learning support significantly predicted both students' achievement anxiety and enjoyment of mathematics, and classroom management in the form of efficiently structured learning environments proved to be a significant predictor of enjoyment (emo-

**Table 3.2** Basic dimensions and features of instructional quality: Cognitive activation, classroom management, and supportive climate (adaptation from Lipowsky et al., 2009)

| *Dimensions* | *Features (operationalizations of each dimension)* | *Description* |
|---|---|---|
| Cognitive activation | Challenging activities at a high cognitive level | Extent to which the teacher encourages sophisticated activities that provoke thinking at a high cognitive level such as comparing, reasoning, explaining, and analyzing (e.g., open questions which stimulate contemplation) |
| | Degree to which prior knowledge and existing concepts are activated | Extent to which the teacher draws on students' existing ideas and conceptions |
| | The interaction between the teacher and the students supports conceptual change and conceptual expansion | Extent to which the teacher and the students develop ideas and disciplinary concepts together in classroom discourse Intensity of student participation in content-based discourse (e.g., the teacher asks students to explain how they arrived at their answers) |
| | Exploration of students' ways of thinking | Extent to which the teacher encourages the students to disclose their thought/reasoning processes (e.g., the students explain their ideas, concepts, and solutions) |
| | The teaching reflects a constructivist concept of learning | Extent to which the teacher avoids solving conceptual problems by specifying the procedures and solution methods to be used by the students |
| Classroom management | Content-related activities (time on task) | Extent to which the students have opportunities to purposefully engage with learning content (e.g., structural clarity, adaptive explanations/reasoning in a subject matter) (Pauli, Drollinger-Vetter, Hugener, & Lipowsky, 2008; Seidel & Shavelson, 2007) |
| | Rules and principles to sustain a productive classroom atmosphere | Extent to which the teacher establishes clear rules and procedures, manages transitions between lesson segments smoothly, keeps track of students' work plan, plans and organizes lessons well, manages disruptions, and keeps a whole group focus |

(*continued*)

**Table 3.2** (continued)

| *Dimensions* | *Features (operationalizations of each dimension)* | *Description* |
|---|---|---|
| Supportive climate | The teacher shows acceptance and respect toward students | Extent to which the teacher shows confidence in students and facilitates self-regulated, individualized learning (Klieme et al., 2009) |
| | The teacher gives students constructive feedback | The extent to which the teacher gives feedback providing concrete support |
| | A climate of relatedness can be observed | The extent to which the students listen to one another, and the nature of students' responses to their peers' contributions (including mistakes) |

tional and motivational development) (Kunter & Baumert, 2013; Kunter & Voss, 2013).

### 3.4.3 Teachers' Professional Competence and High-Quality Instruction

Current empirical education research on classroom learning and instruction conceptualizes teaching in terms of a model of instructional provision and uptake, with classroom instruction being the core business of teaching. Teachers' professional competence and high-quality instruction seem to be important resources in facilitating the provision of cognitively challenging and motivating learning opportunities that students can use effectively in order to learn (Baumert & Kunter, 2013a; Kunter & Voss, 2013). This profession-specific perspective builds on the works of Shulman (1987), Bromme (1997), Berliner (2001) and Darling-Hammond and Bransford (2005) who emphasize the importance of domain-specific knowledge for teacher competence. However, reflecting a broader understanding *professional competence* combines knowledge, values/beliefs, motivational orientations, and self-regulatory abilities that teachers need in order to meet the demands of their profession (Baumert & Kunter, 2013a; Weinert, 2001).

In the context of this "professionalization" of teacher education, Sect. 3.4.3.1 introduces a model of teachers' professional competence that takes a multidimensional perspective on competence informed by the demands of teaching practice. After that, empirical findings that have investigated the relationship between teacher knowledge and beliefs (two components of the aforementioned model) and instructional quality are discussed (Sect. 3.4.3.2). Finally, preliminary research results on the impact of formal learning opportunities at universities on (prospective) teachers' knowledge acquisition are outlined (Sect. 3.4.3.3).

#### *3.4.3.1 A Model of Teachers' Professional Competence*

The multidimensional model of teachers' professional competence developed in the COACTIV Study emphasizes four aspects of competence. Teachers as professionals are required to engage in adaptive and effective professional practice that offers students a variety of high-quality learning opportunities and supports them throughout the learning process.

1. *Professional knowledge*: building on the taxonomy of teacher knowledge proposed by Shulman (1987), three types of teacher knowledge with direct relevance to teachers' instructional practice can be distinguished as key dimensions of teacher competence (Baumert & Kunter, 2013a; Tatto et al., 2012):

   - Content Knowledge (CK): a deep conceptual understanding of the curricular content to be taught (declarative, procedural, and strategic knowledge);
   - Pedagogical content knowledge (PCK): knowledge of how CK is best presented to students (e.g., subject-specific instructional strategies, knowledge of multiple solution paths, and knowledge of typical student difficulties); and
   - Pedagogical/psychological knowledge (PPK): generic knowledge needed to design and improve teaching and learning situations (e.g., knowledge of classroom management, instructional methods, evaluation methods, learning processes, and student characteristics).[18]

2. *Values and beliefs* that student teachers develop in the course of their professional education refer to value commitments (professional ethos), epistemological beliefs (world views), subjective theories about teaching and learning, and goal systems. Research distinguishes between two main beliefs about the nature of learning processes that are decisive for teachers' instructional practice: learning as a result of a direct transfer of information from teacher to students and learning as active knowledge construction.

3. *Motivational orientations* refer to teachers' self-related cognitions (e.g., self-efficacy beliefs) and intrinsic motivation. Teachers with high self-efficacy beliefs show greater enthusiasm for teaching, are more strongly committed to their teaching practice, and are more likely to regulate their psychological experience in their respective professional context. As is known from process-outcome research, enthusiasm—understood as observable teacher engagement in the classroom—is an important element of effective instruction. However, in the context of the COACTIV Study, teacher enthusiasm is conceptualized as a twofold emotional component of intrinsic motivational orientation, that is, enthusiasm for the topic of instruction versus enthusiasm for the activity of teaching itself.
4. *Self-regulatory abilities* refer to the ability to responsibly and effectively manage one's personal resources when coping with the challenges of occupational situations. Self-regulatory skills are reflected in both teachers' occupational well-being and their instructional practice.

Empirical instructional research submits that these key dimensions of professional competence are malleable and learnable—in the context of formal teacher education and throughout the teaching career. Professional development is further influenced by the conditions of the educational and professional context (Kunter, Baumert, Blum, Klusmann, Krauss, & Neubrand, 2013).

#### *3.4.3.2 Professional Competence and Instructional Quality*

Baumert and Kunter (2013b) point out that few empirical studies to date have assessed the various components of teachers' professional competence directly to predict instructional quality and student outcomes (e.g., Hill, Rowan & Ball, 2005; see Terhart, Bennewitz & Rothland, 2014 for an overview of the state-of-the-art of research on teacher education in the German-speaking context). The research done by Hattie (2009, 2012) submits that teachers' subject-matter knowledge (0.09) alone does not improve student achievement; however, it does matter how teachers organize and use their CK in order to help students integrate new knowledge with their prior knowledge. As outlined in Sect. 3.4.2, empirical instructional research in the context of the COACTIV Study has derived three core dimensions of instructional quality: potential for cognitive activation, individual support for students' learning processes (including a supportive learning climate), and effective classroom management. These three dimensions provide an overarching structural framework that can incorporate various related instructional quality features.

Overall, COACTIV points out that the teacher qualities needed to succeed in the teaching profession are as follows: "A high level of PCK, constructivist beliefs, enthusiasm for teaching, and the ability to manage one's resources have all been shown to correlate with higher instructional quality and better student outcomes" (Kunter & Baumert, 2013, p. 363). Knowledge and motivation related to the activity of teaching (PCK and enthusiasm for teaching) were found to be more powerful predictors of instructional quality than purely content-related dimensions such as CK and subject enthusiasm. More specifically, the COACTIV results emphasize the critical importance of *PCK* for the provision of high-quality instruction and for student learning progress, while CK seems to be a necessary condition for the acquisition of PCK, but not a sufficient condition for effective classroom instruction. The results confirmed that CK has no direct influence on instructional features such as cognitive activation, while the level of PCK has been found to be decisive for the quality of instruction (Baumert & Kunter, 2013b; Kunter & Baumert, 2013). The multi-cohort, longitudinal follow-up study COACTIV-R[19] (2008–2010) examined the professional development of teacher candidates in preservice training up to career entry and found systematic relationships between *PPK* and the quality of instruction provided (Voss & Kunter, 2013).

The COACTIV Study also submits that teachers with *high PCK* tend to show more constructivist (i.e., knowledge is established in joint discourse between teachers and students, importance of problem solving and knowledge construction) and fewer transmissive professional beliefs. Teachers with *constructivist beliefs* were shown to provide higher quality instruction, that is, more supportive and cognitively activating learning opportunities, with students showing better learning outcomes. Teachers with *high PCK* used *tasks with higher potential for cognitive activation* and provided *more individual learning support* for students that resulted in higher levels of mathematics achievement in their classes. The findings also show that the use of strategies to ensure the effective use of time (*classroom management*) is a crucial factor for successful instructional practice and, thus, for student learning and motivation (Kunter & Baumert, 2013; see also Seidel & Shavelson, 2007).

*Teachers' enthusiasm for teaching* is an important component of professional competence resulting in higher quality instruction and higher levels of student achievement and motivation, while teachers' enthusiasm for the teaching subject (i.e., mathematics) has almost no practical relevance. Regarding *teachers' self-regulation*, results show that teachers who display high occupational engagement and high resilience provide high-quality instruction (Kunter & Baumert, 2013).

In a nutshell, knowledge and motivation related to the activity of teaching such as pedagogical (content) knowledge, constructivist beliefs, and enthusiasm for teaching were found to be powerful predictors of high-quality instruction and for student learning progress.

#### *3.4.3.3 University-Based Teacher Education and Knowledge Acquisition*

Kleickmann and Anders (2013) point out that research on how first (university-based)- and second (induction)-phase teacher education affects the development of teachers' professional knowledge is scarce. And Kotthoff and Terhart (2013) refer to the results of empirical research on teacher education as being insufficient to give conclusive evidence regarding the effectiveness of individual elements and phases or models of teacher education. So far, the efficacy of teacher education programs has mainly been assessed by self-report measures of professional competence and by distal indicators, such as completed course work and teaching certificates (e.g., Baumert & Kunter, 2013b; Darling-Hammond & Bransford, 2005). Based on findings from meta-analyses, Hattie (2009, p. 126, 2012) submits that initial training programs "have little impact on how well those teachers influence the achievement of their students." He found that beginning teachers' conceptions of teaching are rather transmission-oriented with an emphasis on lesson planning and telling, and that there is little exposure or teaching of new conceptions of teaching and new ways of teaching.

The COACTIV research program has begun to develop test instruments to assess (prospective) teachers' knowledge directly and consider these outcomes in the light of the teacher education received. In COACTIV, a sample of 498 German teacher candidates at the very beginning of the second phase of teacher education was drawn—200 trained to teach in the academic track, 298 in the nonacademic track—to determine the difference between the two groups with regard to their knowledge in the three knowledge domains. The results indicate that academic track candidates outperform the nonacademic track candidates in terms of both CK and PCK, while the latter outperform the former in terms of PPK. The differences in PCK disappeared when the differences in CK were controlled for (Kleickmann & Anders, 2013).

Two comparative international studies, the "Teacher Education and Development Study in Mathematics" (TEDS-M)[20] and its predecessor "The Mathematics Teaching in the twenty-first Century" (MT21) study, have also developed instruments to assess proximal indicators of teachers' professional knowledge. They confirm the above findings (Blömeke, 2014; Tatto et al., 2012) and provide further evidence for differences in teachers' professional knowledge depending on the system of teacher education. For Germany, the TEDS-M study shows that teachers trained to teach mathematics in academic track or comprehensive schools show higher CK and PCK toward the end of the second (induction) phase of teacher education (Referendariat) than their peers who were trained to teach at other school types. No difference was found with regard to PPK. Nevertheless, both academic and nonacademic track teachers used a consistently low didactic level of tasks in their classrooms and the former also provided the lowest level of individual learning support. Kotthoff and Terhart (2013, p. 85) propose that student teachers "should be involved in simulated or real action situations which challenge their knowledge and routines (…) through the use of case studies and various forms of problem- and/or inquiry-based learning."

Overall, preliminary evidence on the acquisition of teachers' professional knowledge suggests that the development of CK, PCK, and PPK depend on the amount of formal learning opportunities in the first phase of teacher education (system of teacher education) and that structural differences in teacher education programs have an effect.

## 3.5 Summary and Conceptual Framework Outline

The discussion in previous chapters deploys a situative view on cognition and learning and provides important lenses through which to look when investigating the pedagogical concept of SCL and how it can be effectively brought to life in higher education practice. Table 3.3 draws on the literature review in Chaps. 2 and 3 and refers to both common design principles and instructional quality dimensions and features of classroom learning, teaching, interaction, and climate that have to be considered when design-

**Table 3.3** Conceptual framework—Common design principles and instructional quality dimensions/features of classroom learning, teaching, interaction and climate

| *Common design principles of SCLEs* | *Instructional quality dimensions and features* | |
|---|---|---|
| | *1. Quality of teaching and learning processes* | *2. Quality of classroom interaction and climate* |
| Curriculum for understanding<br>Customized learning<br>Supportive community of learners<br>Ongoing assessment and tailored feedback<br>Adaptive instruction | *Cognitive activation* (e.g., intellectual challenge, higher-order thinking, activation of prior knowledge, deep approach to learning, exploration of students' ways of thinking, metacognitive strategies)<br>*Learning-focused activities* (e.g., constructive alignment with goals and assessment, student self-regulation, student choice, time on task, active student participation, learning from students)<br>*Adaptive learning support* (e.g., facilitator, modeling, observing/listening, teacher clarity behaviors, teacher questions, resources) | *Dialogic discourse practices*<br>Teacher-student talk in the large group (e.g., distribution of agency, accountable talk)<br>Student-student talk in small groups (e.g., exploratory talk, autonomy)<br>*Norms of interaction* (e.g., listening, revoicing, discourse and thinking routines, address students by name)<br>*Supportive climate* (e.g., concern and respect, rapport, teacher enthusiasm, concern with student progress, constructive feedback) |
| Course design | Classroom learning, teaching, interaction and climate | |

ing powerful SCLEs in higher education classrooms (research question 1, see Sect. 1.3).

The conceptual framework in Table 3.3 serves as an initial blueprint orienting and informing the case study design, data collection, and analysis process in the context of the empirical case study research conducted in three different higher education classrooms at the HGSE (Yin, 2009).

The framework incorporates *common design principles* of powerful SCLEs that were derived from and built upon an extensive research base of over 40 years of learning science research: curriculum for understanding, customized learning, supportive community of learners, ongoing assessment and tailored feedback, and adaptive instruction (see Sect. 2.3).

These well-founded design principles are crucial because they frame how various features of instructional quality can manifest themselves within the educational setting.

The framework also refers to (*deeper-level*) *quality dimensions and features of instruction* mainly based on empirical education research on the effectiveness and quality of learning and instruction (Chap. 3). Process-outcome research on instructional effectiveness, effectiveness research on both SRL and instruction and PBL, and empirical instructional research on quality features of teaching and learning provide quality dimensions and features that can be synthesized into two major aspects of instructional quality

1. The *quality of teaching and learning processes* in order to provide opportunities for deep learning: how the instructor scaffolds students' participation in the construction of relevant content (i.e., subject-matter knowledge) is of interest, with quality features being grouped into three empirically grounded dimensions: cognitive activation, learning-focused activities, and adaptive learning support (e.g., Biggs, 2012; Klieme et al., 2009; Kunter & Voss, 2013).
2. The *quality of classroom interaction and climate* in order to frame the learning context in a productive way: how the social context in which learning occurs is framed interactionally and culturally to create opportunities for deep learning is crucial. Relevant quality features can be grouped into three empirically grounded dimensions based on the literature review: dialogic discourse practices, norms of interaction, and supportive climate (e.g., Cornelius-White, 2007; Engle, Nguyen, & Mendelson, 2011; Greeno, 2011).

Empirical education research on classroom learning and instruction submits that professional competence combines knowledge (CK, PCK) values/beliefs, motivational orientations, and self-regulatory abilities that teachers need in order to meet the demands of their profession, and that these key dimensions of professional competence are malleable and learnable—in the context of formal teacher education and throughout the teaching career. Teachers with constructivist beliefs, high pedagogical (content) knowledge, and enthusiasm for teaching are shown to provide higher quality instruction, that is, more supportive and cognitively activating learning opportunities, with students showing better learning outcomes.

Instructors who hold constructivist educational beliefs concentrate on what students think and do in order to understand, with learning being the result of students' learning-focused activities. The constructive alignment of course objectives, activities, and assignment/assessment tasks is thereby crucial to elicit certain levels of cognitive engagement and participation (Biggs, 2012). The question is then: What kinds of learning and teaching activities are required to reach certain performances of understanding? In the light of a *situative perspective* that sees learning as a cognitive and social process, this combination of analyses of learning content and processes with the cultural and interactional framing of learning contexts is likely to be a fruitful approach for understanding both how and why students engage in deep learning, and how instructors help their students learn in SCLEs (e.g., Engle, 2006).

## Notes

1. Although prior academic achievement is considered the primary predictor of current academic achievement, effectiveness research indicates that instructional behaviors are important for student learning, motivation, and achievement. There is a broad consensus that learning and teaching are intertwined and that the latter is a function of the former to some extent (e.g., Centra, 1993; Hattie, 2009, 2012; Hattie & Marsh, 1996; Zeegers, 2004).
2. Berk (2005) names 12 potential sources of evidence of teaching effectiveness, with student ratings being predominant in the past (Ory & Ryan, 2001): ratings (student, peers, alumni, employer, administrator), videos, student interviews (quality control circles, classroom group interviews, graduate exit interviews), self-evaluation (e.g., faculty activity report), teaching scholarship, teaching awards, learning outcome measures (indirect measure, should be used with caution), and teaching portfolios.
3. Feldman (1989) gathered data from faculty, administrators, and students in multi-section courses of an introductory nature on the characteristics of superior teachers and found that various dimensions are of different importance to the effectiveness of instructors. His findings were largely based on a meta-analysis including 46 multi-section validity studies Cohen used in an earlier meta-analysis examining the associations between student evaluations of their instructors and their achievement and learning in the classes of these instructors (Cohen, 1980; see also Abrami, Cohen & d'Apollonia, 1988).

4. *Low-inference teaching behavior* is a concrete action of the instructor that can be recorded with little or no inference on the part of an observer (e.g., "addresses individual students by name," "signals the transition from one topic to the next") whereas *high-inference teaching behavior* can be assessed only through observer inference or judgment (e.g., "clarity," "task orientation") (Murray, 1997, p. 172).
5. In the literature, terms such as conceptions, beliefs, orientations, approaches, and intentions are often used interchangeably. According to Pratt (1992, cited in Devlin, 2006, p. 112) instructors view the teaching and learning through the lenses of their conceptions and interpret and act in accordance with their understanding of the world. Conceptions of teaching are, thereby, defined as specific meanings attached to university teaching and learning phenomena, which then mediate an instructor's response to situations involving those phenomena.
6. In European higher education, student-oriented views rooted in the German Progressive education movement ("reform pedagogy") gained momentum in the second half of the twentieth century due to the massification of higher education as a rising and increasingly diverse student body entered universities.
7. Nevertheless, the capacity for metacognitive self-regulation has an overarching character, not all dimensions of SRL are equally domain-specific and learners usually employ a combination of general and specific strategies so that domain-transcending aspects of SRL are of relevance too (Leutwyler & Maag Merki, 2009).
8. Boekaert's and Pintrich's models are component models describing competences that enable learners to study in a self-regulated way, while Zimmerman's model represents a process model of SRL which differentiates between phases before, during, and after learning (Wirth & Leutner, 2008).
9. In the higher education literature, the terms self-directed learning and SRL are used interchangeably, and basically have the same meaning (e.g., Bracey, 2010). This section uses the term self-directed learning following the usage of this term in the cited PBL literature.
10. The different educational approaches that exist range from rather teacher-centered models of teaching as transmission, that is, passing knowledge from the instructor to the students, to more learner-centered models of teaching as facilitating learning, that is,

facilitating students' processes of knowledge construction. More traditional, commonly practiced methods of instruction emphasize lecturing supplemented by exercises and classroom discussions on assigned readings with the instructor as the "sage on the stage" disseminating information (e.g., Armstrong & Fukami, 2009).

11. Test performance, thereby, refers to acquiring medical knowledge that can be recalled in a standardized testing format such as the Medical Licensing Examination Step 1 exam used in the USA (USMLE).
12. Going beyond medical education and building on former meta-analyses (Dochy et al., 2003; Gijbels et al., 2005), Walker and Leary's (2009) recent meta-analysis on PBL combines 201 outcomes reported across 82 different studies from 1976 to 2007. One new major contribution of this meta-analysis is the inclusion of 47 outcomes outside the field of medical education and allied health to examine the impact of PBL.
13. Their systematic review encompassed 13 international articles. Study selection criteria included PBL as a teaching method in medical education, physician competences assessed after graduation, and a control group of graduates of traditional curricula. The study population ranged from first-year residents to physicians with up to 20 years of practice. The authors assessed the quality of the studies categorizing competences into eight thematic dimensions (overall, technical, social, cognitive, managerial, research, teaching, and knowledge competences), taking the level of evidence for each competency based on self-reported and observed assessments into account.
14. Hattie proposed that interventions with an effect size above 0.40, which he termed the hinge point, would have an impact greater than that of an average teacher (zone of desired effects).
15. Hamre and Pianta (2010) developed an assessment approach—the CLASS model (Classroom Assessment Scoring System)—which suggests comparable features of teacher–student interactions organized into three dimensions that have been tested and validated: emotional supports, classroom organization, and instructional supports.
16. The COACTIV longitudinal study (2002–2006, Cognitive Activation in the Mathematics Classroom) was one of the first studies in the German-speaking countries that surveyed the mathematics teachers of the PISA classes (first cycle conducted in 2003–2004, German mathematics instruction at lower secondary level) to investigate teacher competence as a key determinant of instructional quality in mathematics.

17. High-inference rating dimensions rated on a 4-point Likert-type scale ranging from 1 (low occurrence) to 4 (high occurrence) (Lipowsky et al., 2009).
18. The COACTIV study broadened Shulman's original definition of "general pedagogical knowledge" (Voss & Kunter, 2013). The first two types of knowledge refer to domain-specific knowledge, that is, knowledge of content and teaching of a subject, the third type refers to domain-general knowledge of how best to shape processes of teaching and learning.
19. R stands for Referendariat, that is, the name for the second (induction) phase of teacher education in Germany.
20. The Teacher Education and Development Study in Mathematics: Learning to Teach Mathematics (TEDS-M), conducted by an international research consortium, examined primary and lower secondary mathematics teacher education with student teachers who had not yet completed their professional education (university-based phase or induction phase of teacher education) in 17 countries.

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CHAPTER 4

# Multiple Ethnographic Case Study Research of Student-Centered Learning Environments in Higher Education Classrooms

The empirical study explores three separate university classrooms (i.e., cases) taught by three different expert instructors during semester-long courses between fall 2009 and spring 2012. The study is embedded within the broader aim of this research project, which is to develop a situative educational model for the design of powerful SCLEs to inform higher educational policy and practice. The objective of the empirical study, whose design is presented below, is to make visible and advance theory building about *how expert instructors in the field of higher education design and bring to life student-centered learning environments that provide students with opportunities for deep learning*. This chapter presents the rationale for multiple ethnographic case study research (Sect. 4.1), an overview of the research design of the empirical study (Sect. 4.2), the case study selection process (Sect. 4.3), the data collection methods and instruments used (Sect. 4.4), and ethical and human subjects' protection issues involved (Sect. 4.5).

## 4.1 Rationale for Multiple Ethnographic Case Study Research

This research project is based on a constructivist-interpretive paradigm that assumes multiple realities, the co-creation of understanding, and a set of methodological procedures that are based in the natural world (Denzin & Lincoln, 2011). Against the background of this qualitative framework,



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multiple case study research is one research strategy to move from a constructivist-interpretive paradigm to the empirical world, while drawing from a variety of data sources like observations, interviews, surveys, and document analyses.[1] Case study research was chosen as the research design for this empirical study because it allows for depth in terms of detail, richness, completeness, and within-case variance, drawing from a wealth of context-driven data and testing views directly in relation to phenomena as they unfold in practice. Case study research provides the opportunity to build theory that closely fits the multiple sources of empirical data, it allows for the use of mixed methods for the exploration of a classroom over time, it offers the possibility to make additional adjustments during the theory-building process, and it enables the researcher to gradually gain a better understanding of the context under study (e.g., Flyvbjerg, 2011; Yin, 2009).

Taking the education research interest and scope of the sponsored research project into account, the empirical study concentrated on three ethnographic cases involving university courses for prospective teachers enrolled in a one-year master's program at the HGSE.[2] Each case was investigated over the course of one term, permitting access to rich empirical data that allowed for thick descriptions and in-depth single and cross-case analyses. Grounded in empirical data, a set of consistently emerging course design elements and instructional quality features were extracted concerning course design and classroom learning, teaching, interaction, and climate. This study did not formulate empirically testable hypotheses to propose descriptions of and explanations for how opportunities for deep learning were created in these classrooms at the beginning. Instead, the approach used aimed to develop and progressively refine a situative educational model in the course of the qualitative research process, taking both the coherence between propositions and the correspondence of propositions with data into account (e.g., Engle, 2011; Engle, Conant, & Greeno, 2007; Glaser & Strauss, 1967; Miles, Huberman, & Saldaña, 2014; National Research Council of the USA [NRC], 2002).

Examining multiple cases can strengthen the gradually evolving theory that is being developed because analytic conclusions arising independently from three cases (cross-case comparability) are more substantial and robust than those of a single case. Yin points out that "the mode of generalization is *analytic* generalization, in which a previously developed theory is used as a template with which to compare the empirical results of the case study. If two or more cases are shown to support the same theory, replication may be claimed" (2009, pp. 38–39). Multiple case study research follows a "replication" design instead of a "sampling" design, fostering the external generalizability of the findings because homogeneous cases allow for literal replication abstracting the conditions under which deep learning appears to happen in the SCLEs under study.[3] Furthermore, the single and cross-case analyses give detailed accounts for the reader so that the study's findings are applicable and generalizable beyond the immediate cases (i.e., establish external validity). The extracted design elements and quality dimensions/features have the potential to inform both the (re-) design of learning environments and research about existing learning environments (see also Engle, 2011; Engle & Conant, 2002). Hence, this approach also provides knowledge about the relevance and applicability of the findings to other educational settings (transfer) (Charmaz, 2005, 2011; Dyer & Wilkins, 1991; Eisenhardt, 1989; Maxwell, 2012; Miles et al., 2014; Strauss & Corbin, 1998; Thomas, Barab, & Tuzun, 2009; Yin, 2009).

The multiple ethnographic case study research applies a mixed-method approach, in which quantitative as well as qualitative methods are used to describe and explain what was happening in each of the three classrooms (i.e., case studies). This grounded approach to data analysis involved conducting constant comparisons to base assertions and theory about quality features inherent in these learning environments in quantitative and qualitative data sources. The comparative microanalysis of learning, teaching, and interaction processes of everyday instructional practice helped to identify underlying regularities in what the expert instructors did that can help explain students' engagement in deep learning and the consistently superior student ratings of these three student-centered courses. The data analysis process is validated by the use of multiple data collection methods, such as participant observations, interviews, and videotaping, and by member checks (Denzin & Lincoln, 2011; Maxwell, 2012; Yin, 2009).

Finally, in contrast to the principles developed in design studies, the course design elements and quality features of the three classrooms under study were not created in the act of designing or redesigning such learning environments, but instead the courses were designed by expert instructors at the Harvard School of Education and conducted repeatedly before this empirical study was carried out in these classrooms (see also Engle & Conant, 2002). Nevertheless, this empirical study is in line with the perspective of the Design-Based Research Collective (2003; see also NRC, 2002; US Department of Education and National Science Foundation,

2013) and with design studies[4] in that it explores the possibilities for both designing powerful SCLEs and developing contextualized theories of learning and instruction (e.g., Burkhardt & Schoenfeld, 2003; De Corte, Verschaffel, & Masui, 2004; Engle, 2006). Classic design-based research projects as well as newer design frameworks have started to develop and refine "design principles" that aim to capture the key theoretical ideas underlying constructivist-learning environments and provide more in-depth guidelines for the design of such environments (Brown & Campione, 1994; Engle, 2006; Engle & Conant, 2002).

## 4.2 Overview of the Research Design of the Empirical Study

The research process started with a literature review of current higher education policies and curricular reforms in European higher education with regard to the pedagogical concept of SCL as the synopsis of the research design depicted in Fig. 4.1 shows.

Furthermore, findings from the learning sciences, from research on instructional quality, and (higher education) teaching and learning research were reviewed (Chaps. 2 and 3). As a result, a *conceptual framework* was developed (see Table 3.3, Sect. 3.5) that outlines and integrates common design principles and instructional quality dimensions and features of SCLEs. The framework serves as a starting point and point of reference to structure the empirical research field. The empirical study investigates how expert instructors in the field of higher education design and bring to life SCLEs that provide students with opportunities for deep learning (research question 2, see Sect. 1.3), tackling four empirical research sub-questions (2a–2d) at the nexus of curriculum design, learning, and instruction (see Table 4.1).

The particularistic focus taken in the context of this research project allowed for the flexibility to modify the research design during research to better understand both the practices studied and the research context. At the same time, starting from the conceptual framework helped to tie the emerging educational model to existing state-of-the-art literature to enhance the internal validity, generalizability, and the theoretical level of theory building from case study research (Eisenhardt, 1989). The conceptual framework together with the designed research instruments that preceded the empirical study provided the necessary structure to

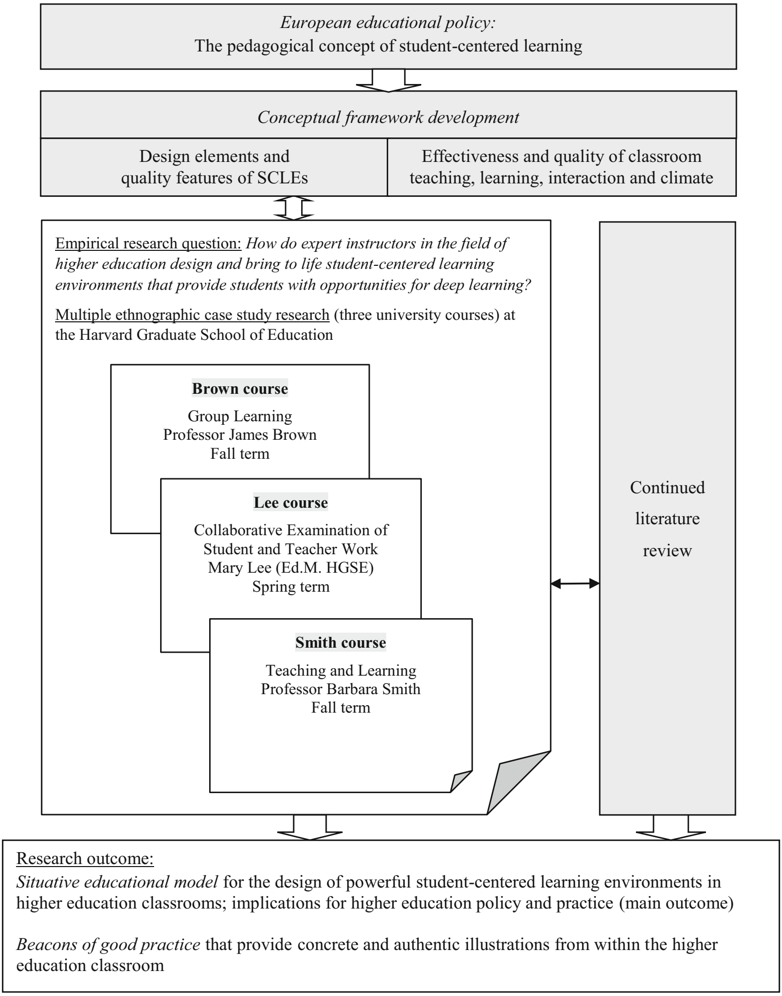


**Fig. 4.1** Overview of the research design of the empirical study

**Table 4.1** Data-planning matrix for the empirical study

Research question 2: *How do expert instructors in the field of higher education design and bring to life student-centered learning environments that provide students with opportunities for deep learning?*

| Empirical research sub-question | Why is the question of interest? | What kind of data will answer the questions? |
| --- | --- | --- |
| (*2a*) *What are characteristic curricular design elements and quality features of the student-centered higher education classrooms under study?* | To understand the design elements of the curriculum and how they are related and brought to life in the classroom | – Class documents (e.g., syllabus, handouts, course websites, assignments)<br>– Information on how the curriculum is brought to life (enacted) in the classroom<br>– Information on how students and instructors perceive certain aspects of the curriculum |
| (*2b*) *How do the instructors scaffold participatory processes of knowledge construction?* | To understand how students learn in these classrooms (e.g., kind of activities, materials used, individual versus collective work)<br>To understand how the instructor helps students learn | – Data on how students learn in class/what they do<br>– Information on how students experience learning in the classroom<br>– Information on how students perceive the instructor and his/her teaching activities in the classroom<br>– Data on how the instructor interacts with students<br>– Data on the instructor's perspective of student learning in class |
| (*2c*) *How do the instructors cultivate a classroom community of learners over time?* | To understand how the instructor establishes and maintains a classroom community | – Data on the instructor's educational beliefs<br>– Data on how the instructor interacts with students<br>– Information on how students experience learning and interaction in the classroom |
| (*2d*) *What are the teaching and learning challenges these constructivist classrooms present for the instructors and/or students?* | To understand how the implementation of the curriculum and the progressive work of the instructors/students can be challenged/hindered | – Information on challenging aspects that occurred in the classroom<br>– Information on challenging aspects from students' and instructors' perspectives<br>– Data on the organizational environment (HGSE) and institutional policies regarding learning and teaching |

systematically compare the classrooms under study (e.g., Maxwell, 2012; Miles et al., 2014).

As Table 4.1 shows, the first empirical research sub-question 2a focuses on characteristic curricular design elements and related quality features of instruction, that is, *course design elements*, such as course goals and content, course structure, and course activities. The second and third sub-questions (2b and c) refer to deeper-level quality features of instruction (instructional strategies) with regard to how *classroom learning*, *teaching, and interaction processes* play out in the classroom: the second sub-question 2b is concerned with the participatory learning processes that students engage in to construct knowledge together. The third sub-question 2c is concerned with how the instructors act/interact in the classroom to cultivate a classroom community of learners. The fourth sub-question 2d critically asks about the specific *challenges*, such as social discomfort (e.g., Bielaczyc, Kapur, & Collins, 2013), that instructors and students may face in these classrooms. Table 4.1 further connects the study's four empirical research sub-questions with the kind of empirical data necessary to answer them and provides an initial roadmap for the selection and design of instruments to collect these data. As a consequence, mainly qualitative data collection methods were used to gather empirical data rich in detail and embedded in authentic contexts (Denzin & Lincoln, 2011; Miles et al., 2014). The in-depth case study research applied in this research project contributes to

- better understand the "participants' perspective," that is, the meanings that the instructors and students in the study make of the events in their respective classrooms and how their understanding influences their behaviors. The study draws on instructors' and students' lived experiences in authentic student-centered higher education classrooms (i.e., teaching and learning processes and classroom interaction and climate) designed by expert instructors in the field of (teacher) education—an area which is still underrepresented in the existing literature. The "interpretive" approach to social science applied in this empirical study concentrates on a small number of higher education classrooms and instructors that are investigated over one semester each, preserving the individuality of each of the case analyses.
- better understand the teaching and learning processes, that is, the actual events and mechanisms that take place in authentic student-centered higher education classrooms (e.g., course activities, teach-

ing patterns, and norms of interaction) and link them to existing theories so as to form explanations for how instructors can design and bring to life powerful SCLEs that provide students with opportunities for deep learning.

- theory development, in that it generates a situative educational model that outlines design elements and instructional quality dimensions and features that are embodied in powerful SCLEs. The generated education research findings and resulting model are comprehensive and experientially credible, since they are grounded in empirical data connecting with instructors' experience of everyday classroom realities and, thus, have the potential to inform educational practitioners and impact higher education practice.

Systematic procedures were followed in every phase of the research process to gather rich data and account for validity and reliability of multiple case study research. Table 4.2 below provides an overview of the various "case study tactics" that were incorporated in this research study. In terms of data analysis, the *within-case analysis* followed common case study research practice. The coding process was based on grounded theory methodologies and interaction analyses. A subsequent *cross-case analysis* allowed for case comparisons, extracting course design elements and instructional quality dimensions/features as well as authentic examples and generating new features based on the integration of the three cases to answer the empirical research sub-questions outlined above (e.g., Charmaz, 2005; Dyer & Wilkins, 1991; Eisenhardt, 1989; Glaser & Strauss, 1967; Miles et al., 2014; Strauss & Corbin, 1998; Thomas et al., 2009).

## 4.3 Case Study Selection Process

In this section, the rationale for the selection of the empirical study site is presented (Sect. 4.3.1). After that, the case selection criteria and procedures as well as the characteristics of the students, instructors, and courses are provided (Sect. 4.3.2).

### *4.3.1 Selection of the Empirical Study Site: Harvard Graduate School of Education*

The USA has several of the world's outstanding universities, with Harvard University being regularly placed on the top (ARWU, 2015; THES, 2014) and with HGSE being ranked as one of the best schools of education in the

**Table 4.2** Case study tactics (adapted from Yin, 2009, p. 41)

| *Construct* | *Case study tactic* | *Research phase* | *Incorporated in this research study* |
|---|---|---|---|
| Construct validity | Use multiple sources of evidence | Data collection | Use of interviews, questionnaires, video materials, and class documents |
| | Establish chain of evidence | | Course and interview data, both taped and transcribed; survey data in digital format; and multiple evidence sources stored in database |
| | Have key informants review draft case study report | Composition | Case study reports reviewed by several key informants (instructor, teaching-fellows) |
| Internal validity | Do pattern matching | Data analysis | Patterns identified across cases |
| | Do explanation building | | Some links identified through thick data description and interpretation |
| | Address rival explanations | | Case variations and challenges considered |
| External validity | Use theory in single case/cross-case study | Research design | Theory used for conceptual framework development and in cross-case comparisons |
| | Use replication logic in multiple case studies | | Three cases investigated using a literal replication logic |
| Reliability | Use case study protocol | Data collection | Same data collection procedure followed for each case, conceptual framework as starting point, consistent set of initial questions used in each interview, and comparable case study outline |
| | Develop case study database | | Interview transcripts, field notes, content logs, and class materials stored in database |

USA (US News & World Report, 2014). Harvard University is a private university that is committed to excellence in teaching, learning, and research. In 2012, for example, Harvard University launched a new initiative for learning and teaching supported by a $40 million grant, "to encourage pedagogical innovation and strengthen learning and teaching throughout the University."[5] The HGSE was chosen as the empirical study site because of its consistently high rankings and its commitment to excellence in teaching and learning. The School of Education's mission is to "prepare leaders in education and to generate knowledge to improve student opportunity, achievement, and success" (HGSE, 2012). The school provides a broad range of academic programs, concentrating on culture, communities, as well as learning and teaching, to name a few. About 100 courses are offered during each semester conducted by more than 130 faculty staff.[6]

Against this backdrop, I hypothesized that a criterion-based selection among HGSE instructors and their courses would most likely fulfill the qualifications in terms of instructional quality (expertise). Moreover, since the students who attend these courses were chosen through the rigid admission and selection procedures at Harvard University, all of the students most likely possess the motivational and cognitive prerequisites so that they can make good use of the learning opportunities provided. In addition, research shows that education is among the disciplines that is the most dialogic and discussion-oriented and that graduate classes are largely interactive as compared to entry-level classes (e.g., Csomay, 2007).

The opportunity to study learning and teaching in a new cultural environment in the USA allowed me as an "outsider" who entered a foreign environment, to pursue the empirical research questions with an independent, fresh, and critical perspective. Furthermore, given that Harvard University is also at the forefront of education research, the study site promised to be a rich source to conduct frontier education research, learn from the practices of an Ivy League institution, and bring the knowledge and theories back to European higher education to inform higher education policy, research, and practice. Due to the favorable preconditions in terms of instructors and students, the multiple case study research at the Graduate School of Education can also be considered as a "benchmark study" that highlights some of the affordances and constraints of authentic SCLEs in higher education practice.

### 4.3.2 Purposeful Selection of Three Ethnographic Cases

The three courses under study were offered in the context of a year-long, intensive, full-time Ed.M. (Master in Education) program for students who wish to study a particular field in education, acquire a general theoretical background for understanding past and future field experiences, or develop skills for use in professional work in education. The HGSE offers 13 different Ed.M. programs and students have to complete eight courses (32 credits in total) to graduate.[7] The three selected courses under study belong to the HGSE's core courses with most of the students being enrolled in one of the following HGSE Ed.M. programs: "Learning and Teaching," "Arts in Education," and "Human Development and Psychology."[8] At least half of the students in each course stated in the course evaluation survey that they chose the courses as an elective, the rest chose these courses because they were recommended by faculty/administrators or a distribution requirement of the school (see Sects. 4.3.2.3 and 4.4.4.2 for more details). The three courses were purposefully selected for this research project based on theory-driven criteria (see Sect. 4.3.2.1). The following graduate courses were designed as seminars and encompassed between 25 and 38 students who were expected to actively participate in class and collaborate with classmates.

- *Teaching and Learning*, Professor Barbara Smith (fall 2009): Mrs. Smith's course aims to develop students' ability to engage different people in thinking about a subject matter, and grasping individuals' specific ways of coming to appreciate and understand the material.
- *Collaborative Examination of Student and Teacher Work*, Lecturer Mary Lee (spring 2010): Mrs. Lee's course aims to develop students' ability to examine student and teacher work in order for them to understand their learners better and to better support the latter's developing understanding of the subject matter they are learning about. Student teachers also learn about how to have focused and productive discussions about students, teaching, and learning with their colleagues.
- *Group-learning*, Professor James Brown (fall 2010): Mr. Brown's course aims to develop students' ability to understand key research findings on the nature of group learning and apply the concepts in practice by closely observing, analyzing, and designing group-learning experiences.

The subject matter of the courses centered on issues around curriculum, teaching, and learning of relevance for prospective teachers (PPK). Each course was conducted during one semester (four months).

#### *4.3.2.1 Ethnographic Case Study Selection Criteria*

Conducting ethnographic case study research is critical to developing a full understanding of powerful SCLEs and all of its components from multiple perspectives. It allows the researcher to look deeper into the characteristics and quality features of these learning environments and to learn from the experience of students and expert instructors in the field of higher education. The above cases were selected due to similar criteria informed by theory because these criteria were of particular interest to the study. Developments in education policy and research reviewed and synthesized in the conceptual framework (Table 3.3, Sect. 3.5) were used to identify three case selection criteria: expert instructors in higher education, instructors with constructivist educational beliefs, and SCLEs. Hence, conclusions drawn from the selected cases were likely to adequately represent expert instructors in higher education who design powerful SCLEs (see Table 4.3). Moreover, only courses with no more than 40 students were considered because classroom research shows that students are more willing and less anxious to participate, and less likely able to "hide," in smaller classes than larger classes (Rocca, 2010; Weaver & Qi, 2005). Karp and Yoels (1976) also found that courses which have more than 40 students have fewer overall interactions per class period (see also Nunn, 1996).

1. Expert instructors in higher education
Expertise refers to both CK of the subject matter ([teacher] education) and pedagogical (content) knowledge, with the latter being the instructor's (content-related) expertise in learning and instruction (NRC, 2000). Each instructor has specialized in education, is affiliated with the School of Education, and conducts education research in educational settings. All of the three instructors have (further) developed and repeatedly conducted their master's course under study for several years. The instructor's performance has been consistently superior to that of the instructor's peers as reported through repeatedly high course evaluation ratings and successful student learning as indicated through surveys of current and former student cohorts[9] (Ericsson, Prietula, & Cokely, 2007).[10] Evaluation data for the selection process could be obtained from prior course evaluations that were openly accessible within the school of education in order to provide information about courses to current and future students to help them with their course choices. Colleagues, administrators, and students also repeatedly recommended the selected instructors' courses.

2. Constructivist instructor beliefs
The instructors hold educational beliefs that reflect a constructivist orientation with regard to the nature of learning and instruction (see Chap. 2).

**Table 4.3** Selection criteria for ethnographic case selection

| *Category* | *Case study selection criteria* |
|---|---|
| Expert instructor in higher education | *The instructor possesses content knowledge of the subject matter as well as pedagogical (content) knowledge*<br>– specialized in the field of education (teacher education);<br>– affiliated with the School of Education; and<br>– conducts research in educational settings<br>*The instructor teaches the master's course under study* and<br>– has (further) developed and repeatedly conducted the course for several years (at least three times);<br>– has a consistently superior performance as compared to that of the instructor's peers as reported through repeatedly high course evaluation ratings by former student cohorts; and<br>– the course was repeatedly recommended by colleagues, administrators, and students. |
| Constructivist instructor beliefs | *Educational beliefs of the instructor that reflect a constructivist orientation*<br>– active role of the student in the learning process as well as a learning process orientation are emphasized;<br>– the course aims to foster higher-order conceptual understanding (deep learning);<br>– adoption of student-focused (learning-oriented) conceptions of teaching that are concerned with what the student does and whether student activities lead to appropriate learning; and<br>– the instructor's educational beliefs and instructional approaches are perceived as matching his/her actions in the classroom. |
| Student-centered learning environment | *The learning environment designed by the instructor displays core characteristics of student-centered learning environments*<br>– curriculum for understanding: students are required to create meaning on their own and demonstrate their understandings (they can do something);<br>– customized learning: students are required to contribute their knowledge and participate in the different classroom activities; they have choices and participate in decision-making processes and use diverse artifacts and materials including new technologies;<br>– supportive community of learners: students work in groups and work together in the whole class; facilitating norms of behavior; positive classroom climate;<br>– ongoing assessment and feedback: the syllabus/course description indicate that there is ongoing assessment and continued feedback from the instructor/teaching fellow; and<br>– adaptive instruction: only a small percentage of the overall class time is devoted to lecturing (time on task); instructor is engaged in different roles. |

The courses are designed according to the instructors' constructivist teaching philosophy and aim to foster higher-order conceptual understanding (deep learning). The constructivist orientation of the instructors' educational beliefs was explored by talking to the three instructors (pre- and post-case study), reading selected academic works of the instructors, reading former course evaluations, talking to students, administrators, and colleagues, observing instructional behavior in the classroom, and listening to their pedagogical explanations in the classroom. The instructors' constructivist understanding of learning and teaching processes was characterized by an active role of the student in the learning process and by a learning process orientation. The instructors have adopted student-focused (learning-oriented) conceptions of teaching that are concerned with what the student does and whether student activities lead to appropriate learning (see also Sect. 3.2.2). Prior course evaluations as well as preliminary conversations with the instructors, students, administrators, and colleagues also indicated that the instructors' educational beliefs and instructional approaches match their actions in the classroom, that is, they also enact the appropriate instructional behavior in the daily flow of events.

3. Student-centered learning environments
Class time is mainly used to provide students with opportunities to actively construct meaning by engaging in diverse course activities and doing assignments that allow students to explore, problem solve, and demonstrate their understandings (e.g., group explorations, student-led discussions, and reflections in class), while only a small percentage of the overall class time is devoted to lecturing (high time on task). These classrooms implicitly or explicitly establish participation structures and norms of behavior that allow for student choice, high levels of student involvement in activities, and decision-making. For example, students often talk to each other, work in groups, and engage in hands-on activities, while the instructors observe and listen. The classes also allow for the usage of diverse artifacts and materials, including new technologies. Assessment is formative, as outlined in the class syllabus, and students get feedback on their work (see Sect. 2.3 and Table 3.3, Sect. 3.5).

#### *4.3.2.2 Rationale for Case Selection Process*

Since granular qualitative research in naturalistic student-centered higher education classrooms is rather scarce and research resources were limited, this project focuses on exploring concrete and successful ground-level examples in depth by looking more closely at authentic student-centered classroom learning, teaching, and interaction practices. The case selection was purposeful insofar as expert instructors in higher education who displayed a constructivist orientation and designed student-centered classrooms, as well as students who experienced these courses were deliberately selected (Patton, 2001). Potential courses of the school of education were prescreened before a final case study inclusion decision was made studying former course evaluations, checking online course websites for information on the course design (e.g., syllabus, assignments), and querying professors as well as master students. In addition, knowledgeable research colleagues at the school and recent contacts with students, administrators, and teaching fellows were used to get an insider's view and identify potential candidates considering the case selection criteria above. The three selected student-centered courses, taught by expert instructors with a passion for their subject and for teaching, were chosen to be studied because they were most likely exhibiting the phenomena under study, that is, how expert instructors design and bring to life SCLEs that provide students with opportunities for deep learning. Homogeneous cases with no more than 40 students (seminars) were selected to elucidate processes, meanings, and contextual influences in these learning environments because they allow for a deeper understanding of typical instances of the settings under study over a longer time span (Maxwell, 2012). The study followed a replication logic in that each selected university course and instructor predict that opportunities for deep learning are likely to be provided within the higher education classroom under study (literal replication).

A rolling process, inter-leafed with coding and analysis, was used to select the three information-rich cases sequentially. Each case was studied in depth during one semester between 2009 and 2012, applying different data collection and data analysis methods that typically generated a large amount of data. The criteria outlined above were applied to purposefully select the first information-rich case and concentrate on one single case during one semester before another case study was conducted in the subsequent semester. The second and third cases were selected as the research unfolded and relied on theoretical sampling to focus on theoretically useful cases that could provide information likely to replicate or extend the emergent theory (Glaser & Strauss, 1967). Theoretical sampling aims at theory construction and helps to discover variation and difference within developed theoretical categories of data, enhancing the concepts identified in the earlier stages of the research process and thus, elucidating the specific research context (Charmaz, 2011).

The following section provides detailed information on student, instructor, and course characteristics based on the empirical data gathered.

#### *4.3.2.3 Student, Instructor, and Course Characteristics*

Table 4.4 below summarizes descriptive information on the participating students based on their course evaluations that were conducted after the courses were over (see also Sect. 4.4.4). In order to provide more information on students' motivation, expectations, and prior knowledge, this section also presents qualitative findings based on 16 interviews with 17 students (see also Sect. 4.4.2) and/or on students' answers to the open-ended questions in the course evaluation survey. Finally, Table 4.5 below provides descriptive information on the three instructors and the courses selected.

The students participating in the selected courses were diverse regarding race, class, age, and professional experience (HGSE, 2010a, 2010b, 2011). Their cognitive ability and interest in the courses were leveled by HGSE's admission procedures and by the fact that about half or more students in these courses chose the courses as an elective.[11] The other half also chose these selectable core courses mainly because of the good course evaluations and because they were recommended to them by the school's administrators, student advisors, or fellow students during the course enrollment phase.

At the time of the student interview, most of the interviewees stated that they plan to work as teachers after their graduation from this one-year master's program.[12] During the second half of the one-year program, students in class had started to apply to public (including charter schools) as well as private schools around the country for teaching positions covering the full range from elementary level through middle school to high school. The following paragraphs provide a glimpse into students' motivation, expectations, and prior knowledge based on student interviews.

Students in Mrs. Smith's course registered for her course because its description "sounded interesting" and other students recommended the class (word of mouth) saying that the class "was life-changing," "a great experience that will change the way you think about teaching," or that it "was a great experience to have been a part of" (e.g., alumni, former course evaluations). The interviewees, who chose Mrs. Lee's course,

**Table 4.4** Student characteristics

| | *Student characteristics* | | |
|---|---|---|---|
| | *Smith case* | *Lee case* | *Brown case* |
| Number of students in class | 38 (8 males) | 25 (3 males) | 33 (17 males) |
| Females | 82% | 88% | 52% |
| Primary school affiliation | Nearly all of the students (95%) in class were affiliated with a one-year HGSE master program (Ed.M.) | All students in class (100%) were affiliated with HGSE Ed.M. master programs | Nearly all of the students in class (97%) were affiliated with a one-year HGSE master program (Ed.M.) |
| Main HGSE Ed.M. programs enrolled | Learning and Teaching (26%)<br>Arts in Education (21%)<br>Specialized Education (16%)<br>Mind, Brain, and Education (13%) | Learning and Teaching (64%)<br>Arts in Education (20%)<br>Human Development and Psychology (8%) | Learning and Teaching (54%)<br>Specialized Education (20%)<br>Human Development and Psychology (13%) |
| Teaching experience | Some students had no prior teaching experience, some gave private tutoring lessons, some had ten years and more of experience working as a teacher or teaching artist, for example. | Students in class had different teaching experiences ranging from no teaching experience to over a decade of teaching prior to graduate school. | The teaching experiences were ranging from one year teaching abroad to over a decade of teaching experience |
| Subject matter and grade levels taught | Chinese, English, mathematics, dance, and poetry<br>Kindergarten up to high school level and adults in private and public schools | Social studies, English language, Chinese language, mathematics, character education, and theater/drama<br>All grade levels from kindergarten (pre-school) to 12th grade | Science, history, English language, and literature<br>Middle or high school students<br>Other teaching-related positions: for example, administrator in educational programs, education advisor, teacher educator in the USA and elsewhere |

**Table 4.4** (continued)

| | *Student characteristics* | | |
|---|---|---|---|
| | *Smith case* | *Lee case* | *Brown case* |
| Main reasons for course enrollment: Elective | 49% | 52% | 70% |
| Recommended or distribution requirement of the school | 51% | 48% | 30% |

**Table 4.5** Instructor and course characteristics

| | *Expert instructors and course characteristics* | | |
|---|---|---|---|
| | *Smith case*[a] | *Lee case* | *Brown case* |
| Academic position of expert instructor | *Prof. Barbara Smith* Professor of Education | *Lecturer Mary Lee* Adjunct Lecturer on Education | *Prof. James Brown* Lecturer on Education, Research Associate |
| Teaching experience | Elementary school, higher education (teacher education) 36 years | Middle school, high school, university courses, and faculty development programs 15 years | Middle school, high school, and higher education 12 years |
| Course taught since | Fall 1981 | Spring 2006 | Fall 2007 (taught for the fourth time) |
| Credit points[b] | Four | Four | Four |
| Course days | 13 days (110 minutes per class/day) plus parallel sections with up to 12 students led by teaching fellows[c] | 25 days (130 minutes per class/day) | 12 days (165 minutes per class/day) |
| Course times | Tuesdays 4–6 pm (class session) and two-hour parallel sections on several days for up to 12 students with no break | Tuesdays and Thursdays 9:15–11:30 am and a five-minute break mid-way through the class | Fridays 10–1 pm with a 15-minute break mid-way through the class |

(*continued*)

**Table 4.5** (continued)

| | *Expert instructors and course characteristics* | | |
|---|---|---|---|
| | *Smith case*[a] | *Lee case* | *Brown case* |
| Teaching fellows | 3 | 0 | 2 |
| Location | Longfellow classroom 308, third floor | Gutman 303, third floor and then moved to Longfellow classroom 308, third floor | Gutman 305, third floor |
| Room furnishings and facilities | Air-conditioned classroom, carpeted floor, clock above the door, teacher's desk together with computer and technology equipment, video-recording devices, and mobile silver screen | | |
| | About 25 $m^2$, two doors, one wall with windows, two walls with bulletin boards, chalkboard, and desk chairs with wheels | About 20 $m^2$, one door, no windows, four walls with bulletin boards/ large whiteboards, flip chart, and chair desks (without wheels) | About 20 $m^2$, two doors, no windows, four walls with bulletin boards/large whiteboards, and chair desks (without wheels) |

[a]Due to the large amount of students enrolling each fall term, the course is conducted with two parallel groups—A1 and A2—of approximately 35–50 students each. This case study focuses on A2
[b]Most HGSE courses carry four units of credit and are equivalent to four semester hours for a period of 13 weeks (HGSE, 2014)
[c]In addition to the weekly two-hour class sessions, four small two-hour sections with up to 12 students each were held in parallel by the teaching fellows throughout the semester

were motivated to take her course because of the course description, the interesting course title, and because they were interested in pedagogy and classroom teaching. Looking at student work and talking about it seemed "intellectually challenging" and "very relevant to the daily practice of teaching." Students aimed "to further my own understanding of collaborative work and to push my own thinking." Some of them were particularly "impressed with Mary and liked her immediately" during the course selection period.[13] Regarding his/her motivation to take both Mrs. Smith's and Mrs. Lee's course one interviewee stated:

> Barbara's class and Mary's class, these two classes were philosophically aligned, I think, theoretically. And I was taking them for a particular reason which was to really think about my own beliefs and to critically evaluate

> what I believed to see what fit and what didn't. In order to do that, you have to work hard. And I think that's why I worked hard. [Student interviewee 3, Lee case]

Some students were motivated to enroll in Mr. Brown's course because of their first impression during the course selection period. One interviewee said that he wanted "to add a class that is hands-on to the schedule" [Student interviewee II, Brown case]. Moreover, the interviewees were interested in the topic and some students felt that higher education is an interactive group process and that group work is important for their studies and profession. Students wanted to understand the theories behind group learning and develop a better understanding of how to collaborate effectively. One interviewee summarized his/her interest in the course:

> Of course the course evaluations were phenomenal. Everyone was like, "group learning, you have to take it." And I am very interested in how groups learn. Not just like how teachers learn together but how students work well together and learn from each other. I thought he did a really good job of organizing the class around central tensions as well as around central questions about what it means for groups to learn and summarizing the readings from that point of view. [Student interviewee IV, Brown case]

Students come to the classroom with certain expectations based on their prior life and school experiences, what they have read and heard about the specific course, and their first impression during the course selection period. According to some of the interviewees, students expect instructors to have both strong expert knowledge of the area they are teaching ("know their content") as well as pedagogical skills. They expect them to be organized and prepared—have a "game plan" (e.g., syllabus, reading list) for what the class is doing. One interviewee stated that s/he expects that "there is a purpose for what we are doing and that it's important and that I can get something out of it somehow and that that's relevant to my life and to my future" [Student interviewee C, Smith case]. That is, the class should be structured to a certain extent because otherwise students can easily get confused. However, the structuring should not be rigid, but instead allow for some flexibility so that students are challenged and that the instructor can be responsive to students' needs and interests and make changes along the way. Students also expected that they would have opportunities to reflect on the work that they were doing and that there would be coherence between what is spoken in class, what they are supposed to read, and the learning activities taking place in class. Students wanted the instructors to keep arrangements and be reliable and contribute their knowledge and share stories. Finally, they expected feedback and support from the instructor as one interviewee put it:

> I expect some kind of support in my uncertainty. And if I am going to go forward in my learning then I need to have some kind of help. And I might not always know when I am confused. So that's why a relationship is important. [Student interviewee 3, Lee case]

Some of the interviewees submitted that some of their assumptions, beliefs, and prior knowledge were challenged and enhanced in these courses (e.g., through principles such as no judgment, listening intensively, and taking in other people's perspective). Students were able to relate the course content to what they knew and learned before; for example, to the other classes they took or to their experiences as learners and/or teachers. Some students also pointed to their own responsibility as learners in relation to the instructor, "I also expect a lot of myself. I think that it's not all them [instructors], it has to be myself. It's a relationship" and to the importance of having the time to further discuss a topic with the instructor if they have questions [Student interviewee 3, Lee case]. A large proportion of students in class went to private or independent schools and colleges before they came to Harvard. Thus, learning for them was often a combination of individual preparatory work at home and discussions and small group activities in class where they could "bounce ideas around with other people" as the following example indicates:

> Obviously there is a lot of homework too because you can't really participate in a discussion if you haven't thought about what it is that's being brought to the table or discussion. But I feel like the homework, the reading, the pre-writing, all of that is getting your ideas in line so that you can make the most of that opportunity to really sort of bounce those ideas around with other people. [Student interviewee D, Smith case]

Students who came from less progressive schools are often used to more teacher-centered pedagogies where the teacher has the superior authority and determines what the students need to know and remember. Thus, the theories they have memorized and the more traditional ways in which they were taught during their prior education impacted their thinking and how they approached activities in class:

> There were some people here who have been very schooled in the traditional way of teaching. And I think that this was a hard class for them because it challenged their beliefs [laughs]. And I actually could watch them. And some of the comments reflected that, you could see that: "Oh, maybe, maybe there is another way but I am not sure." [Student interviewee 3, Lee case]

Interviewees used to traditional schooling (e.g., Chinese students) sometimes felt like they "did not get any sense from an experience" [Student interviewee A, P2, Smith case]. They struggled with the tendency to stay in their "comfort zone" versus making themselves vulnerable and stepping forward to immerse themselves in the course activities.

## 4.4 Data Collection Methods and Instruments

Data were collected from various sources (data triangulation) and with multiple methods (methodological triangulation) in order to investigate the three selected university classrooms over time (Denzin, 1978). Overall, the use of triangulation during the data collection process, that is, the collection of information using a variety of sources and methods, allows for the development of converging lines of inquiry about the phenomenon under study and, thus, to establish construct validity and reliability of the case study evidence. Hence, it is unlikely that findings have been driven mainly by one of the methods used. Instead, combining these different methods increases reliability, that is, the extent to which results reflect consistent instructional aspects of an instructor's practice in the classroom and not other factors, such as the idiosyncrasies of the observer, the instructor, or the students. Greater reliability was achieved and self-report biases by instructors and students were avoided due to multiple observations by a participant observer over a longer time span, parallel videotaping, and course evaluations from several student cohorts (Denzin & Lincoln, 2011; Maxwell, 2012; Yin, 2009).

Table 4.6 provides an overview of the empirical data collected for the three case studies applying several data collection methods. Each data collection method is elucidated below in terms of how the instrument was designed, how the gathered data were analyzed, and what the methodological procedure was: participant observations and class documents

**Table 4.6** Overview of the data collected for the three ethnographic case studies

| *Data collection methods and instruments for the three ethnographic case studies* | |
|---|---|
| Participant observations (41 class sessions) | Videotaping in the classroom (84 hours) |
| – Smith case: 12 out of 13 class sessions (92% of class time)<br>– Lee case: 21 out of 25 class sessions (84% of class time)<br>– Brown case: 8 out of 12 class sessions (67% of class time) | – Smith case: 22 hours (92% of class time)<br>– Lee case: 37 hours (68% of class time)<br>– Brown case: 25 hours (75% of class time) |
| Interviews (27 interview hours) | Course evaluation surveys ($N = 404$)* |
| *Student interviews* (21 interview hours)<br>– Smith case: 7.5 hours (5 interviews; $M = 89$ minutes; $SD = 29$)<br>– Lee case: 6 hours (5 interviews; $M = 74$ minutes; $SD = 29$)<br>– Brown case: 7.5 hours (6 interviews, $M = 73$ minutes; $SD = 20$)<br><br>*Instructor interviews* (6 interview hours)<br>– Smith case: 1.5 hours<br>– Lee case: 3 hours<br>– Brown case: 1.5 hours | – Smith case: six student cohorts (due to two parallel courses each year; $N = 230$)<br>– Lee case: three student cohorts ($N = 67$)<br>– Brown case: three student cohorts ($N = 107$)<br><br>* over the course of three subsequent years for each course |

(Sect. 4.4.1), semi-structured instructor and student interviews (Sect. 4.4.2), videotaping and video-based analysis (Sect. 4.4.3), and half-standardized course evaluations of students (Sect. 4.4.4).

### *4.4.1 Participant Observations and Class Documents*

#### *4.4.1.1 Instrument Design: Participant Observations*

The conceptual framework introduced in Sect. 3.5 and the interview protocols (see Appendices 1–3) were used to inform the participant observations in the classroom and also served as a tentative outline of the initial case study reports; they helped to focus attention on specific aspects of the learning and teaching practices. Such aspects were, for instance: classroom routines, cognitive level of assignments and course activities, opportunities for students to disclose their reasoning processes or to participate in class discussions, the instructor's cognitive conceptions of teaching, and the overall class climate. I participated in most of the course activities to adapt to the natural flow of the classroom interaction and, thus, could also partly experience the classroom from the perspective of the students. However, I did not do all the course work and could choose not to participate in activities or discussions in order to concentrate on my role as an observer. Class materials (including class e-mails from the instructor) and field notes were chronologically organized in course folders together with the content logs of the class videos and the interview transcripts.

#### *4.4.1.2 Procedure and Rationale*

Classroom observations provide glimpses into the classroom practices of instructors and deliver a wealth of information about the learning and teaching that is going on in a real-life classroom. On average, participant observations were conducted in 81% of the classes (see Table 4.6). For the most part, videotapes were available for classes I did not attend. I had access to all classes of the three courses and gathered class documents such as syllabi, handouts, assignments, e-mails, course readers, and information on class websites to corroborate and augment evidence from different data sources. I also wrote field notes throughout the empirical study that—together with the class documents—were analyzed as part of the case studies. These notes include mainly logistic information, the structure of the class, that is, what was going on in the classroom, ideas that came up during the observation, and my own reflections.

As teaching practice varies from lesson to lesson and from student group to student group, multiple observations were necessary to allow for higher levels of reliability. The chance to "live" in the classroom, observing expert instructors and students interact with each other, made learning and teaching tangible. Class documents and artifacts provided by the instructor or other class members were important to investigate how the course curricula were designed and brought to life, that is, what was expected by the different instructors, and how and under what conditions students learned (deeply) in these classrooms, including the problems students and instructors encountered while enacting the curriculum. These are unobtrusive data that contain exact information and details that were reviewed repeatedly (Yin, 2009).

Being on site for the entire term to explore how the interactions in the university classroom evolved over time to provide opportunities for students to engage in deep learning offered a more holistic picture of the classroom and informed the data analysis with contextual information (Rex & Schiller, 2009). Observing authentic interactions between instructors and students in their everyday classrooms makes it possible to gain valid data on how they actually behave as opposed to how they say they would behave. Relying only on interviews or on one or two videotaped classes per course, for example, did not guarantee that the interviewees would actually do what they said they normally do in the concrete situations they described. I also used my presence in the classroom as an observer and student to substantiate what students and instructors said and did in the classroom.

### 4.4.2 Semi-structured Interviews with Instructors and Students

#### 4.4.2.1 Instrument Design: Instructor and Student Interviews

The questions I asked arose from the conceptual framework, from what I observed in class, and from the videotapes helping to confirm or dismiss theoretical propositions and/or my observation conclusions. The interview questions were mainly the same for instructors and students in order to capture different perspectives on similar phenomena, compare answers, and get a more holistic picture of the learning environment. The interviews tackled the following thematic areas related to student-centered course design and pedagogy:

- professional background and current/future situation of the interviewee;
- general impression of the course structure and climate;
- course design (e.g., objectives, content, and assessment);
- teaching, learning, and interaction processes; and
- institutional environment.

The instructors were additionally asked to discuss their teaching philosophy and the instructional strategies that they most frequently used and about their perceptions of the working conditions and support structures for their teaching at the school, including any challenges that they had encountered or perceived with regard to the course. The open-ended interview questions aim to contribute to answering the four empirical research sub-questions presented in Sect. 4.2.[14]

#### 4.4.2.2 Procedure and Rationale

After the courses ended, data were gathered by means of 19 *semi-structured interviews* with the instructor of each course and with 5–6 students per course (17 students were interviewed; one interview was conducted with two students). The goal was to capture instructor and student perceptions of various quality features of the classroom environment, and to generate new findings, and alter or validate findings based on participant observations, document, and video analysis. Appointments for the interviews were scheduled with the participants and the interviews took place in the instructor's office, in my office, or in a study room in the schools' library. A total of 27 hours of instructor and student interviews (see Table 4.6) were audiotaped and transcribed. All interviews were tape-recorded with permission from the participants to provide an accurate rendition of the interview. The interviewees signed an informed consent form.[15]

*Instructor Interviews* Each of the three instructors was interviewed after the course ended. The interview transcripts and a first draft report of the case study were given to each instructor to solicit systematic feedback about my data and conclusions from the people I was studying. A second, more informal conversation, also gave the instructors a chance to reflect on their practice and make future adjustments in terms of course design and teaching given the report of an "impartial" researcher. In addition, peer examination took place insofar as colleagues and teaching fellows with research experience and familiarity with the courses in question were asked to comment on emerging findings presented in the draft case study report. Ad hoc validations during the interviews, member checks with the three instructors, as well as the triangulation of methods and empirical data also contributed to increase the validity of the findings (Denzin & Lincoln, 2011).

*Student Interviews* For each of the three classes, 5–6 student interviews were conducted. The interviews with 17 students lasted up to two hours each and were audiotaped with the permission of the students who were assured confidentiality and anonymity. The interviewee selection process was guided by the emerging theory in order to choose candidates that were willing and able to answer the interview questions. Theoretical sampling procedures were applied searching for students who reflected the student body (sex, age, and race) and provided contrasting perspectives and opinions about the learning and teaching that was going on in the classroom (e.g., program enrolled, quieter and more vocal people). The interviewees were willing to criticize aspects of the course and/or instructor and share positive as well as negative experiences and opinions. The interviews were conducted until I found that the same things appeared repeatedly and I was discovering nothing new in accordance with a grounded theory strategy called "theoretical saturation" (Strauss & Corbin, 1998).

#### *4.4.2.3 Coding of the Interview Transcripts*

The transcribed interview data were organized and documented under the name "Harvard Case" with the qualitative analysis software ATLAS.ti. The software functioned as an evidentiary database and facilitated the qualitative data analysis process, thereby increasing the study's reliability. Each transcript was given a code to assure that personal identity of the data was protected. The coding process was informed by categories and codes drawn from the conceptual framework (Table 3.3, Sect. 3.5), the situative analysis framework (see Fig. 4.2, Sect. 4.4.3.2), and the interview protocols (see Appendix 3). These schemes provided starting points and points of reference for the data analysis process that applied a grounded theory approach (e.g., Hoidn, 2010, pp. 59–83; Strauss & Corbin, 1998; Thomas et al., 2009; Yin, 2009). The initial coding resulted in more than 40 codes that captured the richness of the data (see Table 4.7 below for the list of codes developed).

More specifically, the coding process followed a constant-comparison approach. This approach allowed for a systematic analysis of the case study data gathered and underlying patterns and themes were identified that were representative of the phenomena observed in the classrooms. Codes were assigned to units of text through open coding to build grounded assertions and categories of codes as well as their properties through constantly comparing these codes with one another. Themes were established among the participants' responses to questions to improve the validity of the qualitative coding. Passages that spoke to the interview protocol themes were coded with the appropriate code for each case study. In this way, the coded data had grounded support and could be aligned to the emergent themes illuminating the four research sub-questions (see also Table 4.1).

Following the building of categories out of codes, axial as well as selective coding were performed to discover relationships between categories and to choose core categories to integrate and refine emerging assertions. By continually comparing and reexamining the codes, the associated data and previous research, these codes were eventually assembled into four main categories in the context of the cross-case analysis lending themselves to matching with the four research sub-questions (see Chap. 5).

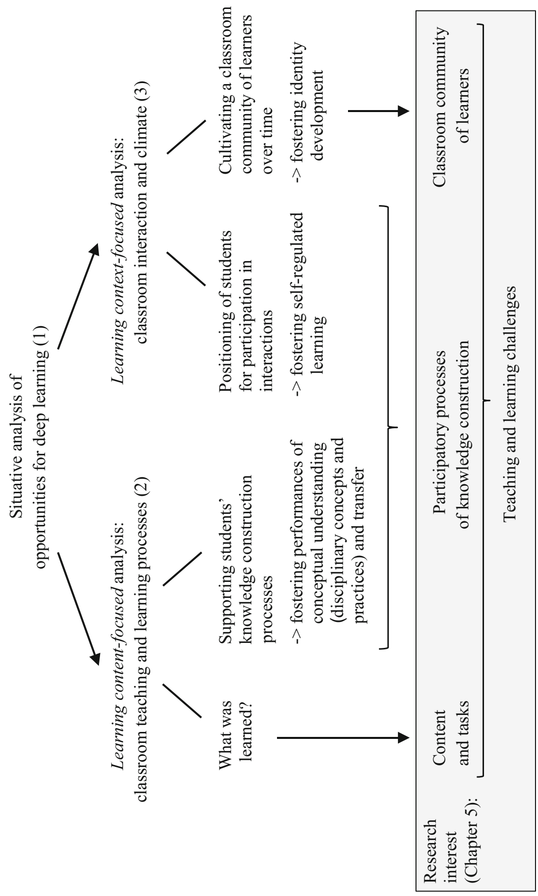


**Fig. 4.2** Situative analysis of opportunities for deep learning

**Table 4.7** Qualitative data analysis—codes and categories

<table>
<tr><th>Categories</th><th>Single codes instructor</th><th>Single codes students</th></tr>
<tr><td>Professional background and current/future situation</td><td colspan="2">Years of teaching experience</td></tr>
<tr><td></td><td>Years of course conduction</td><td>Subjects/grade levels of teaching experience</td></tr>
<tr><td></td><td>History of the course</td><td>Teaching during academic year</td></tr>
<tr><td></td><td>Teaching plans for the next academic year</td><td>Teaching plans after graduation</td></tr>
<tr><td>General impression of the course</td><td colspan="2">Overall impression of the class by instructor/student</td></tr>
<tr><td></td><td colspan="2">Class culture and atmosphere</td></tr>
<tr><td></td><td colspan="2">Class structures, organization, and routines</td></tr>
<tr><td>Course design</td><td>HGSE approach to educate teachers</td><td></td></tr>
<tr><td></td><td>Teaching philosophy/ theoretical influence</td><td></td></tr>
<tr><td></td><td colspan="2">Learning goals</td></tr>
<tr><td></td><td colspan="2">Relevance of course content</td></tr>
<tr><td></td><td colspan="2">Value of assignments for learning</td></tr>
<tr><td></td><td colspan="2">Type of feedback</td></tr>
<tr><td></td><td colspan="2">Form of final research project</td></tr>
<tr><td></td><td colspan="2">Kind of artifacts/technologies</td></tr>
<tr><td></td><td colspan="2">Role of assessment</td></tr>
<tr><td>Pedagogy: Teaching, learning, and interaction processes</td><td>Basic assumptions about students, learning, and teaching</td><td></td></tr>
<tr><td></td><td colspan="2">Role of the instructor</td></tr>
<tr><td></td><td></td><td>Most appreciated (instructor)</td></tr>
<tr><td></td><td></td><td>Expectations (instructor)</td></tr>
<tr><td></td><td></td><td>Expectations met</td></tr>
<tr><td></td><td>Interaction with students</td><td>Student's interaction with instructor</td></tr>
<tr><td></td><td></td><td>Class' interaction with instructor</td></tr>
<tr><td></td><td colspan="2">Student motivation</td></tr>
<tr><td></td><td colspan="2">Role of student's prior knowledge</td></tr>
<tr><td></td><td colspan="2">Allow for exploration</td></tr>
<tr><td></td><td colspan="2">How learning/knowledge creation happened</td></tr>
<tr><td></td><td></td><td>Approach to learning</td></tr>
<tr><td></td><td></td><td>What have you learned?</td></tr>
<tr><td></td><td></td><td>What made learning difficult?</td></tr>
<tr><td></td><td colspan="2">Role of reflection</td></tr>
<tr><td></td><td colspan="2">Social relationships between students</td></tr>
<tr><td></td><td colspan="2">Tensions in class</td></tr>
<tr><td></td><td colspan="2">Inclusion</td></tr>
<tr><td></td><td colspan="2">How you felt treated in class</td></tr>
</table>

**Table 4.7** (continued)

| *Categories* | *Single codes instructor* | *Single codes students* |
|---|---|---|
| Institutional environment | Perception of physical classroom environment | Perception of physical classroom environment |
| | Suggestions for changes/improvement (course) | Suggestions for changes/improvement (course) |
| | Improvement possibilities (context of teaching) | |
| Closing | Further comments | Further comments |

Quotes that directly spoke to the themes and research questions are offered from each case so as to provide examples of how the research questions were illuminated by the data (Charmaz, 2005; Strauss & Corbin, 1998; Thomas et al., 2009).

### 4.4.3 Videotaping and Video-Based Analysis

The opportunity to videotape most of the classes made it possible to capture and investigate naturally occurring interactions as they unfolded in the university classroom, to produce visual documents of the interaction under study, and to ensure the descriptive validity of the researcher's observations. The goal of the video analysis was twofold: first, to gain observational data about the frequency, duration, and manifestations of selected *design elements and related quality features* of the learning environments (Sect. 4.4.3.1); second, to gain a better understanding about how students' participation in knowledge construction processes could account for the advances in their conceptual understanding identifying *deeper-level instructional quality dimensions and features* embodied in these classrooms (Sect. 4.4.3.2).

The video recordings were made with one camera that was stationed by default in the middle or in one corner at the back of each classroom capturing most of the room. Due to the commonly fixed camera in the back of the classroom, coverage was limited to what was visible from a certain position in the room with a certain angle. However, the camera was, in part, manually movable and had a zoom function. For that reason, I often chose to sit near to the camera so that I could comfortably move its radial arm to capture different views of the classroom in case the focus shifted to a place in the classroom that was not visible from the common angle that was captured by the camera. Photographs from the videotapes were used to help visualize the classroom and to convey certain case characteristics in the case study reports. In addition, concrete examples and quotations from the classroom were used for the write-up of the case studies to illuminate and substantiate the research findings.

The video analysis process outlined below made it possible to study the moment-to-moment processes of classroom learning and teaching as a physical, social, and cultural space. Altogether 84 hours of class were videotaped and analyzed (see Table 4.6). For each case study, one class constitutes the *subunit of analysis* for the coding process. A content log was produced for each videotaped class that contained transcriptions of the video material capturing relevant interactions (episodes of interactive activity) in the classroom.[16] Thus, it was possible to systematically explore instructional practices of the student-centered classrooms under study and produce empirical statements about evolving teaching patterns and structures.

#### *4.4.3.1 Instrument Design Procedure and Rationale for the Analysis of Characteristic Curricular Design Elements and Quality Features*

Video records of classroom interactions were first used to gain observational data about the frequency, duration, and manifestations of design features of the three classrooms under study. This analysis speaks to the first empirical research sub-question (2a; see Table 4.1): *What are characteristic curricular design elements and quality features of these student-centered higher education classrooms under study*? In the course of the data analysis, it was possible to identify prevalent course activities, participation structures, and teaching patterns in these courses that helped account for the kinds of opportunities for deep learning that appear to have occurred. The analysis of characteristic curricular design elements and quality features involved two analysis steps.

In a *first step*, event sampling was applied to record events every time they happened in the classroom (Bakeman & Gottman, 1997). A theory- and data-based coding system was developed in an iterative process with the coding process comprising of several coding rounds to analyze the video recordings using the transcribed content logs of each course as the basis. The coding system was, in part, adapted from classroom video studies (e.g., Hugener et al., 2009; Kovalainen & Kumpulainen, 2007) and empirical studies on learning environments (e.g., Stebler & Reusser, 2000), and further developed by inductively assigning newly developed codes to the categories that fitted the empirical data resulting in six coding inventories (see Appendix 4). The analysis started by dissecting the specific course activities prevalent in each course and their duration in minutes (Inventory 1). Course activities were the key category (event) with the other five categories being coded referring to this key category and its duration in minutes. In a second coding round, the social form of instructional activities (Inventory 2) as well as whether the classroom talk referred to learning content and/or processes (Inventory 3) were identified. In a third coding round, the facilitated student activities (Inventory 4) and the mainly adopted roles of the instructor during the course activities (Inventory 5) were addressed. In a last coding round, recurring teaching patterns were identified in a qualitative grouping procedure identifying groups of course activities that represented these different teaching patterns (Inventory 6).[17] The latter category is also partly based on prior classroom research describing some of these teaching practices (e.g., Hugener, 2008; Hugener et al., 2009). The following Table 4.8 shows a coded sample content log excerpt that was generated for each class based on the video transcripts.

In a *second step*, the transcribed content logs were analyzed using the following five design elements as the main conceptual categories for the coding procedure: course objectives and content, course structure, course activities and materials, classroom routines and norms, assignments, and assessment tasks. These design elements were informed by the literature review in Chap. 2 (see Table 2.4), the case selection criteria (Table 4.3), and the empirical case study data gathered from each course (see Chap. 5).The coding process was conducted in line with grounded theory methodologies and followed the coding procedure that was outlined in Sect. 4.4.2.3. The quantitative descriptive data analysis of the video data in Chap. 5 was conducted using the spreadsheet program Microsoft Excel.

In contrast, deeper-level quality features abstract from the design elements and related quality features of learning environments to help explain how the latter work in the context of naturalistic classroom learning, teaching, and interaction practices.

#### *4.4.3.2 Instrument Design Procedure and Rationale for the Analysis of Deeper-Level Quality Features*

The video materials allowed for in-depth glimpses into what was going on in each of the three classrooms over an entire semester. By carefully observing the ways in which expert instructors and students interacted in the classroom while they engaged in different learning and teaching activities,

**Table 4.8** Content log excerpt (Brown case, 10.09.2010)

*Brown case, September 10, 2010*

| *Time* | *Minutes* | *Course activity* | *Teacher and student communication (quotes)* | *RTP* | *CAC* | *CPT* | *FSA* | *TRO* | *SFO* |
|---|---|---|---|---|---|---|---|---|---|
| *0:00–7:09* | 7 | Updates and news | James Brown (JB): Check in with each other—updates and news. (…) | IPCW | UAN | Diverse | ART | M | CL |
| 7:10–09:04 | 2 | ML: Assignments | JB: Let us dig in for today. I have some just top-level things to say about the assignments from last week. Terrific! (…) | CPE | ML | CON/PRO | LIS | CD | CL |
| 09:05–10:59 | 2 | ML: Article summaries | JB: Article summaries—outstanding. I gave some feedback to them, I thought they were terrific. (…) | CPE | ML | CON/PRO | LIS | CD | CL |
| *11:00–1:45:39* | *99* | | | *Article discussion groups* | | | | | |

(*continued*)

**Table 4.8** (continued)

*Brown case, September 10, 2010*

| *Time* | *Minutes* | *Course activity* | *Teacher and student communication (quotes)* | *RTP* | *CAC* | *CPT* | *FSA* | *TRO* | *SFO* |
|---|---|---|---|---|---|---|---|---|---|
| 11:00–13:14 | 2 | ML: Theoretical framing and problem statement | JB: Last week we really stepped into the space: What do we even mean by groups? (…) | IPSU | ML | CON/PRO | LIS | CD | CL |
| 13:15–22:00 | 9 | ML: Reference to student feedback | JB: Now, this is the quick test. How many people in this room know if you are summarizing an article this week? (…) | CPE | ML | PRO | LIS | CD | CL |
| 22:01–1:11:30 | 50 | Article discussion groups | [After counting off by sixes, students work in small article discussion groups] | IPSW | EX | CON | EXP | F | GL |

Legend: See coding inventories in Appendix 4 the craft of teaching as well as the development of students' conceptual understanding became tangible. In order to allow for a systematic examination of video data and for interpretations based on evidence grounded in the videos, the empirical study engaged in a process of data-guided progressive refinement of the evolving educational model (e.g., Engle et al., 2007). Moving back and forth between the emerging theory and the detailed analyses of data and making revisions of both until there was a close fit between them and also with relevant literature contributes to the development of a more robust theory. Such an approach also provides a firmer basis for further development and testing of the resultant model in future research studies using additional data (e.g., Engle, Langer-Osuna, & McKinney de Royston, 2014).

The analyses of deeper-level quality features presented in Chap. 5 investigate the ways in which the instructors support students' participatory processes of knowledge construction in the context of the main course activities and how they cultivate a classroom community of learners over time (empirical research sub-questions 2b and c; see Table 4.1). Moreover, teaching and learning challenges that these constructivist classrooms present for instructors and/or students are detected (empirical research sub-question 2d; see Table 4.1). To answer these three research sub-questions and to guide the video analysis of deeper-level quality features, the situative analysis framework displayed in Fig. 4.2 was developed. The framework takes the literature review into account (see Table 3.3, Sect. 3.5) and distinguishes between the quality of teaching and learning processes (focus on *content of interaction*) and the quality of classroom interaction and climate (focus on *interactional processes* in which information structures are generated) as discussed in Sect. 2.1.3.3 (e.g., Engle, 2006, 2011; Engle & Conant, 2002; Engle et al., 2007). As a result, four research interest areas that speak to the empirical sub-questions were distilled to structure the empirical findings with regard to deeper-level quality features in Chap. 5

- content and tasks;
- participatory processes of knowledge construction;
- classroom community of learners; and
- teaching and learning challenges.

Such a situative approach to data analysis understands learning as a simultaneously cognitive and social process through which individuals participate in the practices of a particular activity.[18] The video analysis provides empirical data to further specify deeper-level instructional quality features with regard to student-centered course design elements and processes of classroom learning, teaching, interaction, and climate that were embodied in the student-centered classrooms under study.

1. The phenomenon under study: opportunities for deep learning
A situative perspective on cognition and learning places a strong emphasis on the co-constructive or social nature of learning and teaching processes and focuses on practices in which students learn (i.e., students' learning-focused activities). A situative view of deep learning (Biggs, 2012) or deep conceptual understanding (NRC, 2000; Sawyer, 2014) is understood broadly in terms of "more effective participation in practices of inquiry and discourse that include constructing meanings of concepts and uses of skills" (Greeno, 1998, p. 14). More specifically, deep learning refers to students' productive disciplinary engagement, that is, "students' deep involvement in, and progress on, concepts and/or practices characteristic of the discipline" they are learning about (Engle, 2011, pp. 163–164).[19] According to Engle et al. (2007; Engle & Conant, 2002), the degree and nature of productive disciplinary engagement can be empirically investigated by considering evidence for: engagement, the disciplinary basis of that engagement, and the productivity of that disciplinary engagement (Engle, 2011). Productive disciplinary engagement occurs when

- students are deeply engaged in an issue ("engagement"), that is, aspects of students' participation that can be assessed by research (e.g., behavioral indicators of engagement);
- students' engagement with an issue makes significant contact with disciplinary ideas and practices ("disciplinary"), that is, the contact between what students are doing and the issues and practices of a discipline's discourse (disciplinary characteristics embodied in students' engagement);
- students make progress on the issue in question through their disciplinary engagement ("productive"), for example, students produce new knowledge; recognize a confusion, or make a new connection among ideas.

Consequently, the phenomenon under study, that is, students' deep learning of, and progress on, concepts and practices characteristic of the discipline of education they were learning about anchors the deeper-level instructional quality features of the learning environments under study (e.g., Engle, 2006, 2011; Engle & Conant, 2002).

2. Learning-content-focused analysis: quality of teaching and learning processes aiming at fostering performances of conceptual understanding and transfer

The content analysis investigates how the students participate in the process of constructing relevant content in the common ground[20] of learning interactions in these classrooms (semantic positioning). Information structures, that is, the content of students' participation in classroom interactions is analyzed to make learning visible and provide content-oriented explanations of deep learning (Engle, 2006; Greeno, 2011). The question is whether the students were exposed to some potentially useful content that provided opportunities for deep learning in the domain of education. Selected episodes during class units that were representative for the course activities in each classroom were examined with regard to occasions in which students could have advanced their conceptual understandings. In essence, the content-focused analysis is concerned with two sub-questions

- What relevant content appeared to have been constructed in the common ground of learning interactions (e.g., Cornelius & Herrenkohl, 2004)?[21]

This question refers mainly to the content that is learned (e.g., What is learned (learning outcomes)?) and to the quality and affordances of the learning task (What are the cognitive demands of the task?).

- How (in what ways) did the instructor support students' knowledge construction processes?

Deep learning involves not just knowing, it also involves doing, with students being able to choose to use what they have learned either individually or collectively to construct knowledge (Cornelius & Herrenkohl, 2004). This question refers mainly to the ways in which students are positioned semantically in relation to the concepts and practices of the discipline in terms of the *agency* with which those contents are deployed in activity (e.g., opportunities to purposefully engage with learning content, time spent on content-related activities, Seidel & Shavelson, 2007).

3. Learning context-focused analysis: quality of classroom interaction and climate aiming at fostering self-regulated learning and identity development

The context analysis investigates how the instructor framed the learning context interactionally and culturally to create opportunities for students to engage in legitimate peripheral participation (systemic positioning; Engle, 2006; Greeno, 2009).[22] The context-focused analysis is concerned with students' social engagement in interactional processes in which information structures are generated (e.g., the kind of social and discourse practice students understand themselves to be engaged in). Students' choices on whether to engage in deep or surface learning can be influenced by how learning contexts are framed socially. Since interactions in the classroom are the social basis upon which learning occurs, understanding processes of interaction is essential to understand how knowledge is constructed socially and how productive and supportive classroom communities can be cultivated over time

- How (in what ways) did the instructor position students for participation in interactions?

This question refers to how the instructor framed the learning context interactionally in order to position students in the participant structures of learning activities in relation to other students and the instructor in the class (e.g., the degree to which a student is entitled and expected to initiate contributions, to question or challenge proposals that are made by others, and to be given satisfactory explanations of meanings and methods involved in instructional tasks). Participant structures that encourage active participation and all voices to speak up, for example, can transform the power relationships in the classroom in constructive ways (Collins & Greeno, 2011; Greeno & Van de Sande, 2007).

- How (in what ways) did the instructor cultivate a classroom community of learners?

Establishing norms and expectations that support productive collaborative learning and that facilitate a supportive classroom climate can contribute to foster students' engaged participation in learning-focused activities. Students are enculturated as participants in a disciplinary community and can move toward a fuller participation in learning activities over time. Thereby, students' participatory identities "correspond to regularities in the ways that they are expected and entitled to participate in interaction" (Greeno & Van de Sande, 2007, p. 11; Collins & Greeno, 2011; Philips, 1972).

The data-based account of characteristic curricular design elements and quality features found in the student-centered classrooms under study (Sect. 5.2), the empirical research sub-questions (Table 4.1), and the situative analysis framework (Fig. 4.2) drove the selection of recorded events to making interpretations about deeper-level quality features that provided students with opportunities for deep learning. Based on the transcribed content logs of the videotapes developed earlier (see Sect. 4.4.3.1), it was feasible to identify the prevalent course activities and recurring teaching patterns in each classroom as well as episodes in which students engaged with disciplinary ideas and practices to develop deep conceptual understandings. Relevant video sequences (episodes) of several segments of the prevalent course activities were identified to study the moment-to-moment processes of learning and instruction in the classroom (Rex & Schiller, 2009).

The videotapes were re-watched several times to identify instructional quality features that might have contributed to students' disciplinary engagement in the classroom. Because the videotapes were reviewed together with the transcripts (content logs), it was possible to capture verbal and nonverbal interaction and look at relevant sequences in greater detail, if necessary. The data analysis was guided by the situative analysis framework outlined earlier (Fig. 4.2) and the coding process followed both grounded theory procedures as outlined in Sect. 4.4.2.3 and interaction analysis procedures. These analyses were informed by situativity theory and situated models (i.e., principles of interactions and concepts of practices, see Sect. 2.1.3), and by empirical education research on the effectiveness and quality of learning and instruction (Chap. 3). A broad approach to interaction analysis was used, zooming in on surface-level features, such as course activities or teaching patterns and taking a closer look at deeper-level features of instruction derived from theoretical criteria based on the literature review and gained from the ground-level data of the empirical study. Hence, it was possible to look at a larger volume of video material and transcripts and identify and generalize broader behavioral patterns across a large corpus of data and over time, and compare them across classroom settings (Enyedy & Stevens, 2014).

Overall, the deeper-level features together with the course design elements and quality features of the earlier analysis (see Sect. 4.4.3.1) have the potential to characterize powerful SCLEs that account for deep learning and to be applicable to innovative and successful learning environments in different contexts (e.g., Engle et al., 2007).

### 4.4.4 Half-standardized Course Evaluations of Students

#### 4.4.4.1 Instrument Design and Analysis: Online Evaluation Survey

The study made use of the course evaluation survey that is regularly administered by the Harvard School of Education (HGSE, 2009). The online surveys were administered confidentially by the school to ensure honest feedback from students.[23] The survey encompassed seven open-ended questions and eight closed questions comprising the following scales and topics.

For the eight closed survey questions, a 5-point scale on which respondents indicated their level of agreement or disagreement with each statement was used to assess various aspects of instructional quality. The students' responses were collated to form three scales: course content/organization, course activities/materials, and instructor who taught the course. Moreover, descriptive data about students concerning the reason for course enrollment, study hours per week outside of class, perceived amount of course workload, benefit of the course, primary school affiliation, and HGSE program enrolled were surveyed.

The seven open-ended survey questions referred to the self-reported and, therefore, subjectively experienced learning quality tackling topics, such as the most valuable things that the students have gained from the course; the course activities or materials students did find most and least valuable and why; the ways in which the instructor was most effective and why; what recommendations students would make to the instructor to strengthen his/her teaching and/or make the course more valuable; and what advice they would give to students who are thinking of taking this course.

To analyze the closed survey questions, location parameters as well as scattering coefficients were calculated and a univariate variance analysis was conducted to check whether the 27 items of the evaluation survey were clearly different for the three courses. For the empirical data set, quantile plots were used to check whether the distribution of the sample followed a standard normal distribution and whether the prerequisites for a univariate variance analysis were fulfilled.[24] The coding procedure of the open-ended survey questions followed the same procedure as the coding of the interview transcripts (see Sect. 4.4.2.3)—except that ATLAS.ti was not used.

#### *4.4.4.2 Procedure and Rationale*

Half-standardized online course evaluations were routinely conducted at the end of each term by the schools' administration to gather perception data from students who took the course. Participation in the course evaluation was mandatory (course requirement). A total of 12 different course evaluation surveys were analyzed for this study as the following Table 4.9 depicts.

Course evaluations assessed the instructional quality of the respective course based on high-inference ratings. Previous effectiveness research shows that student feedback is a reliable measure in higher education (see Sects. 3.1 and 3.4). Students in class experience the instructor all semester long, each week, so that the influence of lesson-to-lesson variation is less likely due to 25–40 students providing feedback of an entire semester of teaching from the same instructor. Thus, their different perspectives are based on many hours in the same classroom. They can also compare their experience in one specific classroom and with one specific instructor to their other experiences in other classes.

**Table 4.9** Number of respondents (*N*) to course evaluation surveys per course in a given year together with means and standard deviations (2008–2011)

| | *Smith case* | | | |
|---|---|---|---|---|
| *Year* | *Course A1* | *Course A2* | *Lee case* | *Brown case* |
| 2008 | 36 | 22 | | |
| 2009 | 39 | 38 | 19 | 48 |
| 2010 | 44 | 51 | 25 | 32 |
| 2011 | | | 23 | 27 |
| Total *N* | 119 | 111 | 67 | 107 |
| Mean | 39 | 37 | 22 | 35 |
| Standard deviation | 4 | 14 | 3 | 11 |

*Note:* *N*'s vary due to different class sizes

In addition, most of the students in class are student teachers who already have some teaching experience and strive to become school teachers, administrators, or educators of some sort after their master's studies. Therefore, most of them have also gained some pedagogical (content) knowledge and teaching experience that helped them to make informed judgments.

Apart from the course evaluations from students directly involved in the three semester-long case studies, a cohort of students who took the courses one year before the empirical study was conducted, as well as a year after its conduction, were also evaluated to solicit feedback from more than one group of students for each instructor. Therefore, it was also possible to measure whether students' engagement and evaluation of the courses and the instructors varied across academic years and between the three different classrooms. In the case of one course (Smith case), additional data from a parallel course conducted by the same instructor were available because the original course was regularly overenrolled and two parallel courses were offered each year (Courses A1 and A2). Hence, in the Smith case, two parallel sections were compared based on the evaluations of different student cohorts for three subsequent years.

Using a larger number of student evaluations from different student cohorts is warranted because a comparison of the primary school affiliation of the 12 student cohorts and their reason for course enrollment that were analyzed based on the course evaluation surveys gathered showed very similar results in terms of the composition of the different student cohorts. The primary school affiliation of the 12 student cohorts (Table 4.10) who took one of these three courses between 2008 and 2011 ($N$ = 263)[25] was HGSE Ed.M./CAS (averaging over 90% of the students). The majority of students were distributed among the following five programs: Learning and Teaching (47%), Arts in Education (17%), Human Development and Psychology (10%), Specializsed Education (8%), and Mind, Brain, and Education (6%). This overall distribution is also mirrored in the three courses under investigation in this case study research (see also Table 4.4).

In addition, a comparison of the two parallel Smith courses, A1 and A2, involving different student cohorts for three subsequent years (2008–2010) shows similar results between these two courses. Furthermore, the majority of students also stated that they took one of the three courses as an elective (57%), or that they enrolled due to recommendation or distribution requirements (42%; see Table 4.11).

**Table 4.10** Main HGSE Ed.M./CAS programs (in %)

| | *Smith case* | | | *Lee case* | | *Brown case* | | *Average* |
|---|---|---|---|---|---|---|---|---|
| | *Case study A2* | *A2 Three cohorts* | *A1 Three cohorts* | *Case study* | *Three cohorts* | *Case study* | *Three cohorts* | *Nine cohorts* |
| *Program* | *N = 38* | *N = 105* | *N = 111* | *N = 25* | *N = 65* | *N = 30* | *N = 93* | *N = 263* |
| Learning and Teaching | 26 | 28 | 24 | 64 | 53 | 54 | 60 | 47 |
| Arts in Education | 21 | 26 | 27 | 20 | 18 | 0 | 6 | 17 |
| Human Development and Psychology | 8 | 10 | 8 | 8 | 8 | 13 | 12 | 10 |
| Specialized Education | 16 | 11 | 8 | 0 | 2 | 20 | 12 | 8 |
| Mind, Brain, and Education | 13 | 9 | 5 | 4 | 6 | 0 | 2 | 6 |

*Note: N*'s vary due to different class sizes. The average of nine cohorts comprises three cohorts of Smith's A2 course, Lee's course, and Brown's course, respectively

**Table 4.11** Reason for course enrollment (in %)

| | *Smith case* | | | *Lee case* | | *Brown case* | | *Average* |
|---|---|---|---|---|---|---|---|---|
| | *Case study A2* | *A2 Three cohorts* | *A1 Three cohorts* | *Case study* | *Three cohorts* | *Case study* | *Three cohorts* | *Nine cohorts* |
| *Reason* | *N = 37* | *N = 108* | *N = 113* | *N = 25* | *N = 67* | *N = 30* | *N = 107* | *N = 282* |
| Required | 0 | 0 | 0 | 0 | 2 | 3 | 1 | 1 |
| Rec. or distrib. req. | 51 | 45 | 34 | 48 | 40 | 27 | 42 | 42 |
| Elective | 49 | 55 | 66 | 52 | 58 | 70 | 57 | 57 |

*Note: N*'s vary due to different class sizes. The average of nine cohorts comprises three cohorts of Smith's A2 course, Lee's course, and Brown's course, respectively

## 4.5 Ethical Issues and Human Subjects Protection

The empirical study was approved by the Committee on the Use of Human Subjects in Research at Harvard University. I also attended a noncredit course on the responsible conduct of research (RCR) for postdoctoral fellows offered on campus in 2009[26] and completed subsequent online training requirements.

I asked the instructors and students for permission to sit in class, videotape the classes, and gather empirical data (participant observation). Students were informed on the first day of class that their instructor would like to participate in an empirical study about learning and teaching in higher education classrooms and that throughout the semester a guest researcher would be present in the class. I introduced myself and the research project, and answered clarifying questions that the instructor and students had before students gave their consent. The instructors also gave permission to use course evaluations for data analysis purposes.

Interviewees signed an informed consent form that allowed me to audiotape and transcribe interviews. The form provided further information on the research project in accordance with the guidelines of the European Commission and the Committee on the Use of Human Subjects in Research at Harvard University (e.g., researcher name and affiliation, contact information, description of the research project and its purposes, confirmation that there are no risks or benefits for the participants, information on subject rights, and university contact information). Interviews lasted from 40 to 170 minutes and the interview transcripts were given an anonymous code to assure that personal identity of the data was protected. The names or personal data of the participants were saved on a separate device and location (home laptop).

Each participant in this study was assured that s/he had the right to refuse to answer particular questions, that data would only be processed with regard to the outlined research project, that confidentiality would be safeguarded at all times, and that the participants' individual privacy would be maintained in all published and written data resulting from the study. Furthermore, I confirmed that all personal data (e.g., name) would be deleted from the home laptop two years after the end of the research project. I also informed instructors and students that participation was voluntary and that they had the right to withdraw their consent or discontinue participation at any time. However, since I conducted case studies related to specifically selected courses depending on the expertise of specific instructors, the latter were asked for permission to mention their names as well as the name of the respective course in case study reports and further publications (Steneck, 2007).

## Notes

1. *Case study research* is used to understand complex social phenomena since it is an adequate method when "how" or "why" questions are being posed in order to retain holistic and meaningful characteristics of contemporary phenomena within a real-life context over which the researcher has little control (Yin, 2009).
2. In the following chapters, the terms (ethnographic) case study, case, (university) course, and classroom are used interchangeably as they constitute the *main unit of analysis* for this empirical study that encompasses three cases. Accordingly, a single class (unit) of a course is termed *subunit of analysis* and a course activity conducted during a class is termed *basic unit of analysis*.
3. The replication logic underlying multiple-case studies can either refer to selected cases that predict similar results (*literal* replication) or to cases that predict contrasting results but for anticipatable reasons (*theoretical* replication). This replication logic must be distinguished from the sampling logic commonly used in surveys (Yin, 2009).
4. Researchers have called these design studies differently, including names such as "design experiments," "design research," or "design-based research." This new way of doing educational research was emerging in the USA in the 1990s when new visions on teaching and learning in the disciplines were being proposed in policy documents and new theoretical frameworks were being explored in the light of sociocultural perspectives, situative perspectives, distributed cognition, and activity theory (Engle, 2011).
5. The university-wide initiative encompasses activities from underwriting faculty- and student-initiated innovations, to reorganizing classrooms, to building expertise in evaluating the effectiveness of teaching techniques (see Harvard Initiative for Learning & Teaching; Source: http://hilt.harvard.edu [January 20, 2016]).
6. In the academic year 2013/2014, for example, overall 934 degree-seeking students were enrolled in the following HGSE programs: Ed.M. (Master in Education) and Certificate of

Advanced Study students (626), Ed.L.D. (Doctor of Education Leadership) students (79), and Ed.D. (Doctor of Education) students (229). Altogether 76% of the students were women, 31% were people of color, and 13% were international students. During the 2013–2014 school year, the school granted 44 Ed.D degrees, 28 Ed.L.D degrees, and 589 Ed.M degrees and Certificates of Advanced Study (Source: http://www.gse.harvard.edu/about/ataglance/index.html [January 20, 2016]).

7. For an overview of all programs see https://www.gse.harvard.edu/masters/programs [January 20, 2016].
8. To graduate from the Learning and Teaching (L&T) program, for example, students need to comply to the following distribution of courses: two core/foundational courses, three L&T-approved courses from the HGSE catalog, and three elective courses.
9. A student cohort is defined as a class of students who were enrolled in a HGSE Ed.M. or associated master's program, took the course under study at the same period of time (semester), and concluded the mandatory course evaluation survey.
10. In referring to the instructor rating scale of the school's evaluation survey, the ratings in the following items had to be above 4.5 (with 5 being the highest and 1 being the lowest rating on a 5-point scale): the instructor established an environment conducive to learning, the course stimulated me to think in new ways, the course provided effective opportunities to learn from other students, and the instructor responded to students respectfully.
11. The test scores for admitted Ed.M. students for the academic year 2015/2016 were, for example: verbal average: 81 (percentile), quantitative average: 64 (percentile), and analytical writing average: 4.6 (Source: http://www.gse.harvard.edu/masters/life/who-studies [January 20, 2016]).
12. Direct quotes from the student interviews are indicated with a code for the student's name in squared brackets and different codes were used for the student interviewees of the three cases. Smith case: student interviewees A–E; Lee case: student interviewees 1–5; Brown case: student interviewees I–V. In Smith's case, one interview was done with two students at once. For these interviewees, the codes A, P1 and A, P2 were used. P1 stands for person 1 and P2 stands for person 2. The rest of the direct quotes used in Sect. 4.3.2.3 stem from student statements in the end-of-course evaluation surveys.

13. Harvard's course selection period (also known as "shopping period") during the first two weeks of classes allows students to participate in courses that interest them without enrolling in them right away.
14. See Appendices 1 and 2 for an outline of the instructor and student interview guidelines.
15. The consent form was designed in line with the guidelines and samples provided by the Research Compliance Office at Stanford University (Source: http://researchcompliance.stanford.edu/hs/new/resources/researchers/index.html [January 20, 2016]).
16. Each class can be parsed into episodes, with episodes being periods of time during which the class is engaged in one relatively coherent type of course activity.
17. Teaching patterns refer to questions concerned with whether learning content and/or processes are (a) presented (with regard to content: lecturing; with regard to processes: metatalk) or (b) modeled by the instructor (authentic modeling), (c) whether a problem-oriented activity facilitated by the instructor leads to the construction of new conceptual knowledge (guided problem solving), (d) whether the new knowledge is discovered by the students or built collaboratively in the knowledge-building process (independent problem solving), or (e) whether thoughts and solution strategies are shared, compared, and discussed together in the whole group to co-construct knowledge (sharing/comparing/discussing).
18. A situative approach to data analysis is applied at the level of the "activity system," that is, classroom, and focuses on the behavior of the activity system in which individuals participate. The approach draws on video-based records of the learning interactions in such activity systems with the course activity (e.g., whole class discussion, lecturing) as the *basic unit of analysis.*
19. The "Productive Disciplinary Engagement framework" was developed and empirically investigated by Engle and Conant (2002; see also Engle, 2006; Engle & Faux, 2006).
20. The common ground that is established in a conversation refers to the content that participants orient to as having been understood and agreed to in each interaction (Clark, 1996).
21. Tasks create affordances for the activity of the class by structuring the kinds of disciplinary knowledge that students have opportunities to use and build (content) and how the knowledge gets con-

structured (process, e.g., social form, methods) (Gresalfi, Martiny, Hand, & Greeno, 2009). Problems and tasks that are challenging for students and prompt high levels of cognitive processing are essential for developing conceptual understanding—that is, tasks that have relevance to practical applications or to students' everyday lives and that require students to explore, discuss, and evaluate multiple solutions, for example.

22. Framing theory suggests that "framing is a constructive process, that is, framings are generated by the participants and framing is ubiquitous, that is, every participant in a situation has a framing that may or may not be aligned with the framings of other participants, although achieving mutual understanding involves reaching some alignment of the participants' framings" (Greeno, 2009, pp. 270–271).
23. The set of questions that the school commonly asks in the course evaluations are added in Appendix 5.
24. Because the hypothesis testing is based on the online whole class surveys of selected cases (three different university courses) it can only be regarded as a proxy measure (Stier, 1999).
25. Twelve course evaluations were analyzed: Smith (A1): 3 cohorts (Fall 2008, 2009, and 2010), Smith (A2): 3 cohorts (Fall 2008, <u>2009</u>, and 2010), Lee: 3 cohorts (Spring 2009, <u>2010</u>, and 2011), Brown: 3 cohorts (Fall 2009, <u>2010</u>, and 2011). The underlined courses are the courses that were selected for the multiple ethnographic case study research.
26. The course was designed to satisfy the RCR requirements associated with research awards from the National Institutes of Health and the National Science Foundation.

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CHAPTER 5

# Characteristic Curricular Design Elements and (Deeper-Level) Quality Features of the Student-Centered Classrooms Under Study

This chapter contributes to answering the second research question of how expert instructors in the field of higher education design and bring to life SCLEs that provide students with opportunities for deep learning (see Sect. 1.3; see also Table 4.1, Sect. 4.2). The following sections present the results of a comparative cross-case analysis discussing similarities and differences among the three cases under study and tying the empirical data to existing state-of-the-art literature.[1] Empirical findings are compared and synthesized using a constant-comparison approach, and connected to existing theoretical concepts of practices as discussed in Chaps. 2 and 3. Section 5.2 focuses on characteristic curricular design elements and related quality features answering empirical research sub-question 2a. Section 5.3 investigates deeper-level instructional quality dimensions and features that the three classrooms under study have in common addressing empirical research sub-questions 2b (scaffolding participatory processes of knowledge construction) and 2c (cultivating a classroom community of learners). Section 5.4 uncovers teaching and learning challenges these constructivist classrooms present for the instructors and/or students (empirical research sub-question 2d).

In order to make the cited empirical data sources traceable, the following legend is used in this chapter and in the subsequent chapter:



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- Direct and indirect quotes from the *instructor or student interviews* are indicated with the instructor's last name or a code for the student's name in squared brackets, for example, [Smith interview] for the instructor or [Student interviewee E] for a specific student.
- Instructor or student quotes from the *class videos* are indicated, for example, with the instructor's last name or the term "Student" and the date of the class [Smith, 06. October 2009].
- Student statements from the *end-of-course evaluation surveys* are indicated with, for example, HGSE and the year of the evaluation survey report (HGSE, 2010a).
- Quotes from *course materials* (e.g., syllabus) or from publications written by the instructor are cited following standard citation guidelines. These sources are also included in the reference list.
- The exact source of student quotes that only comprise a few words is not given; however, the expressions are put in quotation marks to indicate direct speech. Potential sources are student interviews, videotapes, or students' answers to the open-ended course evaluation survey questions.

## 5.1 Overview of the Three Selected Courses Under Study

This section depicts a *detail-rich qualitative and quantitative description and analysis* of how the three instructors' constructivist educational beliefs were manifested with regard to five characteristic curricular design elements for each case (Sects. 5.1.1, 5.1.2 and 5.1.3): course objectives and content, course structure, course activities and materials, classroom routines and norms, and assignments and assessment tasks. Moreover, an overview of the quality of teaching and learning as perceived by students is provided based on a univariate variance analysis of course evaluation data gathered from several student cohorts per course (Sect. 5.1.4).

### 5.1.1 Smith Course: Teaching and Learning

#### 5.1.1.1 Course Objectives and Content

The primary subject matter of the course is teaching and learning (pedagogical [content] knowledge); that is, the student teachers gain a deep understanding of the constructivist research/teaching approach "Critical

Exploration in the Classroom" (see Sect. 2.1.1.3). Course readings introduce the students to constructivist ideas about learning and teaching and present classroom teaching examples that value the learner's experiences and insights. Course topics revolve around the genuine question of how people learn things and what anyone can do to help. The course aims to (1) develop the students' ability to engage different people's minds in thinking about subject matter that they would like them to learn about and (2) to uncover and appreciate how their learners are thinking about the material they are engaging with. Thereby, Mrs. Smith provides her students with three kinds of hands-on learning experiences to support them to establish meanings that hold true for themselves—either individually or collectively: the students (1) experience deep learning themselves where nobody is telling them what to think (exploratory course activities); (2) watch expert instructors working with children or high school students and observe the children learning even though the instructor is not telling them anything (teacher demonstrations); (3) themselves try to engage learners in their subject matter and field of experience to develop their aptitudes with this research/teaching approach (fieldwork). This way, students also learn to appreciate their own and other people's ways of thinking and experience the power and fascination of each human mind. The course also involves a variety of secondary subject matters that the students learn about in the context of doing course activities that revolve around tasks and problems based in literature, physics, and mathematics, for example.

#### *5.1.1.2 Course Structure*

Class sessions, conducted by Mrs. Smith, took place once a week for two hours (110 minutes) and are the focus of this case study.[1] During each session the class sat in a big circle with desk chairs with wheels. Mrs. Smith had an overall agenda that she followed to assure that the students' experiences in class were productive given the time available and what students brought to the table. In terms of the social form of the class the data analysis based on participant observations and video analysis during the fall 2009 term reveals that 84 % of class time was spent in the large group, 12 % of class time was used for small group work, and 4 % for individual work. Mrs. Smith considers herself "the major decision-maker" in the classroom. She communicates her expectations clearly, provides a well-organized syllabus, a course pack with the course readings as well as handouts with information on the various course components. Students also had to buy selected books. The course is supported by a course website containing information, class materials and class videos. Nevertheless, the syllabus that is distributed during the first class explicitly makes room for changes during the semester stating that the class is *very* likely to revise the syllabus, including readings. This flexibility and responsiveness of the syllabus led some of the interviewees to apply the term “fluent” or “dynamic” when asked about the course structure. Each class provided leeway for student engagement and participation in exploratory course activities and discussions to solve problems together. Mrs. Smith refrained from imparting her knowledge (lecturing) and talked little in class as compared to the students.

#### *5.1.1.3 Course Activities and Materials*

The kinds of course activities present in this classroom are heavily interwoven with the notion that “teaching is not telling.” Taking a closer look at the course activities it becomes obvious that lectures (together with related student questions) were the exception rather than the rule in this classroom. The main activities of the two-hour class sessions were as follows:

- Three bi-weekly *exploratory activities* were first done together in class before the students were assigned to do each of them twice during subsequent weeks in their individual fieldwork.[2] In addition, joint fieldtrips allowed students to conduct and experience exploratory activities in natural settings during class time (e.g., discovering different kinds of mirrors and their reflections in the school’s yard).
- *Teacher demonstrations* allowed student teachers to observe Mrs. Smith helping students learn about a subject matter. For example, two children were invited to class to engage in the “going to the movies” activity, with Mrs. Smith modeling certain teacher behaviors to help them learn while the class looked on. During subsequent class discussions the students could share their noticings, questions, ideas, wonderings, and suggestions and reflect on their experience.
- *Lectures or rather mini-lectures* helped to convey important information about the research/teaching approach Critical Exploration, the course structure and components (e.g., syllabus, assignments) together with process-related information (e.g., how the class would go about course activities, behavioral norms). The content- and

process-related input provided by Mrs. Smith was complemented by students' clarifying and information questions and comments.

- *Reading discussions:* Students were asked to prepare for all classes to discuss assigned readings. Some readings were discussed in depth in the large class, while others were mainly for students' self-studies alongside the assignments and for the smaller section discussions.

Due to the flexible structure of the course, the orchestration of the course activities varied from class to class which makes it difficult to reconstruct a typical (sequential) choreography of learning and teaching activities (teaching script). Rather the different activities were combined flexibly and assembled around two structural core elements: exploratory activities and teacher demonstrations. Alternative *one* refers to a choreography that consists of exploratory activities accompanied by a large class discussion/debrief and/or mini-lectures and related student questions, and/or reading discussions and/or field trips. Alternative *two* refers to teacher demonstrations and related class discussions that were taking turns twice during a 110-minute class session. Demonstrations involved Mrs. Smith or guest teachers modeling instructional behaviors while interacting with invited students (e.g., children, high school students).

The class also worked with different artifacts and materials that played an important role as they made it easier for students to think about a problem (Hawkins, 1974). Playing around with the objects helped students to put their thoughts into the objects and "see" how their ideas and thoughts worked out (e.g., building blocks, beans, paper clips). [Student interviewee C] Hence, artifacts and materials also functioned as testing-grounds for students' ideas and thus as a source of authority. The students were not looking to Mrs. Smith as the testing ground; instead it was built into the materials offered to them. In addition, many artifacts were generated by students themselves such as drawings, problem solutions arranging artifacts in a certain way, journal entrees, and fieldwork papers.

#### *5.1.1.4 Classroom Routines and Norms*

Mrs. Smith and the teaching fellows called students by their first names and students called the instructor, Professor Smith or Barbara, and the teaching fellows by their first names too. The established routines and norms helped to (1) regulate learning and teaching processes in terms of how knowledge was constructed (re-occurring teaching patterns) and aimed to (2) facilitate students' participation in course activities (principles for class discussions) as is outlined below.

1. Re-occurring teaching patterns
Six re-occurring teaching patterns aiming to promote students' learning processes were observable in the classroom based on participant observations and video data.

- *Lecturing (mini-lectures):* new key terms, concepts and practices were introduced by Mrs. Smith or invited guests or fellow students, for students to learn new content and comprised 3% of the overall class time as compared to the other five patterns.
- *Metatalk* was used by Mrs. Smith to provide students with learning content- and process-related information on assignments, course activities, and class procedures (3%).[3]
- *Authentic modeling* (13%) refers to the instructor or invited guests/teaching fellows modeling exploratory activities with invited learners while the student teachers observe closely (e.g., the "poem activity" with three high school students).
- *Independent problem-solving* (16%) refers to problems and puzzles that were first introduced and framed by Mrs. Smith (problem setup, 1%) and then independently explored by the students—either individually or in small groups (15%). An example for this pattern is the "going to the movies" activity done individually.
- *Guided problem-solving* (33%) refers to Mrs. Smith asking/providing genuine questions to structure and facilitate large group explorations of a given problem (e.g., joint moon explorations, poem activity in the large group). Although guided by Mrs. Smith, these activities left room for students to contribute their thoughts and drive the exploration.
- *Sharing/comparing/discussing solutions, ideas, noticings, questions* in the large group (32%): this teaching pattern occurred regularly after each of the five patterns outlined above and consisted mainly of (1) student questions/comments after lectures/metatalk (5%) and large group discussions of readings (7%); (2) students' questions, noticings, ideas, wonderings after authentic modeling activities (10%); (3) the whole class discussing different solution paths after independent or guided problem-solving (5%); or (4) activity debriefs in the large group (5%).[4]

2. Principles for class discussion
Mrs. Smith considers the exchange of thoughts around specific questions of shared interest to be an important part of class. In order to empower her learners to explain what they think and why, the following principles were distributed at the beginning of the semester (see Table 5.1). It was expected that students would practice these principles during class discussions to facilitate everyone's learning and sense-making and share with Mrs. Smith the responsibility of making sure they understand each other. Exploratory activities and fieldwork assignments provided further occasions where the students got to practice these principles that are at the core of Critical Exploration. Asked about the learning culture she envisions for the class, Mrs. Smith notes that she would like students to be interested in each other's ideas, respect other people's ideas very different from their own, be willing to rethink and give up their own ideas in the face of good evidence, and be willing to try new things, and to fail and to try again. [Smith interview]

### *5.1.1.5 Assignments and Assessment Tasks*

This pass/fail course contains six different kinds of open-ended assignments and aligned assessment tasks with high cognitive levels of complexity. The tasks are accompanied by short handouts outlining affordances and guidelines (see Table 5.2 below). Overall, the amount of workload

**Table 5.1** Smith case—principles for class discussion

| *Principles for class discussion* |
|---|
| Trying to understand and appreciate in what ways someone else is thinking and feeling about something is the major work of the course. |
| Pay attention to your own moments of high or sagging interest, insights or confusions, try to understand what leads to them and appreciate your own ways of thinking. |
| If you don't understand what somebody says, ask them to try to say again what they mean. This way everybody is held responsible for judging whether what they are trying to say really makes any connection with the current understanding of the rest of the class and for making clear why they think what they think. |
| The most important part of understanding what a person thinks is understanding why s/he thinks it. So keep asking people to give the reasons for saying what they say. |
| Use the class discussion as a place to try out your newly forming ideas, counting on help from the other class members in asking you questions and thoughts that will help you keep thinking about your ideas. |
| Try to refrain from explaining what you think someone else should think and, instead, try out some ways to support that person in taking his/her own thoughts further. |

**Table 5.2** Smith case—aligned assignments/assessment tasks

| *Aligned assignments/assessment tasks* | | | | | | |
|---|---|---|---|---|---|---|
| Assignments | Weekly readings | Moon observation notebook (daily) | Weekly fieldwork and fieldwork reports | Final fieldwork and report | Weekly class journal (reflection) | Final paper |
| Cognitive level Assessment | *Understanding* do the readings | *Analyzing* keep moon observations | *Applying* do the weekly fieldwork and hand in a written report each week | *Creating* do the final fieldwork and hand in a written report | *Evaluating* keep a reflective journal and hand in two or three pages each week | *Evaluating* write the final paper |
| | attend classes and sections (no more than three classes and sections combined may be missed) complete the course evaluation survey | | | | | |

in this course was perceived as "very well-paced," however, requiring "a lot of work on a day-to-day basis" (HGSE, 2010a). The open-ended assignments/assessment tasks allowed for student choice in terms of the questions and puzzles students wanted to pursue in their final fieldwork sessions during the second half of the term. Students also received regular feedback on their individual writings (e.g., fieldwork report, journal entrees) that supported them to develop their understandings and teaching practice further and to reflect on their progress.

The cognitive level of the tasks[5] was high insofar as they required cognitive processing at the level of understanding (readings), applying (weekly fieldwork and reports), analyzing (moon observations), evaluating (journaling and final paper), and creating (final fieldwork). Students had to understand the research/teaching approach Critical Exploration and its teaching implications by doing the readings (which they considered to be valuable and of high quality) and discussing their ideas. The weekly fieldwork allowed them to carry out the exploratory activities with volunteer learners themselves and practice the principles and procedures of the new pedagogical approach. In the context of the fieldwork report the students write down what happened during their teaching session and what they make of what happened (e.g., what seemed to get the learner interested in doing the activity, what the learner did or said, how the students checked out their hunches about what the learner meant, moments when the learner seemed particularly engaged). In conducting different fieldwork tasks with various learners throughout the semester the student interviewees were "surprised" and realized that learners can "discover a lot by themselves totally without the help of others," without being told everything they should learn. (Student interviewee A, P2) Despite being torn between the temptation of telling and letting their learners explore for themselves, the student teachers gradually understood the value of discovery for deep learning.

The weekly moon observations provided opportunities to analyze the movements and shapes of the real moon and determine how they are related and can be explained in the context of the planetary system. The weekly two-to-three-pages journal entrees and final paper were based on students' thoughts, feelings, reactions and how these developed over time. These reflective assignments also allowed students to bring their deepened thoughts back to the discussion. Mrs. Smith submits that "some of the ideas that I like them to risk saying out loud in class, they might risk first in their journal and be willing to see that they went okay there" (Smith interview).

The final fieldwork encompassed five to six teaching sessions that were done with a partner (classmate). The group of two was asked to discuss the details of what happened in these fieldwork sessions where one partner (teacher) helped the other one (learner) exploring a topic. It is up to the student teacher, who acts as the teacher in this dyad, to choose a topic s/he is familiar with and to figure out ways to engage the other person in exploring it and to take their thoughts or abilities further while applying and reflecting upon the teaching practices aligned with Critical Exploration.

As for grades, "satisfactory/unsatisfactory" was deliberately the only scale used in this course because when students are not graded they are more committed to their work and willing to take the risks involved in exploring their own confusions. To obtain a satisfactory grade, a student in this course had to attend classes and sections (no more than three classes and sections combined were to be missed), do the readings, keep moon observations (observation notebook), keep a reflective journal and hand in two or three journal pages each week, do the weekly fieldwork and hand in a written report each week, write the final paper, and complete the course evaluation survey. In choosing to apply pass/fail assessment, Mrs. Smith abandoned some of her formal power from the start as she did not assess students' work in order to grade it but in order to support each student's learning process. Interviewees say that they felt more "relaxed" and "flexible" and "free" because they were not graded. They were more focused on their own learning as compared to graded classes. In this class there was "not as much concern with, like, what you need to do specifically to get an A":

> It's like, you do the work and you are committed to the class and you pass. I agree with that value. I prefer that. I felt like it was more focused on my own learning and kind of the essence of what I felt I wanted to dig into. I felt like I had a little more freedom around that and a little less pressure. (Student interviewee B)

### *5.1.2 Lee Course: Collaborative Examination of Student and Teacher Work*

#### *5.1.2.1 Course Objectives and Content*

In this course student teachers learn how to use student and teacher work that is produced in classrooms to better understand both learners and their learning, and teachers and their teaching. Students also learn how to support collegial collaborations that lead to better learning for both learners and teachers. As a result, students become more aware of their own assumptions as teachers wondering: What can we learn about ourselves as teachers? Students develop an appreciation and clarified understanding of processes of learning and teaching in which learning products (student work) are constructed that inform their teaching. Themes and readings tackled in this course revolve around concepts and practices such as introduction and overview of key terms and issues (e.g., student work, protocols, examination), the (creative, collaborative) art of seeing, processes of documenting student/teacher work (i.e.,, making it visible), collaborative inquiry to examine student work, and reflecting about how examination of student work helps to deepen teachers' understanding of teaching and learning. The work on these topics was loosely guided by a few big questions that were stated in the course description. The syllabus and course readings are grouped along the course's guiding questions and themes.

In particular, students gain experience in using three interrelated practices that have proven helpful for use among teachers in different educational contexts to inform one's teaching through close collaborative examination of student and teacher work:

- *Documentation* as a way of capturing student and teacher work that occurs in classrooms and making it visible so that it can be examined and discussed;
- *Protocols*, that is, structures for guiding reflection and discussion to allow one to look deeply and differently at student work and keep conversations focused and productive;
- *Collaborative inquiry* as an approach to working with colleagues (using protocols) to identify important questions about learning and teaching and pursue those questions through the close examination of student and teacher work.

#### *5.1.2.2 Course Structure*

Mrs. Lee gave the course an overarching structure through guiding questions and thematic readings as outlined in the syllabus. For every class students rearranged their chairs and flexibly chose their seats, sitting in a circle, allowing everyone to face each other. The data analysis based on participant observations and video analysis during the spring 2010 course reveals that in 65 % of class time the class worked in the large group, 30 % of class time was used for small group work, and 5 % for individual work.

The course was designed to "present some kind of reading, theory and skill, but then giving the time to practice and reflect on it." (Student interviewee 3) Mrs. Lee made her expectations regarding the course's agenda and flexible structure clear from the start pointing out that she had not yet mapped out the entire semester. Furthermore, she communicated that the class was designed as a seminar depending on and requiring "good and conscientious participants," "active participation" and "collaboration"; she also pointed out that the assignments and readings will contribute to students' learning. Overall, the course provided students with choices and "sort of turned students loose within the structures for social learning" (Student interviewee 1).

Mrs. Lee engaged students in her curricular decision-making in class and reasoned her decisions. Students sensed that Mrs. Lee was invested, soaking in everything to inform her practice as a teacher (Student interviewee 5). This open stance resulted in a "fluent" and "responsive" syllabus that evolved during the course (HGSE, 2010b). The syllabus was accompanied by a course pack with the class's readings. Students also had to obtain selected books. Additional handouts were distributed in class during the semester. As the class went through the semester, the schedule was periodically updated in response to students' interests, class discussions or the schedules of guest presenters/field trips. The flexible course design allowed the instructor to get to know and learn from her students, take their interests and continuous reflections into account, and respond with thoughtful changes. Mrs. Lee would announce, for example, "I have redone our reading list for the next few weeks in response to our conversation on Tuesday" (Lee, 25. March 2010).

#### *5.1.2.3 Course Activities and Materials*

Mrs. Lee introduced a variety of activities and used real-world objects and materials such as assigned drawings done by real students to support her students' learning in the classroom. The prevalent course activities were:

- *Protocols* provided a formal communication structure that values different points of view and can make communications feel safe (Blythe, Allen & Schieffelin Powel, 2008). Protocols were done in the form of collaborative classroom inquiries based on real student work that was brought to class by Mrs. Lee and/or by student volunteers. The student work was discussed following the steps and guidelines of a specific protocol to learn more about the student's thinking to inform one's teaching.

- *Mini-lectures* informed students about the course components and procedures such as activities, assignments, or rubrics. Mrs. Lee also introduced theoretical concepts the class would talk about or protocols the class would apply and shared content-related stories based on her own experience. At the beginning of the class she made announcements providing logistical and organizational course information (e.g., website updates, handouts, deadlines) and an outline of the day's agenda for the class session (called: "housekeeping").
- *Reading discussions* were mainly done in small groups, applying thinking routines that Mrs. Lee introduced to the class. The students were required to prepare the assigned readings and to bring them to class in order to be able to make substantive, relevant contributions (comments and/or questions) to the group discussion.
- *Student demonstrations* (documentation of two classes) required student groups of three or four to document learning; that is, pay attention to what happened in class and make hypotheses about and interpretations of the learning that was happening for individuals and the group as a whole. The groups were pursuing research questions such as: "How do we use talk in class to make learning visible?" or "How do student reflections on learning compare with teacher goals?" This activity aimed to foster students' observation, listening, critical analysis and presentation skills. Students' presentations were followed by a class discussion where the class asked clarifying and probing questions to the group.
- *Check-ins:* each class began with check-ins, a brief introduction round where Mrs. Lee and each student, one after the other, said their names and—optionally—shared some "news" from their life—not necessarily related to graduate school. Sometimes Mrs. Lee prompted the check-in conversation by asking students to talk about a movie they really liked, or about anything that was uppermost in their mind at that moment. A volunteer started the group off and students went around the room while they could also skip if they felt they did not have anything to say or did not want to contribute (yet).

Course activities were orchestrated depending on the day of class. As a rule each class started with check-ins followed by "housekeeping." Mid-way through each class a short “stretch break” of approximately five minutes took place. Individual quiet reflections also occurred on a regular basis. Written and/or oral individual reflections were alternatively done at the beginning, upon the middle, and/or—most of the time—at the end of class ranging from quick notes of less than a minute to more extensive assignments (e.g., oral reflections, debrief of protocols, two-minute paper). In Tuesday’s class weekly course readings were unpacked and discussed, new protocols were introduced and short protocols applied. Starting after a couple of weeks into spring term, student demonstrations took place every Tuesday. Thursday’s class focused more on collaborative inquiry (in small or large groups) applying different kinds of protocols to look at student work.

Materials at hand in the physical space such as computers, a video camera, whiteboards, and flip charts were used as aides for learning. Mrs. Lee and the students also brought materials and artifacts to the classroom like name tags, the course pack, books, white posters and copy paper, readings, markers and tape, handouts, tape-recorders, armchair work or real student work, compiled student reflections, or relaxing music that was played before the class started. Moreover, several course activities asked for the creation of artifacts that allowed students to visualize, share, and store their current understandings. Artifacts were generated as a visible documentation of the learning that was going on and as products of learning (e.g., drawings, documented protocol results, posters produced during discussions, individual written reflections).

#### *5.1.2.4 Classroom Routines and Norms*

Mrs. Lee already knew all the students’ first names by the second class. Students also called her by her first name and wore name tags for the first couple of weeks. Students were not allowed to use laptops in class as these could potentially distract and interfere with the flow and collaborative nature of the class (Lee interview). Mrs. Lee’s experience has been that adhering to this policy enhances the quality of discussion and face-to-face interaction in the classroom. The routines and norms established in the classroom helped to (1) regulate learning and teaching processes (re-occurring teaching patterns); (2) “read” and inform the class by compiling and sharing written individual reflections; and (3) facilitate one’s own and others’ learning (class norms) as is outlined below.

1. Re-occurring teaching patterns

Five re-occurring teaching patterns were found in the classroom to support students' learning processes based on participant observations and video data.

- *Lecturing (mini-lectures)* comprises 4% of the overall class time. Mini-lectures took place in order to share a story or introduce new protocols the class would learn about and do together. Some of the mini-lectures were also triggered by students' reflections or comments/questions that came up during prior small or large group discussions.
- *Metatalk* was used to give an outline of a day's class (housekeeping), show content on the class website, set up a discussion topic, or introduce assignments/activities (6%).
- *Independent problem-solving* (40%) mainly refers to student groups applying (parts of) protocols that were first introduced and/or (theoretically) framed by the instructor (problem setup, 8%); students work independently in small groups to look at student or teacher work, explore students' questions and ideas, and discuss readings or students' compiled individual reflections from prior classes (32%). Independent problem-solving also refers to quiet individual reflections (3%) and small group reflections (2%) during class that accounted for 5% altogether.
- *Guided problem–solving* (9%) was done in small or large groups with Mrs. Lee posing open-ended questions to guide students in looking closely at student work (e.g., What do you see? What are you wondering about?) and promoting certain principles (e.g., stay neutral and avoid judgment, look attentively). At other times Mrs. Lee would facilitate the process of guiding small groups, exploring important ideas of the readings through the timed protocol steps (e.g., quotes the students picked from the readings).
- *Sharing/comparing/discussing solutions, ideas, noticings, questions* in the large group (41%) often followed after the patterns above: (1) Student questions/comments after mini-lectures/metatalk (housekeeping) (5%); (2) Check-ins (8%); (3) Students/student groups sharing their thoughts, ideas and questions with the large group (10%); (4) Reading discussions in the large group (5%); (5) Student demonstrations and discussions (10%); and (6) Activity debrief in the large group (e.g., what doing the protocol together was like for students; 3%).

2. Compiling and sharing individual written reflections
Individual written reflections were mostly done at the end of class using the following two protocol types: "One- or Two-Minute-Paper" or "Critical Incident Questionnaire" (CIQ).[6] In addition, short email reflections were assigned on a regular basis to help Mrs. Lee catch questions that came up for students and might have otherwise gone unasked or unnoticed in class. Mrs. Lee would send out an email remainder to ask students for a brief individual written reflection on the process of conducting a protocol in class, for example. These reflections—like the written reflections in class—allowed her to "read" individuals and the class as a whole and track each student's thinking on certain issues. She could then react and adjust to what was going on in class and respond directly to single students with: "Oh, here's something to think about" or "That's a great question. Will you bring it up again when we come up to this in a couple of weeks?" This was a way of hearing from everyone, at least to the extent that students were willing to share what was going on. (Lee interview)

3. Class norms
The course was conducted with ground rules that encouraged reciprocity and collaborative construction of knowledge. A student stated with regard to the classroom community of learners that was formed: "From the check-ins to the personal stories, everything she did helped contribute to a classroom community that was welcoming and intellectually stimulating" (HGSE, 2010b). In one of the first classes all students together with the instructor developed the following class norms indicating responsibilities of class members (see Table 5.3 below).

The students worked first in small groups and wrote norms based on matters of importance on flipchart paper. The norms were then discussed and agreed upon in class and Mrs. Lee summarized the key points and handed them back to the class. The class norms speak to the following behaviors: come to class prepared, listen attentively, cultivate an open mind, contribute to class and show commitment, and follow the "48-hour rule" in case someone felt somehow affronted by something.

#### *5.1.2.5 Assignments and Assessment Tasks*

The assignments depicted in Table 5.4 were designed to incorporate higher cognitive levels of complexity at the level of understanding (readings), analyzing (student demonstrations), evaluating (small reflective writing assignments and final report), and creating (research project and draft proposals). Students were expected to do all the readings so that

**Table 5.3** Lee case—class norms

| *Class norms* |
|---|
| In order to support our own and others' learning, we will do our best to: |
| *Prepare*<br>Come to class fully prepared, having done and reflected on the reading and writing, ready to develop new ideas. |
| *Listen*<br>Attentive, respectful, self-aware listening<br>Try not to interrupt |
| *Cultivate an open mind*<br>Welcome diversity of opinions and experiences through collaborative discussion.<br>Be open to all ideas, experiences, and questions.<br>Play the "believing game" with diverse opinions. Be curious: seek to understand<br>Give things the time they need. Confusion and discomfort are part of the process. |
| *Contribute*<br>Full disclosure of ideas: it's okay to "think out loud" and work through thoughts.<br>Keep it relevant: while thinking out loud, also try to keep things connected to the topics at hand.<br>Share the air: be mindful of how much you are talking.<br>Speak thoughtfully and respectfully. Trust that others are doing the same.<br>No monopoly on expertise: don't keep yourself from participating because you feel that the context is different from your own experience. |
| *Assume good intent, and follow the 48-hour rule*<br>We'll assume that every comment is offered in the spirit of being collegial and constructive. However, if we feel somehow affronted by something someone else says or does, we will approach that person within 48 hours to discuss the situation, or we will decide to make peace within ourselves and let go of any hurt or resentment we're feeling. |
| *Commit ourselves as fully to supporting one another's learning as we are to supporting our own learning.* |
| *Laughter and humor are good.* |
| *Help with the class set-up a couple of times over the semester, if possible.* |

they could make substantive contributions to class discussions and draw upon them when doing assignments. Student demonstrations required student groups to develop a guiding inquiry question of interest to them and to pay close attention to what happened in class in order to generate hypotheses and interpretations of the learning that was happening. Documenting the class's learning also allowed documentation teams to put course principles into action and discuss their findings with the large group. Small writing assignments either done in class or via email con-

**Table 5.4** Lee case—aligned assignments/assessment tasks

| *Assignment structure and assessment* | | | | | |
|---|---|---|---|---|---|
| Assignments | Weekly readings | Small writing assignments | Student demonstrations (documenting two classes during one week) | Research project and draft proposals (including peer feedback) | Final report on the research project |
| Cognitive level | *Understanding* | *Evaluating* | *Analyzing* | *Evaluating or creating* | *Evaluating* |
| Assessment | do the readings | hand in the writing (e.g., reflections) | document two classes in a small team and present your findings based on an analysis of the data | do research project and hand in draft proposals | write the final report |
| | class participation (e.g., participate in discussions, bring student work) | | | | |
| | attend classes | | | | |
| | complete the course evaluation survey | | | | |

sisted mainly of individual written content- or process-related reflections on readings, course activities, or topics discussed in class.

Regarding the research project and draft proposals, students were asked to design and conduct a project using student work as a central form of data. Students were free to choose between (1) tackling a question about teaching and learning of interest to them using a collaborative assessment protocol, a protocol type repeatedly done in class (cognitive level: creating), or (2) investigating the use and effects of a protocol of interest to them for examining student work (cognitive level: evaluating). Mrs. Lee provided students with sample project questions from prior years and highlighted: "I would really love you to choose something that you are genuinely curious about, that you would like to explore (…) Really for me the driver is: What do you care about, what's going to be most compelling, what's helpful to you?" (Lee, 23. February 2010). The research project involved identifying a question, choosing and describing a method, gathering and analyzing data, providing a timeline for the study and discussing the findings. Mrs. Lee also "strongly encouraged" students to collaborate with classmates.

Starting in March, each student had to submit three draft proposals over the course of the semester. If students worked together with other classmates they had to make sure that their own contribution was presented in their proposal. Mrs. Lee provided them with feedback on their written work. In addition, each student received peer feedback for their last draft with regard to a focusing question s/he was interested in. Students did not have to provide conclusive thoughts and work their project into a "final" product, as the goal of the writing was to explore one's own ideas, that is, work in progress. This made the task "all the more enjoyable" and students realized that "it's very interesting, like, you are not doing it because of the grades and all of that." One interviewee stressed: "My guidelines that I am meeting are the ones I've created for myself. And that feels good" (Student interviewee 3). In their final report, at the end of the semester, students had to take into account the feedback they received from both their classmates and Mrs. Lee.

The class was deliberately offered as a "satisfactory/no credit" course only because Mrs. Lee felt that this practice helps to "establish a feeling of a real community" where students can learn in a "safe environment":

> I really feel like you're much freer to learn and to make your mistakes. So a lot of what I'm thinking about when I think about this class and setting

> it up, shaping it, is how to make it a place where people can just say stupid things. (Lee interview)

To obtain a satisfactory grade, a student had to attend classes, actively participate in course activities, do the weekly readings, the small writing assignments, as well as a group documentation of two classes (student demonstrations), conduct the final research project and submit draft proposals, write the final report, and complete the course evaluation survey. Participation in class included: being fully present in the room for all sessions; preparing all the required readings before the class session; bringing the required readings to class; actively participating in group activities; making substantive, relevant contributions to group discussions; and abiding by the class norms that were established together at the beginning of the semester. For a satisfactory grade students are required to produce work of B- or better quality; otherwise they receive no credit.

One student interviewee pointed out that the workload s/he had done was "much more in depth" than in other classes because there were no grades. S/He reasoned that to him/her "this is thinking in the making. And how do you put a grade on someone's thinking in the making?" (Student interviewee 3). Overall, the interviewees liked the pass/fail nature of the course and felt "more relaxed" and "less stressed" to learn: "I didn't feel the stress of writing for a specific instructor and knowing what they wanted from me. I felt I did it for my learning" (Student interviewee 5). Students also felt that they did not mind participating in class as they did not feel "the stress to participate" or "the stress of doing something right":

> I mean all teachers have different expectations and even though she might say: "Anything is fine," you want to write or say something that is within her expectations. So if it is graded, you had to fix that rubric in your mind. But for non-graded classes you can actually say whatever you are really thinking and not thinking about what the teacher might be expecting you to say and what she might be expecting you to write in the paper. (Student interviewee 4)

### *5.1.3 Brown Course: Group Learning*

#### *5.1.3.1 Course Objectives and Content*

The course aims to familiarize students with key research findings on the nature of group learning (classroom literature, teacher and leader development, the wider field of team learning and performance) and offers several occasions for participants to apply these concepts in practice by designing, observing, evaluating and reflecting upon group learning experiences. Students build an awareness of key insights so they can better diagnose and support group learning in a variety of contexts such as hospitals, the military, or athletes. The content of the course is structured around three guiding questions and related topics (see Table 5.5):

Mr. Brown wants students to walk away "with multiple conceptual frames of what group learning means" and how it can be supported or undermined and "with some clear practices that would make a difference in their context" (Brown interview). The course also strives to model good group practices. Students learn about group learning, experience it in class and reflect on the degree to which this course itself is creating the conditions for group learning and how, as a group, the class might improve over time.

#### *5.1.3.2 Course Structure*

In the very first class Mr. Brown gave a broad and comprehensive overview of the course's agenda (syllabus) and how he wanted to conduct the course. Students were invited to ask questions in order for them to get an optimal understanding of the course components and structure and to

**Table 5.5** Brown case—course content

| *1) What does it mean for a group to learn? (sessions one to three)* | *2) What are the key dynamics that support/ thwart group learning?(sessions four to ten)* | *3) How can leaders support group learning?(sessions eleven to twelve)* |
|---|---|---|
| Distilling key factors of groups from our experiences and the literature | Paradoxes of knowing: maintaining certainty and doubt | Paradoxes of belonging: managing group and individual identities |
| Exploring group effectiveness | Paradoxes of trusting: disclosing competency and vulnerability | Applying and integrating lessons: final paper workshop |
| The intersection of group performance and learning | Paradoxes of power: enabling leaders and leadership | |

make them feel comfortable (Brown interview). The class sat in the shape of a horseshoe with several parallel shifted rows. Mr. Brown thoughtfully designed the social choreography of the class to allow for multiple ways in which the individuals could engage in ideas: “The students make this course happen, but clearly James is conducting the orchestra” (HGSE, 2011). The data analysis based on participant observations and video analysis during the fall 2010 course shows that in 54% of the time the class worked in the large group, 43% of class time were used for small group work, 2% for pair work and 1% for individual work. Students received a course pack and online documents that encompassed the readings and course documents. The class environment was also supplemented by an online environment (course platform) with class materials (e.g., instructor presentations). Students posted article summaries, class assignments including mid-term and final papers online and received public feedback. Technology (online forum, email) was used in ways that facilitated discussions outside of class and was perceived useful to deepen students’ understandings (HGSE, 2011).

The comprehensive syllabus provided multiple opportunities for students to focus on their interests and explore ideas to deepen their understandings as the following student comment suggests (HGSE, 2011):

> This is a FABULOUS course! All of the assignments/readings/course activities are thoughtfully designed, and help to develop a deep understanding of the subject matter. Whatever type of group context you’re interested in—this course gives you an opportunity to explore it.

Moreover, the students could provide input to determine the course’s direction. (Student interviewee VI) As students got more familiar with course activities they had more choices and “we got particularly more say as the semester went on, in how our activities sort of operated” (Student interviewee I). The course structures became more and more flexible and responsive to what was going on in the classroom and Mr. Brown would ask the class: “Should we do anything differently with our process?” to initiate structural changes:

> I mean in many ways the structures in my class are fairly flexible—there are always kind of set routines and structures but the structure itself actually allows a lot of flexibility and choice and I think that that’s important. (Brown interview)

This curricular refinement process that was inherent in the course design made it possible to continuously adapt and improve the learning experience for current students but also for future courses (HGSE, 2011): "For next year we think about the assignments, we think about some of those structures, tinkering, modifying" (Brown interview).

#### *5.1.3.3 Course Activities and Materials*

Mr. Brown designed diverse course activities that allowed students to engage with the course readings and develop deep and meaningful understandings of theoretical concepts about group learning. In terms of the class session flow, that is, the work within the three-hour class sessions, the course involved the following main activities:

- *Article discussion groups* (ADGs) focused on students' understandings of selected readings followed by group presentations/large group discussions. In many higher education classes readings often do not matter for students as they do not really have to do anything with the readings in the context of the class. Instead, the instructor lectures them about the ideas in the readings (Brown interview). In contrast, Mr. Brown wanted to "put more attention on the voices of authors and literature and give students an experience, a context in which they learn to deeply engage with multiple viewpoints and authors and do sense making over time." (Brown interview)
- *Experiential practices* involved the application of concepts using experiments, role plays and video cases or a field trip. Students would first watch a video clip showing a group learning situation (e.g., students learning in groups, teachers collaborating in teams) and when analyze it in pairs or groups before sharing their ideas with the large group. Close video case observations provided students with an opportunity to try and use theoretical lenses and make sense of the collaborative dynamics of the groups they observed, but also to practice critical observation skills.
- *Mini-lectures* included brief overviews of the class, an introduction to important theoretical concepts (e.g., instructor/guest presentations), the (theoretical) framing of activities, information on assignments and activities, logistical information, a brief summary of important ideas and the sharing of students' feedback with the large group.

- *Student-led group discussions* provided students with a self-organized space where they could share and dig into content-related questions and puzzles that were personally meaningful and relevant and get the conversation started with a small group of people who wanted to join them in their quest. Students self-organized in several small groups to explore their questions and keep the conversation going: "He would state, 'yes, I create a 15-minute discussion at the end of the lesson but you produce the topics.' So there seemed to be collaboration there" (Student interviewee VI).
- *Updates and news* allowed students to reconnect at the beginning of the class: people could say whatever seemed to be relevant to the entire group. That could be anything from seeing new connections to course concepts to events like workshops that were coming up on campus that classmates might be interested in. Students were getting bonus participation points for connecting their updates and news to the actual content of the course.

The flow of the three-hour class sessions was stable in that it was "split into two blocks, one being analyzing the articles, and the other half was sort of open-ended" (Student interviewee III) so that students did not feel drained after three hours. Hence, the course had a relatively stable choreography of learning and teaching activities. After volunteers shared updates and news with the class, Mr. Brown would briefly inform students about the thematic focus of the class and provide an overview of the class' agenda. During subsequent article discussion groups, students had opportunities to become more vocal, discuss one of the three to four articles they had prepared in their group, lead discussion groups, discuss their thoughts and questions, and share their ideas with the whole group later on. After a 15-minute break (students can bring lunch, chat) a mini-lecture and/or experiential practices followed. The class ended with student-led group discussions and a short preview for the next class including assignments. Once in a while Mr. Brown would additionally send out a remainder email before the next class.

The class used diverse materials like readings, the instructor's presentation slides, texts for role plays, video clips, and handouts with formatting guidelines for article summaries and papers. Students also produced artifacts like posters, papers, and online postings. Constructing artifacts was helpful for the visualization of key ideas in the form of metaphors, for example, and facilitated students' collective understanding (Student interviewee I). The artifacts produced by the students were also put online (e.g., article summaries, including public feedback) and became a resource for everyone in class. In addition, materials produced by prior classes were utilized as learning resources (e.g., sample article summaries and mid-term and final papers). The documents and postings were crucial for preparing the mid-term and final papers and students were always looping back to these summaries and key ideas that were stored online (Student interviewee II).

#### *5.1.3.4 Classroom Routines and Norms*

Right from the start, Mr. Brown made it a goal of his to remember all the students' names and students would also call him by his first name. Students felt that Mr. Brown "crafted a learning environment that put us in charge of our own learning." The class gained a common language to talk about group learning as the semester progressed and "it was a great chance to hear perspectives from other students." There was a distinctive culture that formed within the class, based on the little rituals of class sessions and the high level of interaction among peers (HGSE, 2011). The established routines and norms helped to (1) regulate learning and teaching processes in terms of how knowledge was constructed (re-occurring teaching patterns) and aimed to (2) clarify the roles of the instructor/teaching fellows and students (class norms) as is outlined below.

1. Re-occurring teaching patterns

Five re-occurring teaching patterns were applied in the classroom to support students' learning processes based on participant observations and video data.

- *Lecturing* (6%) encompasses mini-lectures given by Mr. Brown to convey content information and advice regarding new group learning concepts, as well as content-related feedback on article summaries, mid-term and final papers, online discussion groups and related assignments.
- *Metatalk* (7%) refers to procedural information on assignments and course activities, options students had available for doing their fieldwork and mid-term/final papers, the course content and class flow and the introduction of guests who visited the class.
- *Independent problem-solving* (55%) refers to article discussion groups, experiential practices and student-led discussions introduced and/or

framed by Mr. Brown (problem setup, 8 %) and then independently explored by students in small groups without direct instructor interference (47 %); of the 55 % altogether 2 % of class time accounted for reflections in small groups or individually.

- *Guided problem-solving* (2 %) refers to Mr. Brown asking genuine questions to structure and facilitate large group explorations such as experiential practices which rarely occurred in class as compared to the other teaching patterns.
- *Sharing/comparing/discussing solutions, ideas, noticings, questions* (30 %) regularly followed after the patterns presented above and consisted of (1) student questions/comments after lectures/metatalk and lecture-related large group discussions (6 %); (2) student groups sharing and discussing noticings, ideas, and questions with the large group after discussing articles (7 %); (3) the whole class shares, compares and discusses different problem solutions after an experiential practice (8 %); (4) updates and news (4 %); and (5) activity debriefs in the large group (5 %).

2. Class norms

Mr. Brown presented the following class norms, introducing the students' and instructor's roles during the first class (see Table 5.6). The norms require students to engage with other people to co-construct knowledge. Moreover, students are asked to connect course content to personal experiences and make conceptual connections with diverse course concepts. Students are also expected to apply their understandings in the context of assignments and course activities. A respondent to the course evaluation survey gave the following account and advice with regard to the students' roles in class (HGSE, 2011):

> Because the professor is less hands-on, he really allows students to make the class. I would argue to be PROACTIVE—if there is an idea you think would be helpful or something you would like to propose, DO IT. The professor is very flexible and willing to work with you. I did not realize till it was too late, how much power and control we, the students, had in class. So be sure to utilize it as soon as possible.

Mr. Brown's and the teaching fellows' roles were threefold: provocateur, facilitator modeling good learning processes, and content provider as outlined in the class norms. Mr. Brown was mostly the "facilitator of

**Table 5.6** Brown case—class norms

| *Our norms are as follows* |
|---|
| Students' roles<br>*Engage:* this is a very hands-on course; you are actively pursuing with other people or alone the ideas of this course.<br>*Connect:* you are looking for connections, not only to your personal experiences but also conceptual connections (e.g., across readings).<br>*Apply:* assignments, mid-term and final papers are applications of the courses' ideas. For the papers you can choose between a design project and a critical observation of a context of group collaboration. |
| Instructor's and teaching fellow roles<br>We will do a lot of *facilitation* as this is not a lecture course. We ask people to engage in small and large group conversations, draw out some key ideas and make those ideas visible.<br>We try to *provoke* you in a way that pushes you to explore elements of collaboration in group settings. There will be moments in this class where you do not feel so comfortable. The idea is to engage in the messiness of group learning and try to be critical and provocative about it.<br>*Presenting material*: there will be moments where we just spread out and deliver some content and deliverables we think are important orienting you as the course moves forward. |
| (Brown, verbal communication, first class session, September 03, 2010) |

the processes" starting the learning process going, providing a syllabus, structure and routines and then keeping the process going and facilitating it as opposed to being the driver of the process. (Student interviewee V) The experiential practices (e.g., evaluating video cases) and partly the class conversations (metatalk) were designed to be rather thought-provoking. Mini-lectures were more about providing expert content—"laying out the land." (Brown interview) The instructor made also sure that students could learn from each other and from students of prior classes:

> I felt like the work of the class was fully within their ownership to tackle. So I was there as someone who facilitated and tried to mediate that experience for them. I mean they were in the flow of their learning. My work was to create contexts and structures in a way. Yeah, to be with and help them think through, but I couldn't really resolve their issues for them. (Brown interview)

#### *5.1.3.5 Assignments and Assessment Tasks*

The course involved different kinds of (online) assignments and aligned assessment tasks with high cognitive levels of complexity—most of them including an individual written element (see Table 5.7). The class assignments were designed open-ended to leave room for student choice. All of the assignments supported students in understanding and applying course concepts and ideas in different contexts and allowed for the discussion of different perspectives on group learning: "All of the work we were asked to do built. None of the work was tangential to what we were doing in the class—it was all relevant" (HGSE, 2011).

The assignments required high levels of cognitive processing: understanding (readings), analyzing (article summaries, fieldwork, mid-term paper), and evaluating and/or creating (online reflections, fieldwork, final paper). According to all respondents to the course evaluation survey, the assigned readings were valuable and of high quality and the class lectures and discussions were related to assigned readings (HGSE, 2011). In class, students could organize in article discussion groups so that each student could discuss an article that was of particular interest to him/her in depth with other group members. So-called article summarizers signed up to lead a discussion group and distilled the essence of the articles scaffolded by guiding questions the instructor provided and based on the discussion groups' sense-making.

The five online assignments (reflections posted online) required students to build on the themes and puzzles from group discussions and scaffolded the development of the mid-term and final papers for the course. Each student had to write a mid-term and final paper based on either (1) critical observations of a real team learning situation (cognitive level: evaluating) or (2) designing a group learning experience that is used in practice (cognitive level: creating). Thereby, students had to apply the course content by analyzing a context through the lens of a few well selected group learning concepts discussed in class. They chose their topics and contexts according to their interests and Mr. Brown was open and accessible for students' ideas and wanted them to pursue their questions and puzzles helping them through the process.

Students received written feedback from the instructor and a teaching fellow on their article summaries and on their three paper drafts. Students also received comments from two fellow students in response to their postings of the online assignments—on the last draft they also received peer feedback in class (HGSE, 2011). Students "really liked" the flexibility and

**Table 5.7** Brown case—aligned assignments/assessment tasks

| *Assignment structure and assessment* | | | | | |
|---|---|---|---|---|---|
| Assignments | Weekly readings | Online reflections: five assignments and comments to two class members | Weekly article summaries (two per term per person, partly paired up with another person) | Fieldwork and mid-term paper | Fieldwork and final paper |
| Cognitive level | *Understanding* | *Analyzing*<br>*Evaluating* | *Analyzing* | *Applying*<br>*Analyzing* | *Evaluating*<br>*Creating* |
| Assessment | | post online assignments and comments<br>20 % | post article summary<br>15 % | conduct fieldwork and write mid-term paper<br>25 % | conduct fieldwork and write final paper<br>25 % |
| | Participation (e.g., participating in group and class discussions, online feedback, contributing to a glossary of terms, attending classes) 15 %<br>complete the course evaluation survey | | | | |

choices they had in doing the fieldwork for the mid-term and final papers and felt good about the task and their work. They got to design their own little experiments and pilot them (Student interviewee II).

Each student had to decide from the start whether s/he wanted to take the course as pass/fail or for a letter grade. Mr. Brown states that he would prefer to offer a pass/fail course only because "the minute that public feedback gets connected to a grade I think that's where the intent of helping someone to develop rubs against the judgment of the grade." And without grades it would just be critical, but supportive feedback aiding the students in their learning instead of passing public judgment in the form of grades (Brown interview). One student submits that the possibility to take the course pass/fail enables students "to be more daring in some of the course choices, rather than playing it safe by trying to guess what the instructor is after" (HGSE, 2011). An interviewee stressed the importance of assignments in order to enhance one's learning not so much what one gets for a grade: "I did the assignments so that process is a learning experience. And I think in James' course the assignments were exactly like that. I learned so much" (Student interviewee VI). All assessment tasks were singular assignments to hold the individual student accountable and were graded by Mr. Brown and one teaching fellow. For students who took the course for a letter grade the grading was designed in a way so that each assessment task accounted for the final grade, although in different percentages.

### *5.1.4 Students' Perceived Teaching and Learning Quality*

For each case course evaluation data from three to six different student cohorts who took the courses between 2008 and 2011 were available and used for data analysis (with an N between 263 and 2832; Stier, 1999). Students' course ratings with regard to each course's benefit, workload and study hours, course content and organization, course activities and materials, and the instructor are compared and the main results are summarized.

Overall, 92% of the students (three cohorts per course, $N = 283$) reported that they perceived the benefit of the courses to them as being high or very high, with Mrs. Lee's case receiving the highest rating (100%). Most students also reported a level of effort between four and seven hours per week and course in terms of study hours dedicated to the courses outside of class. Furthermore, the amount of workload in these courses was rated to be on a medium (Lee case, 53%) or high to very high level (Smith and Brown cases).

The vast majority of students (with an N between 263 and 278) perceived the courses as being intellectually challenging and the courses stimulated them to think in new ways. Students' high ratings on these two items—especially in Mrs. Smith's course and Mrs. Lee's course—indicate that some learning that led to conceptual and/or discursive change has taken place. Table 5.8 shows the particular strengths of each course with regard to the 27 items measured in the course evaluation survey. Mrs. Smith's course had higher ratings than the other two courses regarding the value and quality of the assigned readings, and in terms of course assignments that supported and reinforced the goals of the course and promoted learning and growth. Mrs. Lee's course was rated higher than the other two courses in terms of helping students understand how to apply their learning to real problems and contexts, and providing effective opportunities to learn from other students.

Mrs. Lee established an environment that was considerably more conducive to learning as compared to the other two courses. Mrs. Lee as an instructor, who taught the course, was rated higher with regard to responding to students respectfully, encouraging diverse opinions and perspectives, explaining clearly how assignments would be evaluated, and being accessible outside of class. In addition, course ratings showed that class lectures clarified the subject materials better, class discussions enhanced the understanding of the subject materials more, and

**Table 5.8** Smith case—principles for class discussion

| *Principles for class discussion* |
|---|
| Trying to understand and appreciate in what ways someone else is thinking and feeling about something is the major work of the course. |
| Pay attention to your own moments of high or sagging interest, insights or confusions, try to understand what leads to them and appreciate your own ways of thinking. |
| If you don't understand what somebody says, ask them to try to say again what they mean. This way everybody is held responsible for judging whether what they are trying to say really makes any connection with the current understanding of the rest of the class and for making clear why they think what they think. |
| The most important part of understanding what a person thinks is understanding why s/he thinks it. So keep asking people to give the reasons for saying what they say. |
| Use the class discussion as a place to try out your newly forming ideas, counting on help from the other class members in asking you questions and thoughts that will help you keep thinking about your ideas. |
| Try to refrain from explaining what you think someone else should think and, instead, try out some ways to support that person in taking his/her own thoughts further. |

Mrs. Lee was more effective in leading classroom discussions as compared to the other two courses. The difference of the latter three items was obvious as compared to Mrs. Smith's course. Mr. Brown's course had higher ratings as compared to the other courses with regard to clearly stated course objectives and their alignment with course content, course activities and their alignment with the syllabus, technology use to facilitate communication and deepen understanding, and helpful and timely feedback on course assignments. Mr. Brown's course was rated considerably better than the other two courses regarding a clear, well-organized, and complete syllabus and the use of technology to enable discussions outside of class. Finally, Mrs. Lee and Mr. Brown gave considerably clearer and more structured presentations, and class lectures and discussions were considerably more related to assigned readings as compared to Mrs. Smith.

## 5.2 Curricular Design Elements and Quality Features

Below characteristic curricular design elements and related quality features embodying the instructors' constructivist educational beliefs are presented in greater detail since they evolved repeatedly from the case analyses.

The cross-case analysis summarizes and systematically compares the characteristic curricular design elements. The mainly qualitative analysis is based on grounded theory methodologies to code rich data sources that have the potential to complement and validate each other in order to describe and analyze the course design of the three classrooms under study. The in-depth account is illuminated by instructor and student quotes representative of each classroom. The cross-case analysis also uses video data to research how classroom time was used (e.g., social form of instructional activities, course activities, re-occurring teaching patterns). The following five *characteristic curricular design elements* are presented below to address the empirical research sub-question 2a: relevant and challenging objectives and content (e.g., concepts and practices, Sect. 5.2.1), flexible course structures (e.g., social form of instructional activities, Sect. 5.2.2), participation-oriented course activities and materials (Sect. 5.2.3), well-established routines and norms of interaction (e.g., teaching patterns, behavioral norms, Sect. 5.2.4), and open-ended assignments and formative assessment (Sect. 5.2.5) Finally Sect. 5.2.6 provides a summary of the Pridings.

### *5.2.1 Relevant and Challenging Objectives and Content*

A comparison of the objectives and content of the three cases shows that the courses aim at advancing students' PCK in order for them to understand more deeply how people learn and how they as prospective teachers can facilitate students' learning processes. The courses strike a thoughtful balance between being intellectually challenging (i.e., tackling state-of-the-art educational concepts and practices requiring thinking at a high cognitive level), and relevant to the daily practice of teaching and learning (i.e., tackling various types of knowledge, using authentic problems) (e.g., Anderson & Krathwohl, 2001; Collins, Brown, & Holum, 1991; De Corte, 1996). In the classrooms under study, the design element "relevant and challenging objectives and content" referring to what students know, understand, and are able to do upon completion of a course (i.e., achieved high-level learning outcomes) is characterized by the four quality features outlined below.

#### *5.2.1.1 Critical (Self-)Awareness and an Open Mind*

The courses provide student teachers with opportunities to develop a critical awareness of their own assumptions and what they are doing by stimulating them to think in new ways (O'Neill & McMahon, 2005). The experience of being in these student-centered classrooms challenged students' perceptions and changed their thinking about education, learning, and teaching to a certain degree as illustrated by the ratings of the vast majority of the respondents to the course evaluation surveys (see Sect. 5.1). The courses require a receptive openness with regard to other possible perspectives and ways of thinking to foster a culture of learning, where students and the classroom community as a whole are learning (Bielaczyc & Collins, 1999). The student interviewees stress the importance of an open mind and the pivotal role of a certain amount of buying-in to getting over that "hurdle" saying: "It's going to be a little tricky to put this into practice. And it's not going to be a walk in the park" [Student interviewee D, Smith case]. Hence, especially in the beginning of the semester, when some of the constructivist educational concepts seemed to be challenging and contradict what was happening in most schools and what the students themselves experienced in school, the students needed to be open to new ideas and alternative ways to go about learning and teaching. They had to be open to give them the benefit of the doubt and be willing to live through them as learners and teachers.

In order for the student teachers to develop an attitude and a stance toward learning and teaching that is characterized by student inquiry and engagement, "seeking to understand through observation, through listening, through questioning, through perspective taking" was crucial [Lee interview] as one interviewee in Mrs. Lee's course points out:

> It's not so much about just using those protocols like, "Now we have to use this protocol." It makes you more aware that besides your opinion there are other opinions and it is always valuable to listen to other opinions. [Student interviewee 4, Lee course]

Mrs. Lee, for example, aims to help "students assume responsibility for (…) their own learning, their own capacity to be aware, their own attitudes and responses" to enlarge their perspective [Lee interview]. Thus, they can make conscious choices as learners and prospective teachers that are life giving and option opening for themselves and others and not foreclosing possibilities [Lee, 25. February 2010].

#### *5.2.1.2 Content-Oriented and Process-Oriented Classroom Talk*

Classroom talk concerns not only factual and conceptual knowledge (CK) but also the processes of constructing knowledge together in order to deepen students' understanding. Processes of constructing knowledge refer to procedural knowledge regarding how to go about a course activity and metacognitive knowledge to reflect about learning content and/or processes. As the video analysis using coding inventory 3 (see Appendix 4) shows, on average two-thirds of the classroom talk was learning content-related (67%), one-fourth of the talk contained information on learning content and process (26%), and about 7% referred to process-related content only (e.g., metatalk about whether the course creates the conditions for group learning) with a similar distribution in each of the three courses (see Fig. 5.1).

Hence, process-related talk revolving around procedural information on and student questions about course activities, assignments, and materials, together with metacognitive reflections, was relevant in about one-third of classroom talk. This use of class time indicates that the three classrooms also put an emphasis on the learning process instead of only focusing on factual and conceptual knowledge in order to foster deep learning (Aebli, 1983; Anderson & Krathwohl, 2001).

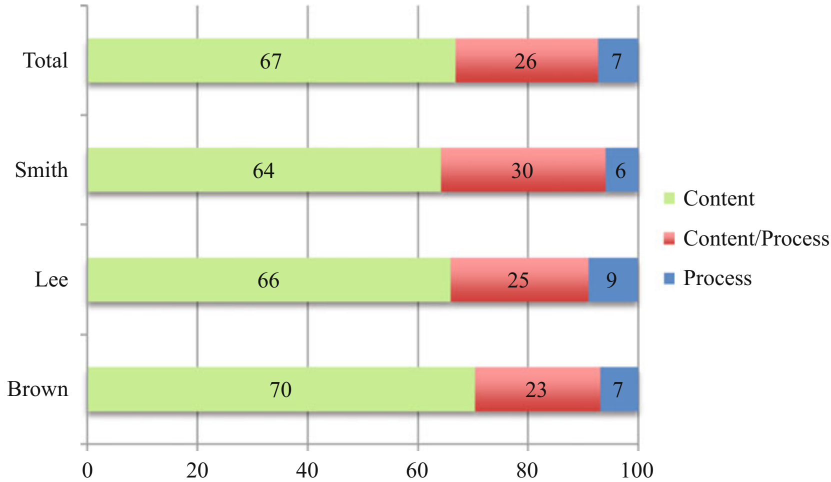


**Fig. 5.1** Content- versus process-orientated talk—case comparison (in %)

#### *5.2.1.3 Focus on Performances of Understanding (Concepts and Practices)*

The designs of the courses focus on what students will be able to do, rather than on the subject matter content the instructors want to cover as outlined in the course syllabi. This indicates a shift from a focus on the instructor or content to a focus on the student (e.g., Kember, 1997; Prosser & Trigwell, 1998). The course objectives refer to what students come to understand (e.g., educational concepts about group learning, pedagogical approaches, different protocol types) and to demonstrations of (advanced) understandings (e.g., applying concepts and practices such as observing closely, reflecting critically, listening intently, following others' thoughts and reasoning, inquiring collaboratively, discussing different viewpoints, withholding judgment) upon successful completion of each course (Duckworth, 1987/2006).

Thus, students have opportunities to gain CK and they learn how to learn in these classrooms in order to become flexible problem solvers (Bielaczyc & Collins, 1999). Apart from knowing (understanding of educational concepts), these courses emphasize doing (e.g., engage in inquiry) and the promotion of reflective practices (e.g., journaling, one-minute paper, activity debriefs) for prospective teachers to make (publicly) visible, that is, demonstrate, what they understand and can do to become self-regulated lifelong learners and teachers. Students are positioned as central and respected members of the community. They demonstrate their understandings and co-construct knowledge together, contributing their expertise and taking on responsibility for advancing the work of the collective (e.g., Bielaczyc, Kapur, & Collins, 2013; Blythe & Associates, 1998; Greeno, 2011; Hickey & Zuiker, 2005; Sawyer, 2008, 2014a).

#### *5.2.1.4 Relevant Content that Connects to Both Students and Education Practice*

The flexible course structures and ill-defined problem spaces (a few big questions and related topics, problem/question to start off an exploratory activity) left room for students' ideas, wonderings, and questions to drive the learning processes in these classrooms (Bielaczyc & Collins, 1999). The students perceived the content as being highly valuable and relevant because they were given choices and opportunities to connect course topics, questions, and practices with their prior knowledge, interests, experiences, and wonderings (e.g., choice in subjects for fieldwork projects and in articles to discuss in greater depth in small groups) in order to make sense (NRC, 2000; Sawyer, 2008).[3] For example, one interviewee explains that the opportunity to craft his/her own final field project in Mrs. Smith's course "really allowed me to shape something that I wanted to explore more deeply and tie into my work directly" [Student interviewee B].

To further connect to education practice and the wider community, experienced school teachers, prior students, children, and high school students came to class to share and discuss insights and examples from their practice (Engle, 2006; Engle, Nguyen, & Mendelson, 2011). Fieldwork, joint field trips, the instructors' own stories as well as real student work and educational problems/dilemmas brought to class—either by the instructors or by students themselves—provided numerous occasions for students to jointly tackle real problems and develop collective understanding. Through their continued and manifold engagement in authentic educational practices, students could easily visualize situations where they could apply their knowledge and skills in a real classroom situation—despite potential challenges due to the current school systems.

### 5.2.2 *Flexible Course Structures*

The flexible course structures together with the exploratory hands-on activities and (reflective) discussions gave students a say in their own learning processes with various opportunities to participate actively in the knowledge construction process. The design element “flexible course structures” is characterized by the two quality features outlined below in the classrooms under study.

#### 5.2.2.1 *Overarching Agenda with Room for Variation and Joint Decision-Making*

The instructors provided focus and structure as outlined in the preliminary course syllabus accompanied by materials and guidelines that communicated comprehensive and high academic expectations in terms of course requirements. Particularly, Mr. Brown’s course was perceived to have a clear, well-organized, and complete syllabus as reported in the student evaluations (see Sect. 5.1). Aside from aligned core elements with regard to content (course topics/questions), activities (e.g., check-ins, group discussions, activity debriefs), and assignments/assessment tasks framed by the instructor (Biggs, 2012; Whetten, 2007), the courses allowed for variation and joint decision-making in terms of both learning content and process. The course structures left room for student choice and discovery and the instructors involved students in negotiating course objectives, content, and investigation paths.

Students had further opportunities to take on the responsibility of co-designing the curriculum to a certain degree as the class moved forward (Hattie, 2009, 2012). Taking students’ contributions and continuous reflections as well as their own “read” on the class into account provided instructors with valuable feedback for continuous course adjustments. Students had an increasing say in how activities were carried out (structural changes) in Mrs. Lee’s and Mr. Brown’s courses as the semester moved on. Particularly in Mrs. Lee’s case, the course was not laid out entirely at the beginning of the semester and evolved over time with regard to content and process in order to take students’ prior knowledge, interests, and experiences into account. As compared to the other two courses, Mrs. Smith considered herself as the major decision-maker in the classroom (which contained 38 students as compared to 25 in Mrs. Lee’s class and 33 in Mr. Brown’s class) to assure that students’ experiences during the two-hour weekly class sessions were productive (the other two courses had four hours per week with the instructor).

*5.2.2.2 Alternations of the Social Form of Instructional Activities*

In terms of the social form of instructional activities, the video analysis using coding inventory 2 (see Appendix 4) reveals that altogether 66% of class time was spent in the large group, 30% of class time was used for small group work, 1% for work on the pair level, and 3% for individual work. This distribution of class time was similar insofar as all of the three courses favored class-level activities. Figure 5.2 shows that Mrs. Smith's course spent 84% of class time in the large group and 12% in small groups, while Mr. Brown's course spent 54% in the large group and 43% in small groups. Mrs. Lee's course was in between with 65% of class time spent on the class level and 30% on the group level. Pair and individual work played only a very minor role in these classrooms.[4] Mr. Brown's course was the one with the most group work time (43%) followed by Mrs. Lee's course (30%).

The frequent back and forth between different individual, pair, small, and large group activities provided students with various opportunities for bodily movement and social interaction with different people in class (e.g., getting to know each other, learning from each other) while also tailoring to different learning styles and interests. These highly interactive courses also allowed the instructors to get to know their students better. Overall, alternations of the social form of instructional activities can contribute to

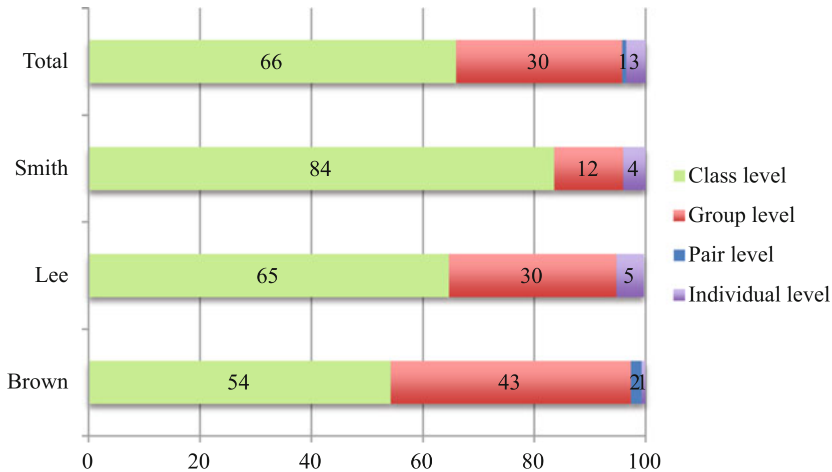


**Fig. 5.2** Social form of instructional activities—case comparison (in %)

encouraging thoughtful student engagement with concepts and practices in a discipline and meaningful conversations with classmates sharing their interests and ideas with each other and constructing knowledge together (Cornelius & Herrenkohl, 2004).

### *5.2.3 Participation-oriented Course Activities and Materials*

The three student-centered classrooms created opportunities for deep conceptual understanding and SRL through a broad spectrum of challenging course activities. These course activities required high levels of student involvement and thus allowed for high time on task, inviting students to both demonstrate and further develop their understandings (Biggs, 2012). These activities provided students with opportunities to explore and make sense for themselves (e.g., field trips, independent problem solving in groups, open-ended assignments), present their findings in comprehensive ways, discuss multiple solution paths, engage in buzz groups, make substantive contributions to discussions, learn from each other, and reflect on the learning process (e.g., reflective journaling).

Overall, the design element "participation-oriented course activities and materials" is characterized by the following four quality features in the classrooms under study:

#### *5.2.3.1 Course Activities with High Student Participation*

The analysis of video data (content logs) shows that class time in the three case studies was mainly used for the following course activities and related discussions (see Fig. 5.3):

- *Smith case*: exploratory activities, teacher demonstrations, lectures and metatalk;
- *Lee case*: protocols, lectures and metatalk (including housekeeping), reading discussions;
- *Brown case*: article discussion groups, experiential practices, lectures and metatalk.

In synthesizing and averaging the course activities that took place in these three courses based on the video analysis using coding inventory 1 (see Appendix 4), explorations (40%), discussions (30%), lectures, including invited guests (14%, including instructor metatalk) were shown to be the most practiced course activities. The data indicate that course activi-

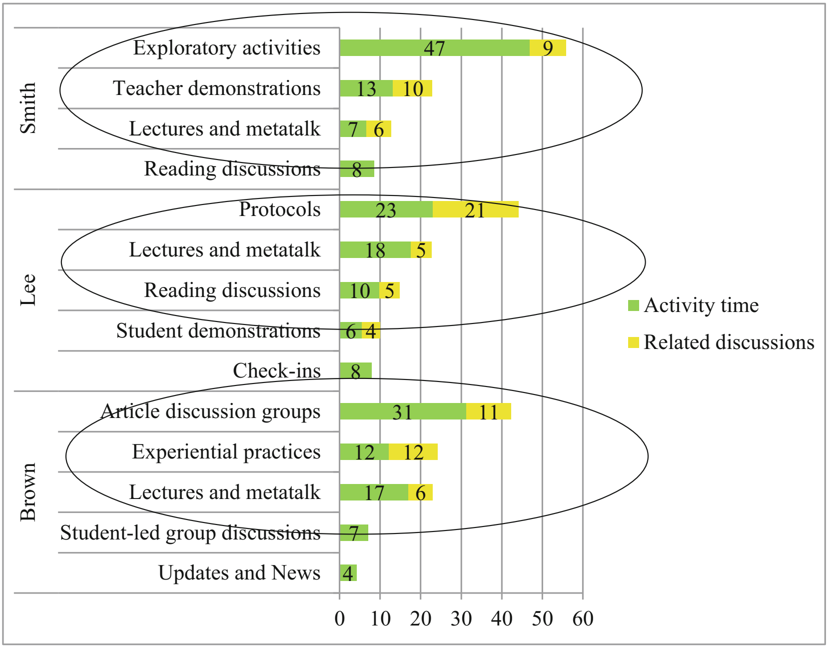


**Fig. 5.3** Main course activities in the three classrooms (in %)

ties with high student participation (time on task) accounted for 82% of the overall class time (lecturing/metatalk and teacher demonstrations excluded).

In Mrs. Smith's course, 80% of class time was spent in participation-oriented activities with explorations (47%) and large group discussions (25%). In Mrs. Lee's course, 82% of class time was spent in participation-oriented activities with large group discussions (35%), explorations (23%), and lectures and metatalk (18%). In Mr. Brown's course, 83% of class time was spent in participation-oriented activities with explorations (50%) and large group discussions (29%) being the main activities in class. Respondents to the course evaluations reported that class discussions considerably enhanced their understanding of the subject material they were learning about and that they had effective opportunities to learn from other students—particularly in Mrs. Lee's course (see Sect. 5.1).

The student perception data also indicate that lecturing and metatalk clarified the subject material and were related to assigned readings (see also Sect. 5.1); however, the video analysis shows that lecturing and metatalk accounted for no more than 14% on average (18% in Mrs. Lee's course, 17% in Mr. Brown's course, and 7% in Mrs. Smith's course) playing a rather minor role as compared to the other course activities. Lectures including metatalk lasted between 1 and 24 minutes[5] with an average of five minutes at a stretch. Teacher demonstrations only took place in Mrs. Smith's course and occupied 13% of the overall class time. Hence, teacher demonstrations occupied nearly twice as much class time as lectures in the latter course.

### *5.2.3.2 High-Engagement Student Activities*

The course activities provided students with options to learn in different ways building on their prior knowledge, and to apply their knowledge in a variety of situations. Figure 5.4 reveals what kind of learning activities the students engaged in based on the video data analyzed using coding inventory 4 (see Appendix 4). The data show that in 77% of the time, students had opportunities to actively participate in class contributing their thoughts and demonstrating their understandings, while mere listening and observing played a minor role (23%).

The inner activity of learning was stimulated and structured by students *exploring* something—individually, in small groups or in the large

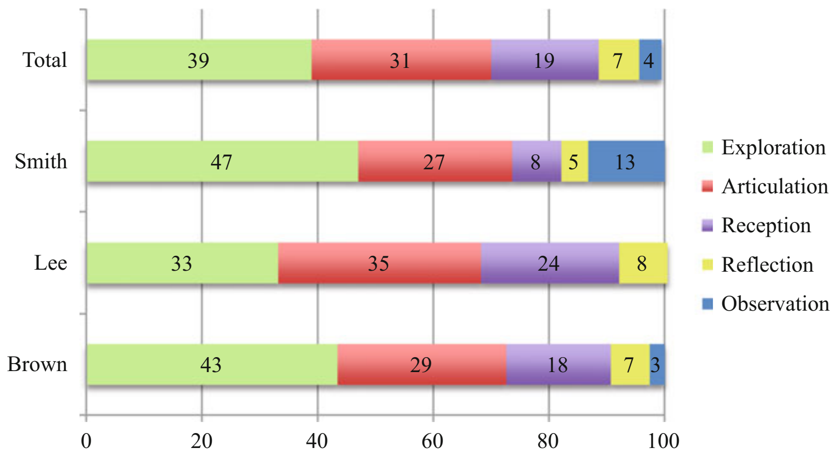


**Fig. 5.4** Student activities (in %)

group—in 39% of class time. Students were also encouraged to *articulate* their thoughts through discussions in 31% of the overall class time (e.g., asking questions, participating in reading discussions, sharing ideas/solution paths). Students *receptively listened* to information and explanations provided by the instructor or invited guests (19%) and they shared their *reflections* with regard to the content and the process of course activities they did together (activity debriefs, 7%). They also *observed* videos that showed authentic problem situations that the class subsequently worked on or the instructor modeling certain behaviors with invited learners (4%).

The distribution of student activities was similar in two courses with students in Mrs. Smith's course exploring in 47% of the overall class time as compared to Mr. Brown's course (43%). In Mrs. Lee's course, articulation in small or large group discussions (35%) and exploring (33%) were both prominent, while in Mrs. Smith's course, observing the instructor modeling certain behaviors was an important practice (13%).

#### *5.2.3.3 Variety of Teacher Roles in the Classroom*

Figure 5.5 indicates that each instructor takes on several roles to provide students with opportunities for deep learning and support their learning

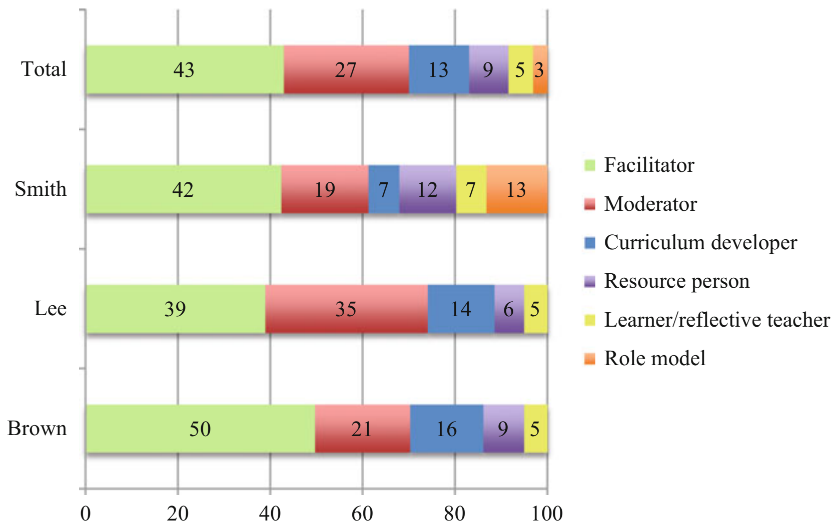


**Fig. 5.5** Teacher roles (in %)

processes in the classroom based on video data using coding inventory 5 (see Appendix 4). In all courses, the instructors act mainly as facilitators of exploratory activities (43%) and as moderators of large group discussions (27%). Less obvious roles of the instructors in these classrooms are curriculum developer (13%), resource person (9%), learner/reflective teacher (5%), and model demonstrating how to help students learn (3%). Hence, the three instructors spend on average 70% of class time scaffolding exploratory activities (facilitator) and moderating discussions in the large group (moderator).

Student respondents to the course evaluation survey stated that Mrs. Lee was particularly effective in leading classroom discussions, encouraging diverse opinions and perspectives, and in responding to students respectfully; overall, she established an environment that was highly conducive to learning. Mr. Brown was rated the highest among the three courses regarding giving clear and well-structured presentations (lecturing) (see also Sect. 5.1).

#### *5.2.3.4 Artifacts and Materials*

Artifacts and materials proved to be important tools for learning and teaching processes. They

- were at hand in the physical space (e.g., computers, whiteboards, flip charts),
- brought to the classroom by the instructors and students (e.g., name tags, readings, white posters and copy paper, handouts, readings), and
- generated in class as visible documentations of the thinking that was going on and as products of learning (e.g., posters, notes, written reflections, papers) informing instructors, teaching fellows, and students about people's understandings at a certain point in time (e.g., Bielaczyc & Collins, 1999).

Artifacts such as high-quality course readings allowed students to prepare for class—particularly in Mrs. Smith's course (see also Sect. 5.1). Artifacts also helped students to visualize key ideas and "see" how their thoughts worked out playing around with the objects. Thus, artifacts became testing grounds for students' ideas during exploratory course activities (Duckworth, 1987/2006; Hawkins, 1974). Many of the artifacts provided and produced were uploaded to the course platform building up a repertoire of resources for everyone in class to use and learn from. In addition, in Mr. Brown's course, artifacts produced by prior classes were utilized as additional learning resources (e.g., article summaries, sample mid-term and final papers of prior classes). Furthermore, communication technologies facilitated information exchange and interaction between the instructors, teaching fellows, and students (e.g., learning platforms and emails were used to distribute and hand in assignments and feedback)—especially in Mr. Brown's course (see also Sect. 5.1).

### 5.2.4 *Well-Established Routines and Norms of Interaction*

There was a distinctive culture that formed within each course in terms of what was important and how things were done based on the little routines and norms[6] that were established and promoted to create an effective classroom in which student learning time was maximized. These classroom routines and norms helped to clarify expectations in terms of what was valued in the instructor's classroom (e.g., Leinhardt & Steele, 2005). They also shaped the ways in which members of the class interacted with each other as they collaborated in activities (Greeno & Engeström, 2014). The design element "well-established routines and norms" is characterized by the three quality features outlined below in the classrooms under study.

#### *5.2.4.1 Discussion-Oriented Seating Arrangements*

In line with the instructors' teaching philosophies, students could choose their classroom seats sitting in a big circle (Smith, Lee) or in a horseshoe shape (Brown). Classroom studies found that tertiary students prefer horseshoe and semicircle seating (e.g., McCroskey & McVetta, 1978) and that seating arrangements including desk arrangement influence the interaction that takes place in the classroom (Atwood, Turnbull, & Carpendale, 2010). One interviewee provides an example from Mr. Brown's course:

> James' group was always set up in a bit of a horseshoe shape that worked fairly effectively for what needed to happen. But very quickly, it would always break down into those small groups as people moved their chairs around. I think he used the space well, as effectively as he could have. [Student interviewee I]

These discussion-oriented arrangements do not orient—visually and attentionally—students solely to the instructor but more to one another. The seating arrangements allowed everyone not only to face each other but also to easily rearrange the classroom to utilize the physical space to support students' learning processes.

#### *5.2.4.2 Ground Rules*

Initial ground rules were provided by the instructors (syllabus), modeled in terms of the instructor's behavior in the classroom, and further developed as each course shaped its own normative conditions over time (Bowers, Cobb, & McClain, 1999). The courses started out with students, teaching fellows, and instructors calling each other by their first names. Halfway through each class, Mrs. Lee's and Mr. Brown's courses took a 5–15-minute break for people in class to de-energize and socialize. Class norms such as principles for class discussion, student and instructor roles, regular reflections in order to get a quick read on the class (particularly in Mrs. Lee's course), or behavioral class norms (e.g., prepare, listen, cultivate an open mind, contribute) were either introduced and distributed by the instructor (Smith and Brown case) or developed together (Lee case) at the beginning of the semester. These class norms for participation and talk became part of the common knowledge to underscore the value of active student participation. They were designed to ensure that useful, productive talk was usually generated (Mercer & Hodgkinson, 2008). Overall, these three instructors established classrooms in which students knew that the ground rules allowed and encouraged extended responses, tentative, exploratory contributions and the development of shared understandings. Thereby, different course activities emphasized different ground rules for students to take responsibility to facilitate their own and each other's sense making so that deep learning by the individual and the collective could take place (Mercer & Dawes, 2008).

#### *5.2.4.3 Re-Occurring Teaching Patterns*

The learning process orientation was observable with regard to re-occurring teaching patterns that regulated learning and teaching processes in the three classrooms under study (e.g., Hugener, 2008; Hugener et al., 2009). Figure 5.6 distinguishes between six teaching patterns that occurred repeatedly in these classrooms as the video analysis (coding inventory 6, see Appendix 4) shows. Teaching patterns refer to questions concerned with whether learning content and/or processes are presented (with regard to content: lecturing; with regard to processes: metatalk) or modeled by the instructor (authentic modeling), whether a problem-oriented activity facilitated by the instructor leads to the construction of new conceptual knowledge (guided problem solving), whether the new knowledge is discovered by the students or build collaboratively in the knowledge-building process (independent problem solving), or whether thoughts and solution strategies are shared, compared, and/or discussed together in the whole group to co-construct knowledge (sharing/comparing/discussing).

Figure 5.6 illustrates that independent problem solving (39%) followed by sharing/comparing/discussing in the large group (36%) were on average the teaching patterns that were most prominent in these classrooms. The teaching pattern sharing/comparing/discussing in the large group can be further differentiated with regard to the content of the discussion as the video analysis shows: 32% of the class time refers to disciplinary discussions (discussions about educational concepts and practices) and 4% refer to reflective discussions (i.e., verbal or written reflections on learning content and/or processes in the classroom).

Compared to the other two courses that focused on independent problem solving (40% in Mrs. Lee's course and 55% in Mr. Brown's course)

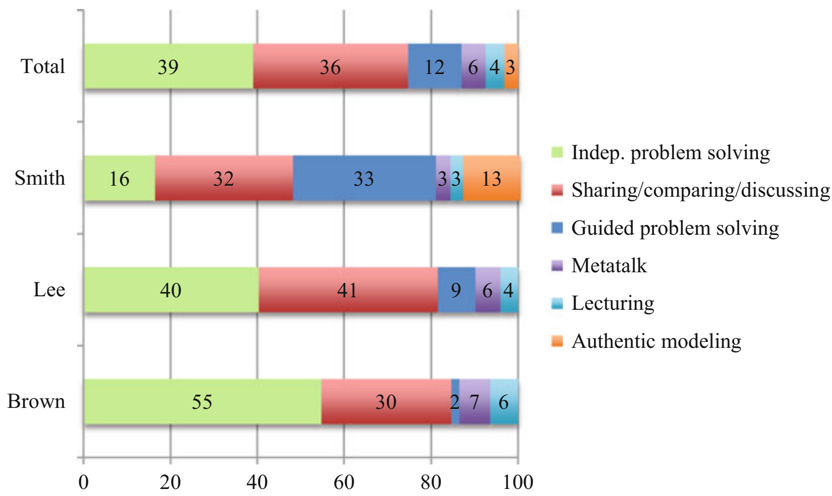


**Fig. 5.6** Re-occurring teaching patterns in the classroom—case comparison (in %)

and sharing/comparing/discussing in the large group (41% in Mrs. Lee's course and 30% in Mrs. Brown's course), Mrs. Smith's course was characterized by guided problem solving (33%) and sharing/comparing/discussing (32%) in the large group with independent problem solving being less prominent (16%). This difference can be in part explained by the fact that the course had accompanying two-hour discussion sections with up to 12 students led by teaching fellows and several fieldwork assignments that specifically promoted independent problem solving and small group discussions.

*Authentic modeling* (3% of the overall class time of all three courses) refers to the instructor modeling activities while the students observe closely to explore certain concepts they have read about and discussed, and to watch certain instructional practices (behaviors) in action. This pattern played an explicit role in Mrs. Smith's course (13%) but not in the other two courses. *Metatalk* (6%) refers to procedural information with regard to the course (e.g., goals, logistics, norms), course activities, assignments, and assessment tasks given by the instructor in order to orient students about the learning process. *Lecturing* (4%) refers to learning content presented by the instructor. *Guided problem solving* (12%) refers to a teacher-led instructional dialogue with the instructor asking genuine questions to structure and facilitate large group or small group explorations of a given problem or question. Thereby the thinking and sense making is up to the students who drive the process. For example, facilitating a collaborative inquiry protocol in the large group in Mrs. Lee's course or collectively looking at a poem to generate a common understanding about it in Mrs. Smith's course. In contrast, *independent problem solving* (39%) refers to ill-structured problems and puzzles that are first introduced and framed by the instructor (problem setup, 6%) and then explored by students independently (individually, in pairs or in small groups) (33%). *Sharing/comparing/discussing solutions*, *ideas*, *noticings*, *questions* in the large group (36%) with the instances moderately the process is a teaching pattern that followed after each of the other patterns outlined above (e.g., after a short lecture, student group demonstration, group exploration) on a regular basis in each course.

### 5.2.5 Open-Ended Assignments and Formative Assessment

Assignments and assessment tasks were designed to help students develop their understandings further and hold them accountable in order for them to achieve the course objectives. The design element “open-ended assignments and formative assessment” is characterized by the three quality features outlined below in the classrooms under study.

#### *5.2.5.1 Open-Ended Assignments*

The syllabus and short handouts outlined affordances and comprehensive guidelines for the assignments designed to capture students’ thinking in the making, and to scaffold students’ individual and collective learning processes throughout the semester (Gresalfi, Martin, Hand, & Greeno, 2009). A combination of open-ended individual and group assignments in each course involved higher-order thinking such as a focused analysis, critical reflection, knowledge application, and knowledge creation in complex authentic contexts that helped students to deepen their understandings and gain practice (Anderson & Krathwohl, 2001). Typical assignments included exploratory fieldwork and individual written elements in the form of fieldwork reports, a final paper, article summaries, and individual reflections (e.g., journaling). The instructors shared power from the start by providing students with open-ended assignments which left room for student choice in terms of topics and questions students wanted to tackle and how they wanted to go about the task.

Students in Mrs. Smith’s course reported in the course evaluation surveys that the assignments in this course supported and reinforced the course goals and promoted learning and growth—the average ratings were higher as compared to the other two courses (see also Sect. 5.1). Continuously preparing and doing the assignments such as the weekly readings was crucial for being a productive class member in these courses and “to get something out of the class.” In Mr. Brown’s course, for example, the reading assignments helped students to gain a deep understanding of different group learning concepts from diverse contexts since they had to come to class prepared and were expected to contribute to the critical discussion of different perspectives in their small article discussion groups, according to the student interviewees.

#### *5.2.5.2 Informative Feedback on Assignments*

The assignments were designed to scaffold students’ individual and collective learning processes with all the different tasks building on and complementing each other. Students received informative feedback on their assignments throughout the semester (from the instructors, teaching fellows, peers) aiding them in their learning. Instead of their being merely subjected to public judgment in the form of grades, feedback on their work enabled students to progress toward challenging learning goals (NRC, 2000). Particularly in Mr. Brown's course, the respondents to the course evaluation survey reported that the feedback they received was timely and helpful for their learning (see also Sect. 5.1). Evaluating students' assignments provided the instructors with valuable feedback on students' understandings, confusions, and struggles and made students' learning visible to the instructors. Understanding what their students understand allowed the instructors to inform their teaching and adapt the next instructional steps (De Corte & Masui, 2009; Duckworth, 1987/2006; Hattie, 2012).

#### *5.2.5.3 Pass/Fail Assessment to Focus on Learning*

As for grades, satisfactory/unsatisfactory was deliberately the only scale used in Mrs. Smith's and Mrs. Lee's course. Mr. Brown let each student choose in the beginning of the semester to take the course pass/fail or for a letter grade. By choosing to apply a pass/fail assessment, the instructors abandoned some of their formal power from the start (Weimer, 2013). Taking the courses as "satisfactory/no credit" courses helped students to focus more on their own learning and to establish a feeling of a community where they could learn in a safe environment that was cooperative rather than competitive and were much freer to make mistakes and learn from their misconceptions and from each other (Zusho & Edwards, 2011; Zimmerman, 2002). Overall, to obtain a satisfactory grade (equals work of B− or better quality), students had to fulfill several assessment tasks throughout the semester: they were expected to attend classes, actively participate in course activities, do the weekly readings as well as writing assignments, submit draft proposals and conduct the final research project, write the final paper, and complete the course evaluation survey.

### *5.2.6 Summary*

How time is used reflects what is valued in the classroom. All of the three courses embody a constructivist pedagogical approach and students had plenty of opportunities to actively participate (see Table 5.9 for an overview of the five curricular design elements).

The *course objectives and content* were challenging and relevant insofar as they challenged students' perceptions to stimulate thinking. The courses emphasized content-related (factual and conceptual knowledge) and process-related (procedural and metacognitive knowledge) classroom

**Table 5.9** Overview of characteristic curricular design elements and related quality features

| *Curricular design element* | *… related quality features* |
|---|---|
| *Relevant and challenging* objectives and content (*high-level learning outcomes*) (5.2.1) | – *Critical* (*self-*)*awareness and an open mind* to challenge current perceptions and stimulate thinking<br>– *Content- and process-oriented classroom talk* to deepen understanding<br>– *Focus on performances of understanding* (concepts and practices) to develop adaptive expertise (pedagogical [content] knowledge)<br>– *Relevant content that connects to both students* (e.g., room for choice, content-related interests) *and education practice* (e.g., guests, field trips, real-world problems) |
| *Flexible* course structures (5.2.2) | – *Overarching agenda with room for variation and joint decision-making* to provide focus and allow for course adjustments based on feedback and formative evaluations<br>– *Alternations of the social form of instructional activities* (66% in the large group, 30% in small groups) |
| *Participation-oriented* course activities and materials (5.2.3) | – *Course activities with high student participation*: on average during 82% of the overall class time (e.g., discussions, explorations, student demonstrations)<br>– *High-engagement student activities* with opportunities for students to actively participate: mainly exploration (39%) and articulation (31%)<br>– *Variety of teacher roles in the classroom*: mainly facilitator of exploratory activities—on average 43% of class time, and moderator of large group discussions (27%)<br>– *Artifacts and materials* as visible documentations of students' current understandings and as testing grounds for ideas (e.g., posters, real-world objects to play around with) |
| *Well-established* routines and norms of interaction (5.2.4) | – *Discussion-oriented seating arrangements* such as sitting in a big circle or in a horseshoe shape to facilitate classroom interactions<br>– *Ground rules* to ensure productive learning (e.g., norms for participation and talk in class to facilitate everyone's sense making, regular reflections on content and/or process)<br>– *Re-occurring teaching patterns*: mainly independent problem solving (39%), guided problem solving (12%), and sharing/comparing/discussing (36%) |
| *Open-ended* assignments and *formative* assessment (5.2.5) | – *Open-ended assignments* that allow for student choice and capture students' thinking in the making<br>– *Informative feedback on assignments* to scaffold students' individual and collective learning processes and make students' learning visible<br>– *Pass/fail assessment* (instead of letter grades) *to focus on learning* and allow students to learn from mistakes in a safe environment |

talk to deepen students' understanding, focused on students' performances of understanding (i.e., educational concepts and practices) involving knowing, doing, and reflecting, and provided connections to students (e.g., prior knowledge, interests, experiences), education practice and to the wider community.

The *course structures* were flexible enough to combine focus and guidance (e.g., course syllabus, guidelines, materials) with variation and joint decision-making in terms of both learning content and process in order to take students' prior knowledge, interests, and experiences into account (e.g., negotiating course objectives, content and investigation paths, course re-adjustments based on student feedback). The syllabi in the three courses explicitly made room for changes during the semester (revisions) in order to provide leeway for student engagement and participation and to flexibly respond to what was going on in the classroom. Instructor metatalk was especially prominent at the beginning of the semester when the instructors presented a comprehensive overview of the syllabus and the different course components, explained assignments (e.g., fieldwork, journaling, article summaries) and managed organizational issues (e.g., seating arrangements). The distribution of class time shows that all of the three courses favored class-level activities (on average 66%) followed by group work (on average 30%). The frequent variations of the social form of instructional activities provided opportunities for bodily movement and social interaction with different people in class, while also tailoring to different learning styles and interests.

*Participation-oriented course activities* provided various opportunities for students to actively engage in their learning processes in the classroom and accounted for 82% of the overall class time in these three courses. Teacher- or student-led explorations (40%), large group discussions (30%) and—to a minor extent—lecturing (14%, including instructor metatalk) were the three most prevalent course activities in each case. Accordingly, the main student activities in these classrooms involved student exploration (39%) and student articulation (31%). The instructors acted mainly as facilitators of course activities (43%) and as moderators of discussions (27%).

*Well-established routines and norms of interaction* helped to clarify expectations and underscored the value of active student participation in these classrooms. Discussion-oriented seating arrangements (big circle, horseshoe shape) promoted student-to-student interactions and allowed instructors to utilize the physical space to support students' learning processes (e.g., rearranging the furniture). Ground rules such as calling each other by the first name, principles for class discussion, defined student and instructor roles (syllabus), regular individual reflections at the end of class, or behavioral class norms (e.g., prepare, listen, cultivate an open mind, contribute) indicated to students what was valued and how things were done in these classrooms. Re-occurring teaching patterns constitute routines that regulate learning and teaching processes in the classroom in order to support students' deep learning processes. Five to six teaching patterns were found in these classrooms with independent problem solving (39%), guided problem solving (12%), and sharing/comparing/discussing (36%) being the most prominent ones on average. Guided problem solving was prevalent in Mrs. Smith's course (33%; independent problem solving: 16%) as opposed to Mr. Brown's course with independent problem solving accounting for 55% of the overall class time (guided problem solving: 2%). Independent problem solving accounted for 40% of the overall class time (guided problem solving: 9%) in Mrs. Lee's course.

*Open-ended assignments and formative assessment* were accompanied by short handouts with affordances and comprehensive guidelines that left room for student choice in terms of topics and questions students wanted to tackle and how they wanted to go about the task. Assignments were designed to capture students' thinking in the making; at the same time, continuous informative feedback scaffolded individual and collective learning in the classroom and provided the instructors with valuable feedback to inform their teaching. The focus was on continuous student learning—grades played only an inferior role in these pass/fail classes.

Apart from that, the analysis of course evaluation data shows that students perceived particular strengths of the three courses with regard to different course design elements and features (see Sect. 5.1). The quality of readings and assignments was rated highest in Mrs. Smith's course. Mrs. Lee's course had particular strengths with regard to establishing an environment conducive to learning by providing students with opportunities to apply new knowledge and to learn from each other (e.g., through discussions) and by establishing a positive teacher–student relationship (respect, encourage diversity, accessibility). Mr. Brown's course was perceived as being successful in clearly stating and aligning objectives, activities, readings, and the syllabus constructively. Well-structured presentations, helpful and timely feedback on course assignments, and technology uses that were valuable for learning were also characteristic for this course according to students' course ratings.

Against this background, the data-based outline of characteristic curricular design elements and related quality features emphasized in these classrooms informs the deeper-level analysis, because how the course elements are designed influences the potential learning opportunities that can unfold in these classrooms. Apart from course design decisions, the instructors' knowledge, beliefs, and expectations influence their talk and subsequent actions in the classroom in terms of the learning opportunities they create for their students and how they position students in the classroom interactions (Rex & Schiller, 2009). The following sections will present a deeper-level analysis of how the student-centered design is brought to life in the classroom to allow for a better understanding of the learning opportunities that these SCLEs provide.

## 5.3 Deeper-level Instructional Quality Dimensions and Features

The following cross-case analysis outlines the deeper-level instructional quality dimensions and features that the three classrooms under study have in common. Findings of the single case analyses (Hoidn, 2010a, 2010b, 2011)[7] are synthesized and structured by the situative analysis framework introduced in Sect. 4.4.3.2 (Fig. 4.2). The latter differentiates between both classroom teaching and learning (content focus) and classroom interaction and climate (context focus). Table 5.10 provides an overview of the quality dimensions—underlying patterns and practices that emerged consistently in the naturalistic student-centered higher education classrooms under study—that were identified and inform the development of the educational model (see Chap. 6). Finally, Table 5.15 at the end of this chapter provides an overview of the deeper-level instructional quality dimensions and features as well as teaching and learning challenges synthesized in the following section.

The comparative qualitative analysis in Sect. 5.3.1 outlines what relevant and intellectually challenging learning content appeared to have been constructed in these classrooms and what affordances the learning tasks required. The findings provide additional answers to the empirical research sub-question 2a, on *curricular design elements* (objectives and content, assignments).

Section 5.3.2 addresses the empirical research sub-question 2b: *How do the instructors scaffold participatory processes of knowledge construction?* The instructional deeper-level quality features of the following re-occur-

**Table 5.10** Overview—cross-case analysis of deeper-level quality dimensions and features

| Research interest | *Learning content* focus | *Learning context* focus | | |
|---|---|---|---|---|
| | What was learned? | Supporting students' knowledge construction processes | Positioning of students for participation in interactions | Cultivating a classroom community of learners over time |
| | 5.3.1 Content and task affordances (refers to empirical research sub-question 2a) | 5.3.2 Participatory processes of knowledge construction (refers to empirical research sub-question 2b) | | 5.3.3 Classroom community of learners (refers to empirical research sub-question 2c) |
| Quality dimensions—overview | Relevant and intellectually challenging learning *content* (learning outcomes)<br>Affordances of the learning *tasks* | Constitutive teaching patterns in these classrooms:<br>*Facilitating* students' (joint) explorations<br>– *Independent* problem solving (small inquiry groups)<br>– *Guided* problem solving (large group)<br>*Moderating* knowledge sharing and discussions<br>– *Disciplinary* discussions<br>– *Reflective* discussions<br>*Lecturing* (including metatalk) and *modeling* while students listen, observe, and ask questions | | *Intellectual climate* of active sense making<br>Iterative cycles of *feedback* to further student learning<br>*Positive emotional climate* of mutual respect, trust, and belonging |
| Research interest | 5.4 Teaching and learning challenges of student-centered classrooms (refers to empirical research sub-question 2d) | | | |

ring teaching patterns (quality dimensions) constitutive of the prevalent course activities in the student-centered classrooms under study are discerned:

- Facilitating students' (joint) explorations (independent and guided problem solving);
- Moderating knowledge sharing and discussions (disciplinary and reflective discussions);
- Lecturing (including metatalk) and modeling.

Section 5.3.3 refers to *how the instructors cultivate a classroom community of learners over time* (empirical research question 2c). The following common quality dimensions are discussed based on the single case analyses: intellectual climate, iterative cycles of feedback, and positive emotional climate.

### *5.3.1 Learning Content and Task Affordances*

Learning is more effective when students perceive the subject matter they are learning about to be interesting, challenging, and relevant to their present and future lives (Barnes, 2008). This section synthesizes the ways in which the content of the three courses under study was intellectually challenging and relevant (Sect. 5.3.1.1) and the affordances that the tasks presented to foster learning (Sect. 5.3.1.2) based on the findings of the single case analyses.

#### *5.3.1.1 Relevant and Intellectually Challenging Content*

In SCLEs, students learn knowledge that is intellectually challenging and relevant with the learning content fostering performances of conceptual understanding (concepts and authentic practices) and transfer, SRL and identity development of both students and the classroom community as a whole (Anderson & Krathwohl, 2001; Bielaczyc & Collins, 1999; Bielaczyc et al., 2013; NRC, 2000, 2005; Tobias & Duffy, 2009).

1. Performances of conceptual understanding (disciplinary concepts and practices) and transfer

The courses aim to help students to develop a thorough understanding of important conceptual ideas and frameworks in their field of study, education, and to develop a rich collective knowledge base over time (e.g., Bergan, 2006). The student teachers in these three classrooms explore, discuss, and reflect upon constructivist ideas, concepts, principles, and procedures in the science of education to develop integrated knowledge structures so that knowledge can be retrieved, applied, and transferred to real-world settings (Anderson & Krathwohl, 2001; NRC, 2000, 2005; Sawyer, 2008, 2014a). Students acquire factual and conceptual knowledge, that is, basic elements and their interrelationships students must know to be acquainted with a discipline and to solve problems. The course content focuses on selected constructivist educational concepts and ideas in teacher education such as the research/teaching approach "Critical Exploration in the Classroom" and similar inquiry approaches that aim to foster students' sense making (Smith case), different types of protocols for collaborative inquiry to look at and evaluate student work and inform one's teaching (Lee case), and social-constructivist concepts of effective group learning in different contexts and paradoxes inherent in group work (Brown case).

The student teachers also apply educational routines and methods and enact disciplinary norms by engaging in collaborative and discursive activities (procedural knowledge, that is, methods of inquiry and discourse together with criteria for these methods) that allow them to develop conceptual agency (i.e., the result of a process depends on choices that the agent makes; Pickering, 1995). The participation-oriented course activities (e.g., engaging in critical explorations [Smith case], collaborative inquiry or reading discussions using protocols [Lee case], experiential practices using video material [Brown case]) require students to engage in authentic teaching practices that are similar to the everyday activities of educators (Sawyer, 2014b). Students can activate their existing ideas, (mis)conceptions and competences that are honored as productive sources to delve deeper into the subject matter and develop performances of conceptual understanding (i.e., professional knowledge, see Sect. 3.4.3.1) that they can later flexibly transfer to real-world educational contexts. Through the experience of grappling with and acting upon complex real-world pedagogical problems central to a teacher's professional life, the students have opportunities to contribute their own ideas, puzzles, confusions, and questions to drive the path of inquiry during explorations and class discussions—often with the use of artifacts that function as visualizations and testing grounds for students' ideas (Bielaczyc et al., 2013; Gresalfi et al., 2009).

2. Self-regulated learning

Students in student-centered classrooms develop an awareness of and knowledge about their own and others' motivation, cognition, and ways of learning (metacognitive knowledge; Zimmerman, 2008). The instructor provides prompts and hints (e.g., guidelines, open-ended questions, exploration strategies) that gradually fade as students gain more practice in actively constructing knowledge (Pea, 2004; Wood, Bruner, & Ross, 1976; see Sect. 2.3.5). At the same time, students are provided with elements of choice and responsibility for their own and each other's learning processes (e.g., choosing a final paper topic, focusing on one reading of their choice for in-depth discussions, conducting independent fieldwork, contributing questions for discussion, monitoring one's airtime). They are encouraged to set some of their own learning objectives depending on their prior knowledge and interests and adopt strategies for attaining these objectives (Duffy, 2009). They actively monitor and evaluate their current level of understanding and practice, remedy gaps in their knowledge, and act upon their new insights (e.g., take instructor feedback into account, figuring out how to be a more productive group member, practicing principles for discussions; Bielaczyc & Collins, 1999; Pintrich & Zusho, 2002).

The instructors balance external and internal regulation since the share of students' opportunities to self-regulate grows with time, with the students taking on more active and responsible roles in these classrooms so that they can develop a sense of agency over their learning (e.g., conducting independent fieldwork in Smith's course, taking on the roles of teacher presenters and facilitators of protocols in Lee's course, self-organizing in small article discussion groups and managing cognitive and relational tensions in a productive way in Brown's course). The instructors provide ample room for students' involvement in joint curricular decision-making processes since they participate in restructuring the physical and social environment to make it more compatible with their goals and needs (Zimmerman, 2008). Students are co-designers of the curriculum and assume responsibility for the ways in which it is enacted in the classroom. They engage in reflective discussions (metatalk), receive and give oral/written feedback and act upon it (Hattie, 2009, 2012; Weimer, 2013). The learning environments aim to foster not only (meta-)cognitive self-regulation strategies but also students' self-regulation of motivation in order to satisfy students' basic human needs for competence, autonomy, and social relatedness, as well as the adoption of learning goals (instead of performance goals) and high self-efficacy beliefs (Deci & Ryan, 2002; Niemiec & Ryan, 2009; Schunk & Zimmerman, 2007; Zusho & Edwards, 2011).

3. Identity development
The student teachers in these courses develop new epistemological beliefs and subjective theories about constructivist learning and instruction and become enculturated as participants in a disciplinary community with certain disciplinary practices, routines, and norms of interaction (Brown, Collins, & Duguid, 1989; Collins & Greeno, 2011; Collins, Brown, & Newman, 1989). They gain a greater disciplinary awareness of their own teaching conceptions and assumptions that influence their instructional behaviors as prospective teachers (metacognitive knowledge) (Biggs, 2012; Prosser & Trigwell, 1998). The constructivist philosophy and pedagogical design that are enacted in these classrooms require student teachers to actively engage with new concepts and practices and rethink their current ideas about education, learning, and teaching (Biggs, 1999; Duffy, 2009; Ramsden, 2003). The students read about constructivist educational ideas, experience their implementation in a classroom firsthand as the instructors "walk their talk" (e.g., they model certain behaviors), and gain firsthand insights into their own and others' ways of thinking and learning during their fieldwork.[8]

The different authentic practices students engage in aim to support them in developing identities as competent and responsible learners. As the semester moves on, they gradually move toward becoming more fully participating and increasingly productive members of the class community as well as more reflective learners and teachers (Collins & Greeno, 2011; Lave & Wenger, 1991). As central and respected members of the community students contribute their expertise to advance the work of the collective, apply principles for class discussion and collaborative work, take on different active roles in the classroom (e.g., presenter, collaborative inquiry facilitator, discussion group leader), and aim to maintain learning-focused relationships with their classmates.

#### *5.3.1.2 Affordances of the Learning Tasks*

The affordances of the learning tasks are of particular importance in order to foster students' performances of conceptual understanding and transfer as well as SRL and identity development. How the instructors design the learning tasks influences the opportunities students have to engage with content and experience and develop competence. The openness of a task creates affordances by structuring both the kinds of educational knowledge that students have opportunities to build and use (learning content) and the ways that knowledge gets constructed (learning process) (Greeno, 2009; Gresalfi et al., 2009; Pickering, 1995). Instructors in the three student-centered classrooms under study pose tasks that actively involve students in their academic experience and provide them with choices trying to meet students where they are in terms of their academic preparation and motivation (NRC, 2000; Ryan & Deci, 2002; Sawyer 2014b). Based on the empirical findings of the three case studies, the learning tasks incorporate the following quality features (Anderson & Krathwohl, 2001; Pickering, 1995; Stein, Smith, Henningsen, & Silver, 2000):

- high levels of cognitive demand of the tasks;
- conceptual agency students can demonstrate as they complete the tasks;
- productive talk students can engage in as they complete the tasks;
- the practical relevance of the aligned tasks (authenticity);
- making sure that students understand the task (content/objectives and process).

1. Tasks with High Levels of Cognitive Demand

Intellectually challenging tasks promote higher-order thinking such as constructing meaning, carrying out or using procedures, breaking material into constituent parts and determining how the parts relate to one another, making judgments based on criteria and standards or reorganizing elements into a new structure; these challenges are essential for developing deep conceptual understanding. Learning tasks with high cognitive levels of complexity (e.g., analyzing, applying, evaluating, or creating) have the potential to cognitively activate and motivate students to engage in SRL since they require them to explore, discuss, and evaluate multiple solution paths and come to their own conclusions (Anderson & Krathwohl, 2001; Greeno, 2011; Gresalfi et al., 2009; Klieme, Pauli, & Reusser, 2009). By presenting students with challenging tasks and making their expectations clear (e.g., instructor metatalk, activity guidelines, genuine, open-ended questions for the students to work on), the instructors prompt the adoption of understanding-oriented goals (mastery goals) and high self-efficacy expectations of students and thus, high levels of cognitive processing (e.g., Atwood et al., 2010; Hattie, 2012). Mr. Brown, for example, clearly communicates his expectations for students in their small article discussion groups to generate answers to guiding questions, share views, generate ideas and new questions, examine and justify propositions, and come to joint understandings that the groups later share with the large group.

The open-ended tasks enable active disciplinary engagement with course-related educational topics, ideas, and questions and allow for student voice and often choice in how (and often with whom) to conduct a task. Students can focus on topics and questions that interest them and tap their understandings in order to make sense out of the educational phenomena they are studying (Weinbaum et al., 2004). The instructors present the students with one or more initial open-ended question(s) (e.g., three genuine questions for the article discussion groups to work on in Mr. Brown's course), procedures for the course activities (e.g., three-step routine for exploring ideas in Mrs. Smith's course, protocol steps and thinking routines in Mrs. Lee's course), and materials embodying subject matter (e.g., poem, student work, readings) to support joint knowledge construction processes.

The challenging tasks are structured enough to help students to focus their attention and avoid negative feelings due to frustrations with too prescriptive or too loose task structures. They are designed to foster different types of knowledge, that is, factual, conceptual, procedural, and metacognitive knowledge, and to foreground structural features of the situation (e.g., focus on specific educational concepts, strategies) that the instructor wants students to understand and talk about (Anderson & Krathwohl, 2001; Greeno, 2009). The protocol-driven facilitation with comprehensive protocol steps that student groups have to follow in Mrs. Lee's course, for example, helps to keep conversations focused, productive, and positive, and gives students in class the possibility to equally contribute.

2. Tasks Foster Conceptual Agency

Open-ended tasks with high levels of cognitive demand also require students to exercise conceptional agency with students being positioned as competent and accountable to the discipline as opposed to disciplinary agency with students having to recall facts or definitions and merely execute procedures of a discipline correctly (Atwood et al., 2010; Pickering, 1995). Tasks that afford students with conceptual agency encourage them to problematize substantive educational issues and allow them to take initiative in constructing meaning and understanding of the concepts and methods that they are learning about (Engle, 2006). The open-ended tasks together with the classroom routines and norms communicate high achievement expectations to students insofar as they require them to actively try to make sense of what they are learning and hold them accountable to disciplinary knowledge and reasoning (Gresalfi et al., 2009; Michaels, O'Connor, & Resnick, 2008; Resnick, Michaels, & O'Connor, 2010). They support students' intellectual activities by positioning them with productive agency in classroom activities in relation to the subject matter they learn about and to each other (Greeno, 2011; Michaels et al., 2008; Pickering, 1995). Guiding questions, routines, posters, and articles for discussion in Mr. Brown's course, for example, provide support structures for students to co-construct knowledge and understanding without much instructor interference (e.g., Mercer, Hennessy, & Warwick, 2010). The metalanguage the instructors use when framing a task/activity is consistent with their educational beliefs and goals as educators (e.g., polite and inclusive language: "I am gonna invite you," "we," "us").

The instructors' actions thus presuppose that students are competent to work productively on the task. In Mrs. Lee's or Mr. Brown's course, for example, students get individual thinking time to choose a reading they prepared for class and self-organize in small groups to discuss a particular reading applying a thinking or discussion routine the instructor introduced earlier to structure their joint knowledge construction processes. Yet, the productive structures the instructors put into place allow for enough flexibility to give students choices and a chance to create and own ideas around the subject matter based on students' current understandings. Students have to relate new ideas, experiences, and information to what they already know and understand and come up with their own reasoned answers in order to develop their thoughts about the subject matter further. After their initial engagement with the inquiry process and in the context of home assignments (e.g., fieldwork), students are expected to continue to pose their own questions. Thus, the learning process is mainly driven by the ideas and questions students contribute as they struggle to make sense of an educational concept or practice positioning them with authority to support their views with reasons, prompt them to discuss differences of interpretations, and hold them accountable as they are required to convince both the instructor and their peers that their ideas make sense (Engle & Conant, 2002; Engle & Faux, 2006; Greeno, 2011; Gresalfi et al., 2009; Mercer & Howe, 2012).

3. Tasks Require Productive Talk

The social framing of the learning context is important since it influences students' choices on whether to engage in deep or surface learning (e.g., Biggs, 2012; Engle, 2006; Engle & Conant, 2002; Engle & Faux, 2006).

In the classrooms under study, students are positioned as responsible co-constructors of knowledge in a classroom community of learners (Greeno & Engeström, 2014). Thus, the learning tasks focus on both the expansion of opportunities for participation in a social context and the development of an identity as competent and responsible learners and prospective teachers (Engle, 2006; Greeno, 2009).

Tasks that require productive talk allow students to participate meaningfully in inquiry, discourse, and reasoning in order to construct shared understandings of the subject matter. Students have opportunities to engage in legitimate peripheral participation with learning manifesting itself in more effective participation in activities that are shaped by the different practices in the discipline students learn about (Greeno, 1997, 1998; Gresalfi et al., 2009; Lave & Wenger, 1991). Open-ended tasks incorporate participant structures that leave room for student choice and student contributions that induct them into educational practices with the instructors facilitating students' participation in these practices. In this context, assigned readings, guiding questions and routines (e.g., protocols, discussion principles, and thinking routines) help not only to reduce the complexity of the task but they also lower the barrier to entry for the students to share their thoughts out loud and to think and talk in class early on in the semester (Michaels et al., 2008; Ritchhart, Church, & Morrison, 2011).

Participation structures that allow for student collaboration to work on problems and develop mutual understandings also contribute to the development of students' identities. The independent inquiry groups in Mr. Brown's or Mrs. Lee's course encourage students to make themselves clear so that others can follow their sense making. They also provide students with the opportunity to experience validation of their contributions by peers and by the instructor (Greeno, 2011). Small groups engaging independently in collaborative inquiry applying protocols in Mrs. Lee's course, for example, require students to work *as* groups and not merely *in* groups, that is, they do encourage and require students to listen, work together, and grapple with each other's ideas to ensure that classroom-based talk is of high educational value (Atwood et al., 2010). The structure of the protocol together with specific ground rules in Mrs. Lee's course communicate to students what they are expected to do when engaging in collaborative inquiry (Mercer & Dawes, 2008; Mercer, Dawes, & Kleine Staarman, 2009).

Routines and norms of interaction (ground rules) communicate to students that active participation in the practices of the domain is valued and expected and distribute responsibility for different aspects of the activity among the participants (division of labor). They provide guidelines for students to engage in productive talk (e.g., listen attentively, attend to and build on each other's thinking) since they generate a common understanding about what students in these courses do in order to learn deeply (Mercer & Dawes, 2008). Tasks and related activities that resemble the actual practices of the knowledge domain students learn about also aim to motivate students to strive to participate more meaningfully in the knowledge practice of those communities (Collins & Greeno, 2011; Greeno, 1998; Hickey & Zuiker, 2005). Ground rules are resources that set the stage for holding the students accountable to disciplinary standards of inquiry (protocol steps, norms) and to each other's contributions and ideas (Engle & Conant, 2002; Mercer & Dawes, 2008).

4. Constructively Aligned Tasks with Practical Relevance

The instructors of these classrooms provide students with authentic assignments/assessment tasks that are of practical relevance and constructively aligned with course goals and assessment tasks (Biggs, 1999, 2012; Whetten, 2007). By linking course activities to learning goals, for example, the concepts or practices that are to be learned, the course activities become a vehicle for student learning with a focus on performances of understanding (Blythe & Associates, 1998). Students are provided with educational problems represented in concrete authentic form (object) such as a poem, a student work sample, or a video clip showing a real group situation. In addition, the instructor poses one or more initiating open-ended questions for exploration and/or discussion. Role plays (e.g., visual essay) and sometimes video clips in Mr. Brown's course, for instance, represent authentic educational situations that function as pivotal stimuli for subsequent student learning. The authentic tasks are designed to establish connections with both scientific ideas (e.g., readings, concepts, theories) and students' life and work contexts as prospective teachers and allow students to jointly think about and apply concepts to authentic educational situations. In addition, home assignments (e.g., fieldwork, final paper) require students to independently apply and transfer factual, conceptual, and procedural knowledge constructed in the classroom to other contexts outside of the classroom (Engle, 2006). Teacher demonstrations in Mrs. Smith's course, for example, helped to establish links to school practice since the instructor brought in children and high school students to demonstrate and share how to implement constructivist pedagogical ideas with real learners. In addition, authentic case studies the students read in preparation for the class, the instructors' own stories and experience with inquiry work in schools, and invited school teachers sharing their teaching experiences and the difficulties they face in real school settings emphasized the activity's relevance to school practice and teachers' professional development.

5. Ensuring that Students Understand the Problem and the Learning Activity

Instructors in student-centered classrooms make sure that students understand the initial question(s) or problem statement, the purpose and procedure of the activity they are about to engage in and what is expected of them. They provide illustrative real-world examples and demonstrations, lay out how they plan to facilitate the group's learning and rephrase or repeat parts of their explanations during activities to help students understand. Classroom routines and norms of interaction (e.g., principles for class participation or talk) play an important role since they carry messages about how members of the class are expected to interact with each other to facilitate the co-construction of knowledge (Leinhardt & Steele, 2005; Mercer & Dawes, 2008). As the semester progresses, these routines and norms become common knowledge helping to ensure that useful, productive talk is usually generated and that students in class develop a sense of community and collective identity.

After framing a course activity the class is about to embark on, the instructors allow room for student questions about the content and process of such participation-oriented activities. The instructors ask genuine questions like the following: "Makes sense?," "Any questions?," "Everyone clear of what we are doing?," "Are there any (other) questions?," or "Is everybody clear about those three steps?" to explicitly invite student contributions. Students have the opportunity to provide comments or ask clarifying, probing, and information questions which the instructors then answer (e.g., explaining the reasoning behind instructional decisions) to make sure that all students understand the objectives and process of a task and activity and feel oriented in terms of what they are expected to do.

It is crucial that students understand the task at hand before they start to engage in a course activity that requires high student engagement because the initial question posed by the instructor does not have one correct answer or one correct path of learning. Students have to understand the problem at hand in order to set/adopt adequate learning goals, activate prior knowledge and positive motivational beliefs, and make informed choices as they actively participate in the activity. Understanding the task and the activity is essential in order for students to come up with their own thoughtful answers in the light of different perspectives and to engage in socially shared regulation in their small groups (Duckworth, 1987/2006; Järvelä & Hadwin, 2013).

### 5.3.2 *Participatory Processes of Knowledge Construction*

The participative nature of the three courses allows the students to engage in active sense making—either individually or collaboratively. The instructors balance "authoritative" talk with "dialogue" by creating an array of opportunities to engage students productively in constructing knowledge (e.g., Engle & Conant, 2002; Mortimer & Scott, 2003): across all of the three courses under study, the students explored in 39% and discussed in 31% of the overall class time. Students' engagement in listening/observing (receptive behavior) accounted for 23% and reflective student activities accounted for 7% of the overall class time (see Sect. 5.2.3, Fig. 5.4). The following cross-case analysis provides integrated answers to the question of how the instructors *scaffold participatory processes of knowledge construction* referring to both students' knowledge construction processes and the positioning of students for participation in interactions (empirical research subquestion 2b). The empirical case analysis findings show that the instructors provide adaptive learning support by facilitating students' (joint) explorations (Sect. 5.3.2.1), moderating knowledge sharing and discussions (Sect. 5.3.2.2), and acting as lecturers and role models (Sect. 5.3.2.3). These three quality dimensions (i.e. re-occurring teaching patterns) emerged consistently in the classrooms under study. The deeper-level quality features (i.e. instructional strategies) that constitute them are presented below.

#### *5.3.2.1 Facilitating Students' (Joint) Explorations*

Students perceive learning as an inquiry process working on challenging tasks that leave space for student choice. Students' ways of encountering and apprehending the material are at the center of learning and teaching—the burden is on the students to work out for themselves what they think and why. Explorations that took place in these classrooms can be characterized as (teaching patterns, Sect. 5.2.4, Fig. 5.6):

- *independent problem solving* (on average 39% of the overall class time), mainly done in small inquiry groups, refers to ill-structured problems and puzzles that are first introduced and framed by the instructor (problem setup, 6%) and then explored by students independently (individually, in pairs or in small groups; 33%) and
- *guided problem solving*, mainly done in the large group (on average 12% of the overall class time), refers to a teacher-led instructional dialogue with the instructor asking genuine questions to structure and facilitate large group or small group explorations of a given problem or question.

Exploratory course activities require students—in small groups or in the large group—to deeply engage and grapple with their own and each other's ideas, synthesizing multiple viewpoints and authors in a variety of contexts in order to construct relevant content in their common ground. The conventional pattern of classroom discourse (IRE pattern; Cazden, 1988; Mehan, 1979) is shifted to one of posing a problem or open-ended question (query) and exploring, presenting, and discussing students' ideas and questions to facilitate students' thinking. The common *deeper-level instructional strategies* that are embodied in facilitating students' (joint) explorations are summarized below (see Table 5.11 for an overview).

(a) Independent problem solving in small inquiry groups
The following deeper-level instructional strategies were found to be embodied in the context of facilitating independent problem solving in small inquiry groups in the three classrooms under study—drawing mainly on data from Mrs. Lee's (40% of the overall class time was spend engaging in independent problem solving) and Mr. Brown's (55%) courses (see Sect. 5.2.4, Fig. 5.6).

*Fostering student autonomy and accountability to invite self-regulated learning*
Students have the autonomy to pick course-related educational topics, materials, and questions (e.g., readings, sample student work, questions they want to explore more deeply in their groups) that are personally meaningful, interesting, and relevant to them and self-organize around their interests in their small inquiry groups and home assignments (e.g., fieldwork, final paper). Students are required to engage in self-regulatory processes (planning, monitoring, evaluating, and regulating) in their inquiry groups

**Table 5.11** Deeper-level instructional quality features to facilitate students' (joint) explorations

| *Quality dimension* | *Instructional strategies* |
|---|---|
| (a) Independent problem solving in small inquiry groups | – Fostering student autonomy and accountability to invite self-regulated learning<br>– Engaging students in small inquiry groups to co-construct knowledge together<br>– Making students' thinking visible to facilitate shared understandings<br>– Keeping students struggling to make sense to deepen their understandings<br>– Sampling the level of the groups' discourses to inform one's teaching |
| (b) Guided problem solving in the large group | – Orienting structures, guiding norms, and modeling behaviors to clarify expectations<br>– Open-ended questions and prompts to develop students' thoughts further<br>– Ensuring mutual understanding to enable joint knowledge construction<br>– Thoughtful and appreciative responses to invite different ideas and voices |

to collectively regulate activity through the group's joint decisions (Järvelä & Hadwin, 2013; Zimmerman, 2008). Each group collaboratively clarifies the goals and standards for the task at hand along with the procedures and strategies it will use within the boundaries of the task the instructor framed. Group members also synthesize their learning to attain the group's outcome in the time span given—often with the use of artifacts—and gain more and more hands-on experience in structuring the educational practices they engage in as the semester progresses (e.g., collaborative inquiry, exploring educational concepts with the use of guiding questions or protocols). Each group's opportunities to engage in autonomous activities promote students' self-reliance and the development of cognitive and metacognitive co-regulation in small groups (Järvelä et al., 2015).

Students also get to take over more and more active roles as authors in the classroom (e.g., article summarizer in Mr. Brown's course, presenting teacher in Mrs. Lee's course) as the semester progresses and feel accountable to make sure that productive learning is going on in their groups and increasingly comfortable to articulate ideas, questions, concerns, and confusions they have, sharing their points of view and critically reflecting on their learning. Ground rules for inquiry and participation ensure shared understandings of how to prepare and engage productively in joint problem-solving processes. They hold students accountable with regard to both the subject matter (e.g., engaging with the readings, doing assignments, sharing what they know, engaging in reasoning) and their peers (e.g., engaging with multiple viewpoints) in order for them to be able to meaningfully and actively participate in constructive activities that involve deeper levels of processing. Since tasks are linked to students' interests and needs, it is more likely that students transfer what they have learned to other contexts in their personal, academic, and social life (Greeno, 2009; Michaels et al., 2008). Through their active engagement and reflections (e.g., activity debriefs), students become increasingly metacognitively aware of the value of their own contributions to the group's collective knowledge construction in terms of being a productive member of the community of learners in their classroom (e.g., Bielaczyc et al., 2013; Collins & Greeno, 2011; Greeno & Engeström, 2014).

*Engaging students in small inquiry groups to co-construct knowledge together*

Student-driven group explorations provide opportunities for students to make meaning of the knowledge and concepts they encounter, to raise issues and tackle their own questions, and to take on responsibility for their own and others' learning progress. Jointly engaging in educational practices allows students to enhance their ownership for learning, maintain their sense of agency, and make intellectual contributions that are driven by their curiosity and insights (Cornelius & Herrenkohl, 2004; Engle 2006, 2011). The instructors support student agency by providing students with ample time to engage with the subject matter (problem) and by adjusting the lesson or syllabus to talk more about challenging topics and questions that students raise.

In their small inquiry groups (e.g., doing exploratory activities or group protocols), students engage in cooperative interaction in the form of "exploratory talk," a type of talk where learners co-construct the reasoning process by building onto, extending and questioning each other's contributions in a rather "teacher-free" dialogic context (Mercer, 1995; Mercer & Dawes, 2008; Mercer & Howe, 2012). Students try out their own ideas and explain what they think and why to each other to see how what they say holds up in other people's eyes, in their own eyes, and in the light of the educational concepts they are trying to understand and thereby gain greater clarity for themselves (Duckworth, 1987/2006).

They develop a meaningful understanding of theoretical concepts and their connections and differences through their joint explorations because the students are the ones who make sense and prepare joint responses in their small groups. They have the authority to tap their knowledge and make their use of reasoning explicit and thus are open to scrutiny and evaluation in the light of publicly available bodies of knowledge (e.g., questioning one's own assumptions and the assumptions of others, outlining reasons for claims, making explicit evaluations and critiques) (Mercer, 1995).

Students in their small inquiry groups also have the opportunity to engage with the varied perspectives and experiences of their classmates and examine their own and other people's thinking to further their understandings ("thinking in the making"). They gain new insights from bouncing ideas off of each other and feel challenged to think more deeply by their peers. Students explain tentative ideas with reasons and try to understand one another's positions to reflect on their perspectives and develop knowledge together. Thus, the students can develop a deep understanding about various ways to go about puzzles/questions as they experience the different ways in which other people grapple with questions and ideas (Barnes, 2008; Mercer & Littleton, 2007).

*Making students' thinking visible to facilitate shared understandings*

Artifacts such as readings and video clips function as pivotal stimuli for students' explorations, reflective criticism, and evaluations of educational concepts and authentic educational situations. The instructors also elicit students' articulation of their thoughts by having them produce posters and other visible illustrations of their ideas, questions, and conclusions in their small groups and share them with the large group. Such visible materials and artifacts allow students to document their ideas, self-observe and monitor their joint knowledge construction processes (Hattie 2012; Zimmerman & Schunk, 2011). As the semester progresses, the groups are increasingly free to explore how they visualize their findings in order to subsequently share them with the whole group.

The materials students work with often also work as the proving ground against which they assess their own and each other's ideas and claims to develop shared understandings (e.g., student work distributed in Mrs. Lee's course). Thus, the materials are the source of authority not solely the instructor or other outside experts (Duckworth, 1987/2006). Making students' thinking visible also allows the instructors to observe and assess each student group's level of understanding and progress in exploring important educational concepts and thus, to follow students' thought processes without direct intervention. Based on their observations, they can then decide on appropriate scaffolds to further the students' thinking (English & Kitsantas, 2013).

*Keeping students struggling to make sense to deepen their understandings*
The independent problem-solving activities the class works on are often new and anxiety provoking for the students and evoke different feelings and comfort levels for different students. Students have to offer tentative (partly developed) thoughts for joint consideration and experience cognitive as well as relational tensions in the midst of learning and with unanswerables (e.g., inquiry groups and critical video case observation in Mr. Brown's course). The lack of "definite answers" requires students to keep wrestling with ideas and questions making them uncomfortable at times as they have to temporarily live through feelings of uncertainty, frustration, and anxiety before they can arrive at certain understandings through their own thinking. Because of their struggles to make sense and integrate new information into their existing cognitive structures, the student teachers also recognize knowledge as a human construction since they are experiencing constructing their own knowledge firsthand instead of being lectured to (Duckworth, 1987/2006).

The instructors in these student-centered classrooms let the students dwell with their own and other people's thinking and resist "the temptation to rush in to clear things up" [Lee interview] during points of ambiguity in the small groups. Instead, they listen very carefully for tensions, accommodate uncomfortable feelings, and remind students of the learning opportunities that such uncomfortable situations imply. In this way, students can also sense the unwavering respect that the instructors display for their thoughts and learning struggles [Student interviewee A, P1, Smith course]. They support the class' learning by allowing students to work in small groups first to discuss their tentative thoughts before they share their ideas in the large group and by encouraging the expression of confusions and acknowledging confusions as a valuable part of learning (e.g., Atwood et al., 2010; Barnes, 2008; De Corte & Masui, 2009).

*Sampling the level of the groups' discourses to inform one's teaching*
During small group work, the instructors (and teaching fellows) circulate through the room ("floating observers") keeping an eye on students

working together. They try to catch both actual content and the tenor of group work processes aiming to make sure that students demonstrate the envisioned level of conceptual understanding and do not miss important concepts and key ideas they are learning about. The instructors closely observe how the classroom community is learning from the materials and puzzles they provide (e.g., where students take themselves) as well as from each other while grappling with the content and process of inquiry learning.

They try to pick up any resonance by unobtrusively standing or sitting close by and scanning the groups' posters. They listen for common questions, confusions, and issues that they think need to be addressed in subsequent lectures or whole group discussions. They make sure that students are listening to each other, check if students need more materials, and raise more challenging questions if a group of students thinks they are finished. For example, the teaching fellows in Mrs. Smith's and Mr. Brown's courses actively participate in groups and occasionally facilitate the groups' discussions by reminding students of certain aspects to make sure the discussions cover key points of the readings.

The instructors (and teaching fellows) also check on the actual outcome by looking at the products the groups have produced (e.g., posters, summaries), listening to their presentations and contributions during whole group sharing and discussions, and by asking clarifying and probing questions to examine students' thinking and understanding. Observing and listening to students exploring and following their ideas provides the instructors with valuable information to decide about what to do next, that is, how much and what kind of scaffolds to provide in order to keep students engaged in the subject matter and help them deepen their understandings (e.g., give the groups more time, provide additional instructions, raise more questions) (e.g., Hattie, 2009, 2012; Van de Pol & Elbers, 2013).

(b) Guided problem solving in the large group

The following deeper-level instructional strategies were found to be embodied in guided problem solving in the large group in the three classrooms under study (see also Table 5.11 for an overview)—drawing mainly on data from Mrs. Smith's course (33% of the overall class time was spend engaging in guided problem solving) and partly from Mrs. Lee's course (9%; see Sect. 5.2.4, Fig. 5.6).

*Orienting structures, guiding norms, and modeling behaviors to clarify expectations*

Discussion-oriented seating arrangements, including flexible physical arrangements and ground rules such as principles for class participation in Mrs. Smith's course or class norms in Mrs. Lee's course, help to clarify expectations and maximize class time (Atwood et al., 2010; Leinhardt & Steele, 2005). Course activity structures such as assigned course readings, open-ended learning tasks, goal- and process-oriented activity guidelines (e.g., handouts with protocol steps in Mrs. Lee's course; handouts on how to conduct an exploratory activity with a learner in Mrs. Smith's course), and artifacts as tools for learning help to focus attention on educational key points and processes and support useful, productive talk. Orienting activity structures and class norms provide a thoughtful balance between structure and freedom for students to make informed choices while co-constructing knowledge together under the guidance of the instructor.

Moreover, all of the three instructors practice in their own classroom what they "preach" (e.g., Bandura, 1997; Collins et al., 1989). They interact with students in ways that correspond with their educational beliefs, expectations and with the class norms (e.g., using inclusive language, asking probing questions, encouraging students to elaborate on their ideas, showing confidence in students, being respectful). The instructors' modeling behaviors are not explicitly stated as a learning goal with the exception of Mrs. Smith's course (i.e., teacher demonstrations; Duckworth, 1987/2006) and it is left up to the students to make that additional link between the instructor's "good practice" in the classroom and what the class is reading and talking about:

> Every day I would enter class, ready to look at the class in two ways, in two layers. One, the layer of "I am engaging with Carini [reading, S.H.] today, I am thinking about her writing and her ideas." And two: "I am looking at Mary's practice today and I am looking at what she has us do and how she has us do it." [Student interviewee 5, Lee case]

The instructors model ways in which to use language and artifacts to think collectively by making decisions about useful lines of thought for the whole class to explore further. They model educational practices by listening to what students have to say, helping students listen to each other and trying to get a classroom conversation going with very different points of view often balancing facilitating conversations, answering clarifying and probing questions, and sharing their own experiences and perspective as experts in education.

*Open-ended questions and prompts to develop students' thoughts further*

The instructors introduce thinking routines and use high-quality questioning and prompting that focus attention, open new lines of thought, encourage contributions, and provoke thoughtful answers to facilitate joint sense making. As compared to the students, the instructors in the student-centered classrooms under study kept mainly quiet, listened attentively, and often nodded or briefly commented once in a while to track students' current understandings and keep the conversation going. Whole class explorations that revolve around students' ideas/questions require CK and PCK in order for the instructor to know which kind of questions to use and why to help students developing their thoughts further (Mercer & Dawes, 2008).

Teacher-led explorations in the large group offer students opportunities to engage in talk of an exploratory nature by being given the floor to disclose their thinking process and exchange their ideas. The instructors elicit students' prior knowledge and their wider relevant experience asking: "What do you notice in this student work?" or "What puzzles you about this poem?" so that the students can externalize and build on their current understandings. They invite a variety of voices so that the class can hear from a range of reasoned thoughts and build on each other's ideas. They give students time to consider their answers, seek extended contributions from students, and foster active listening in order to facilitate the co-construction of ideas (e.g., Mercer & Howe, 2012; Michaels et al., 2008).

The instructors use prompts together with clarifying (e.g., "What do you mean by …?") and probing questions (e.g., "What makes you think that?") to hold students accountable to disciplinary knowledge and to reasoning and keep them thinking and productive toward a "general direction" (Michaels et al., 2008). They explore students' ideas by encouraging them to put the main ideas in their own words and by getting students to elaborate on their ideas, explain their reasoning, and justify their views asking, "How did you know that? Why?" This way, they also facilitate students' use of language as a tool for reasoning toward the envisioned learning outcomes (e.g., concepts and practices of the discipline) instead of only checking the state of students' understanding of the topic being studied (Mercer et al., 2009; Resnick et al., 2010; Wolf, Crosson, & Resnick, 2006).

*Ensuring mutual understanding to enable joint knowledge construction*

The instructors make sure they and students in class understand each other's statements or questions. They think aloud while trying to unfold students' thinking and repeat back to students what they understand them say (revoicing) to ensure common understanding. They ask clarifying questions while at the same time signaling interest in students' thoughts and a willingness to follow their thinking closely (O'Connor & Michaels, 1996, 2007). They occasionally ask students to rephrase or restate what they have been talking about, or to "tell them more" in order to ensure mutual understanding. They show vulnerability by disclosing that they do not follow a student's thinking quite yet (Duckworth, 1987/2006). For example, they invite students to sketch out their ideas on the chalkboard or to re-enact them individually or with the help of their peers to demonstrate their understandings (e.g., moon movements and drawings in Mrs. Smith's course). Students are encouraged to externalize their ideas and express themselves clearly, listen attentively, and ask clarifying and probing questions to each other in order for them to think collectively and develop their understandings further. The students are responsible to clearly explain to others what they think and why and thus, ensure mutual understanding—for example, by asking their peers "Does that make sense to people?" (e.g., Michaels et al., 2008).

*Thoughtful and appreciative responses to invite different ideas and voices*

How instructors receive and use their students' written and spoken contributions is crucial in shaping how students will set about learning and what they will learn (e.g., Barnes, 2008). Students' queries and comments are often taken as starting points for reasoned discussions in these classrooms (e.g., to get students involved in exploring subject matter or to explore a topic in more depth; Leinhardt & Steele, 2005). The instructors provide students with the time to construct thoughtful questions or answers (e.g., quiet thinking time, prior pair or group work) as well as with extended turns to express their thoughts and reveal their confusions and misunderstandings. They invite students' contributions calling people who raise their hands by their first names, nodding, keeping track of the time, and asking for more voices and people who have not spoken yet to hear from different students.

The instructors encourage joint knowledge construction by deliberately trying to avoid both judging comments on others' ideas and praising students for contributions or results. Instead, they show confidence in students and express interest in and excitement for their ideas. The instructors maintain a theoretically neutral stance so as to position students as competent and keep encouraging the expression of diverse views (Atwood et al., 2010). They follow students patiently in their thoughts and students feel that "there was totally no correct answer." The instructors also re-utter students' ideas to value and position contributions within the context of a specific conversation and validate students' attempts to join in the thinking (Barnes, 2008; O'Connor & Michaels, 1996, 2007).

#### *5.3.2.2 Moderating Knowledge Sharing and Discussions*

In the three classrooms under study, discussions stimulate students to share, compare, question, build, and reflect upon their ideas and solution paths with the instructors acting as moderators. Discussions are mainly done in the whole class and on average account for 36% of the overall class time in all of the three courses (Smith case: 32%, Lee case: 41%, Brown case 30%; see Sect. 5.2.4, Fig. 5.6). They regularly follow after or are intertwined with other course activities such as student-/teacher-led small group explorations, small group discussions, lectures/metatalk, and student/teacher demonstrations or they focus on discussing readings. The deeper-level instructional strategies that can be found in these discussion-based activities are structured distinguishing between disciplinary discussions about concepts and practices, and reflective discussions about learning content and processes (e.g., activity debriefs, course design). Table 5.12 provides an overview:

(a) Disciplinary discussions

The four deeper-level instructional strategies below were found to be embodied in activities that facilitate disciplinary discussions in the whole class.

*Small inquiry groups sharing out to demonstrate their understandings*

After independent problem solving in small inquiry groups, the groups are often asked to share their ideas, solutions, and how they came to their conclusions with the large group in these student-centered classrooms.

**Table 5.12** Deeper-level instructional quality features of discussion-based activities (whole class)

| *Quality dimension* | *Instructional strategies* |
|---|---|
| (a) Disciplinary discussions (educational concepts and practices) | Small inquiry groups sharing out to demonstrate their understandings<br>Encouraging students to express their thoughts to further joint sense making<br>Promoting critical dialogue to provoke conceptual changes<br>Inviting a variety of voices to enhance collective participation |
| (b) Reflective discussions (metatalk) | Engaging students in self-reflective practices to deepen their understandings<br>Engaging students as co-designers to improve their learning experiences and outcomes<br>Taking student feedback into account to inform one's teaching |

The group presentations allow students to think aloud and discuss their thoughts/questions with the rest of the class to continue to engage in productive learning. In cases where student groups worked on different topics, the presentations contribute to deepen the other groups' understanding about certain concepts they read about in preparation for the class. All students can ask questions to the presenting group so that the entire class continues to learn by providing and receiving feedback on each other's contributions. The instructors encourage peer evaluation and comparisons of the findings between groups and ensure that the findings relate back to the learning goals and initial question(s) of the task (e.g., Mercer et al., 2009).

The instructors also thank the presenting groups and acknowledge the groups' learning and contribution to foster student self-efficacy and motivation. Brief appreciative notes that can often be heard after student groups share their ideas and questions in Mr. Brown's class are, "nice connection," "nice difference," "these are really good points," "that's a great question," for example. Thus, the instructors also contribute to shape students' forethoughts for their subsequent engagement in course activities allowing the latter to learn from the experience and make adequate adjustments, if necessary (Zimmerman, 2008). The groups' contributions also provide valuable information about their level of comprehension and on how to proceed to advance students' understandings. Student group presentations are often followed by whole class discussions—especially in Mr. Brown's course.

*Encouraging students to express their thoughts to further joint sense making*

The instructors frame disciplinary discussions, position students as active participants, and try to keep conversations focused in these classrooms. They give students the authority to engage in sense making and move beyond their current understandings. Thus, students gain practice in having purposeful, professional conversations about relevant educational topics while the instructors mainly act as "arbitrators passing the torch" (e.g., Alexander, 2008; Michaels et al., 2008). As the class engages in a shared inquiry about an educational topic, the students are being given the floor and extended turns to express their thoughts and reveal their reasoning. The instructors encourage the students to put knowledge into their own words instead of repeating technical terms they read or hear about and make sure they understand each other (e.g., revoicing). Students contribute their points of view, listen to their class members' thoughts, bounce ideas off of one another, juggle ideas that come up, and develop ideas together attacking an issue from many different angles to dive deeper into the material in these dialogic classrooms (Mercer et al., 2009; Resnick et al., 2010).

The instructors keep their students thinking by re-uttering and affirming their views and being respectful of students' responses. They also make on-the-spot decisions as to whether topics or questions raised or comments made by students are a useful line of thought for the class to continue working on. In this way, they invite students' questions and ideas as a springboard to shift the direction of a discussion. The instructors value the potential input from students and allow for students' observations, questions, and ideas to drive the discussion to a great extent. They also hold students accountable for the learning that is going on (Gresalfi et al., 2009; Michaels et al., 2008; Resnick et al., 2010). They listen to students and decide when to step in and guide a discussion and when to let a discussion run its course and see how it goes without intervening. This flexibility on part of the instructors requires not only a deep understanding of content but also resourcefulness and sensitivity to student needs.

*Promoting critical dialogue to provoke conceptual changes*

The educational dialogue in these classrooms challenges students' educational beliefs and invites conceptual change. Students' continued engagement with new disciplinary concepts and practices prompts them to rethink their current ideas about education, learning, and teaching (change of mindset, e.g., Weimer, 2013). The instructors encourage students to relate their current thinking with new ideas and to share critical thoughts that have the potential to refine previous conceptions around the subject matter. Making students doubt their own existing knowledge also leads to insecurities and negative feelings as students' minds struggle with new ideas. The instructors channel the discomforts that are created in a productive way moving the learning process along and fostering student motivation through the joint generation of knowledge (Cornelius & Herrenkohl, 2004; Mercer & Howe, 2012).

The instructors listen carefully to grab important moments of learning so as to provoke, probe, prod, or point out germinating ideas building on what students said (e.g., what they have heard during small group work). They point some things out themselves (e.g., conflicting ideas, similarities) and/or add in new elements to the conversation and/or another level of complexity to facilitate further thinking. They offer new ideas for consideration if they see a different point of view that no one else has mentioned, point out something inconsistent or vague and give illustrative examples from their own experience to encourage further thinking and talking. The instructors also underscore important points and synthesize and/or summarize key aspects of the topic the class was talking about earlier to make sure students in class understand each other and the learning content (e.g., O'Connor & Michaels, 1996, 2007; Murray, 2007a, 2007b).

*Inviting a variety of voices to enhance collective participation*

The instructors encourage the interaction of many minds to foster the collective knowledge construction process. By enhancing students' collective participation in domain-specific discourse, the instructors facilitate students' intrinsic motivation (goals, self-determination), performances of understanding, and self-regulation as the students become more attuned to the affordances of the situation over time. The instructors regularly ask genuine questions about things they really want to know the answer to and often phrase questions so that anybody who is present can have something to say, given what they have just been doing in class (e.g., Michaels et al., 2008).

They encourage students to enact the class norms (e.g., listen attentively, make substantive comments, speak to the whole class not merely to the instructor) and explicitly invite a variety of voices stating: "Other thoughts?," "I would like to hear from other people," or "Let's hear from one or two other voices." The instructors encourage students to dare to say things they are not sure about showing and expressing excitement, delight, and surprise for students' ideas and staying neutral to students' contributions (e.g., Duckworth, 1987/2006; Mercer & Howe, 2012).

They also prompt further student participation by deliberately addressing students who have not contributed yet to hear from a larger variety of voices stating: "Let's hear another voice of someone who hasn't shared." In Mr. Brown's course, students are often asked to call on someone else during whole class discussions so that students themselves pick the next speaker, for example (e.g., Mercer & Dawes, 2008).

(b) Reflective discussions

Students in these courses continuously reflect on their learning experiences—in oral and written form, individually and collectively. Reflective large group discussions aim to stimulate students to articulate and reflect upon what they have learned (content; e.g., "What ideas were coming up for you?") and what the learning experiences were like for them (process; e.g., "What was the process of doing the activity like?"). Moreover, students have opportunities to engage as co-designers of the curriculum. The following deeper-level instructional strategies were found to be embodied in activities that facilitate reflective discussions in the whole class.

*Engaging students in self-reflective practices to deepen their understandings*

In these classrooms, the instructors prompt inquiry groups to share what worked well during the learning process and what the groups might do differently in the future. Individual reflections or activity debriefs prompt students to step out of their comfort zone to critically reflect on their class experiences and thus, take responsibility for their learning while also practicing metatalk (e.g., judging their task execution, attributions, affective reactions, general task assessment; e.g., Zimmerman, 2008). Students in Mr. Brown's course are often invited to reflect on their group learning experience, for example, in order to learn from some of the tensions, anxieties, internal and social conflicts that are inherent to social learning and try to adapt their attitudes, thoughts, and behaviors accordingly. Thus, reflective discussions provide students with opportunities to self-evaluate and compare their performance of understanding with expectations, learning goals, and standards. They have the opportunity to point to outcomes and processes they are satisfied with whereby experiencing positive affect regarding their joint performance and to identify adjustments for future learning processes (e.g., lessons learned) (Bembenutty, Cleary, & Kitsantas, 2013; Hattie, 2009).

The reflective and/or critical nature of Mr. Brown's course, for example, also caused some of the students to feel at times a bit unsafe and uncomfortable in class, but also more likely to become more reflective and critical in general. Uncomfortable experiences also made students think and continuing reflections in the large group helped them to address uncomfortable feelings and situations and learn from them. Reflections allow students to do both—address uncomfortable feelings and situations they find themselves in and acquire skills to monitor their group interactions and initiate change to make their class/group experiences more worthwhile and effective. Due to the continuous sharing of reflections/debriefs in the large group, students are always in dialogue with the rest of the class and they realize that they are often struggling with the same things and can learn from each other. These self-reflective processes feed forward to the forethought phase of subsequent efforts to reach one's learning goals (e.g., Zimmerman, 2008).

*Engaging students as co-designers to improve their learning experiences and outcomes*

The instructors also demonstrated their openness to adopt curricular changes based both on what was happening in the class (e.g., the instructors' observations) and on individual and collective student feedback (e.g., through student reflections). Classroom observations together with student reflections provide the instructor, teaching fellows, and students with instantaneous feedback and a better read on "where the groups' thinking was." This awareness of one another allows the instructors and students to react and adjust to what is going on in class and initiate immediate changes to make the class/group experiences more worthwhile and effective (e.g., Hattie, 2012; Weimer, 2013).

By providing students with opportunities to influence the educational agenda, the instructors are not only responsive to students but they also shift the decision-making in the class to empower students. The instructors in the three classrooms gave students a voice and responded to students' needs and interests with course adjustments as the class moved forward resulting in a "fluent" and "responsive" syllabus that evolved or shaped during the course in terms of content and process. They incorporated students' feedback going forward indicating that they were also still learning and constantly looking for how they could improve students' learning experiences and outcomes in class. Such positive responses to students' needs and concerns did improve the learning experience for students and contributed positively to students' motivation with the classrooms becoming even more student-centered over the course of the term (e.g., Weimer, 2013).

*Taking student feedback into account to inform one's teaching*

The instructors in these three classrooms were continuously monitoring and reflecting on their own teaching (e.g., Bain, 2004; Barnes, 2008). They signaled to the students that they were open to critical thoughts and suggestions regarding both the course design and their teaching (e.g., during protocol debriefs, written reflections). They were interested in their learners and got to know them through close observation, careful listening, and reading students' writings. Their careful "read" of the class allowed them to teach to the speed of the class. Otherwise, students could get easily confused and frustrated and unable to process learning. There was "a lot of feel, energy and watching people," to not "miss anything" in her class, according to Mrs. Lee:

> For any group there's a kind of breathing that the group does. There's a time to sort of be all together and structured and there's a time to just let out a little bit more and let the individual come more out and more engaged in the moment. [Lee interview]

The instructors opened up the floor repeatedly "to go macro" (i.e., engage in metatalk) so that students in class could take initiative in suggesting adjustments when it was felt necessary throughout the semester. Students got more say in what problems were tackled in class and how course activities were operated as the semester moved on. The instructors explicitly asked students to pay attention to conflict and tensions in their work together. They encouraged the students to share critical thoughts and offer pushback—not only to their peers in class but also to the instructor/teaching fellows and acknowledged that self-organizing in course activities and engaging in critical reflections might be uncomfortable for some students. The instructors stayed aware and (together with the teaching fellows) reflected on the learning processes that took place in class and about themselves and their choices as instructors (e.g., self-awareness, self-control) throughout the semester (e.g., Mercer & Dawes, 2008).

#### *5.3.2.3 Lecturing and Modeling While Students Listen and Observe*

The distribution of classroom time shows that the instructors do not present an authoritative canon of scientific knowledge in a "lecturing" style, but rather engage students in more dialogic, participation-oriented educational practices in these classrooms (Alexander, 2008; Mortimer & Scott, 2003).[9] On average, lecturing/metatalk accounted for 10% of the overall class time in all of the three courses of which 6% consisted of instructors' metatalk (lecturing/metatalk accounted for 10% in Lee's case, 13% in Brown's case, and merely 6% in Smith's case). Lectures lasted between 1 and 24 minutes with an average of five minutes at a stretch (see Sect. 5.2.4, Fig. 5.6). Lecturing mainly aims to provide students with knowledge just in time when they need it and links it with other places and people.

Authentic modeling only took place in Mrs. Smith's course and occupied 13% of the overall class time and thus, twice as much class time as lectures.[11] Lectures and teacher demonstrations were usually followed by large class discussions including student questions and reflections. The deeper-level instructional strategies below were found to be embodied in lecturing/metatalk (first two features) and modeling (third feature; modeling only in Smith's course) (see Table 5.13).

*Conveying relevant information students need in order to learn*

The instructors let the students explore a new topic first, based on the readings and tasks and with the help of interesting artifacts/objects as other expert resources, before they deliver any new content in a lecture-like format themselves. Handouts describing the task or activity are sometimes distributed only after doing activities to make sure that students have the experience first—and not just words on paper. The instructors center their efforts on framing activities and enabling students to see that

**Table 5.13** Deeper-level instructional quality features of lecturing/metatalk and modeling

| *Quality dimension* | *Instructional strategies* |
|---|---|
| Lecturing (including metatalk) | Conveying relevant information students need in order to learn<br>Connecting new knowledge to topics and questions raised by the students |
| Modeling | Modeling behaviors to support knowledge building and develop confidence |

their own ideas are perfectly reasonable and the best starting point for their learning. As Mrs. Smith puts it with regard to lecturing:

> It would be all too easy, if I were to give my account for people to sit back, stop thinking, and assume that they understand what I am saying and that what I say is right—not to mention the likelihood that the topic will cease to hold any interest for them if they are simply listening to what I think. [Smith interview]

Thus, for teaching to be effective, the type and amount of lecturing/metatalk provided must be relevant for student sense making and set the stage for the activities that follow (e.g., Tobias, 2009). Lectures/metatalk are regularly accompanied by students' information and clarification questions and/or subsequent whole class discussions to provide students with opportunities for productive talk and ensure commitment and shared understandings.

All of the three instructors are experienced experts in their field. Occasions when they do convey information involve the instructor bringing in their own research results and thoughts on the topic, elaborating on their teaching approach, sharing thought-provoking stories and (funny) anecdotes on certain topics, or inviting guests to share their practices bringing real-world knowledge and experiences into class (e.g., class alumni, authors of the readings). They also assume the content expert role every once in a while providing an overview of important concepts/ideas to support sense making when they sense that things are not clear enough for students (Duffy, 2009).

The instructors' metatalk mainly refers to introducing the syllabus together with the main course components, showing materials on the course platform, and explaining assignments and assessment tasks accompanied by documents (e.g., readings, final paper guidelines). The instructors also give an outline of a day's class, frame class topics, and explain the process of doing course activities. The instructor's metatalk provides students with some level of information about what they are expected to do and helps to support a particular intellectual climate of active sense making that surrounds and carries the subject matter work (Atwood et al., 2010; Leinhardt & Steele, 2005).

*Connecting new knowledge to topics and questions raised by the students*

The instructors provide students with additional information on topics the students themselves want to know more about, adding to students' comments and sharing their insights and experience ("I want to be really clear about my thinking"). They share with students their take on some of the questions that come up and are open to engage with challenging questions and students' queries and concerns. They ask genuine and clarifying questions they are curious about opening up further possibilities to think about an issue. However, they avoid presenting their contributions as a "right" idea but rather as another idea that should be considered.

The instructors occasionally contribute to the large class sharing brief stories and their thoughts on certain topics linking their own ideas, explanations, and experiences to issues raised by the students in order to illustrate particular aspects or in case something important escapes the students' notice. They also contribute thoughts they are not sure about as another thought offer on the table. Mrs. Lee would pick a quote from a reading, for example, and briefly share what the reading encouraged in her and how she felt about it—also making connections to other readings, students' prior comments, and students' reflections she compiled from the prior class. The instructors think of themselves as "learning along with the group" and signal to students that they do not have all the answers and also learn constantly. The instructors in these classrooms do not only "teach" their students but are also co-learners who move around the classroom and constantly learn from and with their students (e.g., Duckworth, 1987/2006, 2001).

*Modeling behaviors to support knowledge building and develop confidence*

Mrs. Smith models in her class how an instructor can orchestrate and facilitate activities in ways that allow students to figure things out for themselves and come to their own conclusions either individually or collectively. Teacher demonstrations help students to witness the potential of learners to make sense of a subject matter for themselves with the instructor facilitating students' thinking processes. They make the evolution of learners' ideas visible for the observant student teachers so that they can build up a conceptual model of the learning and teaching processes they repeatedly observe (Bandura, 1997; Duckworth, 1987/2006).

The instructor instills confidence in the student teachers that they themselves can teach in the same way (e.g., teacher demonstrations with school children and high school students). Students can develop confidence in their own capacity as prospective teachers while repeatedly observing the instructor or invited classroom teachers modeling how to use language and objects to help "real" students learn (e.g., Barnes, 2008; Mercer &

Howe, 2012). During student-driven large class discussions that follow her demonstrations in front of the whole class, the instructor holds back her own thoughts and explanations until the ideas and questions of the student teachers have been heard.

### *5.3.3 Classroom Community of Learners*

The following cross-case analysis answers the question of how the instructors *cultivate a classroom community of learners over time* to foster students' identity development as competent actors. From the single case study analyses, it became obvious that the instructors' educational beliefs, classroom practices, and norms of interaction are aligned in these classrooms. Overall, for the students to develop an interest in subject matter and confront challenging tasks requires a learning environment that is marked by the following quality dimensions: an intellectual climate of active sense making (Sect. 5.3.3.1); iterative cycles of feedback to further student learning (Sect. 5.3.3.2); and a positive emotional climate of mutual respect, trust, and belonging (Sect. 5.3.3.3). The instructional strategies of each of these three dimensions are synthesized and discussed below (see Table 5.14 for an overview).

**Table 5.14** Deeper-level instructional quality features of a classroom community of learners

| *Quality dimension* | *Instructional strategies* |
|---|---|
| Intellectual climate of active sense making | Establishing a dialogic "thinking culture" with learning as thinking in the making<br>Recognizing students' identities as valuable and productive |
| Iterative cycles of feedback to further student learning | Tailored feedback to deepen students' intellectual involvement<br>Mastery-oriented (public) feedback to keep students thinking<br>Allowing for student peer assessment and self-assessment to promote self-regulation |
| Positive emotional climate of mutual respect, trust, and belonging | Developing a strong sense of mutual respect and concern for one another<br>Fostering social stability and integration in the classroom (collective identity) |

#### *5.3.3.1 Intellectual Climate of Active Sense Making*

The three instructors presented sympathetic personalities and exhibited knowledge and expertise in teaching and learning and other subject matters. From the beginning, they signaled to the students that their stance toward student learning was one of active student sense making through participation-oriented educational practices. The following deeper-level instructional strategies contributed to the intellectual climate of active student sense making that was facilitated in these classrooms.

*Establishing a dialogic "thinking culture" with learning as thinking in the making*

The intellectual climate that was created was pushing students forward due to their high involvement in the learning process with language, artifacts, and classroom norms of interaction playing a facilitating role in students' learning. Students felt that they could come from where they were at, build on that and move forward, that is, the courses took students' interests, questions, and ideas into account. The instructors fostered a dialogic thinking culture by asking students to give reasons for their answers and to offer supporting evidence (e.g., "What do you think about this?") and by probing students' answers (e.g., "What makes you think that?"; Michaels et al., 2008; Resnick et al., 2010). Students were not overly vulnerable since everybody's thoughts were understood as "thinking in progress" (Rex & Schiller, 2009); this was illustrated in Mrs. Lee's course, for example:

> I actually found that some of the things that are useful to say are "I wonder…," "Have you thought about…?," "What do you think about…?" not, "In my situation I did this as opposed to that." That almost feels like "So what?" I mean sharing that experience is important, but it may not add to: "Can you tell me more?" [Student interviewee 3, Lee case]

Routines for inquiry and discussion and norms of interaction ensured shared understandings of how to engage productively in these classrooms and held students accountable to disciplinary knowledge, reasoning and to the classroom community of learners (Resnick et al., 2010). Students tried to carefully listen, value, and challenge their classmates as they figured out what they themselves were going to take away from the class. The instructors invited students to share tentative ideas and observations, and showed appreciation of and respect for their current misunderstandings and confusions as a productive source of learning. They indicated that every student's thoughts at a certain point in time were valuable and perfectly reasonable in their learning trajectory (Barnes, 2008; Mercer 1995; Mercer & Littleton, 2007).

The instructors considered tensions to be a sign that the group was getting somewhere in the collaboration/discussion and that some productive learning was going on in class. They encouraged students to consider anxiety-provoking situations and uncomfortable feelings as growth opportunities and to be more critical about one's own reactions and actions in moments of learning. That mindset created an atmosphere where students could contribute and develop expertise as individuals and as a group and have some sense of ownership and choice over what and how they learn. By actively engaging in joint reasoning and warranting opinions with respect to public bodies of knowledge, the class formed a collective identity and built a common knowledge base (Barnes, 2008; Cornelius & Herrenkohl, 2004; Engle, 2006). Ceding most of the knowledge generation to the class community and being open to engage with students' questions, concerns, or confusions also augmented the instructors' standing as natural authorities and (pedagogical) content experts.

*Recognizing students' identities as valuable and productive*

How students are positioned in the participation structures of learning activities is an important aspect of students' identities (Collins & Greeno, 2011; Rex & Schiller, 2009). The relationships students have in the classroom influence the identities they present because students and instructors position themselves in relation to others as they engage socially. The distribution of authority together with a mutual recognition of worth and productive identity for the work at hand are thereby essential for whether students will engage in deep learning and participate in building and sustaining a classroom community of learners. In the classrooms under study, students' diverse contributions to the collective goals of the classroom community were seen as productive since they were the basis for further thoughts and demonstrated students' accountability (Gresalfi et al., 2009; Michaels et al., 2008).

The instructors invited different viewpoints on topics and the instantiation of self-revision to provide opportunities for the students to demonstrate their understandings and learn from each other. Listening attentively to students' contributions, the instructors then thought about what questions to ask next or what experience to offer next or where to direct students' attention next in order to further deepen students' thinking. The instructors expressed their interest in students' contributions and validated students' experiences (e.g., student volunteers, substantive contributions to class discussions). They avoided evaluating students' contributions and closed activities with a positive, appreciative note thanking individuals and groups for sharing their thoughts and actively participating in the discussion (Leinhardt & Steele, 2005).

Over the course of the semester, students had more and more opportunities for legitimate participation in educational teaching and discourse practices (Lave & Wenger, 1991) that cultivated their identities and interests as prospective teachers (Cornelius & Herrenkohl, 2004). The different course activities signaled to students the value of engaging in joint problem solving and discussion to foster performances of conceptual understanding and SRL. Students experienced an increasing sense of autonomy as well as responsibility for their own and each other's learning as they became more used to the class routines and how the course in general and the activities in particular were structured (Ryan & Deci, 2002; Zimmerman, 2008). They grew increasingly comfortable to veer away from the original routines and experiment with different ways of exploring new themes independently. The instructors supported students' productive engagement in course activities and lessened the structuring and support as the students' expertise developed. Students were allowed to believe and experience that they were talking within an educational practice, rather than about an educational practice (Lave & Wenger, 1991).

#### *5.3.3.2 Iterative Cycles of Feedback to Support Student Learning and Growth*

The instructors in these classrooms spent less time on evaluative feedback, that is, feedback on the accuracy of task completion, and more time on formative feedback to further student learning and growth. The following deeper-level instructional strategies were found with regard to the feedback culture in these classrooms.

*Tailored feedback to deepen students' intellectual involvement*

The instructors (and teaching fellows) monitored student progress and gave performance-specific and process-related feedback instead of (merely) traditional academic feedback in the form of grades. They provided periodic verbal and written quality feedback on individual assignments and papers—especially the final research project proposals—to help students determine what they needed to work on to deepen their connection with the subject matter. They took the time to carefully read students' online posts, email comments, papers, and written work trying to understand what they were getting at to be able to give quality feedback to support students' learning. The instructors tailored their constructive feedback to different students' needs and expressed their appreciation for students' insights in order to improve the students' knowledge and skills (competency support), promote students' self-efficacy beliefs, and reduce performance-related anxiety (Bandura, 1997; Zimmerman, 2008). For some students, feedback on their papers was just another alternative perspective to add into the mix, for other students, it was much more about helping with the structure and organization and the steps needed to pursue a question.

The instructors and teaching fellows pushed back on what students had to say in their papers and wanted students to think critically about the issues they raised motivating them to further improve and strive to do well in their papers. They provided concrete and extensive critical feedback seizing on the strengths and weaknesses so students could make their papers stronger. The instructors used comments and questions to explore students' views and understandings in order to provide feedback that helped them to clarify their understandings and fostered their intellectual involvement. They tried to help students to understand their own ideas more deeply and shared thoughts that students might want to consider in moving forward. They provided starting points for students to continue to think (e.g., confirming comments, probing questions, suggestions) and asked students to point out in subsequent work how they had taken their feedback into account. The instructors hoped to motivate students to tell them what they thought about their topic, to work with their ideas and push them forward, and broaden the frame a little bit, outlining some other alternatives for students.

*Mastery-oriented (public) feedback to keep students thinking*

Feedback as a form of social learning is also relevant to support SRL (Zimmerman, 2002). By providing non-threatening, mastery-oriented feedback, the feedback giver indicates to students that their contribution is valuable and competent and that the student's performance is approved by "significant others" (e.g., the instructor says, "good"). Iterative cycles of feedback coupled with milestones (deadlines) are seen as opportunities to provide scaffolds. The feedback giver reviews student progress and provides tailored feedback that encourages students to continue thinking independently, allowing them to revise their thinking and tentative ideas so that they may improve gradually (e.g., Abrami, d'Apollonia, & Rosenfield, 2007; Blythe & Associates, 1998; NRC, 2000).

Mr. Brown provided his feedback on article summaries students had to complete as part of the assignments publicly on the learning platform; consequently, students knew that the instructor and teaching fellow read their article summaries, for students to learn from each other, and to make sure that students learn some of the key ideas of the articles that were summarized. Displaying the work and the feedback publicly raised anxiety, but it was also a social learning opportunity.

The instructors also gave genuine feedback and advice to the entire class in terms of clarifying expectations for assignments (e.g., depth over breadth, leverage your appendices), and highlighting what students in class did well and what they should avoid moving forward toward their mid-term papers, for example. They also offered to provide (additional) feedback if students needed it and wanted them to respond to something in particular. The instructors and the teaching fellows were an important resource for providing feedback to students' ideas, online reflections, and drafts; this feedback became even more effective with time with the teaching fellows getting to know students better and realizing what the students needed to make progress with their work (e.g., De Corte & Masui, 2009).

*Allowing for peer assessment and self-assessment to promote self-regulation*

Continuous oral and written feedback from the instructors and teaching fellows allowed students to assess their own and each other's work. Students learned how to assess their own work and that of their peers by asking critical questions in a constructive manner (e.g., student evaluation of the academic quality of their peers' work). This collegial recognition helped students experience self-efficacy, the belief that one is capable and has the power to produce a desired result (Cornelius-White, 2007; Kunter & Voss, 2013; Rex & Schiller, 2009).

The instructors provided time and guidelines for students to develop the skills they needed to assess their own work and to reflect and give useful feedback to each other (e.g., on final paper drafts, journal entrees).

Mrs. Lee and Mr. Brown also provided opportunities for peer feedback in the classroom toward the end of the semester with students giving each other feedback on their final paper drafts in small groups, for example. Peer feedback on paper proposals required students to become invested in the collaborative learning process and to feel accountable toward each other providing their group members with feedback on their online assignments and paper drafts.

This feedback from the instructor, teaching fellows, and peers led the students to revisit their own work and provided them with opportunities to develop their own ideas further and thus, empowered them with autonomy and intellectual responsibility for their work (Ryan & Deci, 2002).

#### *5.3.3.3 Positive Emotional Climate of Mutual Respect, Trust, and Belonging*

Students felt safe and comfortable with each other as they got to know each other through their continuous engagement with each other's thinking. The instructors maintained a safe climate in which students were able to expose and share ideas without being afraid of giving an incorrect answer (Leinhardt & Steele, 2005). Students felt comfortable participating in class because their contributions were heard and respected rather than dismissed. The following deeper-level instructional strategies were found with regard to the emotional climate in these classrooms.

*Developing a strong sense of mutual respect and concern for one another*

All students were perceived as capable and recognized as worthy of having something to say in these classrooms. The class norms together with the instructors' modeling helped to foster a community with a strong sense of mutual respect and concern for one another. Incorporating social relationship building is one means of circulating power and contributing to the formation of a classroom community of learners. The instructors incorporated diverse community-building activities from the start to give students a chance to get to know each other and develop a sense of belonging. Time is necessary to build relationships that allow for cooperation and the willingness to stay in the process, even when it gets difficult. Students experienced positive feelings and an additional sense of academic confidence and self-worth through the experience of their own voices being heard, respected, valued, and taken seriously with other class members confirming and referring to each other's ideas in the whole group (Leinhardt & Steele, 2005; Rex & Schiller, 2009).

The instructors interacted with students from a place of respect and not from a place of formal authority. Students felt safe enough to say something they were not sure about, to hold contradicting ideas, to ask clarifying and probing questions, to provide and receive feedback, and to express uncertainty and doubt. They felt comfortable enough to put their thoughts on the table and to stay in the tensions produced by class discussions and reflections based on students' different views and experiences. Students felt that the instructor and the teaching fellows knew who their students were and that they were interested in them. They felt trusted and respected to speak up or approach the instructor/teaching fellow or their peers if they had ideas, questions, or something on their mind that they needed help figuring out. They facilitated a community in the classroom that made students feel "very comfortable" talking in class (e.g., the instructor shares his/her stories, shows "vulnerability," is respectful, knows students' names, switches activities, makes time for check-ins).

*Fostering social stability and integration in the classroom (collective identity)*

The instructors maintained social stability in the classroom by fostering norms for collective identity and knowledge construction so that learning could go forward together and learners felt the power of their own learning. These norms forwarded a sense of community in which everyone felt powerful in their relationships to each other and experienced a feeling of belonging; this was of particular importance for students' motivational self-regulation (Leutwyler & Maag Merki, 2009). Social stability/group identity depends on mutual recognition of worth and identity; who one wants to be and whether or not that identity is recognized as productive for the work at hand determines whether individuals will participate (Rex & Schiller, 2009). Instructors can focus on the identity they want students to assume through the ways they talk with them. Over time, the instructor's actions can shape student identities that are proactive and constructive instead of reactive and passive. When the instructors are in alignment with the students, the students then can trust them enough to talk in class.

The instructors established a positive and embracing atmosphere in class that aimed to reduce a reluctance to participate. They tried to adapt to the students to make sure that everyone felt good being a member of the class and facilitated the mutual recognition of worth and identity so that students could feel a sense of their own capacity. They created an inclusive environment where the group heard from a variety of voices (e.g., involving people who have not shared yet), where students could learn from each other and where students could feel the value of their progress in figuring something out. The instructors also set a certain tone for the class being kind and respectful in their interactions with students showing in the conditional, inclusive, and polite language that they frequently used (e.g., "Let me invite you," "we") (e.g., Cornelius-White, 2007; Klieme et al., 2009). The instructors—especially Mr. Brown—displayed memorable gestures and facial expressions that indicated their engagement and that they were intently listening to and interested in what students were saying. By being accessible and invested in students' learning, the instructors contributed to positive relationships with their students (e.g., Abrami et al., 2007; Murray, 2007a, 2007b).

## 5.4 Teaching and Learning Challenges

Many of the student interviewees and respondents to the course evaluation surveys referred to these courses as some of the, if not the most, valuable courses they took during their graduate studies at Harvard. They found these courses to be revelatory, stimulating, and sparking major changes in their pedagogical ideas. Nevertheless, the constructivist student-centered approaches that were enacted in these classrooms also brought challenges for students and instructors. First and foremost, many of the students in these courses lacked the experience of being in constructivist learning environments with very high student engagement and were more used to teacher-centered instruction making it more challenging for them to learn in these environments and change their own teaching practice as prospective teachers. The instructors, on the other hand, wanted to model such a constructivist learning environment to create new ways for students to learn with and from one another that they could later apply in their own classrooms or in other educational contexts. *What are the teaching and learning challenges these constructivist classrooms presented for the instructors and/or students* (empirical research sub-question 2d)? To answer this question, this section synthesizes the main challenges that were derived in the single case analyses together with further challenges elicited from case study data based on students' and instructors' perspectives (student and instructor interviews, participant observations, video analyses, and course evaluations). The teaching and learning challenges of these student-centered classrooms are categorized with regard to course design elements and support structures (Sect. 5.4.1), scaffolding participatory processes of knowledge construction (Sect. 5.4.2), and cultivating a classroom community of learners (Sect. 5.4.3).[12]

### 5.4.1 Challenges with Regard to Course Design Elements and Support Structures

Teaching and learning challenges with regard to course design elements and support structures uncovered in the classrooms under study encompassed the following aspects: student preparation, demanding open-ended assignments, relevance to real-life contexts, the adaptive nature of the course structure and activities, course activities students perceived as the least valuable of all course activities, class size and teacher-centered classroom spaces, and cultural and institutional forces at the school.

*Student Preparation* The students' motivation to prepare all of the readings over the course of the semester fluctuated. Interviewees from Mrs. Lee's course stated that they sometimes reduced or dropped the readings or did not do the readings properly because of other more pressing deadlines (e.g., other papers were due) and/or because the readings were not discussed in class as scheduled and/or because the class had fallen behind a little bit discussing the readings. Thus, students' motivation regarding readings waned whenever they knew that they would not be talking about the assigned readings in class. But this does not necessarily mean that students were not motivated to come to or participate in class as the following statement indicates:

> The class discussions, even if I hadn't done the reading for a week, were always fascinating. And exercises like final word protocol, like just taking out a sentence. Even if I hadn't read an entire chapter I could get something from that. So, definitely outside class sometimes time constraints factored in, but I was never unsure about wanting to be in class. [Student interviewee 2, Lee case]

If students did not prepare readings that were discussed in these courses and did not do the assignments, learning was rather difficult for them and they felt their contributions would potentially not be as effective as they could be. Students also found it difficult when they were randomly assigned to participate in groups to discuss readings as they did not connect to all of the readings equally and felt that they sometimes had not enough experience to bring something valuable to the table.

*Demanding Open-Ended Assignments* Some interviewees found it difficult that the assignments for the final paper were so completely open-ended and that they did not have rubrics; this raised feelings of frustration and uncertainty about what was expected. The purpose of some of the assignments was not always clear to them as well as the evaluation criteria and how they would be scaffolded in developing their mid-term and final papers. Some students found it difficult to pick up the style, format, and structure that were required for the written papers and journals. Yet others, who deliberately took Mr. Brown's course for a letter grade, for example, felt that they had to write a paper to impress the instructor rather than to further their learning. Students were challenged by the tasks as they did not have much experience in closely observing classrooms and analyzing empirical data for their fieldwork and papers, for example, and they found it sometimes difficult to find students or a group to complete their assignments in due time. Yet, although the process of writing the papers was "painful" occasionally, students realized—sometimes in hindsight—that the "frustration" they felt doing the assignments was a productive one that fostered their learning. Some students in Mr. Brown's course also wished that they could have done a group project for the papers to put the concepts they learned about into practice by working in groups and found it "quite bizarre" that they had to write individual papers and received grades for their individual work.

Assigned reflections on learning content and/or process in Mrs. Lee's course (e.g., one- or two-minute papers), for example, could be a little irritating to students in the beginning of the semester because they were not used to them and did not learn to pay too much attention to their own thoughts, processes of thinking, and their own questions in traditional schooling. Some students were surprised about the amount of continuous oral and written reflections that was going on in these courses and suggested that there should not be too many reflections as well as choices in terms of the activities that students wanted to reflect upon, for example.

Some interviewees in Mr. Brown's course stated that they did not like the online assignments "because I'm not a huge fan of discussing online" [Student interviewee II, Brown case]. The papers seemed very academic research oriented, while much of what was learned in the class was material that the students wished to practice in practical applications (HGSE, 2011; Brown case). Others felt that the final paper did not have a significantly different purpose than the mid-term paper. And it seemed like Mr. Brown wanted the papers structured a certain way and students had to learn to lay it out in a certain way: “If it had been a pass/fail and I felt freer to experiment, I think it could have been much more effective” [Student interviewee I, Brown case]. Yet others felt that they had to write a paper to impress Mr. Brown rather than to write a paper based on something that was going to help them and did not think that the papers were key elements in assessing what they got out of the course.

*Relevance to Real-Life Contexts* Some of the student teachers wondered if it was possible to really use these constructivist teaching approaches in schools with large classes and whether they were able to put the Pedagogical Knowledge they acquired into practice under the constraints of a real school environment. Moreover, some students were getting a bit “frustrated” when parts of the courses were “quite theoretical” (e.g., rather academic-oriented assignments) while they were hoping for more practical ideas they could (easily) use in practical applications and in their own teaching. Particularly in Mrs. Smith’s and Mr. Brown’s courses, students sometimes wondered how to actually use the concepts and ideas they learned under the conditions of real-world contexts. In Mrs. Smith’s course, some students found the student-centered approach that was applied “one-sided,” were “skeptical,” partly unaware of “what exactly they were learning” and found their experiences in the classroom frustrating and baffling from time to time. A respondent to the course evaluation survey in Mrs. Lee’s course suggested with regard to engaging in educational practices: “More time be spent doing protocols with student work, more practice with the protocols, more examples of different types of student work” (HGSE, 2010b; Lee case).

*Adaptive Nature of the Course Structure and Activities* The fact that the syllabus was subject to change throughout the semester led to some students feeling “frustrated” and wanting “a clearer syllabus at the beginning of the course” and/or a more timely record of changes in Mrs. Lee’s course: “Some people were frustrated that the semester was not laid out”

[Student interviewee 3, Lee case]. One respondent to the course evaluation survey in Mrs. Lee's case put it this way (HGSE, 2010b; Lee case):

> One frustration that many experienced was the changing nature of the syllabus. When changes were made, sometimes these were not recorded on the website in a timely manner. Maybe having a mechanism to record changes with less time delay would decrease the stress that others felt.

And while the different kinds of activities seemed "quite inspiring" to some of the students as a model of how to organize a class, others felt "disoriented" at times because of the many elements in one class leading these students to become "a little bit more inactive" for some parts of the class and "more responsible, more involved" for other parts.

Sometimes, conversations in small groups would trickle over when Mrs. Lee, for example, did not have a clear signal or a trigger for the class when switching back from the small groups into the large group. She would say, "three minutes left," for example, but sometimes conversations would trickle over, and there was "not necessarily a clear transition from us having small conversations to coming back to focus on her." The interviewee reasoned that she might not have wanted to stop any thought process and give students the time to finish that last thought as she wanted the students to get where they needed to be and keeping that balance might have been a challenge [Student interviewee 5, Lee case]. Interruptions of the group work process occurred when the instructor repeatedly made announcements during group work (e.g., to announce the time, repeat or give instructions) which was mainly the case in Mrs. Lee's course.

Mr. Brown would also not strictly follow a prepared agenda and class discussions went on for a longer time than anticipated by the instructor. This caused tensions because some students felt bad that other activities "got sometimes cut back because of timing."

The artifacts that students produced together in these classrooms did not always stay around long or were not made available to the entire class (e.g., posters). The documentation groups' presentations in Mrs. Lee's course, for example, were not stored, although some groups distributed short handouts.

*Least Valuable of All Course Activities* There were open-ended course activities and assignments in every course that some students were not so intrigued by, did not connect well with, and found not so valuable or the least valuable of all activities done in the course as was evident from students' course evaluations.

In Mrs. Smith's course, the moon explorations were repeatedly mentioned as the least valuable activity. Students' interest in watching and discussing the moon seemed to fade over the course of the semester and some struggled to connect to this activity. Writing a moon journal felt "a little overwhelming" at times and some students found themselves "scrambling to turn in my journal every week." Apart from that, the longer class discussions of different students' moon observations resulted in some students feeling "bored" and tuning out of the discussion.

The five (online) assignments in Mr. Brown's course "annoyed a lot of the students" and they did not find the idea of online discussion groups (ODGs) particularly engaging. During the first few weeks of the semester, the members of the ODGs did not know each other in person as they were only interacting online. They also felt that the individual assignments they did online did not always scaffold students' mid-term and final papers and seemed rather disconnected with what was done in class. Because students pursued different research interests, doing the online assignments felt like an "isolated experience."

Mostly, students in Mrs. Lee's course were "frustrated" with student demonstrations because the purpose was vague and they wished the activity was a little bit more structured and the weekly student presentations felt "tedious" or "as if they were not contributing something new to the class learning" and "sometimes seemed to drag." The way the group documentations played out also seemed a bit disconnected from the rest of the class since there was not a lot of feedback and some students wanted a little more support and guidance in documenting or in structuring their analysis and presentations. Moreover, the class did not revisit or build on these documentations.

*Class Size and Teacher-Centered Classroom Spaces* The class size made it more difficult to build a classroom community—especially when students rarely discussed or worked in small groups during class or when community-building activities were rare with students having trouble remembering everyone's name midway through the semester. For example, in Mrs. Smith's course, some interviewees felt that in the large group with about 40 people, there was more of "a community of sort of rigorous learning and interest in the topic, but not necessarily in each other." Some of the interviewees in Mrs. Lee's course also felt that the class was "too big" and "holding that many minds in my head for the volume of what we are doing" was sometimes hard, according to Mrs. Lee.

Although the instructors aimed to use the classroom space and equipment effectively, they pointed out some difficulties with regard to spatial configuration as most of the classrooms were designed as traditional teacher-centered spaces. There were only a few classrooms available at the school that would allow up to 50 students "the flexible ebb and flow of small to large group environments" and that had walls students could utilize and get up and move and use the space [Brown interview]. Even these seminar-type classrooms were often a bit small for about 40 people sitting in a circle or spreading out to do exploratory activities in groups; they also did not have enough chalkboards, whiteboards, and pin-up space. The room in which Mrs. Lee's course took place for the first couple of weeks had no windows, loud air-conditioning, and no easily moveable chairs, for instance. Later on in the semester, the class was able to move to a better room due to the instructor's initiative. Younger faculty experience institutional pushback if they want to offer smaller classes and cut enrollment to 35 students, for example, as the school tends to favor bigger classes. The HGSE administration also tends to schedule bigger classes of more than 50 students in lecture halls that are not very flexible in terms of spatial configuration. [Brown interview].

*Cultural and Institutional Forces at the School* Teacher-centered instructional practices are predominant in the HGSE higher education classrooms according to the instructors although faculty members have the autonomy to decide on instructional delivery. Mr. Brown points out that "if an institution wants to take seriously the student-centered approach one has to think long and deep about breaking monolithic patterns for models of teacher-centered spaces" [Brown interview]. There might be a critical mass of progressive-minded teachers that needs to be put in place in order for the institution to actually adapt to cultural and structural forces to better facilitate innovative approaches. Courses at HGSE are on a one-year contract basis and as long as a course gets good reviews and seems to be a good addition to the school's curriculum, it is offered. However, at any moment, the institution could drop courses.

Institutional forces such as class size, course evaluation requirements, and grading affordances can inhibit constructivist teaching approaches, and are sensed by faculty who consider offering more student-centered classes with high student involvement and more flexible and adaptable class structures. Hence, there are some natural and institutional limitations and challenges for instructors who are trying to push their own practice and pedagogical strategies. Expert instructors acting upon constructivist educational beliefs can also sometimes feel like they are "a bit on an island," although the school administration is open to new teaching approaches and experiments. Nevertheless, there are instructors who have been able to conduct their courses in a more student-centered way—often only with the crucial help of teaching fellows. Hence, there seem to be some cultural forces that enable student-centered approaches; however, instructors also experience other forces that tend to inhibit their progressive agendas.

### *5.4.2 Challenges with Regard to Scaffolding Participatory Processes of Knowledge Construction*

The instructors in these classrooms avoided "lengthy talk" because "whenever I'm talking as a teacher that is a brilliant performance of understanding for me, of my understanding. I have no idea what it does for anybody else's understanding" [Lee interview]. However, the student-centered classrooms under study also presented teaching and learning challenges with regard to scaffolding participatory processes of knowledge construction that encompassed the following aspects: keeping all students engaged in large group explorations, validating a variety of student ideas, engaging in metatalk to reflect on joint learning experiences, ensuring the educational value of small group work, and socially shared regulation in small groups.

*Keeping All Students Engaged in Large Group Explorations* Large group activities made it more difficult for students to build on each other's ideas and develop their thoughts together as compared to small group work—especially when classes were as big as 30–40 students. Some interviewees felt that they did not get "much out" of large group discussions as everyone needed to be "on the same page." For example, when the large class explored a poem together in Mrs. Smith's course, everybody was supposed to state what they noticed in the poem they had read and the activity ended up "kind of dragging on." During large group explorations, students were also likely to look at and talk to the instructor and not so much to each other and it was harder to go back and forth between people and develop a discursive dynamic. Large course activities were also harder to do because students were at different levels of understanding, they had different ideas about what they wanted to be doing or experiment with and there was no "closure" or definite answers to questions or puzzles. Thus, it was difficult to keep all students engaged and "on the same page" for a longer period of time to contribute to students' larger understanding.

*Validating a Variety of Student Ideas* It was also difficult to conduct the Tuning Protocol in the large group in Mrs. Lee's course, for example, as there were many potential voices in the classroom, but each protocol step as well as class time were limited. And while many students raised their hands to contribute their ideas, the instructor sometimes had to pick only a few to voice a comment in the large group due to the class size and time constraints. Some people were asked to talk more and elaborate on their ideas, but not others. The validation of everyone's ideas was more difficult in the large group since everyone's ideas were not heard and it made it seem like some people's ideas—the ones who spoke—were discussed by the whole class and thus appeared to be the most interesting ones. These decisions also comprised an element of unpredictability for some students, as it seemed certain ideas were "worth" writing down, dwelling upon, or worth pursuing in the large group, while others were not. Hence, some students lacked or lost interest along the way while others felt "isolated" and "inactive" once in a while and "tuned out" when explorations and discussions were kept in the large group when only one person could share his or her ideas at a time and everyone was supposed to be paying attention.

Students experienced discomfort when they perceived an instructor's responses as a little "unpredictable" because it seemed to some students like sometimes they were "cut off" or "shut down" in class, that is, those students' ideas were not pursued further (HGSE, 2010a; Smith case):

> I appreciate the desire to make sure everyone has the chance to speak, but I felt that sometimes people were cut off from contributing.

Some interviewees reasoned that decisions to pursue one idea but not another in Mrs. Smith's course were probably made for the sake of the many students who were not yet ready for that new idea and would not have been able to access (assimilate) it. Such rather rare situations made some students "to not want to participate in class" and "it wasn't encouraging, it wasn't inspiring," instead it was a rather "crushing thing giving the importance of everybody's ideas and thinking in that tone in class" and it "soured" some of the students to a lot of those constructivist ideas [Student interviewee D, Smith case].

*Engaging in Metatalk to Reflect on Joint Learning Experiences* The reflective class discussions produced discomfort and tensions for some students in class when the groups shared their reflections about their group learning process (e.g., how leadership was exerted in their small groups) with the large group in Mr. Brown's course. Yet, when students shared experiences in the large group, they also realized that they/the groups were struggling with the same things and that this might be something that students could learn from and collaborate on addressing. Such deep learning experiences also evoked different feelings and comfort levels for students in class:

> I've done eight courses. In terms of benefits, in terms of usefulness I put this as my number one or number two course. And I maybe even think I was learning about myself and that that was the informal learning. Because I really had to reflect and ask myself, "Why am I feeling this way? What is wrong? How come it's coming out this way?" But in terms of the comfort-level it was at times excruciating. [Student interviewee VI, Brown case]

There was an openness and courage to be actively involved and to reflect at the large group level in Mr. Brown's course, for instance, when students challenged ideas and "went meta in a provocative way." The large group reflected not only on content but also on process based on students' own experiences in class. Students were willing to step out of their comfort zone to "a really uncomfortable meta-space" and engage in discussions about the class itself. Some students were uncomfortable with the idea of challenging the instructor or their classmates, while others found them very interesting. Yet, the class atmosphere made most people comfortable enough to put things on the table and to work through whatever tension or anxiety that openness created, although some students felt at times "stressed," "uncomfortable," and not "safe enough" with each other.

Instances where productive tensions came up during reflective discussions in Mrs. Lee's course and where some students expressed some criticism or concern in their reflections in class or via email could result in an email response from the instructor addressed to the whole class or in feedback shared with the class, for example. The instructors assumed that there would be tensions in class and took these tensions as signs that the group was getting somewhere in their discussions. Tensions arose when students disagreed and had different opinions regarding an educational dilemma or challenging question, and/or due to personal style when there were things that students did not like about somebody else (e.g., the way they voiced their ideas).

*Ensuring the Educational Value of Small Group Work* Turning the learning process over to small groups involved the risk that the learning experiences would not lead to deep learning for all students. The depth and breadth of exchanges in groups varied and discussions were not always as valuable and productive as the instructors and/or students had hoped. Some groups would drift off a bit with personal experiences starting to take up airtime, especially toward the end of the group discussions. Group work was not as valuable when several group members had not done the readings properly, when students had different explorative interests, when groups were not well organized or willing to open up their agenda and move the conversation forward asking further questions, or the group dynamic did not work out. Another difficulty that occurred in small group explorations was that some students had a much clearer (prior) understanding of the problem at hand than others and had already figured it out, while other group members were still struggling on different parts of the problem.

Group activities such as article discussion groups or the student-led discussions at the end of class in Mr. Brown's course got a bit repetitive and less flexible and "forced" upon the class and "by the end of the course it was doing the same thing over and over and over" [Student interviewees I, VI; HGSE, 2011; Brown case]. And while the three big questions were considered to be important at the beginning of the semester, it became difficult for the students "to get away from those three questions" in the second half of the semester when they were freer to structure the discussions themselves [Student interviewee II, Brown case]. The way the groups discussed the articles at the beginning became so ingrained that it became difficult for some groups to try something new when they were given the opportunity to innovate later on in the semester (HGSE, 2011; Brown case).

*Socially Shared Regulation in Small Groups* Problems occurred occasionally in terms of social collaboration when there were group members who took a lot of airtime and were not open enough to be challenged, pursue a new line of interest, or build on other people's comments. The flow of the small group explorations was also hindered in cases when conversations started to center too much around individual concerns and skepticism, for example [Student interviewee E, Lee case]. Such instances hindered learning at times, with the group trying to figure out how to work through such tensions and channel them in productive ways (e.g., trying to get different people to talk). Students were aware that "it's all part of the experimenting process" and such experiences also led to individual students trying to adapt their attitudes, thoughts, and/or behaviors accordingly. Yet, some students tried to deliberately avoid working in groups with certain people after feeling "frustrated" by a prior encounter seeking an easy way out instead of dealing with these situations since there were other (easier) choices available (e.g., in Mr. Brown's case).

### 5.4.3 *Challenges with Regard to Cultivating a Classroom Community of Learners*

Teaching and learning challenges with regard to cultivating a classroom community of learners uncovered in the classrooms under study encompassed the following aspects: building an atmosphere of trust and safety to facilitate participation, tense class atmosphere during the first few weeks, and providing timely feedback and formative assessment.

*Building an Atmosphere of Trust and Safety to Facilitate Participation* The instructors provided structures that required the students to actively prepare and participate in class as all courses were highly dependent on students' engaged participation. This also meant that perspectives of students who did not contribute so much were lost. For example, Mrs. Lee was concerned about a quarter of the class who were very quiet in the large group. Although she respected that some students chose to not talk too much as receptive learning is also taking place by listening intently, it was an expectation of the large group, including the instructor, that everybody got to talk and that many different voices could be heard in class.

One interviewee felt that the environment in Mr. Brown's course did not seem to be as safe for introverts and/or reflective people as it seemed to be for extroverts. In the big group, there were a couple of people who excessively took on active roles (e.g., leadership roles during article discussion groups, contributions during class discussions), while others were holding back. The voices of quieter people did not seem to count as much as the class often favored certain ways of operating or meaning making and thus, producing some undercurrent or tension beneath the surface that led some students to feel at times "very stressed," "very uncomfortable," and not safe enough with each other in class:

> And in a way we learned about something but at the same time we were actually going through it ourselves. And the depth of learning, the further explorations that we could have done might have been more beneficial, meaningful, deeper and personal if I felt people were safer with each other. [Student interviewee VI, Brown case]

Some students suggested that the instructor should pay attention to this silence and could have invited the voices and ideas of "quieter people" in class more explicitly to honor and appreciate and affirm different ways to learn and respond in class (e.g., personal reflections). Interviewees suggest that the explicit building of a sense of community and inclusiveness very early in the course is crucial to facilitate a more intense atmosphere of trust and safety among all learners and invite more and different student "voices" (HGSE, 2011, Brown case):

> I was sorry that there were several voices in the class that were silent for much of the semester, and I wish we had all done something to get those people participating. In some cases, this happened late and in others not at all. I think this may be inevitable in any course, but I think James could have addressed it somehow in his design or reached out to those students and paid attention to the silence.

Moreover, the competitive atmosphere some students sensed in Mr. Brown's course, where part of the students chose to take the course for a letter grade, for example, made them feel unsafe and judged when they participated in class—either by the instructor, teaching fellows, or their classmates. Some people seemed to be very eloquent in what they were saying and at times were perceived as trying to perform instead of trying to grapple with ideas.

*Tense Class Atmosphere During the First Few Weeks* The class atmosphere was "a little tense" in the beginning, because students were intimidated by the instructors' experience and reputation and by the fact that there was relatively little talk on part of the instructors. Students were also intimidated by their classmates in the beginning as some of them seemed to be so "quick on their feet"—this was especially true for international and nontraditional (e.g., older) students for whom the environment was new and who needed time to gradually adapt and "feel their way." And students who were from a different cohort (e.g., another school or program) and did not belong to the tight cohort from the Learning and Teaching program at HGSE, where students knew each after from other events and courses, sometimes felt a little bit left out as they were not so familiar with the new environment and with the students in class. Non-native speakers felt that they could always jump into an ongoing discussion when they had something to say. However, when the discussion was about American schools or topics, these students usually decided to listen to learn more as they lacked the background knowledge. Occasionally, some students would become a little bit impatient when Asian students could not express their ideas very fluently. This led to foreign students being quieter during large group activities and feeling a little bit "isolated" or "awkward."

*Providing Timely Feedback and Formative Assessment* Some students had to get used to pass/fail classes where "there is feedback involved but not a whole lot of assessment involved" and they did not know what level work they were doing in terms of grades. Some of the students/groups in Mrs. Lee's course would have liked clearer evaluation criteria for the open-ended assignments. Although most of the students in class stated that Mrs. Lee provided helpful feedback on course assignments, only about half of them thought that feedback on course assignments was provided in a timely manner (HGSE, 2010b, Lee case). Some of the students would have liked more timely feedback on assignments at the various stages of the final project. Some groups only received feedback in the early stages of the research proposal and did not get feedback at any other stage (this is also due to the fact that Mrs. Lee had no teaching fellow). However, they did not seem too concerned:

> We are not as concerned because we are pretty happy with what we know based on … she gave such clear expectations. And reading other people's papers we know that it's good work. [Student interviewee 2, Lee case]

Mrs. Lee tried to give feedback on the proposal and first draft, but she "was really slow giving feedback on the first drafts," and not managing to

**Table 5.15** Overview of deeper-level instructional quality dimensions and features

| *Research interest* | *Quality dimension* | *Instructional strategies* |
|---|---|---|
| Content and tasks | Learning content (outcomes) | Disciplinary concepts (factual and conceptual knowledge) |
| | | Disciplinary practices (procedural knowledge) |
| | | Self-regulated learning (metacognitive knowledge) |
| | | Identity development (metacognitive knowledge) |
| | Learning tasks affordances | High level of cognitive demand of the tasks |
| | | Conceptual agency students can demonstrate as they complete the tasks |
| | | Productive talk students can engage in as they complete the tasks |
| | | Practical relevance of the aligned tasks |
| | | Ensuring that students understand the task (content/objectives and process) |

(*continued*)

**Table 5.15** (continued)

| *Research interest* | *Quality dimension* | | *Related quality features* |
|---|---|---|---|
| Scaffolding participatory processes of knowledge construction | Facilitating explorations | Independent problem solving in small inquiry groups | Fostering student autonomy and accountability to invite self-regulated learning<br>Engaging students in small inquiry groups to co-construct knowledge together<br>Making students' thinking visible to facilitate shared understandings<br>Keeping students struggling to make sense to deepen their understandings<br>Sampling the level of the groups' discourses to inform one's teaching |
| | | Guided problem solving in the large group | Orienting structures, guiding norms, and modeling behaviors to clarify expectations<br>Open-ended questions and prompts to develop students' thoughts further<br>Ensuring mutual understanding to enable joint knowledge construction<br>Thoughtful and appreciative responses to invite different ideas and voices |
| | Moderating discussions | Disciplinary discussions (educational concepts and practices) | Letting small inquiry groups share out to demonstrate their understandings<br>Encouraging students to express their thoughts to further joint sense making<br>Promoting critical dialogue to provoke conceptual changes<br>Inviting a variety of voices to enhance collective participation |
| | | Reflective discussions (metatalk) | Engaging students in self-reflective practices to deepen their understandings<br>Engaging students as co-designers to improve their learning experiences and outcomes<br>Taking student feedback into account to inform teaching |
| | Lecturing and modeling | Lecturing (including metatalk) | Conveying relevant information students need in order to learn<br>Connecting new knowledge to topics and questions raised by the students |
| | | Modeling | Modeling behaviors to support knowledge building and develop confidence |

| | | |
|---|---|---|
| Cultivating a classroom community of learners | Intellectual climate of active sense making | Establishing a dialogic "thinking culture" with learning as thinking in the making<br>Recognizing students' identities as valuable and productive |
| | Iterative cycles of feedback to further student learning | Tailored feedback to deepen students' intellectual involvement<br>Mastery-oriented (public) feedback to keep students thinking<br>Allowing for student peer assessment and self-assessment to promote self-regulation |
| | Positive emotional climate of mutual respect, trust, and belonging | Developing a strong sense of mutual respect and concern for one another<br>Fostering social stability and integration in the classroom (collective identity) |
| Teaching and learning challenges… | Course design elements and support structures | Student preparation; demanding open-ended assignments; relevance to real-life contexts; adaptive nature of the course structure and activities; least valuable of all course activities; class size and teacher-centered classroom spaces; cultural and institutional forces at the school |
| | Scaffolding participatory processes of knowledge construction | Keeping all students engaged in large group explorations; validating a variety of student ideas; engaging in metatalk to reflect on joint learning experiences; ensuring the educational value of small group work; socially shared regulation in small groups |
| | Cultivating a classroom community of learners | Building an atmosphere of trust and safety to facilitate participation; tense class atmosphere during the first few weeks; providing timely feedback and formative assessment |

give feedback to all students on the first draft felt like a “loss” to her [Lee interview].

The feedback in Mr. Brown’s course was very transparent and making the individual feedback available publicly on the course platform helped to leverage some of the social power in a group setting. However, the public feedback also raised anxiety and not all students felt comfortable with the fact that their work was exposed—this was also partly due to the competitive culture that some students perceived in the class. However, Mr. Brown also offered to remove the public feedback if a student felt uncomfortable with it.

Students working on different ideas/problems and the quick turn-around time limited the value of the peer feedback that took place in Mr. Brown’s course. Some students were “frustrated” because they felt that they lacked the knowledge and skills to provide rich feedback. Others thought that the comments students posted to their peers did not seem detailed enough “to be of any great use.” The online discussion forum was the least favorite activity in Mr. Brown’s course because it “became just another thing that we had to do,” or was “too forced” having to post online and respond to members within the group by the next day creating a “pseudo-community”—hence the feedback was of limited help (HGSE, 2011; Brown case).

Table 5.15 provides an overview of the deeper-level instructional quality dimensions and features outlined above (see Sect. 5.3), including the teaching and learning challenges that these classrooms presented (see Sect. 5.4).

## Notes

1. A rich data-based account identifying characteristic curricular design elements and related quality features as well as deeper-level instructional quality dimensions and features that are manifested in each course (single case analyses) can be reviewed upon request from the author (Hoidn, 2010a, 2010b, 2011).
2. N’s range due to occasional missing data (e.g., a student did not respond to each survey question).
3. Aligned with the two-hour class sessions conducted by Mrs. Smith several parallel *sections* met once a week for two hours (110 minutes) with up to 12 students and led by a teaching fellow. The vast amount of time in the smaller sections was devoted to student-

driven discussions focusing on the weekly readings students were particularly interested in, on the weekly field work each student did in one-on-one interactions with different learners, and served as a forum for discussing and reflecting on ideas, insights, noticings, puzzles, difficulties and confusions generated by the various course components. The section discussions would help students to see what was going on in class and during their field work while they practiced Critical Exploration and to reflect about what it meant for teaching and learning practice (HGSE, 2010a).

4. Two of the three activities are briefly described here. (1) *Going to the movies activity:* The teacher presents the learner with a small story: Three (or more) kids are going to the movies. There are four (or more) seats and the learner is supposed to figure out all the different ways the kids could arrange themselves. The teacher places four (or more) objects (e.g., paper clips, beans) in a row representing kids that are sitting in a movie theater. The problem for the learner is in essence to figure out all the possible ways the kids could sit. What makes her/him sure that s/he has got all the possible ways to sit at the movies, with no repeats? The teacher challenges the learner if necessary asking questions like, "Could you find any other ways?", "What makes you think you don't have any repeats?", "What makes you think you have all the possible ar-rangements?" (2) *Poem activity:*The teacher presents a group of learners with a poem that the learner(s) read themselves. After that s/he asks the learners to tell him/her things they notice about the poem—something that is on the page and that they can point to (no interpretation). After the initial noticings phase the learners point out phrases that puzzle them and share thoughts they have themselves about these phrases. After that, the learners start to talk about what they make of the poem and re-read parts of it together. From time to time someone reads the entire poem out loud. The teacher tries to find out where the students' thoughts go as they keep attending to the poem, noticing more, considering different angles and making sense of the poem. The teacher refrains from telling students what the author's (assumed) intentions are/were.
5. The instructor's metatalk is language that "organizes, foreshadows, summarizes, or connects classroom activities," it helps students to organize the flow of class activities and provides them with

markers for upcoming class activities and content (Leinhardt & Steele, 2005, p. 92).

6. Teaching patterns can encompass one or more course activities (basic unit of analysis). For example, the teaching pattern guided problem solving combines two course activities: lecturing and teacher-led explorations, while the teaching pattern independent problem solving combines lecturing and student-led problem solving. Lecturing thereby refers to the instructor framing the learning content and task (problem setup).
7. See Anderson and Krathwohl (2001) for Bloom's revised taxonomy that classifies thinking according to six cognitive levels of complexity in order to construct knowledge.
8. The CIQ is an anonymous way to critically reflect on the week (two classes) asking students to think about the process of the class and noting when they were engaged and when they were not engaged, for example.
9. Students' perceptions are based on students' responses to the course evaluation surveys and on student interviews coupled with participant observations.
10. The emphasis to work on the class level in Mrs. Smith's course as compared to the other two courses is in part because this course is accompanied by parallel discussion-driven sections with up to 12 students led by teaching fellows. Hence, students had additional opportunities to work in small groups in these separate sections.
11. There was one exception in Mrs. Smith's course where one deliberate lecture took 30 minutes with a subsequent 45 minutes discussion period. Mrs. Smith gave a narrative of the origins and key ideas of Critical Exploration (week ten). During that lecture, Mrs. Smith addressed almost every major element of the course. The lecture then led up to a discussion where students would ask questions and discuss their ideas responding to the lecture and related to readings they did prior to the class.
12. Routines are socially scripted elements that reflect educational and subject-specific philosophies that reduce the cognitive complexity of the classroom while norms of interaction are (written) expectations governing behavior (Leinhardt & Steele, 2005).
13. The single case analyses of deeper-level instructional quality dimensions and features (research question 2, see Table 4.1, Sect. 4.2), that are not part of this book (Hoidn, 2010a, 2010b, 2011) and

can be reviewed from the author upon request, depict the three case studies separately to situate the reader inside of the classroom. The within-case analyses are informed by several data sources to allow for different perspectives (students, instructor, researcher) to be considered, and constitute a delicate balance between data description and interpretation.

14. Some of the respondents to the course evaluation survey in each of the three cases explicitly state that they became aware of their own assumptions as learners and prospective teachers. As a result, their perception of learning, teaching, and student work changed over the course of the semester (HGSE, 2010a, 2010b, 2011).
15. Bligh (2000) found that lecturing is effective when the objective is learning of facts and general information. However, it is not effective when objectives center on promoting thought, changing attitudes, or developing problem-solving skills and interest in the discipline (see also Middendorf & Kalish, 1996; Twigg, 2000).
16. The analysis of the course evaluation surveys suggests that Mrs. Lee's and Mr. Brown's courses were rated considerably higher in terms of the instructors giving "clear and well-structured presentations" as compared to Mrs. Smith's course. Considering that lectures only played a minor role in Mrs. Smith's course, this difference may be mainly due to the diminished part lecturing played in this course where there was hardly any presentation of knowledge given by the instructor (see Sect. 5.1).
17. This cross-case analysis refers to the teaching and learning challenges that each classroom presented for instructors and/or students mainly based on students' and instructors' perceptions (i.e., interviews, evaluation surveys; Hoidn, 2010a, 2010b, 2011).

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CHAPTER 6

# Situative Educational Model for the Design of Powerful Student-Centered Learning Environments

European policy makers, researchers, and educators alike have increasingly emphasized and demanded the pedagogical concept of SCL as a promising approach to promote quality higher education. However, little empirical in-depth research has been done so far in naturalistic higher education classrooms to investigate SCLEs. Existing constructivist design principles and frameworks presented by education research are often disjointed and not specific enough to effectively support educators in higher education to make informed curricular and pedagogical decisions in their respective classrooms. *How can instructors design and bring to life SCLEs that provide students with opportunities for deep learning*?

In order to answer this holistic research question and contribute to educational theory development and research on classroom teaching and instructional quality, this research project focused on the micro level of learning and instruction with students and instructors as key players in the higher education classroom. Interdisciplinary literature reviews synthesizing relevant education research were conducted and three different student-centered classrooms were researched in the context of university-level (teacher) education at the HGSE in the USA. Instructor and student perceptions of their student-centered classrooms (interviews, evaluation surveys) and real-life learning and teaching practices enacted by the students and instructors in these classrooms (participant observations, video analyses) were investigated. A mixed-methods approach using a variety of qualitative and quantitative methods to gather rich empirical data was



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applied to provide detailed descriptive and interpretive research evidence anchored in naturalistic classrooms.

As a result, a situative educational model was developed that structures the research findings and contributes to transform European higher education classrooms into powerful SCLEs that provide students with opportunities for deep learning.[1] The findings substantiate the proposition that SCLEs *can* foster deep learning, that is, student sense making. The model ties the empirical findings, namely participation-oriented educational practices that are by their nature social and situated, to existing state-of-the-art research on classroom learning and instruction and develops theory that informs and improves practice.

Section 6.1 introduces the educational model and its basic architecture. The model integrates the main results of this research project and puts them in a theoretical perspective abstracting and systemizing characteristic curricular design elements and instructional quality dimensions/features under which deep learning appears to happen in student-centered classrooms. Synthesizing results by moving from the concrete (authentic practices) to the abstract (educational model) is difficult since every synthesis abstracts from the authentic ground-level higher education practices it is anchored in. Chapter 5 presented the practices that underlie each component of the developed model—the following sections will refer to prior analyses where appropriate in order to make the connection between synthesized results and concrete empirical data traceable. Section 6.2 lays out the model's implications for higher education policy and practice. Section 6.3 reflects on potential limitations of this research project and points to areas for future research. Finally, Sect. 6.4 provides a short summary of the main results and contributions of this research project.

Educators in higher education and other educational settings can use this educational model to design more SCLEs that embody the characteristic curricular design elements of such classrooms and position students for participation in knowledge construction and interactions. Educators can adopt the instructional strategies the model proposes to scaffold participatory processes of knowledge construction (e.g., explorations, knowledge sharing, and discussions) and to cultivate a productive and supportive community of learners over time in their classrooms. Instructors can start by making small changes in their respective classrooms that position students in certain ways in relation to the content, other students, and the instructor (e.g., introduce principles for discussions, let the students call on each other during class discussions, let students self-organize in small inquiry groups, provide formative feedback).

Overall, the findings support educators from different disciplines in making informed decisions with regard to student-centered course design elements and instructional quality dimensions and features of classroom learning, teaching, interaction, and climate. The model will also be used to support the (re-)design of student-centered curricula (e.g., in the context of design and evaluation studies) and to develop faculty workshops to help instructors to teach in a student-centered way.

## 6.1 Situative Educational Model to Provide Opportunities for Deep Learning

The nature of classroom activity on a micro level is an interaction between students, instructors, and the subject matter. Rethinking the content (the what?), the students (who?), and the instructors (with whom?) of the classical instructional triangle and accounting for situative views on cognition and learning provide structure and offer new perspectives and ways of designing powerful SCLEs in higher education classrooms (e.g., Cohn, 1975/2009; Greeno & Engeström, 2014; Reusser, 2008, 2009).

Designing student-centered classrooms requires first and foremost an awareness of existing educational beliefs on learning and instruction and adaptive professional competence on the part of the faculty. The research findings of this project show that SCLEs can provide students with opportunities for deep learning, when

- the learning environment embodies aligned *curricular design elements* that allow the students to engage with relevant and challenging content (e.g., questions, tasks) so that they achieve the desired learning outcomes (Sect. 6.1.1).
- *students* are positioned for active participation in knowledge construction and interactions—as accountable authors, active and vocal participants, and responsible co-designers (Sect. 6.1.2).
- the *instructor* applies adaptive instructional strategies to (1) support students' participatory processes of knowledge construction and (2) to cultivate a productive and supportive *classroom community of learners* over time (Sect. 6.1.3); thereby the instructors draw on the best available knowledge in the subject field concerned and on state-of-the-art pedagogical (content) knowledge.

The design of these core components of the situative educational model—content, instructor, students, and community—creates affordances and constraints for how instructors and students interact in the classroom to foster student sense making (deep learning). Section 6.1.4 summarizes the *challenges* to the implementation of student-centered learning and instruction in higher education classrooms.

The situative educational model depicted in Fig. 6.1 provides a useful reference point to plan, conduct, analyze, and reflect on student-centered educational practices in higher education in particular, and in postsecondary education and other educational settings in general.

### 6.1.1 Curricular Design Elements of Powerful Student-Centered Learning Environments

HEIs have to equip students with high-level subject-specific know-how as well as transversal competences and skills to enhance their individual potential and development, prepare them for life as active citizens in a democratic society, and ready them for high-skill occupations, future careers, and lifelong learning (Bergan, 2006; European Commission, 2006, 2013). The focus of powerful SCLEs thus lies on *learning processes* and *competences* in terms of what the students will be able to do instead of mere content, that is, knowledge acquisition (Sawyer, 2014) with the goal of fostering performances of understanding as well as SRL skills and identity development. *What are characteristic curricular design elements and quality features of student-centered higher education classrooms* (*e.g.*, *course goals and content*, *course structure*, *course activities*)? As instructional agents of a curriculum that fosters understanding, instructors in student-centered classrooms (see Fig. 6.1):

1. Determine *relevant and challenging course content* students have to engage with in order to achieve high-level learning outcomes;
2. Provide *flexible course structures* (i.e., overall agenda/syllabus) that give students a say in their own learning process;
3. Develop *participation-oriented course activities and materials* that focus on learning and leave room for engaged student participation;
4. Establish *routines and norms of interaction* that are enacted in the classroom in order to support student learning;
5. Provide *open-ended assignment tasks and formative assessment* that allow for an ongoing co-construction of knowledge.

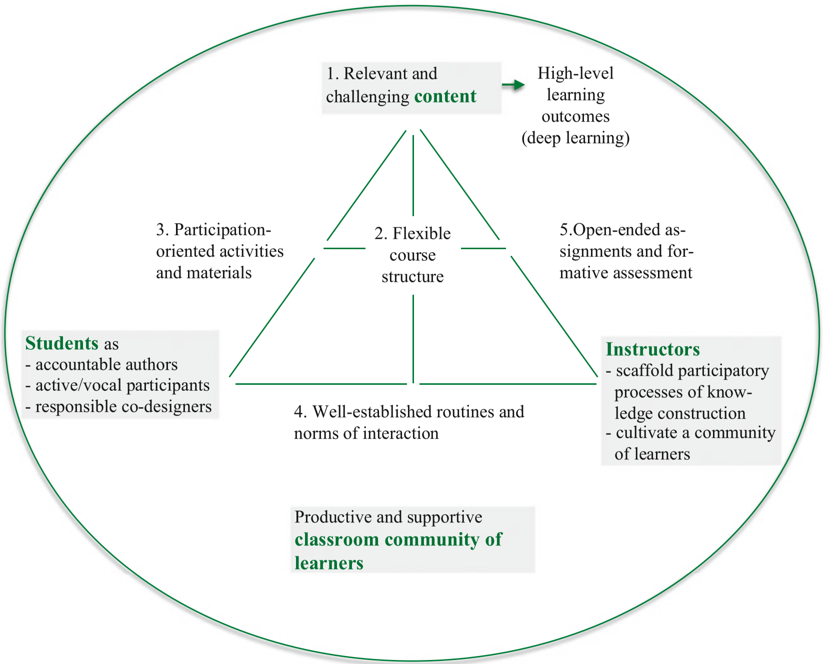


**Fig. 6.1** Situative educational model—basic architecture of powerful SCLEs

In this context, instructors also take on a specific meta-monitoring role in that they create opportunities for students to co-design their learning environment over the course of the semester. Powerful SCLEs align and embody these five characteristic curricular design elements and related quality features while at the same time enabling the co-development of the learning environment. This section synthesizes the theoretical findings on common design principles outlined in Sect. 2.3 and the empirical findings of the cross-case analyses on characteristic curricular design elements outlined in Sect. 5.2 (see the summarizing Table 5.2, for instance) and those found in Sect. 5.3.1 (learning content and task affordances).

1. Relevant and challenging content for students to achieve high-level learning outcomes

Powerful SCLEs are designed around content that is intellectually challenging in terms of the educational concepts and practices that students engage with; they are also relevant to the daily practice of teaching and learning and to the wider community (see Sect. 5.2.1). The curriculum is not fixed, but gives students various choices and opportunities to connect course topics, questions, and practices with their prior knowledge, interests, experiences, and wonderings. Open-ended questions or puzzles with the potential to draw students' interest and stimulate some disequilibrium (e.g., conflicting ideas) aim to foster students' "adaptive expertise" as prospective teachers, meaning the ability to apply knowledge and skills flexibly in different contexts (e.g., Bransford et al., 2006; Darling-Hammond, 2008; De Corte, 2012; NRC, 2000; Perkins, 2008). The curriculum provides students with a thoughtful balance of opportunities to study educational concepts (factual and conceptual knowledge) and actively engage in educational practices applying norms of discourse and learning behaviors (procedural knowledge). Students also develop a critical awareness of their own assumptions and of what they do as learners and teachers stimulating them to think in new ways and change their thinking about education, learning, and teaching in the light of other possible perspectives and ways of thinking (metacognitive knowledge). Hence, apart from knowing and doing, the courses also emphasize the promotion of reflective practices for prospective teachers to become self-regulated lifelong learners and teachers (e.g., Anderson & Krathwohl, 2001; Bielaczyc, Kapur, & Collins, 2013; Blythe & Associates, 1998; Greeno, 2011).

Against this background, the situative educational model aims to raise educators' and students' awareness of the potential of powerful SCLEs to engage students with relevant and challenging content fostering:

- *Performances of conceptual understanding* (disciplinary concepts *and* practices) and transfer of the subject matter knowledge;
- *Self-regulated learning* enabling students to become metacognitively, motivationally, and behaviorally active participants in their own learning processes;
- Students' *identity development* as cognitively active and engaged participants in the practices of their professional communities (e.g., classroom, professional, and wider society).

Instructors have to provide students with various learning opportunities to engage their minds with the subject matter and to demonstrate their understandings in order for the students to achieve these high-level learning outcomes (see also Sect. 5.3.1.1).

2. Flexible course structures

Powerful SCLEs are structured in a way so that they give students a say in their own learning process with various opportunities to participate actively in the knowledge construction process and in decisions concerning the course's educational agenda. Thus, students are allowed to take responsibility for (meta-)cognitive, emotional, and social aspects of their learning based on their ideas, experiences, questions, and interests (Elen, Clarebout, Léonard, & Lowyck, 2007; see Sect. 5.2.2).

Dynamic course structures are necessary to allow for meaningful and productive learning experiences to take place in the classroom. The syllabus provides focus and structure and communicates comprehensive, high, and positive academic expectations to students that embody the constructivist educational beliefs of the instructor (Biggs, 2012; Kember, 1997; Prosser & Trigwell, 1998). At the same time, the course structure leaves room for student choice, collaboration, and discovery to provide students with opportunities to engage in co-constructive processes and learn from each other. The instructors have an educational trajectory in mind relating to the core of educational topics and a web of ideas that they wish to address when approaching the course or a class unit. However, in designing a class unit, they also pave the way for a number of paths through the educational topic and provide ample time and space for students to thoughtfully engage with the subject matter, since how students will think about and approach the content cannot be completely predicted in advance. Consequently, instructors will often have to decide in the moment which path to follow in the large group with thoughtful reasons for deviating from or following certain pathways (Leinhardt & Steele, 2005). Alert and flexible instructors can then use the information they gain from listening closely to the thinking and reasoning of their students to effectively modify the flow of the class.

A flexible course structure also gives students opportunities to co-develop the curriculum (e.g., negotiate course objectives/content, activities, and assessment) and to be involved in decisions around the distribution of responsibilities for the learning process. Students can influence the educational agenda because the instructors shift the decision-making in class to allow for mutual ownership of the educational process. The instructors also use their "read" on the class and the continuous oral and written feedback they get from the students to adjust the course. By positively responding to students' needs and concerns, the instructors facilitate students' motivation and contribute to continuously improve students' learning experiences and outcomes in class. Such an interconnected and flexible design of the course is based on teacher expertise, particularly pedagogical (content) knowledge, that is necessary in order for the instructor to navigate the disciplinary landscape and make informed instructional decisions that support deep learning (Hattie, 2012; Leinhardt & Steele, 2005; Weimer, 2013).

3. Participation-oriented course activities and materials

Understanding the practices of the learning environment and the affordances they provide for meaning making is crucial in order to create better opportunities for students to engage productively in classroom learning processes. In designing the social choreography of student-centered classrooms, the instructors are very conscious of not going on at length lecturing by monitoring their "air time." An emphasis is put on students' learning processes with high levels of student participation and cooperation so that students can assume responsibility and take ownership over products and processes of their learning (Barnes, 2008; Cornelius & Herrenkohl, 2004; Piaget, 1977/1995; see Sect. 5.2.3).

Participation-oriented activities with a focus on learning are high-engagement activities—done individually, in small groups or in the large group—that stimulate and structure the inner activity of learning. They provide students with options to learn in various ways building on their prior knowledge and applying their knowledge in a variety of situations. They keep students' minds engaged in exploring the subject matter (e.g., generate their own ideas and questions) and in actively contributing to disciplinary or reflective discussions about the subject material (e.g., encourage different perspectives) to further students' learning processes.[2] Student activities such as exploration, articulation, and reflection provide opportunities for students to contribute their thoughts and demonstrate their understandings, while mere listening and observing play a secondary role. Furthermore, instructors in student-centered classrooms apply different instructional strategies to scaffold participatory processes of knowledge construction. They act as facilitators of exploratory activities, moderators of large group discussions or to a lesser extent as resource persons, learners/reflective teachers, and models.

Artifacts and materials—at hand in the physical space, brought into the classroom or generated by the class—are important tools for student-centered learning and teaching processes. Artifacts such as readings, flip charts, posters, handouts, or written reflections allow students to prepare for class, help them to visualize key ideas, and become testing grounds for students' ideas (Duckworth, 1987/2006; Hawkins, 1974). Artifacts and materials are also building up as a repertoire of resources for subsequent classes to use and learn from while communication technologies are utilized to facilitate information exchange and interaction between students, instructors, and teaching fellows.

4. Well-established routines and norms of interaction

The general roadmap instructors set out in student-centered classrooms further develops as each classroom shapes its own normative conditions over time with the students advancing the process together with the instructor. Routines and norms clarify expectations and carry messages about how members of the class interact with each other to facilitate each other's sense making so that deep learning of the individual and the collective can take place (Greeno & Engeström, 2014; Leinhardt & Steele, 2005; Mercer & Dawes, 2008).

Discussion-oriented seating arrangements (e.g., semicircle seating), routines such as calling students by their first names or taking a break half way through the class as well as principles for class participation become part of the common knowledge to underscore the value of active student participation and to ensure that useful, productive talk is generated (Alexander, 2008; Mercer & Hodgkinson, 2008; Mercer & Howe, 2012). These routines and norms are important since they scaffold each class' joint learning processes in terms of the amount and quality of learning and dialogue that take place in the classroom.

Classrooms as social systems are organized around shared practices, that is, regular and recurring patterns of activity (Greeno, 2011; Greeno & Van de Sande, 2007). Prevalent and shared patterns of activity in student-centered classrooms safeguard that the thinking and sense making are up to the students who drive the process, while the instructor facilitates the learning process (e.g., through questions, tasks, activity structures, materials). The following re-occurring teaching patterns were characteristic for the three classrooms under study (see Sect. 5.2.4): (1) Independent problem solving referring to ill-structured problems that are first introduced and framed by the instructor and then explored by students independently; (2) Guided problem solving referring to a teacher-led instructional dialogue with the instructor asking genuine questions to structure and facilitate explorations of a given problem or question. These two main patterns were regularly followed by a third prevalent pattern called: (3) Sharing/comparing/discussing in the large group with students sharing, comparing, or discussing problem solutions, ideas, noticings, questions, or reflections continuing to co-construct knowledge together.[3]

Following these routines and norms of interaction also creates favorable conditions for students to develop a sense of community and collective identity in class. Students in these classrooms know that the ground rules allow and encourage extended responses, tentative contributions, confusion, uncomfortable silences, and the development of shared understandings. Through establishing certain disciplinary standards of explanation, challenge, and revision, instructors can hold the entire class accountable to the discipline of (teacher) education and to each other as a classroom community of learners. The instructors also hold themselves accountable to the discipline of education and to the culture by modeling certain behaviors in the classroom (e.g., Leinhardt & Steele, 2005; Resnick, Michaels, & O'Conno, 2010).

5. Open-ended assignments and formative assessment
How the instructors design the learning tasks influences the opportunities students have to construct and use educational knowledge in order for

them to deepen their understandings and gain practice (Greeno, 2009; Gresalfi, Martin, Hand, & Greeno, 2009; see Sect. 5.2.5). In the three classrooms under study, open-ended assignments encompassed exploratory fieldwork and individual written work that students had to submit on a regular basis (e.g., fieldwork reports, a final paper, article summaries, individual reflections). Tasks were accompanied by comprehensive guidelines and assessment criteria. Continuously preparing and doing the home assignments such as the weekly readings was crucial for students to become productive class members.

In SCLEs, assignments and assessment tasks are designed to capture students' thinking in the making, to scaffold students' individual and collective learning processes, and to hold students accountable in order for them to achieve the course objectives. These different tasks build on and complement each other and involve higher-order thinking such as a focused analysis, critical reflection, knowledge application, and knowledge creation in complex authentic contexts (Anderson & Krathwohl, 2001). Yet, there is also room for student choice in terms of topics and questions students want to tackle and how they want to go about a task.

Overall, the empirical study revealed that in order to foster students' performances of conceptual understanding and transfer as well as SRL and identity development, affordances of the learning tasks have to incorporate the following deeper-level quality features: high levels of cognitive demand of the tasks, conceptual agency students can demonstrate as they complete the tasks, productive talk students can engage in as they complete the tasks, the practical relevance of the aligned tasks (authenticity), making sure that students understand the task (content/objectives and process) (see also Sect. 5.3.1.2).

Providing formative assessment for deeper conceptual understanding is under-emphasized in higher education. However, continuous timely and tailored feedback from instructors, teaching fellows, and peers on various course assignments throughout the semester can tap student understanding by helping students to identify learning gaps, reflect on and revise their thinking, and develop their thoughts further. Informative feedback on their work enables students to progress toward challenging learning goals instead of students being merely subjected to public judgment in the form of grades. Since course objectives are embedded in the assessment tasks due to the constructive aligned learning environment the latter also elicit certain levels of cognitive engagement. Thereby, assessment methods and criteria have to be explained to students and negotiated where appropriate so that students are clear on what is required and when they have reached the course's goals. This way, students experience a greater sense of control over and responsibility for their own and each other's learning (e.g., Brown, Rust, & Gibbs, 1994).

A continuous cycle of tailored feedback also provides students and teachers with valuable feedback on students' current understandings, confusions, and struggles and makes students' learning visible. Based on their evaluations, instructors can make decisions about how to proceed with subsequent teaching and learning, (e.g., in terms of activities), and how to reshape the current curriculum and teaching practice to tailor instruction to individual needs (Biggs, 2012; Hattie, 2009, 2012).

The SCLEs under study let the students choose whether they wanted to take the course pass/fail or for a letter grade or they were offered as pass/fail only to help students to focus more on their learning. Foregoing summative assessment in the form of grades can help to establish a feeling of a community where students learn in a safe (and less competitive) environment and are much freer to make mistakes and learn from their misconceptions and from each other.

### *6.1.2 Positioning of Students for Participation in Knowledge Construction and Interactions*

In powerful student-centered classrooms, social interaction plays an essential role in knowledge construction and students' self-regulation, with instructors and students positioned in certain ways in the learning activity so *both* are *agentive*. Course activities are mainly designed to encourage students to participate in cooperative forms of interaction in small groups or in the large group for achieving mutual understanding through sharing different perspectives that can be questioned, affirmed, or revised (Piaget, 1977/1995). The students' active participation in and reflection about educational practices are fundamental in what they learn (e.g., Greeno, 1998). How students are positioned in learning activities in relation to the content, other students, and the instructors is of particular interest because how learning environments are framed intellectually and socially influences whether students engage in deep or surface learning and whether students have opportunities to engage in SRL (Biggs, 1999, 2012; Engle, 2006; Greeno, 1998, 2011; Ramsden, 2003).

The findings of this research project show that powerful SCLEs hold students accountable for demonstrating their understandings in accordance with shared disciplinary norms and practices (students as accountable authors in knowledge construction processes; Sect. 6.1.2.1). Moreover, students are held accountable to their classmates and their instructors for being active and vocal participants in social interactions (i.e., contributing members; Sect. 6.1.2.2), and they have opportunities to act as responsible co-designers of the educational agenda for the benefit of their own and each other's learning (Sect. 6.1.2.3). The following sections synthesize the relevant theoretical findings outlined in Chaps. 2 and 3, and the empirical case study findings outlined in the cross-case analysis of deeper-level instructional quality dimensions and features in Chap. 5.

#### *6.1.2.1 Accountable Authors in Knowledge Construction Processes*

Powerful SCLEs aim to support students' knowledge construction processes in order to foster performances of understanding (i.e., the acquisition of disciplinary concepts and practices) and transfer. Since the student teachers in the three courses under study already had some knowledge of education as a science and some practice as teachers, and were entitled and expected to contribute their prior knowledge and ideas (including naive theories and (mis)conceptions), they had the opportunity to gradually establish their own authority in these classrooms (e.g., Atwood, Turnbull, & Carpendale, 2010).

In student-centered classrooms, students are provided with opportunities to develop integrated knowledge structures since knowledge that has been integrated by the students has the capacity to affect how they think, feel, and act. Student-centered classrooms encourage students to relate new ideas and ways of thinking to existing understandings and expectations in order to modify them (Bain, 2004; Barnes, 2008). Students are provided with opportunities to participate in the practices of the discipline because they are more likely to flexibly retrieve, apply, and transfer knowledge they have authored to real-world settings to solve challenging problems (Cornelius & Herrenkohl, 2004). Prior research also suggests that university students are more likely than primary or secondary students to use prior conceptual understandings in order to comprehend new ideas and they also believe that they are on a closer footing with their instructors (e.g., Atwood et al., 2010).

As authors of meaningful content, students experience that they are creators of their own theories and practices so that they can develop ownership of ideas about subject matter. SCLEs allow students to explicate their thinking and take responsibility for their own ideas. Students often use phrases like "I think" and develop intellectual, disciplinary relations with the concepts and practices being studied (Engle, 2006). They apply conceptual principles and strategies and generate explanations that connect general concepts/practices of the discipline (stored in the learner's long-term memory) with the specifics of the (sample) problem under study (Greeno, 2009; Resnick et al., 2010). Having ownership of ideas also shifts power from the instructor to the students. The students are trusted to come up with their own noticings and to figure out how to solve a problem with the ownership for the ideas belonging more to them than to the instructor. Classroom research indicates that students are more likely to be willing to accept criticism, self-assess, and build new knowledge in an environment that permits power to circulate, since they have many opportunities to ask and respond to questions and comments, and revise their thoughts (Weimer, 2013).

The tasks and related course activities in these classrooms allow students to construct meaning and understanding of the concepts and methods they are learning about and provide them with opportunities for choices and more than one solution path. This way, students exercise conceptual agency because they apply procedures (e.g., thinking routines, protocols) while also critically considering their meanings and adapting them to the task at hand (Stein, Smith, Henningsen, & Silver, 2000). They draw on educational knowledge and principles they gained from prior classroom explorations, course readings, their own fieldwork, or class discussions to reason about educational concepts and practices. They use evidence to justify their claims, draw on experiences from everyday life or they draw analogies to other courses. Positioning students with productive (conceptual) agency in the context of the educational agenda creates social expectations that students will be able to play central intellectual roles as accountable authors in knowledge construction processes in the classroom. Overall, accountability to the discipline is distributed in these classrooms and students are positioned as competent in jointly working on tasks and monitoring their progress (Michaels, O'Connor, & Resnick, 2008).

#### *6.1.2.2 Active and Vocal Participants in Interactions*

The development of knowledge through students' active engagement in course activities is a co-constructed activity of all classroom members, constituted in and through talk (Atwood et al., 2010). In student-centered classrooms, both asymmetrical and symmetrical kinds of talk happen with power circulating among all class members and with the instructor being no longer the only powerful person in the room. Participation-oriented course activities such as student-led explorations or dialogic class discussions allow for a change in the relationships of power and authority with students' views being sought and valued through social interaction. Power circulates between different speakers and actors (i.e., it is moving interdiscursively through utterances) who interact with each other in the process of co-constructing knowledge. With each turn, students experience the power of being positioned as capable and independent so that they can experience a sense of their own agency (Rex & Schiller, 2009).

In student-centered classrooms, instructors let students do the talking and their contributions drive the discussions. Students who participate in dialogic classroom talk have opportunities to learn with and from each other by sharing their thoughts, hearing different perspectives, asking and answering questions, addressing misconceptions and confusions, and developing ideas together. Individual students have opportunities to explicate their ideas and deepen their own reasoning while the entire class community engages in co-constructing ideas together, building on each other's thinking and critiquing and refining the emergent shared understanding. Discussions foster both students learning the content of what is discussed and students learning to participate in educational discourse practices that organize the discussions (Greeno, 1998). In discussion-based activities, constructive processes of understanding and reasoning occur when participants build information structures in the common ground that they construct in their interactions, that is, through their contributions (Greeno, 2011).

In a dialogic classroom in which students talk more than the instructor, students' accountability to the community of learners is a source of continued effort in terms of preparation and participation as was the case in the three classrooms under study. Students accept responsibility for their own learning and for facilitating everyone's sense making by doing the home assignments (i.e., preparing for class) and by actively participating in class in order to be able to make use of the opportunities provided to learn from the materials and from one another. Students are accountable for listening attentively to one another (e.g., making eye contact, body language, referring to previous comments), making themselves clear, clarifying someone else's idea, or requesting clarification of a peer's idea (e.g., ensure that their ideas and solutions make sense, ask clarification questions) and building upon each other's ideas to co-construct knowledge together (e.g., challenge an idea, add on to a previous idea) (Michaels et al., 2008; Resnick et al., 2010).

Students feel comfortable and are confident enough to contribute their ideas and progressively build joint meaning together. In their small groups, students are also responsible for self-organizing and channeling cognitive and relational tensions in a productive way, trying to figure out how to productively work together. They feel accountable for having good group discussions and become increasingly invested in the learning that is going on in the classroom. Over the course of the semester, students feel more and more comfortable and free to take ownership of ideas, questions, confusions, inquiry paths and possible solutions, and mix things up due to the flexibly structured course setup (e.g., Engle, 2006). Students develop a metacognitive awareness of the value of active participation for learning within the scope of the curriculum subject they are learning about. This includes an appreciation for student-driven activities where they learn collaboratively and are given opportunities to practice what they have learned in order to demonstrate and further develop their understandings as was evident in the three case studies.

#### *6.1.2.3 Responsible Co-designers of the Educational Agenda*

Students in student-centered classrooms experience that they can do something to change and modify their learning environment. The instructors involve students in curricular decision-making processes and adjust course design elements and instructional features in order to meet students' needs to better facilitate their learning processes. Students become the co-designers of their own learning environment and assume responsibility for their learning processes (Lea, Stephenson, & Troy, 2003). Their ideas and feedback on content, learning and teaching processes, and on how the curriculum as a whole is enacted are explicitly invited (e.g., reflections, course evaluations), valued, and taken seriously. Some of the power shifts from the instructor to the students when more cooperative instructor–student relationships with a mutual ownership of the educational agenda are established (Piaget, 1977/1995; Rex & Schiller, 2009).

Instructors in SCLEs continuously assess individual learning and collective participation and adjust practices in the classroom (e.g., Hattie, 2009, 2012). They take their own classroom experiences and noticings, as well as weekly briefings with their teaching fellows, into account to make curricular and pedagogical decisions. The interactive nature of the courses allows the instructors to explore what sense the students are making and what is going on with them and get to know their students better over the course of the semester. As a result, they can respond adequately and make informed decisions in the moment about what to do next based on their reading of students' thinking and feeling (e.g., decide on which student ideas to pursue further in the large group).

Evaluation research shows that the willingness to constantly collect student feedback for ways they could improve their teaching performance is characteristic of award-winning university teachers. Expert teachers continually reflect on the subject matter and on student thinking in order to strategize how they might adjust the activities for subsequent classes to maintain a productive educational trajectory in their classroom (Bain, 2004; Biggs, 1999). These instructor reflections on student thinking are then often the impetus for subsequent activities, questions, or probes that drive the dialogues in the next class. The instructor's reflections together with regular meetings with teaching fellows and oral and written reflections from students also help to keep the class on target, troubleshoot student thinking, and allow interesting threads of thinking to be revisited in future class sessions.

### *6.1.3 Adaptive Instructional Strategies to Provide Students with Opportunities for Deep Learning*

As can be seen in the three case studies, instruction sometimes moves "from teacher modeling, through guided practice using prompts and cues, to independent and fluent performance by the students" (Rosenshine, 2009, pp. 207–208). The instructors monitor student learning and provide adaptive learning support (scaffolding) which is increasingly reduced as students exhibit more mastery. The instructors tailor their scaffolding structures to the students' levels of expertise and to the objectives and complexity of the learning tasks resulting in more or less guidance of the students' intellectual journey (e.g., providing examples, posing adequate clarifying, or probing questions to scaffold students' thinking). Consequently, the students' cognitive, affective, and social learning experiences are central and guide the instructors' decisions as to what is done in these classroom and how (e.g., Weimer, 2013).

Adaptive instruction requires highly trained professionals who have both, subject matter expertise (CK) and pedagogical (content) knowledge of when and how to use their expertise to facilitate students' learning processes (e.g., Baumert & Kunter, 2013; Hmelo-Silver & Barrows, 2006; Leinhardt & Steele, 2005; NRC, 2000). The findings of this research project show that instructors in powerful SCLEs

- scaffold participatory processes of knowledge construction using various instructional strategies tailored to four re-occurring teaching patterns prevalent in the three student-centered classrooms under study (Sect. 6.1.3.1).
- cultivate a classroom community of learners by establishing and maintaining a productive and supportive intellectual and emotional classroom climate together with continued feedback (Sect. 6.1.3.2).

This section synthesizes the theoretical findings outlined in Chaps. 2 and 3 and the empirical case study findings outlined in the cross-case analysis of deeper-level instructional quality dimensions and features in Chap. 5.

#### *6.1.3.1 Scaffolding Students' Participatory Processes of Knowledge Construction*

*How do the instructors scaffold participatory processes of knowledge construction*? The participant structures in the three student-centered classrooms under study enabled and incited disciplinary thinking by incorporating four re-occurring teaching patterns to varying degrees. These classroom practices embody certain quality features that are likely to provide the appropriate level of learning support for the task at hand. This section presents the findings with regard to the following four teaching patterns and related instructional strategies:

- Independent problem solving in small inquiry groups (student-led explorations)
- Guided problem solving in the large group (teacher-led explorations)

- Dialogic disciplinary and reflective large group discussions around scientific educational ideas, concepts and practices students learn about and engage with
- Lecturing (including metatalk) and modeling (played only a minor role)

1. Facilitating independent problem solving in small inquiry groups
Independent problem solving refers to student–student talk with the instructor introducing and framing ill-structured problems and puzzles that are then explored by the students independently—individually or often in small inquiry groups (i.e., discussing educational concepts, applying practices). Nevertheless, the instructors (and teaching fellows) unobtrusively monitor student learning constantly to gain access to information about students' levels of understanding so that they can provide an appropriate level of learning support.

A large part of the overall class time in these classrooms is spent with small inquiry groups exploring concepts and applying practices essential to the social group the students belong to as prospective teachers. Studies on group-based learning in naturalistic and experimental settings in schools found that collective, goal-directed, curriculum-based activities among students without the teacher present can be beneficial to the progress of students' learning because they enable them to take more active and independent ownership of knowledge (Barnes, 2008; Barnes & Todd, 1977; Mercer & Howe, 2012; Slavin, 2009).

Instructional strategies that are likely to provide students with opportunities for deep learning embody the instructional quality features summarized in Table 6.1 below.

2. Guided problem solving in the large group
Guided problem solving refers to teacher-led instructional dialogue (teacher–student talk) with the instructor asking genuine questions to structure and facilitate large group (or to a minor extent small group) explorations of a given problem or question. Thereby, instructors have to navigate an endless string of decision points during an instructional dialogue. They identify core issues within the content and explore them together with the class through the development of multiple representations and examples and by following students' ideas, including misconceptions (Leinhardt & Steele, 2005).

**Table 6.1** Instructional strategies to facilitate independent problem solving in small inquiry groups

**Fostering student autonomy and accountability to invite SRL**
– Students have choices (e.g., topics, questions) and take over active roles in the classroom
– Students self-organize in their small groups to explore concepts and engage in educational practices without much instructor involvement
– Establish and maintain routines and norms of interaction that help to hold students accountable to the subject matter and each other (e.g., prepare, share one's knowledge)

**Engaging students in small inquiry groups to co-construct knowledge together**
– Provide students with the time and authority to tap and explain what they think and why to each other for students to take ownership of ideas
– Allow students to build onto, extend, and question each other's contributions in order for them to exercise conceptual agency and to author meaningful content
– Require students to make their use of reasoning explicit (i.e., explain their reasoning) and open to scrutiny and evaluation in the light of publicly available bodies of knowledge

**Making students' thinking visible to facilitate shared understandings**
– Deploy artifacts/objects as pivotal stimuli for initiating higher cognitive processing (e.g., critiquing, evaluations, creation)
– Use visible illustrations of student groups' ideas, questions, and conclusions to allow students to monitor and share the group's knowledge construction process (e.g., poster)
– Artifacts serve as proving ground against which students assess their ideas/claims
– Use artifacts as documentation to unobtrusively observe and assess the groups' level of understanding and progress in order to decide on appropriate scaffolds to further thinking

**Keeping students struggling to make sense to deepen their understandings**
– Require students to temporarily live through feelings of uncertainty, frustration, and anxiety to arrive at certain understandings through their own thinking
– Encourage the expression of confusions and acknowledge tentative thoughts and misunderstandings as valuable parts of the learning process
– Let students engage with varied perspectives, dwell with each other's thinking, and take responsibility for their own and others' learning processes

**Sampling the level of the groups' discourses to inform one's teaching**
– Circulate through the room trying to catch both actual content (e.g., key ideas) and the tenor of the group work process (e.g., do the groups tolerate or invite diverse perspectives?)
– Unobtrusively ask clarifying and probing questions to the groups to gain access to information about students' levels of understanding

Instructional strategies that are likely to provide students with opportunities for deep learning embody the instructional quality features summarized in Table 6.2 below.

3. Moderating dialogic disciplinary and reflective discussions in the large group

Dialogic disciplinary and reflective discussions of educational concepts and practices in the large group took place at multiple points in a class unit in the three classrooms under study. Instructional strategies that are likely to provide students with opportunities for deep learning embody the instructional quality features summarized in Tables 6.3 and 6.4 below.

The instructor as "moderator" helps the class to stay on topic and ensures adequate participation from a variety of voices. The instructor keeps the discussion moving by using productive talk moves to bring about dialogic exchanges of ideas while subtly assessing students' understanding of ideas, concepts, and practices (Michaels, O'Connor, Hall, & Resnick, 2010). Thereby, instructors have to adjust their strategies to the moment-to-moment interactions in the classroom to address the underlying learning goals (e.g., elicit students' initial ideas, probe students to provide explanations).

*Disciplinary Discussions* Dialogic disciplinary discussions of educational concepts and practices between instructor and students constitute an integral part of student-centered classrooms. The class has to engage in disciplinary ways of talking about educational ideas and negotiate meaning in order for disciplinary-specific discourses to actually occur (Cornelius & Herrenkohl, 2004).

*Reflective Discussions* Dialogic reflective discussions (metatalk) between instructor and students can help students to deepen their understandings, provide instructors with feedback on student performance to inform their teaching practice, and assist them with the (re-)design of their course. By requiring students to critically think about their own learning, the instructors hand students more responsibility and invite further learning (Barnes, 2008).

Encouraging students to become cognizant of what and how they learn allows them to develop the intellectual habit of engaging in critical

**Table 6.2** Instructional strategies to guide problem solving in the large group

| |
|---|
| Orienting structures, guiding norms, and modeling behaviors to clarify expectations<br>– Classroom teaching practices correspond with the educational beliefs<br>– Discussion-oriented and flexible seating arrangements in the classroom<br>– Learning-focused course activity structures (e.g., assigned readings, guiding questions, procedural activity guidelines, artifacts as tools for learning)<br>– Develop, facilitate, and model a common disciplinary language to talk about subject matter and norms of interaction (e.g., thinking routines, principles for class participation) |
| Open-ended questions and prompts to develop students' thoughts further<br>– Elicit students' current views on a problem (prior knowledge) and their wider relevant experience in order for them to build on their current understandings<br>– Pose genuine questions to open new lines of thought and invite a variety of voices for students to practice disciplinary talk (e.g., explore students' ideas)<br>– Encourage students to put the main ideas in their own words<br>– Allow students to disclose their thinking process (e.g., engage in accountable talk) explaining their reasoning and justifying their (tentative) views<br>– Provide students with ample time to construct thoughtful questions and answers, and encourage extended contributions to provoke thoughtful answers<br>– Ask clarifying and probing questions to focus attention and hold students accountable to disciplinary knowledge and to reasoning |
| Ensuring mutual understanding to enable joint knowledge construction<br>– Signal interest in students' thoughts and a willingness to follow their thinking closely by listening attentively<br>– Think aloud while trying to unfold students' thinking (revoicing) and/or ask students to rephrase or restate and to "tell more"<br>– Show vulnerability in terms of disclosing that you do not follow a student's thinking quite yet<br>– Pass the responsibility to clearly explain to others what they think and why over to the students and encourage them to ask clarifying and probing questions<br>– Invite students to demonstrate their understandings (e.g., sketching ideas on the chalkboard, students taking on active roles in the classroom) |
| Thoughtful and appreciative responses to invite different ideas and voices<br>– Take students' queries and comments as starting points for reasoned discussions<br>– Give students extended turns to express their thoughts and reveal their confusions<br>– Ask for more voices and students who have not spoken yet to hear from different voices<br>– Show confidence in students and express interest in and excitement for their ideas<br>– Maintain a theoretically neutral stance so as to position students as competent<br>– Follow and re-utter students' thoughts/ideas to validate their attempts to join in the thinking |

**Table 6.3** Instructional strategies to facilitate disciplinary discussions in the large group

Letting small inquiry groups share out to demonstrate their understandings
– Let student groups contribute to other students'/groups' understandings about certain concepts, ask each other questions and respond to each other
– Ensure that findings relate back to the learning goals and initial question(s) of the task
– Allow groups to learn from their experience, make adequate future adjustments, and acknowledge students' contributions and learning progress (e.g., by thanking them)
– Listen carefully to the groups' presentations and contributions when they share their joint responses to gather valuable information about students' levels of comprehension
– Reflect on how to proceed to advance students' understandings based on their performances

Encouraging students to express their thoughts to further joint sense making
– Keep the conversations learning-focused acting as an "arbitrator passing the torch"
– Give students the authority to engage in sense making (e.g., contribute their viewpoints)
– Let students express their thoughts and reasoning and hold them accountable for their learning
– Require students to express their own thoughts and put knowledge into their own words
– Make sure that students listen to their peers' thoughts and build on each other's comments
– Norms of interaction ensure that students feel safe to offer educational ideas, questions and critique, and that all students have opportunities to contribute and learn
– Re-utter and affirm students' views and be respectful of students' responses
– Make on-the-spot decisions in terms of useful lines of thought for the entire class to follow inviting students' questions and ideas as a springboard to shift the direction of a discussion

Promoting critical dialogue to provoke conceptual changes
– Prompt students to rethink their ideas about disciplinary concepts/practices they learn about
– Encourage students to share critical thoughts that invite more learning
– Listen carefully to grab important moments of learning building on what students said
– Add in new elements to the conversation or another level of complexity and prompt students to relate their current thinking with new ideas offered
– Point out inconsistencies to make students doubt their own existing knowledge
– Underscore/synthesize/summarize key aspects to ensure (mutual) understanding

Inviting a variety of voices to enhance collective participation
– Ask genuine questions about things you really want to know the students' answers to
– Phrase some questions so that anybody who is present can have something to say
– Encourage students to enact the class norms and to dare to say things they are not sure about
– Show excitement, delight, and surprise for students' ideas and stay neutral to their contributions
– Avoid an unhealthy level of unevenness in participation and take measures to provide all students with opportunities to express their ideas
– Let students call on someone else so that they themselves pick the next speaker

**Table 6.4** Instructional strategies to facilitate reflective discussions in the large group

| |
|---|
| Engaging students in self-reflective practices to deepen their understandings |
| – Require students to critically think about their own learning and to practice metatalk |
| – Help students see the purpose of their study of a topic and of the practices they engage in |
| – Prompt student groups to share what worked well in their group and what they might do differently in the future |
| – Provide students with opportunities to self-evaluate and compare their performance of understanding with expectations, learning goals, and standards |
| – Allow students to address uncomfortable feelings and situations in the context of learning and learn from them |
| – Ensure that students are in dialogue with the rest of the class (e.g., share feedback) |
| Involving students as co-designers to improve their learning experiences and outcomes |
| – Demonstrate openness to adapt curricular changes and incorporate student feedback to make course adjustments throughout the semester |
| – Collect instantaneous feedback to get a better read on where the students'/groups' thinking is in order to decide what to offer next |
| – Provide students with opportunities to influence the educational agenda (responsive curriculum/syllabus) |
| Taking student feedback into account to inform one's teaching |
| – Continuously monitor and reflect on the learning processes that take place in the classroom and your instructional choices |
| – Signal openness to critical thoughts and suggestions from students |
| – Open up the floor to let students take initiative in suggesting course adjustments |
| – Acknowledge that self-organizing in course activities and engaging in critical reflections might be uncomfortable for students |
| – Give students more say as the semester moves on, encourage critical thoughts and pushback |

thinking about their learning outcomes in relation to their goals, identify strategies that work well and that do not work well, how their processes compare to those of others, draw lessons learned, and determine what questions are still unanswered. Reflective discussions can help students to see the purpose of their study of a topic and of the practices they engage in and reveal areas where students struggle and thus, provide crucial insights into students' learning experiences.

4. Lecturing (including metatalk) and modeling

Lecturing, that is class time where only the instructor or invited guests talk, plays only a minor role in SCLEs because with knowledge transmission there is a risk that students only notice the eye-catching surface features and fail to recognize the structure beneath to gain a deeper understanding. As a result, students might not be prepared to apply their knowledge and skills and transfer them to new situations (Schwartz, Lindgren, & Lewis, 2009). In powerful student-centered classrooms, instructors refrain from pretending they have all the answers and resist the temptation to tell and ask leading questions. They provide new knowledge just at the moment when students need it to solve a problem, answer a question, or engage in an activity since knowledge that answers a question that has not yet been asked will likely be forgotten soon (Barnes, 2008; Weinbaum et al., 2004). The instructors' metatalk helps students to keep track of the multilayered nature of course design elements and provides structure for actions (Leinhardt & Steele, 2005). Instructors in student-centered classrooms use descriptors that initialize a new course activity (e.g., information about the type of task, how the activity is conducted, what students are expected to do) and provide the students with ample time to thoroughly explore and discuss concepts and practices.

Instructional strategies for lecturing/metatalk and modeling that are likely to provide students with opportunities for deep learning are summarized in Table 6.5 below.

Apart from lecturing, instructors can model ways in which to support deep learning and use talk to think collectively by practicing in their classrooms what they are preaching so that students experience firsthand that the instructors' educational beliefs are consistent with their behavior in the classroom. If students are expected to listen to each other and treat tentative ideas with respect, for example, instructors should do so themselves in their own classrooms (Mercer & Hodgkinson, 2008). The instructors and/or invited guests (e.g., teachers) demonstrate to the observing students how to help real learners construct knowledge by modeling certain instructional behaviors such as active listening, conveying respect for students' thinking, struggles and questions, reflective practice, and asking thoughtful questions to further understanding. This way, students can sense integrity around what the instructors do in class since the latter live their values and "practiced what they preached":

> I thought that because of the consistency between their ideals and their actual classroom practice it was very, very easy to see the value and espouse the ideals that they were putting forward … because they lived it so truly during those class periods. [Student interviewee D, Smith case]

**Table 6.5** Instructional strategies for lecturing/metatalk and modeling

| |
|---|
| Conveying relevant information students need in order to learn<br>– Give a comprehensive overview of the syllabus with the main course components, materials, scripts at the beginning of the course<br>– Frame class topics and clearly explain the process of doing course activities (metatalk)<br>– Ensure that the type and amount of lecturing/metatalk is relevant for student sense making and merely sets the stage for the activities that follow<br>– Distribute activity handouts after doing activities to make sure that students have the experience first, if appropriate<br>– Enable students to see that their own ideas are perfectly reasonable and the best starting point for their learning<br>– Convey expert knowledge in order to bring other perspectives and experiences in (including guests) and clear things up that do not seem clear to students<br>– Allow for student information and clarification questions as well as class discussions after lecturing/metatalk to ensure commitment and shared student understanding |
| Connecting new knowledge to topics and questions raised by the students<br>– Provide students with additional information on topics they want to know more about<br>– Avoid presenting your contributions as a “right” idea, but rather as another idea to be considered/another thought offer on the table<br>– Ask genuine and clarifying questions you are curious about, opening up further possibilities to think about an issue<br>– Engage with challenging questions and students’ queries and concerns<br>– Share brief stories and your thoughts on certain topics linking them to issues raised by the students in order to illustrate or point out particular aspects that escaped the students’ notice<br>– Link disciplinary explanations to students’ ideas and to educational practices<br>– Signal to students that you do not have all the answers and learn constantly along with the group |
| Modeling behaviors to support knowledge building and develop confidence<br>– Demonstrate with real learners how an instructor can orchestrate and facilitate learning activities in certain ways to help students construct knowledge<br>– Make the evolution of learners’ ideas visible for the observing students so that they can build up a conceptual model of the learning and teaching they repeatedly see<br>– Let students observe invited classroom teachers modeling how to use language and objects to help students learn<br>– Hold back your own thoughts and explanations during demonstrations and subsequent discussions until the ideas and questions of the student teachers have been heard |

#### *6.1.3.2 Cultivating a Productive and Supportive Classroom Community of Learners*

*How do the instructors cultivate a classroom community of learners over time?* The climate that is established and maintained in the classroom is a critical factor in the development of students’ identities as learners in general and as learners in the field of education (student teachers) in particular (e.g., Leinhardt & Steele, 2005). Empirical research in school and higher education classrooms revealed that the classroom climate influences how students view subject matter, how they perceive themselves to be positioned in relation to the subject matter, and how accountable they feel with regard to each other and to the discipline itself (e.g., Engle & Faux, 2006; Hattie, 2012; Klieme, Pauli, & Reusser, 2009; O'Connor & Michaels, 1996).

The findings of this research project outlined in the cross-case analysis of deeper-level instructional quality dimensions and features in Chap. 5 show that powerful SCLEs promote three quality dimensions: intellectual climate of active student sense making, iterative cycles of feedback to further student learning, and positive emotional climate of mutual respect, trust, and belonging.

1. Intellectual climate of active student sense making
Instructional strategies likely to cultivate an intellectual climate of active student sense making are depicted in Table 6.6.

2. Iterative cycles of feedback to further student learning
Instructional strategies likely to cultivate iterative cycles of feedback to further student learning are shown in Table 6.7.

3. Positive emotional climate of mutual respect, trust, and belonging
Powerful student-centered classrooms require a safe intellectual environment for students to challenge one another, to correct another and oneself, and to make mistakes in order for them to learn deeply. Instructional strategies likely to cultivate a positive emotional climate of mutual respect, trust, and belonging are summarized in Table 6.8.

### *6.1.4 Challenges to the Implementation of Student-Centered Learning and Instruction*

Although the pedagogical concept of SCL is a promising approach to promote quality higher education, there are obstacles, criticism, misconceptions, and teaching and learning challenges to the implementation of student-centered learning and instruction as the findings of this research project show.

First, the implementation of SCLEs—like other curricular and pedagogical innovations—faces diverse obstacles from the faculty's and students' perspectives. Higher education faculty are often reluctant to embrace calls for educational reforms due to extrinsic barriers to change: deteriorating conditions for academic work such as teaching workloads, an increase in bureaucratic tasks, a decrease in tertiary investment and job security, and recruitment and promotion policies that favor research productivity over teaching quality (ESU & EI, 2010; Jones, 2006; Lea et al., 2003). Apart from that, intrinsic barriers to change such as teacher-centered faculty beliefs together with a strong tradition of telling as teaching in higher education, a lack of the necessary pedagogical (content) knowledge and limited motivation, time, and energy for faculty to develop new curricula and further their teaching skills—all constitute major factors retarding the implementation of education reforms (Baumert & Kunter, 2006; Bonwell & Eison, 1991; Geven & Attard, 2012; Pauli & Reusser, 2011; Prosser & Trigwell, 1999). Obstacles from the students' perspectives such as expectations of higher education with the instructor as knowledge transmitter, a lack of motivation and interest in, and prior bad experiences with, methods associated with SCL,

**Table 6.6** Instructional strategies to cultivate an intellectual climate of active student sense making

| |
|---|
| Establishing a dialogic "thinking culture" with learning as thinking in the making |
| – Build on what students bring to the classroom (e.g., interests, questions, ideas) |
| – Engage students in joint reasoning with respect to public bodies of knowledge |
| – Show appreciation of and respect for students' current misunderstandings and confusions as a productive source of learning |
| – Use language, artifacts, and norms of interaction to invite "thinking in progress" and hold students accountable to disciplinary knowledge, reasoning, and the community of learners |
| – Encourage students to consider anxiety-provoking situations and uncomfortable feelings as growth opportunities |
| – Allow students to have some sense of ownership and choice over what and how they learn |
| – Ask students to give reasons for their answers and to offer supporting evidence, probing students answers |
| Recognizing students' identities as valuable and productive |
| – Value students' contributions as productive (e.g., listening intently, signaling interest) and avoid evaluating to ensure mutual recognition of worth and identity |
| – Invite different viewpoints on topics as well as the instantiation of student self-revision |
| – Provide increasing opportunities for the students to demonstrate their understandings and learn from each other (legitimate participation in educational practices) |
| – Allow students to experience an increasing sense of autonomy as well as responsibility for their own and each other's learning (distribute authority) |

**Table 6.7** Instructional strategies to cultivate iterative cycles of feedback to further student learning

| |
|---|
| Tailored feedback to deepen students' intellectual involvement<br>– Monitor student progress and take the time to carefully read students' written work trying to understand what they are getting at<br>– Provide continuous verbal and written performance-specific and process-related feedback on individual assignments and papers to help students figuring out what they need to work on<br>– Tailor constructive feedback to different students' needs and express your appreciation for students' insights<br>– Provide concrete and extensive critical feedback ("push back") seizing on the strengths and weaknesses so students can make their papers stronger<br>– Use comments and questions to explore students' views and understandings in order to provide more constructive feedback<br>– Share thoughts that students might want to consider in moving forward and provide starting points and some other alternatives for students to continuing to think<br>– Ask students to point out in subsequent work how they have taken the feedback into account |
| Mastery-oriented (public) feedback to keep students thinking<br>– Indicate to students that their contribution is valuable and competent and approved by "significant others"<br>– Provide students with scaffolds (iterative cycles of feedback and deadlines) and review student progress toward the learning goals<br>– Allow students to revise their thinking and tentative ideas and learn from their "mistakes" so that they can improve gradually<br>– Provide feedback publicly for students to learn from each other and to make sure they get the key ideas<br>– Provide genuine feedback and advice to the entire class in terms of clarifying expectations for assignments and sharing experiences<br>– Offer to provide (additional) feedback if students need it |
| Allowing for student peer assessment and self-assessment to promote self-regulation<br>– Encourage students to ask critical questions in a constructive manner and provide them with the time and guidelines to do so<br>– Provide opportunities for peer feedback requiring students to become invested in the collaborative learning process (e.g., reading each other's papers, providing verbal feedback)<br>– Allow the students to revisit their own work and develop their ideas further to empower them with intellectual responsibility for their work |

surface-level conceptions of learning and a lack of knowledge about student-centered learning and instruction, as well as transferable skills to engage in SCL are also major barriers to the successful implementation of student-centered approaches in higher education classrooms (e.g., Biggs & Tang, 2011; ESU & EI, 2010; Lea et al., 2003; Ramsden, 2003; Richardson, 2011).

**Table 6.8** Instructional strategies to cultivate a positive emotional climate of mutual respect, trust, and belonging

| |
|---|
| Developing a strong sense of mutual respect and concern for one another |
| – Get to know your students and show interest in them |
| – Establish class norms and model behaviors in line with your educational beliefs |
| – Incorporate community-building activities to create a sense of a community and give students a chance to get to know each other to develop a sense of belonging |
| – Recognize students as capable and worthy of having something to say and interact with them from a place of respect |
| – Provide students with the experience of one's voice being heard, valued, and taken seriously with other class members confirming and referring to one's ideas |
| – Make students feel safe enough to ask clarifying and probing questions and give each other feedback |
| – Make students feel comfortable enough to talk in class or approach you if they need help figuring something out |
| – Make students feel safe enough to express uncertainty and doubt, and talk about their struggles and things they are not sure about |
| Fostering social stability and integration in the classroom (collective identity) |
| – Foster norms of interaction that forward a sense of community in which everyone feels powerful in relation to each other (collective identity) |
| – Stay aligned with the students through the ways you talk with them and set a positive tone for your interactions with students |
| – Act in ways that shape student identities that are proactive and constructive |
| – Establish a positive and embracing atmosphere in class to reduce the fear to participate |
| – Acknowledge student identities as productive for the work at hand so that students can feel a sense of their own capacity |
| – Create an inclusive environment where the group hears from a variety of voices |
| – Allow students to experience the value of their progress in figuring something out |
| – Stay accessible and invested in students' learning to establish positive relationships |

Criticism of constructivist ideas on learning and instruction and misconceptions about constructivist perspectives constitute another hurdle to the successful implementation of SCLE (e.g., De Corte, 2012; Kirschner, Sweller, & Clark, 2006; Mayer, 2004, 2009; Tobias & Duffy, 2009). Controversies revolve around research comparing guided and unguided forms of instruction to find effective combinations of learning processes and environmental support (e.g., Clark & Hannafin, 2011; Kirschner et al., 2006). However, newer empirical research findings propose that constructivist learning cannot be equated with unguided or minimally guided forms of instruction, but it provides rather diverse scaffolds to facilitate student learning by offering an effective balance between student exploration and systematic guidance (Alfieri, Brooks, Aldrich, & Tenenbaum, 2011;

De Corte, 2012; Hmelo-Silver, Duncan, & Chinn, 2007). Furthermore, classroom research submits that behavioral activity of the students (e.g., hands-on activities) does not "guarantee" that the learner will engage in appropriate cognitive processing during learning. Instead, the quality of the knowledge construction processes that the instructional methods promote in learners, that is, cognitive activity, is essential in order to foster sense making (Mayer, 2004, 2009). Moreover, misconceptions about constructivist perspectives that constitute the theoretical foundation of SCLEs have resulted in misinterpretations with regard to the meaning of learner goals, instructional support, and the goals of education in general. Such misconceptions are rooted in fundamentally different assumptions and theories about learning and instruction that exist between the acquisition (direct/explicit instruction) and participation (constructivist instruction) metaphor that have not yet been resolved (Duffy, 2009; Jonassen, 2009; Tobias, 2009; Tobias & Duffy, 2009).

Finally, designing and enacting SCLEs in the higher education classroom also brings teaching and learning challenges for students and instructors. *What are the teaching and learning challenges these student-centered classrooms present for the instructors and/or students?* Table 6.9 provides an overview of the teaching and learning challenges that instructors and students are likely to face in student-centered classrooms (see also Sect. 5.4). Instructors have to keep these potential challenges in mind when designing and enacting powerful SCLEs in their higher education classrooms.

## 6.2 Educational Implications for Higher Education Policy and Practice

The implementation of powerful SCLEs presents major challenges for HEIs which are known to be very resistant to change. So far, situative perspectives aiming to bridge cognitive and sociocultural concepts and research findings seem to have had relatively little impact on educational policy and practice in European higher education although the practical implications are quite profound (e.g., Greeno, 1998, 2006; Mercer & Howe, 2012). Scientific knowledge and successful ground-level examples such as the participation-oriented educational practices of the three in-depth case studies conducted in the USA can help educational managers, administrators, curriculum developers, instructors, and faculty developers in HEIs to navigate student-centered course design and instruction deci-

**Table 6.9** Overview—teaching and learning challenges in student-centered classrooms

| *Challenges with regard to* | | |
|---|---|---|
| *Course design elements and support structures* | *Scaffolding participatory processes of knowledge construction* | *Cultivating a classroom community of learners* |
| – Student preparation<br>– Demanding open-ended assignments<br>– Relevance to real-life contexts<br>– Adaptive nature of the course structure and activities<br>– Least valuable of all activities<br>– Class size and teacher-centered classroom spaces<br>– Cultural and institutional forces at the school | – Keeping all students engaged in large group explorations<br>– Validating a variety of student ideas<br>– Engaging in metatalk to reflect on joint learning experiences<br>– Ensuring the educational value of small group work<br>– Socially shared regulation in small groups | – Building an atmosphere of trust and safety to facilitate participation<br>– Tense class atmosphere during the first few weeks<br>– Providing timely feedback and formative assessment |

sions and have profound implications for educational policy and practice in higher education.

What can be done to change the current situation in European higher education classrooms? For HEIs to change the status quo and improve the quality of learning and instruction, an educational shift on two levels is necessary: on a curricular and pedagogical level in higher education classrooms (Sect. 6.2.1) and on an institutional level in HEIs (Sect. 6.2.2).

### *6.2.1 Higher Education Classrooms*

SCL begins in the classroom (curricular and pedagogical level) and requires a change in mindset and behavior on the part of the students and the instructors as key players. An educational shift on a curricular and pedagogical level has implications with regard to the following major aspects: awareness about instructors' and students' educational beliefs, balanced orchestrations of well-designed guided and unguided course activities, and productive instructional and dialogic talk in the context of classroom interactions.

1. Awareness about instructors' and students' educational beliefs

Adapting the pedagogical concept of SCL requires a degree of awareness on the part of both the instructors and the students that is not commonplace in traditional higher education. All too often instructors' and students' ideas and beliefs about learning and instruction adhere to the knowledge transmission model that is difficult to accommodate in the SCLE conception (e.g., De Corte, 2012). Research findings suggest that students' and teachers' beliefs about learning and instruction can be a serious obstacle for the implementation of SCL with the history of education showing the deeply entrenched stability of more conventional teaching practices (Berliner, 2008). Changing these educational beliefs and practices constitutes a challenge for educational professionals, especially educational leaders and policy makers (De Corte, 2012). It takes effort for instructors and students to transcend the conventional beliefs and patterns of classroom learning and interaction. In SCLEs that focus on learning instead of teaching, learning is considered as an active knowledge construction process. Consequently, less time is devoted to lecturing and more time to activities that increase the level of students' cognitive engagement and participation through a variety of hands-on activities, discussions, and reflections administered to promote deep learning.

Empirical research indicates that *students' conceptions of learning* are highly relevant to the effectiveness of learning environments since it is each student's approach to learning that effects how well they learn. Students who use deep approaches to learning intend to understand and seek meaning referring to activities that are appropriate to handle the task and to achieve the intended outcome. They tend to earn higher grades, retain, integrate, and transfer information at higher rates, enjoy learning more, read more widely, draw on a variety of resources, discuss ideas, reflect on how individual pieces of information relate to larger patterns, apply knowledge in real-world situations, and are more likely to persist at a particular college or university as compared to students who use surface approaches to learning (Biggs, 2012; Marton & Säljö, 1976a, 1976b; Nelson Laird, Seifert, Pascarella, Mayhew, & Blaich, 2011; Pascarella & Terenzini, 2005; Ramsden, 2003; Richardson, 2011).

Instructors have considerable freedom in choosing the pedagogical approach they apply in their classroom practice—their personal beliefs therefore constitute a major influence (e.g., Baumert & Kunter, 2006; Pauli & Reusser, 2011; Turner, Christensen, & Meyer, 2009). In higher education, there has been considerable interest in conceptions of teaching because they influence instructors' decisions and behaviors in the classroom and have thus implications for student learning. SCLEs require *constructivist conceptions of teaching* that are manifested in student-focused (learning oriented) strategies that lead to conceptual changes in students' understanding of the world (Chism, 2004; Kember, 1997; Prosser & Trigwell, 1998, 1999; Ramsden, 2003). In this view, learning is the result of students' learning-focused activities with a focus on both what the student does in order to understand something at the desired levels and how students' intellectual development can be supported by the instructor (learner focus) (Biggs, 1999, 2012). Recent classroom research shows that teachers with constructivist beliefs provide higher quality instruction, that is, more supportive and cognitively activating learning opportunities, with students showing better learning outcomes. Moreover, teachers with high PCK tend to show more constructivist and fewer transmissive professional beliefs (Kunter & Baumert, 2013). The teaching challenge is then to teach in a way so that most students apply a deep approach to learning using higher cognitive level processes. Instructors can promote deep approaches to learning by constructively aligning learning outcomes, activities, and assessment tasks in the context of a learning-centered course design (e.g., Biggs, 2012; Fry, Ketteridge, & Marshall, 2009).

The constructivist educational beliefs that instructors hold manifest themselves in how they design and bring to life SCLEs in their respective classrooms. Newer models of teachers' professional competence therefore begin to consider values and beliefs (e.g., value commitments [professional ethos], epistemological beliefs [world views], subjective theories about teaching and learning)—apart from knowledge, motivational orientations, and self-regulatory abilities—as crucial competences that teachers need in order to meet the demands of their profession (e.g., Baumert & Kunter, 2013; Weinert, 2001).

2. Balanced orchestrations of well-designed participation-oriented course activities

Leveraging the potential of powerful SCLEs to promote performances of deep understanding, SRL, and identity development requires not only a change in mindset but also in behavior on the part of the students and the instructors as key players in the classroom. The quality of the knowledge construction processes, that is whether course activities engage students in appropriate cognitive processing during learning (cognitive activity), not the percentage of hands-on activities (behavioral activity) is essential for deep learning (Alfieri et al., 2011; De Corte, 2012; Mayer, 2004, 2009). Participation-oriented activities are designed to support students to develop ideas and make meaning together—either in independent small inquiry groups or in guided large group explorations and dialogic discussions. Such course activities enable students to play more active roles in the classroom and provide instructors with better opportunities for informally assessing their students' learning (Mercer & Howe, 2012). Guided whole class explorations or discussions and independent group-based activities in which students can try out ways to solve problems together are not alternative ways of learning, but complementary ones.

Empirical research shows that powerful innovative learning environments require an *effective balance between discovery and guidance* while being sensitive to students' needs. This allows the students to become cognitively active in the process of making sense. New information is organized into a coherent structure and integrated with prior knowledge so that useful knowledge is generated. A thoughtful combination of a variety of well-designed course activities in the large and small group draws on students' existing common knowledge and requires a focused and reasoned consideration of different ways of solving problems, or the evaluation of different possible explanations that elicit the consideration of new and conflicting ideas and the search for additional information (Mercer & Dawes, 2008). Fostering student sense making in more dialogic classrooms also depends on the instructor establishing and maintaining adequate ground rules for course activities (Mercer & Howe, 2012). These different course activities (e.g., small versus whole group activities, explorations versus discussions) have to be underpinned with some different ground rules that need to operate in order to make expectations clear and allow for productive learning experiences to take place (e.g., Mercer & Dawes, 2008). Through repeated practice and the instructors' modeling, the rules can then become a part of the common knowledge of the class; however, the development of shared understandings about norms of interaction takes time.

3. Productive instructional and dialogic classroom talk

Powerful SCLEs require changes in the culture of classroom talk with regard to instructors' orchestration and facilitation of discussions and students' participation during discussions. Sociocultural pioneers argued years ago that the role of talk in (higher) education classrooms needs to be better understood in order to improve students' engagement and learning outcomes (Atwood et al., 2010; Cazden, 1988). A situative perspective views language or talk as both a psychological tool for individuals to use to "try out ideas" and a cultural tool which instructors and students can use to "think together" (e.g., Mercer & Dawes, 2008, p. 11; Mercer & Howe, 2012). Mercer, Dawes, and Kleine Staarman point out that "an effective teacher of science will not only be concerned with helping students understand the content of the science curriculum but will also help them understand better the dialogic processes involved in studying and practicing science" (2009, p. 354). Preparing both instructors and students for productive classroom talk requires training in how to use talk to the best effect for pursuing educational activities (e.g., awareness raising, competence development for instructors, role models for using talk for learning, developing the talk repertoire of students).

This means that *instructors* have to recognize the dominant patterns of teacher–student talk in their classrooms, that is, how they talk with their students, and the effects these patterns have on students' cognitive activation and participation. Raising awareness of the IRE structure of most classroom talk and guiding instructors in reviewing their own classroom talk and in designing dialogic forms of interaction can help them develop a more effective use of talk. Instructors have to develop awareness for their role as a model for using talk for learning and engage in critical reflection of their beliefs and the social interactions that go on in their respective classrooms before they are able to change those patterns in order to improve the quality of talk in their classroom (e.g., Mercer & Dawes, 2008; Mercer et al., 2009). Classroom research shows that one's classroom interactions hold promise for increased learning success with greater numbers of students (Rex & Schiller, 2009). However, instructors need support and prompts for guiding productive discussions in their respective classrooms (e.g., structuring group interactions and tasks, creating norms of interaction).

In addition, the talk repertoire of the *students* needs to be developed, since students do not always know how to make useful, productive talk happen (e.g., Mercer & Dawes, 2008). The nature of productive discussions in group-based educational activities needs to be discussed to raise students' metacognitive awareness of the potential educational power of talk, so they can develop shared understandings. Research on classroom talk suggests that developing students' awareness and skill in using talk as a tool for problem solving helps their learning (Mercer et al., 2009). Classroom research also shows that students need to learn about the value of talk for learning within the scope of certain curriculum subjects and need to be provided with opportunities to apply what they have learned across their study of the curriculum in order for them to become self-regulated learners that can use talk effectively (Dubs, 2007; Leutwyler & Maag Merki, 2009; Mandl & Friedrich, 2006).

Overall, adopting a student-centered approach is neither easy from the perspective of the instructors nor the students. Faculty members who are used to formal and hierarchical cultures with less interactive learning traditions have to be willing to make meaningful changes happen in their classrooms, experiment with student-centered approaches to instruction, engage in self-reflection, learn to work as part of pedagogical teams and coordinate at the program level (e.g., Geven & Attard, 2012). An increasingly diverse student body (e.g., part-time students, traditional and non-traditional learners) has to engage in more interactive learning processes as accountable authors, active (self-regulated) participants, and co-designers of the curriculum.

### *6.2.2 Higher Education Institutions*

HEIs have to nurture a SCLE so that faculty and students can fulfill their respective new roles in the classroom. The working conditions in HEIs must serve to enhance the motivation and capabilities of faculty to teach in a student-centered way and avoid giving raise to individual resistance. An educational shift on an institutional level has implications with regard to the following aspects: promoting the scholarship of teaching in higher education and sustained professional faculty development.

1. Promoting the scholarship of teaching in higher education

Faculty play a pivotal role in enhancing the quality of students' learning—effective teachers focus on students and make informed decisions in context. Thus, more attention needs to be paid to the "scholarship of teaching" (Boyer, 1990) and efforts to improve teaching need to begin with instructors who have to develop expertise in teaching and learning as a second discipline. Policy makers and university leadership have to induce and promote actions and regulations aimed at

- reducing the currently detrimental conflict between research and teaching at universities (e.g., adapting recruitment and promotion policies, recognition and reward of teaching innovation and competence; Kember, 2009; Lavoie & Rosman, 2007; Lea et al., 2003).
- providing faculty with the freedom to take a more scholarly approach to higher education teaching based on scientific evidence (Geven & Attard, 2012). Education research and successful practices have to be disseminated in journals read by faculty, faculty developers, administrators, and educational managers (Handelsman et al., 2004). Instructors also require opportunities to reflect on their teaching (i.e., engage in reflective practice), share their experiences with colleagues, experiment with new methods, and discuss literature on learning and instruction with other educators.
- promoting more rigorous education research involving both qualitative and quantitative empirical investigations to provide a scientific foundation to inform instructional practices in the higher education classroom. An empirically rich body of knowledge for teaching is available that can inform educational practice, although more research is needed taking changing contextual factors on the higher education landscape into account.

2. Professional faculty development and support
Implementing powerful SCLEs requires a change in mindset and behavior on the part of the instructor and therefore sustained professional faculty development and support.

In the course of their professional development, instructors generate specific beliefs on the subject matter they teach and on the nature of student learning. The instructors' existing prior knowledge, beliefs, and experiences play a crucial role in the implementation of new pedagogical ideas and practices. Research shows that teachers interpret new ideas through past experiences and they often rely on traditional beliefs about learning and teaching. An iterative process in which current views are challenged by learning about successful alternative practices can facilitate the changing of predominant perceptions and beliefs about learning (NRC, 2000). Student teachers in the context of initial and further education as well as university faculty in the context of professional development courses have to be immersed in the kind of learning environments that they are advised to create and refine in their own classrooms (De Corte, 2012). Effective teaching behaviors such as designing learning tasks that facilitate deep approaches to learning, giving clear explanations, presenting well-organized material, facilitating collaborative learning, giving prompt feedback, or asking challenging questions appear to be learnable by faculty. Hence, instructional effectiveness and innovative pedagogical practices can be improved through purposeful programs designed to help faculty hone those pedagogical skills to foster the educational success of their students. Empirical research shows that a teacher's professional competence (knowledge, skills, beliefs, motivation) is crucial for quality instruction and student achievement as it manifests itself in the quality of classroom teaching practice (e.g., Kunter & Baumert, 2013; Kunter et al., 2013). University leadership has to induce and promote actions and regulations aimed at

- providing real opportunities for instructors to acquire new pedagogical (content) knowledge and skills. Higher education governance has to become aware of the importance of faculty development and needs to establish an environment where faculty members have the freedom and support to engage in new teaching practices. Pedagogical and administrative support structures need to be mobilized to improve educational practice and allow instructors to concentrate more on classroom activities and less on administrative work, for example (Geven & Attard, 2012).
- making the following aspects that are often overlooked inherent parts of professional development and training: awareness about and knowledge of (a) how to design high-level learning outcomes with a focus on performances of deep conceptual understanding (fostering concepts and practices of a discipline), that is, what students are able to do; (b) how to critically examine classroom talk and social interaction from a sociocultural/situative perspective in order to promote instructors' capacity to facilitate dialogic and productive discussions to support students' learning (e.g., Mercer & Howe, 2012); (c) how to arrange a supportive learning environment that fosters the enhancement of SRL in regular higher education classrooms (e.g., Kistner et al., 2010).

The situative educational model developed in the context of this research project can be used to train faculty on how to improve the instructional quality of their classrooms by designing powerful SCLEs.

## 6.3 Reflections on Potential Limitations of the Research Project

The findings generated in the context of teacher education at the HGSE advance our understanding of how to design and bring to life powerful SCLEs that provide students with opportunities for deep learning. The research project generated a situative educational model with characteristic curricular design elements and instructional quality dimensions and features that applies to higher education in particular and learning and teaching in general. This research project was informed by theory and empirical research from different educational contexts—not only higher education classrooms but also schools, partly due to a lack of research in higher education. Although the findings produced by this qualitative research project are valuable, there are a number of potential limitations addressed below.

The empirical study consists of a relatively *small sample of cases* (i.e., three classrooms with one instructor and between 25 and 38 students each) within a single North-American graduate school of education. Seminars with no more than 40 students were selected because they allow for a deeper understanding of typical instances of the settings under study over a longer time span (Maxwell, 2012). The selected cases (i.e., university courses) are not representative for HGSE courses or for US universities in general. However, the ethnographic case study research applied in the context of this project intended to investigate good practices and aimed for analytic not statistical generalization (see Sect. 4.1).[4] Thus, purposefully choosing three theoretically useful cases at one of the best schools of education in the USA and concentrating on one single case during one semester was the research strategy chosen—also given the scope of this research project.[5] The school and the cases were selected according to certain selection criteria as outlined in Sect. 4.3. Hence, the selection was appropriate for the purpose of this project because through the in-depth study of three authentic higher education classrooms new knowledge on how to design and bring to life SCLEs was generated.

The *many forms and flavors* of student-centered curricula, programs and courses together with variances in assessment methodologies make it difficult to evaluate, compare, and generalize findings of studies related to student-centered learning and instruction. Against this backdrop, PBL researchers submit that the research focus has to shift from merely comparing guided and unguided instruction or (traditional) teacher-centered and student-centered approaches to studying the nature and effectiveness of specific support structures and strategies of implementation in different institutional contexts including barriers, drivers, and challenges of student-centered approaches (e.g., Beddoes, Jesiek, & Borrego, 2010; Ravitz, 2009; Strobel & Van Barneveld, 2009). Since granular qualitative research in naturalistic student-centered higher education classrooms is rather scarce and research resources were limited, this project focused on analyzing homogenous cases in university-level (teacher) education to inform the theory-building process (literal replication). Exploring three concrete and successful ground-level examples in depth and looking more closely at authentic learning, teaching, and interaction practices provided rare and detailed glimpses into student-centered classrooms to carve out and systematize curricular design elements, re-occurring teaching patterns, and instructional strategies for the successful facilitation of student sense making, as well as teaching and learning challenges (NRC, 2002).

The *selected faculty participants* (two females, one male) are not representative for all university faculty. They have expertise in the field of (teacher) education and hold constructivist educational beliefs with regard to learning and instruction, were recommended by peers and students, and have consistently shown superior teaching performances to that of their peers. The selected instructors have different levels of research and teaching experience and volunteered to take part in this research project. Consequently, the results are not statistically generalizable to educator populations from other disciplines and with other educational beliefs or experiences (e.g., with transmission beliefs). Future qualitative studies might want to investigate courses across schools and universities involving instructors with different disciplinary backgrounds and experience in order to determine prevalence and transferability. Nevertheless, instructors with other disciplinary specializations and educators from other education settings can learn from the authentic and successful educational practices of these expert instructors who have both a specialization in (teacher) education (CK of the subject matter) and pedagogical (content) knowledge by starting to adapt some of these practices and examples to their own educational settings.

The *graduate students* at the HGSE that took the courses under study were diverse regarding race, class, age, and professional experience. The majority of students in Mrs. Smith's and Mrs. Lee's courses were female (as is often the case in core teacher education courses), while the gender distribution in Mr. Brown's course—that caters to several programs—was balanced (see Sect. 4.3.2.3). Yet, the students' cognitive ability and interest in courses were leveled by the school's highly selective admission procedures. Hence, these students do not represent a student body that is typical at most universities in the USA or around the world. Moreover, students in class chose these courses as an elective from the course catalog or among several selectable core courses in their respective programs. Nevertheless, the purposefully selected courses present leveled and favorable teacher and student prerequisites (e.g., expertise, cognitive ability, motivation) for the in-depth study of the quality of course design, teaching and learning processes, classroom interaction, and classroom climate in naturalistic student-centered higher education classrooms that are at the core of this research project.

Are the *descriptions, interpretations, and conclusions* produced by doing multiple-case studies *credible*? Quantitative research designs deal with anticipated and unanticipated threats to validity by using (prior) controls such as control groups, statistical control of extraneous variables, randomized sampling and assignment, framing of explicit hypotheses in advance of collecting the data, and the use of tests of statistical significance. In contrast, qualitative research offers some strategies to identify and try to rule out validity threats (e.g., plausible alternatives, threats to interpretations made) to increase the credibility of conclusions drawn. Several *strategies* were applied in this research project to test the credibility of conclusions made and the existence of potential threats to those conclusions (e.g., Denzin, 1978; Denzin & Lincoln, 2011; Maxwell, 2012; Miles, Huberman, & Saldaña, 2014).

- How the project dealt with possible researcher "bias" and with the effect of the researcher on the individuals studied (reactivity) was disclosed. The goal in qualitative research is not to eliminate the researcher's influence, but to understand it and use it productively by presenting the conceptual framework that was developed prior to the empirical study, making the rationale for the case study research design explicit and by revealing the nature of the researcher–participant relationships;
- Intensive, long-term involvement of the researcher in the field to gather "rich" ground-level data that show a fuller picture of the three classrooms under study was provided (e.g., repeated participant observations, semi-structured interviews, real-time access to course data). The semester long performance data of information-

rich cases that made it possible to capture and analyze concrete and authentic beacons of good practice from within the student-centered higher education classroom constitute one of the strengths of this research project;

- Respondent validation of the researcher's account (member checks): soliciting feedback about data (e.g., interview transcripts) and conclusions (e.g., single case study report) from the instructors and teaching fellows of each course helped to avoid misinterpretations of the meanings of what the students/instructors thought, said, and did;
- Discrepant evidence, that is teaching and learning challenges these student-centered classrooms present for the instructors and/or students, was reported (see e.g., Sect. 5.4);
- Quasi-statistics about prevalent practices/patterns in the classrooms under study (e.g., social forms, student activities, teaching patterns) and high-inference course ratings of several student cohorts were analyzed based on survey data, video data, and participant observations in order to get a fuller picture of the three classrooms under study (see Sects. 5.1 and 5.2);
- Comparing homogenous cases, that is, student-centered classrooms with regard to characteristic curricular design elements and instructional quality dimensions and features: the comparison was informed by published research from different educational contexts and by the instructors and students contrasting their own classroom practices and experiences with other classes at HGSE and elsewhere explaining what happened in these classrooms and how and why these practices were beneficial to support deep learning;
- Theories, data, and methods were triangulated to reduce the risk of chance associations and of systematic biases and to corroborate the researcher's experiences as a participant observer. A mixed-methods approach using a variety of qualitative and quantitative methods was applied in order to gather rich empirical data, and to make sure that the resulting theoretical model is anchored in authentic practices and has important practical meaning so that it can inform and improve education research, policy, and practice. Instructors' and students' perspectives were taken into account and teaching practice was in part measured by student and teacher self-reports (e.g., interviews, course evaluations data). Since self-reports can be subject to faulty memories or socially desirable answers, they were

triangulated with participant observation data and video data to see how attitudes and beliefs are related to the actual teaching practices in the classroom.

The *generalizability of the findings* of this research project may be limited due to purposefully selecting three cases rather than applying a probability sampling strategy. Are the findings of this study generizable beyond the three HGSE classrooms studied? To what extent can the conclusions drawn from this research project hold for other similar groups or sites or for the future? The generalizability (or rather transferability due to the qualitative research design) of this qualitative empirical case study research is based on the development of a situative educational model (analytical generalization) that was informed and corroborated by theory and empirical research from different educational contexts such as universities and schools and by case study research conducted in authentic higher education classrooms. Consequently, the research findings can likely be extended to other real-life educational settings in higher education with similar dynamics, conditions, and constraints (e.g., Eisenhardt 1989; Maxwell, 2012; NRC, 2002). Moreover, the research project studies teaching and learning—basic processes that share similarities that tend to hold in a variety of contexts and with a variety of participant samples (presumed depth or universality of the phenomenon studied) and thus, can in part generalize from one sample of humans (e.g., students located in North America, school students) to other samples of humans (e.g., students located in Europe, tertiary students), since all humans share a common genome, brain organization, and capacity for cognition, perception, and emotion (e.g., Haeffel, Thiessen, Campbell, Kaschak, & McNeil, 2009).

Moreover, it is questionable as to what degree and how the specific study results gained from selected classrooms at a single HEI in Cambridge, MA, USA, can be generalized and/or transferred to different cultural and regional education contexts. Cultural variation does not necessarily imply that there are no similarities between different contexts. The question is rather: How far do certain contextual factors (context of interaction) influence the design and enactment of powerful SCLEs in a particular situation? Future research would have to investigate (test) how the situative educational model developed in the context of this research project can be successfully adopted in different disciplines other than teacher education and in different cultural and institutional (higher) education contexts in Europe and elsewhere, including barriers, drivers, and new challenges that evolve from implementing these findings. Meanwhile, the detailed account of the research situation with rich descriptions of the methods and the findings of the investigated learning environments, as well as the outlined implications for higher education classrooms and HEIs allow instructors, curriculum and faculty developers, administrators, and educational managers to make connections between the research project's findings and their own experience. The findings help them to make informed judgments and assess for themselves whether they can transfer (part of) the findings to their own educational practices taking into account differences between the research situation outlined in this study and their own classrooms and institutions.

## 6.4 Summary of Main Results and Contributions

The design of powerful SCLEs for deep learning constitutes an important goal for the second Bologna decade that aims to increase the quantity and quality of higher education graduates. Aside from policy proposals, education research, and beacons of good practice in higher education also point to SCL as a promising pedagogical approach for higher education learning and instruction (e.g., Biggs & Tang, 2011; Greeno & Engeström, 2014; Handelsman et al., 2004; Land, Hannafin, & Oliver, 2012). SCLEs place students as active participants in their learning processes at the center of the educational endeavor and unfold a broad spectrum of teaching and learning practices. The latter aim to develop students' deep conceptual understandings and self-regulation capacities as contributions to students' development of strong identities as learners and increasingly effective participants in meaningful social practices (e.g., Greeno, 1998, 2011).

This research project makes visible how instructors can design and bring to life powerful SCLEs for deep learning in higher education classrooms focusing on participation-oriented university courses with no more than 40 students. Rooted in educational science, this research project aims to contribute knowledge in the fields of general pedagogy, and more specifically, higher education learning and instruction. The findings contribute to educational theory development (development of a situative educational model) and empirical research on classroom teaching and instructional quality in the context of university-level (teacher) education; they aim to inform education research as well as higher education policy and practice.

The in-depth case study research conducted in authentic higher education classrooms investigated instructor and student perceptions of their learning environments (interviews, surveys) as well as real-life learning and teaching practices enacted by students and instructors in these learning environments (observations, videos) to contribute to the development of an educational model that is anchored in multiple sources of empirical data. In-depth information from the purposively selected classrooms was obtained to provide rich scientific descriptions and uncover meanings, processes, and patterns constitutive of powerful SCLEs. How these learning environments were designed, what was happening in these classrooms, how and why, is not only of interest to educators, administrators, and educational managers in higher education, but may be generalizable and transferable to other similar groups or sites, or for the future. These findings propose concrete ideas and strategies that have promise in different educational settings (e.g., NRC 2002).

More precisely, this research project adds to the scientific knowledge base about SCLEs as it links and takes into account state-of-the-art research on classroom learning and instruction based on literature reviews and (Sect. 6.4.1) authentic and good student-centered higher education classroom practices (Sect. 6.4.2) to develop an experientially credible situative educational model:

### *6.4.1 Expansive literature review on classroom learning and instruction and conceptual framework development*

The developed conceptual framework synthesizes state-of-the-art research findings derived from the learning sciences in general and from empirical education research on the effectiveness and quality of learning and instruction in particular (see Table 3.3, Sect. 3.5; see literature reviews in Chaps. 2 and 3). The framework incorporates both *common design principles* and *instructional quality dimensions and features* of classroom learning, teaching, interaction, and climate that have to be considered when designing powerful SCLEs in higher education classrooms:

- Five common design principles of SCLEs were derived from established design frameworks reflecting broad representations of a situative constructivist view of learning and instruction: curriculum for deep conceptual understanding, customized learning (individualized learning experiences), supportive community of learners (working together), ongoing assessment and feedback, and adaptive instruction (see Sect. 2.3). These well-founded design principles are crucial because they frame how features of instructional quality can manifest themselves within the educational setting.

- Research-based instructional quality dimensions of SCLEs were discerned analyzing and synthesizing the current research literature (see Chap. 3). These quality dimensions fall into two categories: the quality of teaching and learning processes (quality dimensions: cognitive activation, learning-focused activities, and adaptive learning support) and the quality of classroom interaction and climate (quality dimensions: dialogic discourse practices, norms of interaction, and supportive climate).

Building on prior education research, the conceptual framework served as an initial blueprint and reference point for the subsequent multiple case study research and helped to tie the emerging educational model to existing state-of-the-art literature.

### *6.4.2 Development of a comprehensive, experientially credible situative educational model based on multiple case study research findings*

A situative educational model was developed and progressively refined in the course of the qualitative research process involving an expansive literature review (resulting in a conceptual framework, see above) and multiple ethnographic case study research investigating concrete and successful student-centered higher education classrooms (see Fig. 6.1, Sect. 6.1). Researching authentic instructional practices was crucial since they display how instructional expertise manifests itself in the quality of classroom teaching. Grounded in empirical data, the model integrates the main results of this research project and puts them in a theoretical perspective. The cross-case analyses of the three case studies depicted in Chap. 5 give detailed accounts of good practices for the reader and provide integrated research results with regard to characteristic curricular design elements, instructional strategies (scaffolding processes of knowledge construction and cultivating a classroom community of learners), and teaching and learning challenges, so that the study's findings are applicable and generalizable beyond the immediate cases.

Overall, the situative educational model provides a useful reference point to plan, conduct, analyze and reflect on student-centered educational practices in higher education and other educational settings. The model's extracted design elements and quality dimensions/features have the potential to inform research about existing learning environments, the (re-)design of student-centered curricula and learning environments (e.g., in the context of design and evaluation studies) and it can be used as groundwork in faculty workshops to help instructors to teach in a student-centered way. The model can help educational managers, administrators, curriculum developers, instructors, and faculty developers in the field of education and from other disciplines to navigate student-centered course design and instruction decisions.

In contributing to the scientific knowledge base about designing and bringing to life SCLEs, the empirical case study research findings of this project show that these learning environments can provide students with opportunities for deep learning, when certain conditions are met and taken into account as outlined below (reference to empirical research question 2, see Table 4.1, Sect. 4.2). The developed situative educational model integrates the main empirical results of this research project and puts them in a theoretical perspective abstracting and systemizing characteristic curricular design elements (Sect. 6.4.2.1), students' positioning in knowledge construction and interactions (Sect. 6.4.2.2), the instructors' adaptive strategies to provide students with opportunities for deep learning (Sect. 6.4.2.3), and challenges to the implementation of SCLEs (Sect. 6.4.2.4).

##### *6.4.2.1 Characteristic curricular design elements and related quality features*

The learning environment embodies aligned curricular design elements that allow the students to engage with relevant and challenging content (e.g., questions, tasks) so that they achieve the desired learning outcomes (see also Sect. 6.1.1). The case analyses in Chap. 5 depict a detail-rich qualitative and quantitative description and cross case analysis of the characteristic design elements and related quality features of the three classrooms under study based on grounded theory methodologies and a constant-comparison approach (see Tables 5.1 and 5.2, Sect. 5.2, for an overview of the main empirical findings across the three courses).

The findings show that powerful SCLEs align and embody five characteristic curricular design elements and provide detailed quality features for each element:

1. *Relevant and challenging objectives and content* that provoke students' perceptions in order to stimulate thinking. The course content connects to both students (e.g., interests, questions) and education practice (e.g., real-world problems, collective inquiry practices, thinking routines). Students develop critical (self-)awareness, engage in content-oriented and process-oriented classroom talk (discourse practices), and learn about educational concepts and teaching practices (i.e., acquire performances of conceptual understanding).
2. *Flexible course structures* combine focus and guidance (overarching agenda, educational trajectory) with variation and joint decision-making (course adjustments based on student feedback and formative instructor evaluations) to allow for meaningful and productive learning experiences. Dynamic course structures leave room for student choice, collaboration, and discovery and often involve frequent variations in the social form of instructional activities.
3. *Participation-oriented course activities and materials* allow students to actively engage in their learning processes. The prevalent course activities—explorations and discussions—require high student participation (more than 80% of the overall class time) with the instructors acting as facilitators of exploratory activities and as moderators of class discussions. Class materials function as visible documentations of students' current understandings and as testing grounds for students' ideas.
4. *Well-established routines and norms of interaction* encompass discussion-oriented seating arrangements (e.g., the class sits in a big circle), dialogic principles for class discussion (e.g., prepare, listen, cultivate an open mind) and re-occurring teaching patterns (mainly independent problem solving, guided problem solving, and sharing/comparing/discussing) that clarify expectations and underscore the value of active student engagement and participation.
5. *Open-ended assignments and formative assessment* accompanied by comprehensive guidelines leave room for student choice, capture students' thinking in the making and incorporate regular informative instructor and peer feedback focusing on learning. Evaluating

students' assignments made students' learning visible to the instructors in order for them to inform their teaching and adapt the next instructional steps.

The findings show that the instructors act as agents of the curriculum designing the above course elements and also have a specific meta-monitoring role in that they create ongoing opportunities for students to co-design their learning environment over the course of the semester. Furthermore, the findings of the deeper-level analysis in Sect. 5.3.1 provide additional results with regard to the quality of the course design elements "content and objectives" and "assignments." The findings reveal that the student-centered classrooms under study aimed to foster three major *learning objectives*: students' performances of conceptual understanding (i.e., students' deep understandings of educational concepts and practices), students' SRL capacities enabling them to become metacognitively, motivationally, and behaviorally active participants in their own learning processes, and students' identity development as cognitively active and engaged participants in the practices of their professional communities (e.g., classroom, professional, and wider society; see also Sect. 5.3.1.1).

In terms of the *quality of the learning task* (assignments), several quality features were found in the course of the deeper-level analyses of the student-centered classrooms under study (see Sect. 5.3.1.2). The tasks incorporate high levels of cognitive demand (i.e., leave room for student choice and different solution paths; have high complexity levels such as applying, evaluating, or creating; incorporate different knowledge levels: factual, conceptual, procedural, and metacognitive knowledge). Students have opportunities to demonstrate conceptual agency as they complete the tasks, that is, they are positioned as competent and accountable to the discipline of education allowing their ideas and questions to drive the learning process and requiring them to construct meaning and understanding of the concepts and practices they are learning about. Students have opportunities to engage in productive talk as they complete the tasks inducting them into educational discourse practices constitutive for their future profession. Authentic tasks with practical relevance allow students to establish connections with both scientific ideas and their life and work contexts as prospective teachers (e.g., fieldwork with learners or teacher groups, field trips to schools, invited teachers discussing their practices). Finally, instructors in student-centered classrooms make sure that students understand the initial question(s) or problem statement, the purpose, and procedure of the activity they are about to engage in and what is expected of them in order for the students to actively engage in the learning task and take on responsibility for their own and each other's learning processes.

Furthermore, course evaluation data from three to six different student cohorts who took the courses between 2008 and 2011 were available and used for data analysis (with an N between 263 and 283; nine cohorts).[6] These student perception data were based on students' course ratings at the end of the semester using univariate variance analysis of survey data (see Sect. 5.1). The quantitative account of the course evaluation data show that 92% of the students reported that they perceived the benefit of the courses to them as being high or very high. The vast majority of students perceived the courses as being intellectually challenging and the courses stimulated them to think in new ways. Several student cohorts' high ratings on these two items indicate that some learning that leads to conceptual and/or discursive change is taking place in these classrooms. In terms of course activities and materials the items "Course provided effective opportunities to learn from other students", "Assignments supported and reinforced the goals of the course", "Assignments promoted learning and growth" and "Class discussions enhanced the understanding of the subject material" were rated highest across all three courses (9 cohorts). Regarding instructor behaviors, responding to students respectfully, establishing an environment conducive to learning, encouraging diverse opinions and perspectives and effectively leading classroom discussions were rated highest on average across all three courses (9 cohorts).

Apart from characteristic curricular design elements and students' perceived teaching and learning quality, the empirical study also provides rare and detailed glimpses into what was happening in each of the three classrooms. The subsequent deeper-level instructional quality dimensions and features that the three higher education classrooms under study have in common—underlying patterns and practices that emerged consistently in these naturalistic student-centered classrooms—were identified in answering the empirical research sub-questions 2b and 2c. The findings are based on the cross-case analysis in Chap. 5 that compared and synthesized the empirical single case analysis findings and connected them to existing theoretical concepts of practices as discussed in Chaps. 2 and 3, using interaction analyses and a constant-comparison approach. The depiction of the findings is structured by the theory-informed situative analysis framework introduced in Sect. 4.4.3.2 (Fig. 4.2) differentiating between both classroom teaching and learning (content focus) and classroom interaction and climate (context focus).

#### *6.4.2.2 Positioning of students for active participation in knowledge construction and interactions*

Analyzing the interactional dynamics that inform meaning making and participation-oriented problem-solving activities as they occur in the "wild" reveals that social interaction plays an essential role in knowledge construction and students' self-regulation, with instructors and students positioned in certain ways in the learning activity so *both* are *agentive* (see also Sect. 6.1.2). The course activities in the classrooms under study are mainly designed to encourage students to participate in cooperative forms of interaction in small groups or in the large group for achieving mutual understanding through sharing different perspectives that can be questioned, affirmed, or revised. How students are positioned in learning activities in relation to the content, other students and the instructors is of particular interest because how learning environments are framed intellectually and socially influences whether students engage in deep or surface learning and whether they have opportunities to engage in SRL.

In synthesizing relevant theoretical findings outlined in Chaps. 2 and 3, and the empirical case study findings outlined in the cross-case analysis of deeper-level instructional quality dimensions and features in Chap. 5, the findings of this research project show that powerful SCLEs position students in the following three ways:

- *Students as accountable authors in knowledge construction processes*: students play central intellectual roles as accountable authors in knowledge construction processes in these classrooms since they are positioned with productive (conceptual) agency. Students are held accountable for demonstrating their understandings in accordance with shared disciplinary norms and practices. They have the opportunity to gradually establish their own authority in the classroom since they are entitled and expected to contribute their prior knowledge and ideas in order to develop integrated knowledge structures. They have opportunities to participate in educational practices, explicate their thinking (e.g., critical observation, collaborative inquiry, reflective discussion), and experience themselves as creators of their own theories and practices so that they can develop ownership of ideas about subject matter. The students are trusted to come up with their own noticings and to figure out how to solve a problem and they have choices in terms of how to go about a task that allows for more than one solution path.

- *Students as active and vocal participants in interactions*: student-centered classrooms hold students accountable to their classmates and their instructors for being active and vocal participants in social interactions (i.e., contributing community members). The development of knowledge is a co-constructed activity of all classroom members, constituted in and through (asymmetrical and symmetrical kinds of) talk. Participation-oriented course activities provide opportunities for students to participate in educational discourse practices that organize the discussions and allow for a change in relationships of power and authority with students' views being sought and valued through social interaction. Students experience the power of being positioned as capable and independent, and they have opportunities to learn with and from each other by sharing their thoughts, hearing different perspectives, and developing ideas together. In dialogic classrooms in which students talk more than the instructor, students' accountability to the community of learners is a source of continued effort in terms of preparation and participation.
- *Students as responsible co-designers of the educational agenda*: student-centered classrooms provide students with opportunities to act as responsible co-designers of the educational agenda (course curriculum, syllabus) for the benefit of their own and others' learning. Students are involved in curricular decision-making processes and their ideas and feedback are explicitly invited, valued, and taken seriously. Students experience that they can do something to change and modify their learning environment due to the mutual ownership of the educational agenda that is established in these classrooms. The interactive nature of the courses allows the instructors to explore what sense the students are making and to respond adequately by making informed curricular and pedagogical decisions about what to do next in order to further students' learning processes.

#### 6.4.2.3 *Adaptive instructional strategies to provide students with opportunities for deep learning*

The findings of this research project provide evidence that the introduction of SCLEs does not result in a reduction of the instructors' responsibilities and tasks, but in a revision of their nature. The onus is on the faculty to use classroom time wisely and provide challenges with proper safeguards; to encourage students to work independently while concurrently providing ample learning support which is increasingly reduced as students exhibit more mastery. The students' cognitive, affective, and social learning experiences are central, and guide the instructors' decisions as to what is done in these classrooms and how it is done (e.g., Elen et al., 2007; Weimer, 2013). What do the instructors do with their expertise if they do not mainly communicate it through lectures in their classrooms? The findings of this research project show that instructors in powerful SCLEs apply adaptive instructional strategies in order to support students' participatory processes of knowledge construction and to cultivate a productive and supportive classroom community of learners over time (see also Sect. 6.1.3):

1. Scaffolding Students' Participatory Processes of Knowledge Construction

Adaptive instructional strategies (quality features) were tailored to the four predominant teaching patterns (quality dimensions) below that were constitutive of the participation-oriented course activities in the student-centered classrooms under study (see Sect. 5.3.2). The findings show that student-centered classrooms provide students with a balanced orchestration of well-designed independent and guided problem-solving activities and dialogic discussions—mainly conducted in the large group with between 25 and 38 students. The predominant teaching patterns embody certain instructional quality features that are likely to provide the appropriate level of learning support for the task at hand to foster deep learning (see Tables 6.1, 6.2, 6.3, 6.4 and 6.5 for detailed results, Sect. 6.1.3.1):

- *Independent problem solving in small inquiry groups* (student-led explorations, 39% of the overall average class time) invites the joint co-construction of knowledge as well as SRL without much instructor interference (i.e., instructors mainly observe and listen). The instructors take measures to foster student autonomy and accountability and for the students to make their thinking visible (e.g., posters, written work). They keep students struggling to make sense by staying neutral and resisting the temptation to "tell." Instead they sample the level of the groups' discourses, that is, they unobtrusively observe and listen to the groups grappling with the content and process of inquiry learning, to check for understanding and inform their subsequent teaching.

- *Guided problem solving in the large group* (teacher-led explorations, 12%) requires orienting structures, guiding norms, and modeling behaviors to clarify expectations. The instructors guide collective learning processes by asking open-ended questions and providing prompts to develop students' thoughts further. They also ensure mutual understanding to enable joint knowledge construction (e.g., rephrasing students' contributions, asking clarifying questions) and provide thoughtful and appreciative responses to invite different ideas and voices.
- *Dialogic disciplinary and reflective large group discussions* around scientific educational ideas, concepts, and practices students learn about and engage with (36%) encompass instructional quality features such as: small inquiry groups sharing out to demonstrate their understandings, encouraging students to express their thoughts to further joint sense making, promoting critical dialogue to provoke conceptual changes, and inviting a variety of voices to enhance collective participation. Reflective discussions engage students in self-reflective practices (e.g., journaling, brief written reflections in class), in co-designing the curriculum (e.g., students have a say in how to go about an activity or they drive the content of a discussion) and they provide valuable student feedback for the instructors to inform their teaching.
- *Lecturing* (including instructor metatalk, 10%) *and modeling* (3%) are rather rare in these classrooms. Short lectures (content information) and metatalk (process-related information) that—on average—lasted about 5 minutes at a stretch, conveyed relevant information students needed in order to learn and helped to connect new knowledge to topics and questions raised by the students (e.g., the instructor answers student questions). Modeling behaviors that only occurred in one classroom aimed to support students' knowledge and confidence development by demonstrating to them that learn-

ers can figure things out for themselves without being told what the correct solution is.

2. Cultivating a Productive and Supportive Classroom Community of Learners Over Time

In order to investigate how a classroom community of learners was cultivated over time in the student-centered classrooms under study, common instructional quality dimensions and features as well as the ways in which students moved toward fuller participation in the community's practices over the course of the semester were identified (see Sect. 5.3.3 for detailed accounts). The instructors used various adaptive instructional strategies (instructional quality features) tailored to the following three quality dimensions (see Tables 6.6, 6.7 and 6.8 for detailed results, Sect. 6.1.3.2):

- *Intellectual climate of active student sense making:* The intellectual climate in student-centered classrooms is characterized by a "thinking culture" with learning being understood as thinking in the making (e.g., students share tentative thoughts and have to provide reasons for their answers, misunderstandings, and confusions are seen as productive sources of learning) and with language, artifacts, and norms of interaction playing a facilitating role in students' learning. The instructors recognize students' identities as valuable and productive, listen intently to what students have to say, invite the instantiation of student self-revision, and distribute authority in the classroom by allowing for student-driven discussions.
- *Iterative cycles of feedback to further student learning:* Instructors in student-centered classrooms cultivate iterative cycles of feedback to further and deepen student learning by providing tailored and mastery-oriented feedback (e.g., they read students work carefully, provide critical feedback seizing on strengths and weaknesses for students to make their work stronger, use questions to explore students' views and understandings and require students to point out in subsequent work how they have taken the feedback into account), and genuine feedback and advice to the entire class to share experiences and clarify expectations. Such feedback deepens students' intellectual involvement and keeps them thinking. The instructors also provide students with opportunities for peer assessment and self-assessment to promote students' self-regulation in

that they encourage them to ask critical questions in a constructive manner and provide them with the time and guidelines to do so.

- *Positive emotional climate of mutual respect, trust, and belonging:* Instructional strategies involve developing a strong sense of mutual respect and concern for one another by getting to know the students (e.g., their names, interests), incorporating community-building activities to develop a sense of belonging (e.g., weekly news sharing at the beginning of class, students pick the next speaker), and by making students feel safe enough to ask clarifying and probing questions and express uncertainty and doubt. Cultivating a positive emotional climate also involves measures to foster social stability and integration in the classroom (collective identity). Fostering norms of interaction that forward a sense of community (e.g., listen to others speak, make yourself clear to others, build on each other's ideas), establishing a positive and embracing atmosphere in class to reduce the fear to participate and invite a variety of voices (e.g., use inclusive language, show respect for students' ideas) and allowing students to experience the value of their progress in figuring something out (e.g., by following students ideas and explorations) are strategies that were used in these classrooms.

The findings across the three classrooms also show that students moved toward fuller participation in the community's educational practices over time. The course agendas changed over the course of the semester in these classrooms with students' prior knowledge, interests, and experiences influencing the direction of the courses. Students had to continuously prepare and actively engage in student-driven explorations and discussions in the classroom. As the semester progressed students were given increasing opportunities to demonstrate their understandings through their active engagement in educational practices and freedom to self-organize in their inquiry groups (e.g., as presenters, facilitators of inquiry groups, group leaders). Students were required to do the weekly assignments/assessment tasks taking feedback into account to develop their ideas further and deepen their understandings. The open-ended course assignments left space for student choice and also involved students in independent research projects during the second half of the semester. A sense of a community of learners was cultivated over time valuing the search for understanding, incorporating community-building routines, and supporting a "thinking atmosphere" as outlined above.

#### *6.4.2.4 Challenges to the implementation of student-centered learning and instruction in higher education classrooms*

Finally, this research project also points to obstacles, criticism, misconceptions, and teaching and learning challenges to the implementation of SCLEs in higher education. The implementation of SCLEs—like other curricular and pedagogical innovations—faces diverse obstacles from the faculty's and students' perspectives such as insufficient time to plan instruction, inadequate support, teacher-focused conceptions of teaching, unfamiliarity with student-centered learning and teaching, prior bad experiences. In addition, there are teaching and learning challenges that instructors and students are likely to face in real-world student-centered classrooms. The empirical case study findings show that such challenges involve aspects such as: insufficient student preparation for class, class size, and teacher-centered classroom spaces, the difficulties of keeping all students engaged in large group explorations and validating a variety of student ideas, engaging in metatalk to reflect on joint learning experiences, building an atmosphere of trust and safety to facilitate participation or provide timely feedback to name just a few (see Sects. 5.4 and 6.1.4 for detailed accounts). Instructors have to keep these potential challenges in mind and take measures to meet them when designing and enacting powerful SCLEs in their higher education classrooms.

The above empirical findings indicate that for HEIs to change the status quo and improve the quality of learning and instruction, an educational shift on the curricular and pedagogical level of the higher education classroom and on the institutional level of HEIs is necessary (see Sect. 6.2). SCL begins in the classroom (curricular and pedagogical level) and requires a change in mindset and behavior on the part of the students and the instructors as key players with implications in terms of raising awareness about the importance of instructors' and students' educational beliefs, providing balanced orchestrations of well-designed participation-oriented course activities, and fostering productive instructional and dialogic talk in the context of classroom interactions.

HEIs have to nurture SCLEs so that faculty and students can fulfill their respective new roles in their classrooms. An educational shift on an institutional level has implications with regard to promoting the scholarship of teaching in higher education and fostering sustained professional faculty development. To implement these measures, the working conditions in HEIs must serve to enhance the motivation and capabilities of faculty to teach in a student-centered way and avoid giving raise to individual resistance.

In conclusion, this research project explored the potential of SCLEs to foster deep learning and developed a contextualized educational model that advances theory building about learning from instruction. The model contributes to the innovation of student-centered educational practices in higher education classrooms and other educational settings—especially in smaller seminars with up to 40 students—, provides a scientific foundation to guide future practices in the classroom and can be widely adopted and implemented in everyday educational practices. Reforms of instructional practice in higher education begin with educators who design student-centered educational practices and apply instructional strategies accordingly to scaffold participatory processes of knowledge construction and to cultivate a community of learners in their respective classrooms. Thereby, instructors can start by making small changes in their classrooms that position students as accountable authors, active and vocal participants, and responsible co-designers. They can provide students with well-designed participation-oriented practices, including independent and guided problem solving as well as dialogic disciplinary and reflexive discussions. The proposed model has the potential to change the ways instructors teach and students learn in higher education in particular, in postsecondary education and other educational settings in general, and may also influence institutional and public education policy.

The implementation of powerful SCLEs requires fundamental changes in instructors' beliefs as well as the acquisition of new professional knowledge about learning and instruction, that is, professional competence. Professional development and support are therefore crucial.

## Notes

1. The educational model presented in this chapter adopts a situative perspective on learning and instruction indicating that learning is always embedded in a situation and knowledge is always stored in connection with the context in which it is constructed. The model integrates cognitive and social constructivist perspectives because the individual processes information—memory, attention, perception are important to determining what we learn. Similarly, learning is certainly in the doing and part of identity development. We judge

our status as researchers, parents, and community members based on our ability to engage in discourse and activities—our ability to participate and act—in the particular community (Duffy, 2009, p. 353; see also Sawyer & Greeno, 2009; Schuh & Barab, 2008).

2. In the three classrooms under study lectures/metatalk accounted for an average of 14% of the overall class time (one semester per course) with an average duration of 5 minutes at a stretch. High-engagement activities accounted for an average of 82% of the overall class time. On average, two-thirds of the class time was spent in the large group and one-third in small groups (see also Sect. 5.1).
3. Other re-occurring teacher patterns that were present in these classrooms but played a comparatively small role were authentic modeling and lecturing/metatalk. Authentic modeling refers to the instructor modeling activities while the students observe closely to explore certain concepts they have read about and discussed and to watch certain instructional practices in action. Lecturing refers to learning content (knowledge) presented by the instructor while metatalk refers to procedural knowledge with regard to the overall course, course activities (e.g., thinking routines, protocols), assignments, and assessment tasks given by the instructor (see Appendix 4, inventory 6 for an overview and Sect. 6.1.3.1).
4. Critics often state that single cases offer a poor basis for generalizing; however, contrasting ethnographic case study research to survey research (the latter a typical quantitative instrument) is incorrect since case studies rely on analytic generalization while survey research relies on statistical generalization (Yin, 2009, pp. 43–44).
5. This project was carried out in the context of an individual fellowship awarded to the author. Thus, the scope of this project in terms of personnel and financial resources was limited.
6. Instructional effectiveness research has consistently found that student perceptions of teacher classroom behaviors or instructional practices are reasonably reliable and stable with moderate to high positive correlations with various measures of course learning indicating that students learn more when instructor evaluations are high (e.g., Feldman, 2007; Marsh, 2007; Pascarella, 2006). Student evaluations make instruction visible from the students' perspective and provide crucial sources of information for teachers to learn from.

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# Appendices

## Appendix 1: Interview Guidelines Instructor

**Professional Background**

- How many years of teaching experience do you have regarding teaching in schools and teaching at universities (what subjects, what grade levels)?
- For how long have you conducted your course at Harvard?
- What motivated you to design this course for the Ed school?
- Will you teach the course again next year?

**General Questions**

- What is your overall impression of this year's class?
- How would you describe the class culture and the overall atmosphere in this course?
- In general, how was the class organized? Or in other words, was there a special class structure or were there class routines? What happens on a typical day?

**Curriculum Development (the process of designing and preparing a course; Planned educative experiences)**

- Is there a HGSE approach to educate (prospective) teachers (e.g., some major joint principles)?



S. Hoidn, *Student-Centered Learning Environments in Higher Education Classrooms*, DOI 10.1057/978-1-349-94941-0

- What philosophical/theoretical principles influence your teaching?
- What were the learning goals in this course?
- How relevant/important was the course content (e.g., practical relevance, real-world experience)?
- Learning assignments and feedback, artifacts:

    (a) How would you evaluate the effectiveness of the assignments given in this class for students' learning? (e.g., How useful were the weekly readings in the context of the class?)
    (b) What kind of feedback did you give in response to students' writings (e.g., on the final research project)?
    (c) What form of final research project did students choose and why (also why single or with a partner)?
    (d) What kind of artifacts/technologies played what role in the classroom? In what way were they helpful for students' learning?

- What role did assessment play in this class (extent to which the objectives have been achieved)?

**Teaching (Interaction between teacher and student(s))**

- What are the basic assumptions about students, learning, and teaching, that is, propositions or beliefs, you hold in your capacity as an instructor at the university?
- How would you describe your role as an instructor? How do you help students learn?
- How did you create and experience your interaction with the students (in terms of authority, power relations, participation of the class in decisions)?

**Learning**

- Motivation/Engagement: Were your students motivated in this course? Did their motivation continue or were there times when they were not motivated to prepare and/or participate?

- Learning Activities

    (a) What is the role of students' prior knowledge in your course?
    (b) Did the learning environment allow for exploration?

(c) How did learning/knowledge creation happen in the classroom? In what way have your students experienced learning opportunities in class (e.g., individual, collaborative)?
(d) What role did reflection play in this class?

- Social Interaction

(a) How did you experience the social relationships between students in this class?
(b) Do you remember any situation in class where tensions arose (small group or large group/group dynamics)?
(c) Were all students equally included in class activities?
(d) How did you as an instructor feel treated in this course?

**Institutional Environment (Historical, political, social context)**

- How did the physical classroom environment affect learning (e.g., sitting in a circle, space)?
- What do you think should be different in the future with regard to this course, if anything (suggestions)?
- Anything else you can think of regarding the context of your teaching that would make it easier for you to teach?

Any further comments you would like to add?

## Appendix 2: Interview Guidelines Students

**Professional Background Information**

- How many years of teaching experience did you have prior to the master's program?
- What subjects have you taught? What grade levels?
- Did you also teach this academic year?
- Will you work as a teacher after graduation? What subjects and what grade levels will you teach?

## General Questions

- What is your overall impression of this year's class?
- How would you describe the class culture and the overall atmosphere in this course?
- In general, how was the class organized? Or in other words, was there a special class structure or were there class routines? What happens on a typical day?

## Curriculum Development

- What were the learning goals in this course?
- How relevant/important was the course content (e.g., practical relevance, real-world experience)?
- Learning assignments and feedback, artifacts:

  (a) How would you evaluate the effectiveness of the assignments given in this class for your/students' learning? (e.g., How useful were the weekly readings in the context of the class?)
  (b) What kind of feedback did you receive/give in response to your/students' writings (e.g., on the final research project)?
  (c) What form of final research project did you choose and why (also why single or with a partner)?
  (d) What kind of artifacts/technologies played what role in the classroom? In what way were they helpful for your/students' learning?

- What role did assessment play in this class (extent to which the objectives have been achieved)?

## Teaching (Interaction between teacher and student(s))

- How would you describe the instructor's role in this class?
- What did you appreciate most about the instructor?
- What do you expect from your instructor (role)?
- Were your expectations met in this course? (Suggestions for improvement?)
- How did you experience your interaction with the instructor (e.g., authority, power relations, participation of the class in decisions)?
- How did you experience the class' interaction with the instructor (in class, email, and personal interaction)?

**Learning**

- Motivation/Engagement: Did this course interest you? Did your motivation continue throughout the course or were there times when you weren't motivated to prepare and/or participate?

- Learning Activities

  (a) What is the role of students' prior knowledge in your course?
  (b) Did the learning environment allow for exploration?
  (c) How did learning/knowledge creation happen in the classroom? In what way have you experienced learning opportunities in class (e.g., individual, collaborative)?
  (d) What is your approach to learning, that is, what means learning to you, when do you learn?
  (e) What have you learned from this course? (e.g., Did you learn something about yourself as learner and teacher?)
  (f) What made learning difficult for you in this class?

- Social Interaction/Whole Group

  (a) How did you experience the social relationships between students in this class?
  (b) Do you remember any situation in class where tensions arose (small group or large group/group dynamics)?
  (c) Were all students equally included in class activities?
  (d) How did you as feel treated in this course (by other students, the instructor)?

**Institutional Environment (Historical, political, social context)**

- How did the physical classroom environment affect learning (e.g., sitting in a circle, space)?
- What do you think should be different in the future with regard to this course, if anything (suggestions)?

Any further comments you would like to add?

# Appendix 3: Interview Protocols

| | *Interview questions instructors* | *Interview questions students* | *Organizational concept* |
|---|---|---|---|
| 1. | 1.1 How many years of teaching experience do you have regarding teaching in schools and teaching at universities (what subjects, what grade levels)?<br>1.2 For how long have you conducted your course at Harvard?<br>1.3 What motivated you to design this course for the Ed school?<br>1.4 Will you teach the course again next year? | 1.5 How many years of teaching experience did you have prior to the master's program?<br>1.6 What subjects have you taught? What grade levels?<br>1.7 Did you also teach this academic year?<br>1.8 Will you work as a teacher after graduation? What subjects and what grade levels will you teach? | Professional background and current/future situation |
| 2. | 2.1 What is your overall impression of this year's class?<br>2.2 How would you describe the class culture and the overall atmosphere in this course?<br>2.3 In general, how was the class organized? Was there a special class structure or were there class routines? What happens on a typical day? | | Overall impression (atmosphere, structure) |
| 3. | 3.1 Is there a HGSE approach to educate (prospective) teachers (e.g., some major joint principles)?<br>3.2 What philosophical/theoretical principles influence your teaching?<br>3.3 What were the learning goals in this course?<br>3.4 How relevant/important was the course content (e.g., practical relevance, real-world experience)? | | Curriculum development (pedagogical approach, goals, content, artifacts/technology, assignments and feedback, assessment) |

| | | | |
|---|---|---|---|
| | 3.5 Learning assignments and feedback, artifacts:<br>(a) How would you evaluate the effectiveness of the assignments given in this class for your/students' learning? (e.g., How useful were the weekly readings in the context of the class?)<br>(b) What kind of feedback did you receive/give in response to your/students' writings (e.g., on the final research project)?<br>(c) What form of final research project did you/students choose and why (also why single or with a partner)?<br>(d) What kind of artifacts/technologies played what role in the classroom? In what way were they helpful for your/students' learning?<br>3.6 What role did assessment play in this class? | | |
| | *Role of the Instructor* | | |
| 4. | 4.1 What are some basic assumptions about students, learning, and teaching, that is, propositions or beliefs, you hold in your capacity as an instructor at the university?<br>4.2 How would you describe your role as an instructor? How do you help students learn? | 4.2 How would you describe the instructor's role in this class?<br>4.3 What did you appreciate most about the instructor?<br>4.4 What do you expect from your instructor (role)?<br>4.5 Were your expectations met in this course? (Suggestions for improvement?) | Teaching and Learning (role of the instructor, assumptions, expectations, interaction instructor—students, motivation, learning activities, approach to learning, difficulties, reflection, social interaction) |
| | *Instructor–Student Interaction* | | |
| | 4.6 How did you create and experience your interaction with the students (e.g., in terms of authority, power relations, participation of the class in decisions)? | 4.7a How did you experience your interaction with the instructor (e.g., authority, power relations, participation of the class in decisions)?<br>4.7b How did you experience the class' interaction with the instructor (e.g., in class, email, and personal interaction)? | |
| | *Student Motivation/Engagement* | | |
| 5. | 5.1 Were your students motivated in this course? Did their motivation continue or were there times when they weren't motivated to prepare and/or participate? | 5.1 Did this course interest you? Did your motivation continue throughout the course or were there times when you weren't motivated to prepare and/or participate? | |

(*continued*)

(continued)

| | Interview questions instructors | Interview questions students | Organizational concept |
|---|---|---|---|
| | *Learning Activities* | | |
| | 5.2 What is the role of students' prior knowledge in your course? | | |
| | 5.3 Did the learning environment allow for exploration? | | |
| | 5.4 How did learning/knowledge creation happen (for you) in the classroom? In what way have you/students experienced learning opportunities in class (e.g., individual, collaborative)? | | |
| | | 5.5 What is your approach to learning, that is, what means learning to you, when do you learn? | |
| | | 5.6 What have you learned from this course? (e.g., Did you learn something about yourself as learner and teacher?) | |
| | | 5.7 What made learning difficult for you in this class? | |
| | 5.8 What role did reflection play in this class? | | |
| | *Social Interaction* | | |
| | 5.9 How did you experience the social relationships between students in this class? | | |
| | 5.10 Do you remember any situation in class where tensions arose (small group or large group/group dynamics)? | | |
| | 5.11 Were all students equally included in the class activities? | | |
| | 5.12 How did you feel treated in this course (by other students, the instructor)? | | |
| 6. | 6.1 How did the physical classroom environment affect learning (e.g., sitting in a circle, space)? | | Institutional environment (historical, political, etc.), changes |
| | 6.2 What do you think should be different in the future with regard to this course, if anything (suggestions)? | | |
| | 6.3 Anything else you can think of regarding the context of your teaching that would make it easier for you to teach? | | |
| 7. | Any further comments you would like to add? | | Final comment |

# Appendix 4: Six Coding Inventories

## Overview

Inventory 1: Course activities (CAC)
Inventory 2: Social form of the class (SFO)
Inventory 3: Learning content and/or learning process-related talk (CPT)
Inventory 4: Facilitated student activities (FSA)
Inventory 5: Teacher roles (TRO)
Inventory 6: Re-occurring teaching patterns (RTP)

**Inventory 1** Course activities (CAC)

| *Code number* | *Code* | *Acronym* | *Definition of code and examples* |
|---|---|---|---|
| CAC-01 | Lectures | ML | Content-related information: teacher gives a content presentation, introduces objectives/topics |
| CAC-02 | Metatalk | MT | Process-related information: teacher provides class overview, communicates expectations, elaborates on activities, assignments and materials |
| CAC-03 | Explorations | EX | Teacher facilitates students' explorations in the large group (teacher-led) or individual or group learning and problem solving without teacher interference (student-led)<br>Explorations encompass "exploratory activities" in Mrs. Smith's course, inquiry protocols in Mrs. Lee's course and article discussion groups in Mr. Brown's course |
| CAC-04 | Teacher demonstrations | TD | Teacher models certain instructional behaviors while the teacher students are observing the process that is used (only in Smith's course) |
| CAC-05 | Reading discussions | RDIS | The class discusses readings in small groups or in the large group |
| CAC-06 | Discussions | DIS | Teacher and students (whole class) temporarily form a discourse community to co-construct knowledge together (e.g., students ask clarifying/probing questions, students share and discuss their noticings, puzzles, wonderings) or to engage in metatalk (activity debrief) |
| CAC-07 | Student demonstrations | SD | Student groups demonstrate and explain CK prepared for presentation to the whole group (only in Mrs. Lee's course) |

(*continued*)

**Inventory 1** (continued)

| *Code number* | *Code* | *Acronym* | *Definition of code and examples* |
|---|---|---|---|
| CAC-08 | Check-ins/ Updates and News | CHI/ UAN | News-sharing round at beginning of class/ socialising (only in Mrs. Lee's and Mr. Brown's courses) |

**Inventory 2** Social form of the class (SFO)

| *Code number* | *Code* | *Acronym* | *Definition of code* |
|---|---|---|---|
| SFO-01 | Class level | CL | The entire class works together |
| SFO-02 | Group level | GL | Students work in groups of three or more learners |
| SFO-03 | Pair level | PL | Two students work together |
| SFO-04 | Individual level | IL | Students work alone |

**Inventory 3** Learning content and/or learning process-related talk (CPT)

| *Code number* | *Code* | *Acronym* | *Definition of code* |
|---|---|---|---|
| CPT-01 | Content | CON | Talk refers to learning content, that is, subject matter knowledge |
| CPT-02 | Process | PRO | Talk refers to learning processes and specific or more general procedures/strategies on how to go about an activity or assignment as well as metacognitive information |
| CPT-03 | Content and process | CON/ PRO | Talk contains content- as well as process-related information |

**Inventory 4** Facilitated student activities (FSA)

| *Code number* | *Code* | *Acronym* | *Definition of code and examples* |
|---|---|---|---|
| FSA-01 | Listening | LIS | Students listen to information/explanations, read quietly |
| FSA-02 | Observing | OBS | Students observe expert and peer models |
| FSA-03 | Articulation | ART | Students verbalize their knowledge and thinking through discussion participation |

**Inventory 4** (continued)

| *Code number* | *Code* | *Acronym* | *Definition of code and examples* |
|---|---|---|---|
| FSA-04 | Exploration | EXP | Students explore subject matter—often with the help of objects/manipulatives |
| FSA-05 | Reflection | REF | Students reflect on learning content and process (e.g., individual written reflection, activity debriefs) |

**Inventory 5** Teacher roles (TRO)

| *Code number* | *Code* | *Acronym* | *Definition of code and examples* |
|---|---|---|---|
| TRO-01 | Agent of the curriculum (course designer) | CD | The teacher frames activities, poses a problem/question for students to work on, provides process-related information on course components (e.g., class overview, assignments) |
| TRO-02 | Authentic role model | RM | The teacher models certain strategies or behaviors for students to observe closely |
| TRO-03 | Resource person | RP | The teacher provides CK and shares content-related experiences |
| TRO-04 | Facilitator | F | The teacher scaffolds exploratory activities (cognitive and socio-emotional level) |
| TRO-05 | Moderator | M | The teacher moderates discussions in the large group (e.g., reading discussions, activity debriefs) |
| TRO-06 | Learner and reflective teacher | LRT | The teacher listens to student contributions, participates in small group discussions, takes student feedback into account |

**Inventory 6** Re-occurring teaching patterns (RTP)

| *Code number* | *Code* | *Acronym* | *Definition of code and examples* |
|---|---|---|---|
| RTP-01 | Lecturing/Content presentation | LCP | Students learn new content (terms, rules, concepts) without problems (the teacher presents knowledge in form of a lecture) |

(*continued*)

**Inventory 6** (continued)

| *Code number* | *Code* | *Acronym* | *Definition of code and examples* |
|---|---|---|---|
| RTP-02 | Metatalk (content and process-related elaborations) | CPE | Students receive mainly learning process-related information about assignments, activities, and other components of the course (e.g., the teacher introduces the main components of the course during the first class, the teacher provides information on how one can go about an assignment or how an activity is conducted in class) |
| RTP-03 | | CW-P | Students ask clarifying questions referring to CPE (large class) |
| RTP-04 | Authentic modeling by the teacher (problem solving) | IPAM | The teacher models certain instructional behaviors with real problems in authentic situations while the class is observing (e.g., the teacher demonstrates how s/he helps children or high school students come to their own understandings) |
| RTP-05 | Guided problem solving | GPS | New content is developed/explored based on problems together with the teacher facilitating the process (this includes the teacher framing the problem and/or activity and providing additional procedural information to move the learning process along) |
| RTP-06 | Independent problem solving | IPSU | Problem setup: teacher introduces/ frames a problem/puzzle that the students then tackle independently |
| RTP-07 | | IPSW | Independent student work (seatwork): students learn about new theoretical concepts, ideas, and practices by solving a challenging problem independently without teacher interference (individual or small group work) |
| RTP-08 | Sharing/comparing/ discussing | IPCW | Students share/compare/discuss problem solutions, ideas, noticings, questions, reflections with the large class and co-construct knowledge (classwork) |

Legend: *CW* stands for classwork, *P* for process (as opposed to content). *IP* stands for "independent problem" meaning that the teaching is based on a problem. *SU* stands for setup and *SW* for seatwork and *CW* for classwork

## Appendix 5: Course Evaluation Survey

1. What are the most valuable things you have gained from this course? Possibilities may range from acquisition of concrete skills or knowledge to changes in perspective or ways of thinking.
2. Please indicate the extent to which you would agree with the following statements. If there is a question for which you do not know the answer or that is not applicable to this course, indicate NA.

| *Course content* | *1—Not at all* | *2* | *3* | *4* | *5—Very much* | *NA* |
|---|---|---|---|---|---|---|
| A—Course was intellectually challenging | | | | | | |
| B—Course stimulated me to think in new ways | | | | | | |
| C—Diversity issues related to course content were well addressed | | | | | | |
| D—Course helped me understand how to apply my learning to real problems and contexts | | | | | | |
| *Organization* | | | | | | |
| E—Course objectives were clearly stated | | | | | | |
| F—Course content was clearly aligned with stated objectives | | | | | | |
| G—Syllabus was clear, well organized, and complete | | | | | | |

3. Please consider specific course activities and materials (lectures, case studies, readings, written assignments, etc.). Please evaluate each item carefully and independently. If there is a question for which you do not know the answer or that is not applicable to this course, indicate NA.

| | *1—None of the time* | *2* | *3* | *4* | *5—All of the time* | *NA* |
|---|---|---|---|---|---|---|
| A—Course activities were aligned with the syllabus | | | | | | |
| B—Class lectures clarified the subject material | | | | | | |
| C—Class discussions enhanced the understanding of the subject material | | | | | | |
| D—Assigned readings were valuable and of high quality | | | | | | |

(*continued*)

(continued)

| | 1—None of the time | 2 | 3 | 4 | 5—All of the time | NA |
|---|---|---|---|---|---|---|
| E—Class lectures and discussions were related to assigned reading | | | | | | |
| F—Assignments supported and reinforced the goals of the course | | | | | | |
| G—Assignments promoted learning and growth | | | | | | |
| H—Technology was used to: | | | | | | |
| * Illustrate and deepen understanding of subject matter | | | | | | |
| * Enable discussions outside of class | | | | | | |
| * Facilitate communication between students and instructors | | | | | | |
| I—Course provided effective opportunities to learn from other students | | | | | | |

4. What specific course activities or materials (lectures, case studies, readings, written assignments, group projects, class discussions, etc.) did you find MOST valuable? Why?
5. What specific course activities or materials did you find LEAST valuable? Why?
6. About the instructor of the course:

6.1 Please take a moment to think specifically about the instructor(s) who taught this course. Please evaluate each item carefully and independently. If there is a question for which you do not know the answer or which you think is not applicable to this course, please indicate NA in the response area. NOTE: This section refers to the faculty member(s) teaching this course; there is a separate section that evaluates the performance of Teaching Fellows (TFs).

| | 1—None of the time | 2 | 3 | 4 | 5—All of the time | NA |
|---|---|---|---|---|---|---|
| A—The instructor established an environment conducive to learning. | | | | | | |
| B—The instructor gave clear and well-structured presentations | | | | | | |

(continued)

| | 1—None of the time | 2 | 3 | 4 | 5—All of the time | NA |
|---|---|---|---|---|---|---|
| C—The instructor effectively led classroom discussions | | | | | | |
| D—The instructor encouraged diverse opinions and perspectives | | | | | | |
| E—The instructor clearly explained how course assignments would be evaluated | | | | | | |
| F—The instructor provided helpful feedback on course assignments | | | | | | |
| G—The instructor provided timely feedback on course assignments | | | | | | |
| H—The instructor was accessible to students outside of class | | | | | | |
| I—The instructor responded to students respectfully | | | | | | |

6.2 In what ways was the instructor most effective? Why?

6.3 What recommendations would you make to the instructor to strengthen his or her teaching and/or make the course more valuable?

7. What was your reason for enrolling in the course?

| Required | Rec. or Distrib. Req. | Elective | No response |
|---|---|---|---|

8. On average, how many hours per week did you dedicate to this course outside of class?

| Less than two hours | 2 to 4 hours | 4 to 7 hours | 7 to 10 hours | 10 to 15 hours | More than 15 hours | No response |
|---|---|---|---|---|---|---|

9. What advice would you give to students who are thinking of taking this course (about its level, the amount of work required, any prior training needed, ways to get the most out of the course, etc.)?

10. How would you characterize this course in terms of the following?

| | *1—Very low* | *2* | *3* | *4* | *5—Very high* | *No response* |
|---|---|---|---|---|---|---|
| A—Amount of Workload | | | | | | |
| B—Benefit to You | | | | | | |

11. What is your primary school affiliation?

| HGSE Ed.M./CAS | HGSE Ed.D. | Other Harvard Master's Program | Other Harvard Doctoral Program | Other Harvard Degree Program | Other University Degree Program | Non-Degree | No Response |
|---|---|---|---|---|---|---|---|

12. If you answered "HGSE Ed.M./CAS," what is your program?

| |
|---|
| Arts in Education |
| Education Policy and Management |
| Higher Education |
| Human Development and Psychology |
| International Education Policy |
| Language and Literacy |
| Learning and Teaching |
| Mind, Brain, and Education |
| Risk and Prevention |
| School Leadership |
| Specialized |
| Teacher Education |
| Technology, Innovation, and Education |
| No Response |

13. In this space, you may add any additional specific feedback not addressed in earlier sections of this survey.

Source: HGSE (2009)

# Glossary

***Adaptive expertise*** *(or* ***adaptive competence****)* in a domain is defined as the ability to apply knowledge and skills flexibly in different contexts—it is the "ultimate" goal of academic learning and instruction (Bransford et al., 2006; Darling-Hammond, 2008; De Corte, 2013; NRC, 2000, 2005; Perkins, 1998, 2008). Adaptive expertise in the field of teacher education, for example, requires highly trained professionals who have both subject matter expertise (CK) and pedagogical (content) knowledge of when and how to use their expertise to facilitate students' learning processes (Baumert & Kunter, 2013; Hmelo-Silver & Barrows, 2006; Leinhardt & Steele, 2005; NRC, 2000).

***Adaptive instruction*** *(or* ***adaptive learning support, scaffolding****)* supports different kinds of students throughout the learning process resulting in more or less guidance of the students' intellectual journey. The students' cognitive, affective, and social learning experiences are central and guide the instructors' decisions as to what is done in the classroom and how with the learning support being reduced over time as students exhibit more mastery (Kunter et al. 2013; Terhart, 2014; Weimer, 2013). The notion of adaptive instruction is aligned with the concept of scaffolding that is adapted to or contingent upon students' understanding in order to promote deep learning (Pea, 2004; Sawyer, 2014b; Van de Pol, 2012; Wood, Bruner, & Ross, 1976).



S. Hoidn, *Student-Centered Learning Environments in Higher Education Classrooms*, DOI 10.1057/978-1-349-94941-0

The ***Bologna Process*** constitutes a voluntary, intergovernmental harmonization undertaking that was an important driver for European higher education reforms in the last decade and is based on a collective effort of public authorities, universities, teachers, and students, together with stakeholder associations, employers, quality assurance agencies, international organizations, and institutions (European Communities, 2009). The Bologna Process aims to create an EHEA, promote mobility and employability of students, and increase the compatibility, comparability, and competitiveness of European higher education systems (Crosier & Parveva, 2013).

A ***case*** is defined as a university-level graduate course (over the duration of one semester) or in other words, a classroom of students with an instructor.

A ***classroom community of learners*** supports students engaging in peripheral participation in the community in a way that is consistent with its disciplinary norms and practices (Bielaczyc, Kapur, & Collins, 2013). Students are enculturated as participants in a disciplinary community and can move toward a fuller participation in learning activities over time.

***Deep learning*** *(or deep conceptual understanding)* focuses on sense making and involves both knowing and doing, with students acquiring the right kind of knowledge at hand and the capacity to use it flexibly in different contexts (Biggs, 2012; NRC, 2000; Sawyer, 2014a). Deep learning builds on what students bring to the table and depends on both the kinds of learning-focused activities students get to participate in to construct knowledge and the ways they are positioned for participation in interactions (Engle, 2006, 2011; Engle & Conant, 2002; Engle & Faux, 2006).

***Deeper-level quality features of instruction*** refer to the quality of both the actual learning and teaching processes and the teacher–student interactions. Deeper-level instructional features aim to foster the cognitive processing of the individual learner and the interactional processes of a community of learners engaged in practices of social knowledge construction (Aebli, 1983; Brophy, 2006; Helmke, 2009; Klieme & Rakoczy, 2008; Pauli & Reusser, 2011).

An ***educational model*** is defined as a structural framework (theory) for the design of learning environments based on education research (De Corte, Verschaffel, & Masui, 2004).

***Effective learning*** is a constructive, cumulative, self-regulated, goal-directed, situated, collaborative, and individually different process of meaning construction and knowledge building (De Corte, 2013; Dubs, 1995; Reusser, 2006).

***HEIs*** refer to the diverse establishments providing higher education, mainly Universities, Universities of Applied Sciences, HEIs of art and music, Universities of teacher education. The terms higher and tertiary education as well as universities are used synonymously in this work. Currently, the European higher education landscape spans around 4000 HEIs with over 19 million students and 1.5 million staff (European Commission, 2009, p. 22). In contrast, postsecondary education is a reference to any education beyond high school/secondary school and includes universities, colleges, professional schools, and polytechnics, among others.

***Identity development*** refers to individual student teachers' developing identities as cognitively active and engaged participants in the practices of their professional communities (e.g., classroom, professional, wider society). The students in class become gradually enculturated in a disciplinary community with certain disciplinary practices, routines, and norms of interaction. They gain a greater disciplinary awareness about their epistemological beliefs and teaching conceptions through their continued engagement with new concepts and practices. They rethink their current ideas about education, learning, and teaching and establish self-defined characteristics as competent and responsible learners and (prospective) teachers as a result (Biggs, 1999; Brown, Collins, & Duguid, 1989; Collins & Greeno, 2011; Lave & Wenger, 1991).

***Learning opportunities*** are understood broadly as the full range of instructional activities offered to students by the teacher.

***Participation-oriented educational practices*** involve high-engagement activities that stimulate and structure the inner activity of learning. They revolve around high levels of in-class student participation with participation defined broadly as verbal student contributions to class (e.g., asking questions, responding to questions, making comments) (Dirk, 2010; Sutton-Brady & Stegemann, 2010).

***Performances of conceptual understanding*** refer to disciplinary concepts and practices (e.g., educational concepts and authentic practices) that students acquire through their active participation, collaboration, and reflection and as part of a community of learners. Students have opportunities to apply their knowledge, skills, and prior experiences in a variety of situations with the help of peers, teachers, and diverse resources and make publicly visible what they know and think (Blythe & Associates, 1998; NRC, 2000).

***Practices*** are understood as regular and recurring patterns of activity with the object of activity being the content of the knowledge to be learned (Greeno & Engeström, 2014; see also Sect. 2.1.3.4).

***SRL*** requires the active participation of students in their own learning and manifests itself in students' active monitoring and regulation of the learning process in order to attain desired goals (Pintrich & Zusho, 2002). Students become metacognitively, motivationally, and behaviorally active participants in their own learning processes (Zimmerman, 2008). Thereby, SRL is both a desired product of classroom instruction and, to a substantial degree, the precondition for successful and productive classroom learning (Leutwyler & Maag Merki, 2009).

The ***situative educational model*** that was developed in the context of this research project outlines design elements and instructional quality dimensions and features that are embodied in powerful student-centred learning environments (see Fig. 6.1, Sect. 6.1). The model is called "situative" because learning is understood as being always embedded in a situation and knowledge is always stored in connection with the context in which it is constructed (Sawyer & Greeno, 2009).

***SCL*** is rooted in a constructivist view of learning and instruction that puts the student at the heart of the learning process and unfolds a broad spectrum of participation-oriented teaching and learning practices to support deep conceptual understanding (e.g., Dubs, 2013; EUA, 2010; Land, Hannafin, & Oliver, 2012; Lea, Stephenson, & Troy, 2003; O'Neill & McMahon, 2005).

***SCLEs*** share common constructivist foundations on learning and instruction and emphasize participation-oriented educational practices, despite differences in the various student-centred designs (e.g., PBL, cognitive apprenticeships, learning communities). The focus of powerful student-centred learning environments thus lies on learning processes and competences in terms of what the students will be able to do instead of mere content, that is, knowledge acquisition (Sawyer, 2014a) with the goal of fostering performances of understanding as well as SRL skills and identity development.

***Surface-level quality features of instruction*** refer to the "sight structures" describing teaching practices and the organization of learning activities in the classroom; more precisely, observable characteristics of the learning environments such as social forms, choreography of activities, complexity level of the problems, instructional methods, and use of teaching materials (Aebli, 1983; Brophy, 2006; Helmke, 2009; Klieme & Rakoczy, 2008; Pauli & Reusser, 2011).

***Traditional (teacher-centered) instruction*** considers teaching as knowledge transmission, that is, passing knowledge from the expert instructor to the novice students. Knowledge is the object (e.g., concepts stored in the head) that is acquired and then applied with the support of direct instruction (e.g., to reduce cognitive load). Commonly practiced methods of instruction emphasize lectures, seminars, and examinations supplemented by exercises and classroom discussions on assigned readings with the instructor as the "sage on the stage" disseminating information (e.g., Armstrong & Fukami, 2009; De La Sablonnière, Taylor, & Sadykova, 2009). Traditional teacher-centred methods mainly focusing on rote learning, memorization and on testing standards often follow an elicitation pattern known as IRE: the instructor initiates a question to which s/he already knows the answer (I), followed by a short student reply (R), and an instructor evaluation of the student's response (E) (Cazden, 1988; Mehan, 1979).

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S. Hoidn, *Student-Centered Learning Environments in Higher Education Classrooms*, DOI 10.1057/978-1-349-94941-0

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# Index



Note: Page number followed by ‘n’ refers to notes



S. Hoidn, *Student-Centered Learning Environments in Higher Education Classrooms*, DOI 10.1057/978-1-349-94941-0

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