This is a post-peer-review, pre-copyedit version of an article published in Instructional Science. The final authenticated version is available online at:
[http://dx.doi.org/ 10.1007/s11251-013-9304-3](http://dx.doi.org/10.1007/s11251-013-9304-3)

Please cite this article as:

Goeze, A., Zottmann, J. M., Vogel, F., Fischer, F., & Schrader, J. (2014). Getting immersed in teacher and student perspectives? Facilitating analytical competence using video cases in teacher education. *Instructional Science*, 42(1), 91-114. doi:10.1007/s11251-013-9304-3

Goeze, A., Zottmann, J. M., Vogel, F., Fischer, F., & Schrader, J.

**Getting Immersed? Facilitating Analytical Competence with Multiple Perspectives and
Conceptual Knowledge by Using Video Cases in Teacher Education**

Annika Goeze (*corresponding author*)

University of Tuebingen, Germany

Institute of Educational Science, Muenzgasse 11, D-72070 Tuebingen, Germany

annika.goeze@uni-tuebingen.de; tel: +49 7071 29 72868; fax: +49 7071 29 5140

Jan M. Zottmann

LMU Munich, Germany

Department of Psychology, Leopoldstrasse 13, D-80802 Munich, Germany

Freydis Vogel

LMU Munich, Germany

Department of Psychology, Leopoldstrasse 13, D-80802 Munich, Germany

Frank Fischer

LMU Munich, Germany

Department of Psychology, Leopoldstrasse 13, D-80802 Munich, Germany

Josef Schrader

University of Tuebingen and German Institute for Adult Education, Germany

Institute of Educational Science, Muenzgasse 11, D-72070 Tuebingen, Germany and

German Institute for Adult Education - Leibniz Center for Lifelong Learning,

Heinemannstr. 12-14, D-53175 Bonn, Germany

Abstract

The ability to analyze and understand classroom situations through the eyes of not only teachers but also students can be seen as a crucial aspect of teachers' professional competence. Even though video case-based learning is considered to have great potential for the promotion of analytical competence of teachers (i.e., becoming immersed in student and teacher perspectives as well as applying conceptual knowledge to better understand classroom situations), only a few studies have investigated the effects of corresponding instructional support. This empirical field study examines the effects on analytical competence of two types of instructional support—hyperlinks to multiple perspectives and hyperlinks to conceptual knowledge—by using a 2×2 factorial design in a computer-supported video case-based learning environment inspired by cognitive flexibility theory and participatory design. The study examines collaborative learning processes to discover what specific kind of instruction may help to counteract some of the known deficits of case-based learning and teacher thinking, such as limited perspective-taking. From a participatory design point of view, training novices to become immersed in teacher and student perspectives can be considered as an alternative for direct involvement of teachers and students in the design process. The study was realized as a four-day university course for pre-service teachers ($N = 100$). ANCOVAs of learning processes (small-group discussions) and outcomes (written case analyses) provide evidence that both types of instructional support (i.e., hyperlinks to multiple perspectives and conceptual knowledge) are beneficial. In particular, hyperlinks to multiple perspectives affected small-group case discussions and written post-tests as they led to increased immersion (i.e., perspective-taking). Hyperlinks to conceptual knowledge furthered the application of this knowledge, especially in the written post-tests. Implications for teacher education, participatory design, and further research are discussed.

Keywords: video case-based learning; teacher education; teacher expertise; perspective taking; immersion; computer-supported collaborative learning

Introduction

Despite heterogeneous academic disciplines, scientific approaches, geographic borders, and language barriers, educational researchers and practitioners worldwide agree that teachers hold the crucial key position for the core aim and legitimization of every educational institution—successful learning processes. As the Organization for Economic Co-operation and Development (OECD 2005) succinctly put the sentiment on a book cover: “Teachers Matter”! Evidence for this claim comes from empirical research on learning and instruction: One of the most important variances in school achievement (after students’ prior knowledge) can be explained by teachers’ characteristics and their classroom performance (Hattie 2009). Regarding classroom performance and professional development, teachers’ abilities to “think like a teacher” (i.e., their cognitive skills in grasping the complexity of pedagogical situations, especially from the students’ point of view) is considered crucial in many empirical studies (e.g., Borko 2004; Sherin et al. 2011). In particular, “analytical competence”—the ability to observe, analyze, and assess classroom situations—can be seen as an essential aspect of teacher expertise and competence. Presumably, this analytical competence is a necessary (albeit not sufficient) precondition for the promotion of professional classroom practice (Minnameier 2009).

The concept of analytical competence presented here comprises three components. The first component is a teacher’s ability to become immersed and to adopt multiple perspectives of the students and staff involved in a pedagogical situation. Research shows that students’ perceptions of learning environments appear to determine the effectiveness of their learning (Elen and Lowyck 1999; Elen et al. 1998; Entwistle 1991; Könings et al. 2007). Relevant stakeholders in the educational process have different perspectives, and there is a need to bridge these differences in order to facilitate better learning (see the Editorial of this special issue). Yet, according to Ball and Cohen (1999), “learning to attend to one’s students with insight requires expertise beyond what one gathers from one’s own experience. What one enjoyed, thought, or felt as a child may afford helpful speculation about one’s students, but is insufficient as a professional resource for knowing learners” (p. 9). In fact, these authors further state that teachers “would need ways to expand the interpretive frames they likely bring to their observations of students” (ibid., p. 9). Research suggests that a strong focus on students’ internal cognitive, motivational, or emotional processes is a fundamental component of teacher expertise and student achievement, as is perceiving the classroom “through teachers’ eyes” (see the book title of Sherin et al. 2011; also see Berliner 1991). Participatory design “stresses collaboration between stakeholders, in which stakeholders work on better understanding of

each other's perspectives and improving instructional design by close collaboration" (see the Editorial of this special issue), so becoming immersed in the perspectives of others can be considered as an alternative for direct involvement of students and teachers in the design process.

Besides the importance of perspective-taking abilities, research has shown the crucial role of the second component of analytical competence, that is the ability to apply conceptual knowledge (i.e., domain-specific facts, concepts, or principles) in order to better explain the pedagogical situation at hand (Berliner 1994, 2001). In addition, this may lead to the third component, the ability to describe pedagogical situations in a professional (i.e., differentiated and categorizing) way (Carter et al. 1988). This sets the stage for studying analytical competence through descriptive accounts.

Case-based learning (specifically via video, see below) has high potential for enhancing the components of this competence (Lundeberg and Scheurman 1997; Merseth 1996; Shulman 1992). Considering this background, we developed a video case-based learning environment in line with a participatory design rationale that Willis and Wright (2000) would probably describe as being between the dichotomy of "strong versus weak participatory design" (p. 7). That is, within strong participatory design processes, the users' full participation is utilized throughout the entire design process, whereas within a weak participatory design, the designers themselves mainly undertake the decision making, even though input from users and other stakeholders is solicited (Willis and Wright 2000). According to this definition, the participatory design process in the current study is not entirely strong but is more than weak because it incorporates pilot tests and video selection, as well as recommendations and design decisions by students, instructional design researchers, and practitioners (e.g., teacher educators as well as pedagogical content knowledge experts). With this learning environment design, the aim of the study is to investigate how the aforementioned competence can be promoted with regard to the learning process as well as the learning outcome through specific types of instructional support.

Theoretical grounding

Research on teacher expertise

Teacher expertise: Novice and expert differences

To examine the development of teacher competencies and expertise, research addresses differences between novice and expert teachers. Although research findings under the heading of teacher expertise are very broad and bring up diverse influential factors, two among them are outstanding and particularly relevant to this study.

First, in reviewing the literature on novice and expert teachers, Hogan et al. (2003) concluded that expert teachers concentrate equally on both student and teacher perspectives: “Expert teachers tend to focus on student learning and achievement when asked to recall and reflect on a teaching lesson by elaborating on the organization and management of the lesson, emphasizing both student and teacher behaviors” (p. 242). Trainings often aim at overcoming the tendency of novice teachers to perceive complex educational situations one-sidedly (Harrington 1995; Oser and Baeriswyl 2000; Zottmann et al. 2012).

Second, teacher expertise is essentially characterized by the type and the amount of knowledge and is used in remembering and problem-solving. In general, quantitative and qualitative differences exist between novices and experts; for example, experts outperform novices in creating and applying chunks of information and forming an episodic memory (Rothe and Schindler 1996).

The role of perspective-taking

Expert teachers demonstrate an important prerequisite: They not only plan and arrange lessons from the content perspective or from their personal beliefs about how to teach successfully, they also immerse themselves into the student perspective (Berliner 1991, 2001; Borko and Livingston 1989). Like members of any “classic” profession (e.g., doctor, lawyer), teachers do not act on their own behalf; professional teachers can be successful in their daily work only by understanding and serving their students’ needs (i.e., assessing and acting upon their cognitive, emotional, or motivational processes in a concrete situation). To do that, expert teachers put themselves into the “mental shoes” of the students, getting immersed in their perceptions of the task at hand and the classroom situation as a whole (Bromme 1987; Miller 2001). This immersion or perspective-taking describes the “understanding for another individual’s overall situation” (Steins and Wicklund 1993, p. 228; see also Hodges et al. 2011). In our context, perspective-taking is defined as “[to free] oneself of one’s own view and to recognize and understand the thoughts, feelings, and motives of the self and others” (Menna and Cohen 1997, p. 189).

Shulman (1987) subsumed the focus on student thinking under the term “pedagogical content knowledge,” meaning knowledge about students’ content-related cognitions (“preconceptions,” “conceptions,” and “misconceptions”), whereas Grossmann (1990) described it as “knowledge of students’ understanding.” Regardless of the terminology, the phenomenon is clear: Expert teachers can immediately perceive relevant student behavior,

identifying what that behavior means in terms of student understanding and engagement. What makes this kind of perception especially important and consequential, of course, is that teachers act only on what they notice (Schoenfeld 2011). As teachers constantly consider their next moves, the competence to analyze learners' strategies and interpret their (mis-)understandings "are not ends in themselves but are instead starting points for making effective instructional responses" (Jacobs et al. 2011, pp. 99–100). Critical decision making on the basis of reading a situation in a specific moment (i.e., "sizing up students' ideas and responding"; Ball et al. 2001, p. 453) has been identified as one of the core activities of teaching (Jacobs et al. 2011). Accordingly, the studies by several researchers (Ball and Cohen 1999; Fennema et al. 1996; Jacobs et al. 2010; Rodgers 2002) emphasize the significance of understanding students' cognitive efforts in order to instructionally support their learning processes. van Es (2011) developed a "framework for learning to notice student thinking," additionally stressing the evaluative benefits of perspective-taking: "Teachers often use student behavioral cues as evidence that their teaching methods were effective, but adopting cognitive perspectives to make claims about effective teaching is equally important" (p. 134).

Several different approaches—some dating back to Dewey and even Descartes (for an overview, see Weinberger and Seyfried 2009)—hold in common that taking over perspectives does not necessarily mean fully adopting or "merging" with them non-reflectively, without any further reconsideration and observer awareness. In contrast, although simply replacing one's own perception by adopting another person's perspective is a first step (also from a developmental point of view; see Piaget 1932), that process is cognitively less advanced than reflective perspective-taking. Selman's (1980) "stages of perspective-taking" and the Reflection Instrument for Education (RIFE) coding manual for reflection measurement (Weinberger and Seyfried 2009) suggest distinguishing non-reflective and (self-)reflective perspective-taking when analyzing the quality of immersion. In non-reflective perspective-taking, a person claims that his or her interpretation doubtlessly applies to the given situation (e.g., "As students, we like that kind of exercise"). In contrast, in reflective perspective-taking, a person is aware that his or her perception is an interpretation originating from an observer's point of view (e.g., "It appeared to me that most of the students seemed to like the exercise"). Statements showing reflective perspective-taking are more open for inter-subjective verification or falsification in group learning processes and therefore are regarded as more valuable than statements without observer awareness.

The role of conceptual knowledge

For the development of teacher expertise, numerous research findings stress the powerful role of a differentiated and well-organized knowledge base (e.g., Berliner 1994; Boshuizen et al. 2004; Ericsson 2009). Conceptual knowledge influences how teaching experts perceive a situation, how they assimilate and process further information, and how they react to tasks and problems within their domain of expertise. With this background, academic expertise is considered to be based on the cognitive ability to make adequate use of broad, scientifically sound knowledge, and thus, according to Tietgens (1988), “in many ways abstracted knowledge in concrete situations, or vice versa, to recognize in such situations which elements from the pool of knowledge might be relevant” (p. 37). Relevant knowledge does not necessarily have to be scientific, but conceptual—that is, “static knowledge about facts, concepts, and principles that apply within a certain domain” (De Jong and Ferguson-Hessler 1996, p. 107). In the field of education and in Shulman’s (1986, 1987) terms, although content knowledge is essential, what exerts an even greater influence on teacher thinking and performance is the overarching idea of conceptual knowledge, such as pedagogical content knowledge (e.g., knowledge on what and how representations promote students’ learning of subject matter key concepts) and general pedagogical knowledge (e.g., knowledge on classroom management) (Darling-Hammond 2000).

In conclusion, an open question remains: How can multiple perspective-taking and conceptual knowledge applications be systematically promoted in teacher education? This question is especially relevant to reflective perspective-taking, that is, reflective immersion in both teacher and, most importantly, student perspectives. Case-based learning has great potential for this aim.

Video case-based learning as a promising approach to foster teachers’ analytical competence

In educational science, case-based learning is expected to foster analytical and problem-solving skills, to deepen the capacity for self-reflection, and to convey a realistic picture of the complexity involved in teaching and learning (Merseth 1996). Moreover, it enables learners to broaden their viewpoints beyond their own perspectives (Koury et al. 2009) and to bridge the gap between conceptual knowledge and classroom practice (Derry et al. 2006).

In the context of teacher education, video technologies have been ascribed high potential since the early 1960s. Currently, digital video technology allows the visualization of dynamic processes, approximating a fuller representation of complex reality to learners. Its usage (e.g., for the design of digital video cases) is regarded as especially beneficial in such ill-structured

domains as teacher education (see Goldman et al. 2007). “Professional development facilitators have gravitated to using classroom artefacts in part because they are ecologically valid—they capture aspects of authentic practice, yet by being removed from the immediacy of the classroom itself they can be examined and reflected upon in a more deliberate and considered manner” (Goldsmith and Seago 2011, p. 170) without the pressure to act. Moreover, teachers as learners are enabled to work with digital videos in new and innovative ways—for example, by annotating the case videos (see Wolfe 2008) or by providing the videos in a split-screen format in which one screen displays the students and the other shows the teacher in order to help analyze different perspectives (for more on this, see the section “Method”).

Empirical studies on teacher training show that teachers’ cognitive skills can be purposefully enhanced with video cases. If compared qualitatively as well as quantitatively with content-identical text-based cases, video cases prove to be significantly superior concerning the core issues mentioned above (a) conceptual knowledge acquisition and results in comprehension post-tests, and (b) the important shift in perspective that focuses less on oneself and more on student activities and learning and develops empathy for the learner (Choi and Yang 2011; Rosaen et al. 2008). Choi and Yang (2011) used an instrument based on the competency model of Rosier (1995) to measure learner empathy in a control-group experiment with college students majoring in education. They referred to qualitative data (Choi 2007) to explain why video is a more effective medium than text for developing learner empathy. Participants reported that the video helped them distinguish emotions, in particular for understanding the personal learner situation.

Most concepts of case-based learning with videos emphasize and implement the value added if cases are discussed in groups. According to Hansen (1987), “Just as a piece of music exists only partially when it isn’t being sung or played, a case comes fully to life only when it is being discussed” (p. 265). Group work enables learners to discuss their own case-based thoughts and content-related “readings.” Rarely is there only one valid perspective on a case, so group processes in particular call for immersion; that is, multiple perspective-taking as described above. With this background, it is reasonable to assume beneficial learning effects for divergent, critical views that initiate thought-provoking questions, cognitive conflicts, reciprocal explanations, and thus, deep elaboration on a case (King 2007; Lin and Anderson 2008; Nussbaum 2008; Webb et al. 1995).

As Nemirovsky and Galvis (2004) contend, “Because of the unique power of video to convey the complexity and atmosphere of human interactions, video case studies provide powerful opportunities for insightful reflection. Nevertheless, the discussion of video cases

does not always focus on this complexity and nuance. It often drifts into general comments, in which the richness of video is irrelevant” (p. 68). Therefore, instructional support might be crucial, mainly for the learning processes in groups outlined above, but also for the outcomes.

Instructional support for the facilitation of video case-based learning using computer-supported learning environments

Spiro and Jehng (1990) define cognitive flexibility as “the ability to spontaneously restructure one’s knowledge, in many ways, in adaptive response to radically changing situational demands” (p. 165). According to cognitive flexibility theory (CFT), a cognitively flexible knowledge application would allow for restructuring a situational conception by taking into account different knowledge bases. Likewise, cognitively flexible perspective-taking would allow for restructuring a situational conception by taking into account multiple perspectives of individuals who might have different perceptions of the same situation.

Although flexibility can take many forms, learning environments following CFT are organized in the form of hypermedia links to support the self-directed exploration of a complex, non-linear knowledge field. Items that are linked could be audio or video recordings, graphics, animation, or text (Jacobson and Archodidou 2000), thereby providing a hypermedia landscape that can be criss-crossed by learners (Spiro and Jehng 1990). Consequently, according to CFT principles, a learning environment can facilitate a complex yet flexible representation of (1) additional conceptual knowledge (e.g., through hyperlinks containing case-relevant theories and models); and (2) different personal perspectives on a case, such as hyperlinks containing multiple perspectives (i.e., commentaries of the people involved). Both types of instructional support might be helpful to thoroughly understand what a case is all about, but these kinds of scaffolding have not been examined together by previous research.

In spite of all the advantages of video case-based learning, empirical research (e.g., Brophy 2004; Fitzgerald et al. 2009; Moreno and Valdez 2007) has demonstrated using cases alone does not ensure learning, and that adequate instructional support is needed (Kirschner et al. 2006). As LeFevre (2004) put it: “Video is not a curriculum. Video is rather a medium which can be developed into a resource and used in specific ways to enhance learning” (p. 235).

Reflecting on teaching can become overwhelming (Santagata et al. 2007). On the one hand, novice teachers in particular might benefit from guidance (van den Berg 2001), but on the other hand, additional instructional support through non-linear hyperlinks may also add to the overwhelming complexity of the task. More generally spoken, the more features that are implemented into a hypermedia learning environment, the more important it will be to avoid

any detrimental effects that may be caused by placing too much cognitive load on the learners (Ayres and Sweller 2005; Kalyuga 2011). Altogether, little is known about the effects of corresponding instructional support on the crucial abilities to (1) self-directedly apply conceptual knowledge to classroom cases, and (2) overcome pre-service teachers' tendencies to perceive complex educational situations one-sidedly (Harrington 1995; Oser and Baeriswyl 2000; Zottmann et al. 2012) by immersing them in multiple perspectives (perspective-taking). Although there is broad consensus in educational research on the importance of these analytical competencies as a central performance prerequisite, systematically controlled research with regard to its promotion is rare (Cochran-Smith and Zeichner 2005), especially concerning both self-directed knowledge application and perspective-taking.

Against this backdrop, for instructional support in the form of hyperlinks to multiple perspectives or conceptual knowledge alone in a learning environment, we expect positive effects for both learning processes and outcomes. In addition, however, we ask whether instructional support through non-linear hyperlinks to multiple perspectives and conceptual knowledge may have negative effects due to the overwhelming complexity of the task if pre-service teachers would be provided with this combined instructional support.

Research questions and hypotheses

Three research questions are relevant here, leading to three hypotheses.

(RQ1) How do hyperlinks to multiple perspectives, hyperlinks to conceptual knowledge, and a combination of both facilitate processes of video case-based learning with respect to participation in small group discussions, the quality of immersion in multiple perspectives (reflective versus non-reflective), as well as the application of conceptual knowledge among pre-service teachers in a computer-supported learning environment?

(RQ2) How do hyperlinks to multiple perspectives, hyperlinks to conceptual knowledge, and a combination of both facilitate outcomes of video case-based learning with respect to the quality of immersion in multiple perspectives (reflective versus non-reflective), the type of immersion in multiple perspectives (teacher versus student), as well as the application of conceptual knowledge among pre-service teachers in a computer-supported learning environment?

(RQ3) To what extent is the immersion in multiple perspectives (i.e., perspective-taking) in the learning process related to immersion in multiple perspectives in the outcome? To what extent is the application of conceptual knowledge in the learning process related to the application of conceptual knowledge in the outcome of video case-based learning?

We hypothesize positive effects for both learning processes in small-group discussions (H1) and outcomes (written cases analyses; H2). For the processes, we assume that providing multiple perspectives in a learning environment would have a positive effect on pre-service teachers' immersion in multiple perspectives (H1a). Likewise, we assume that providing conceptual knowledge would have a positive effect on the application of conceptual knowledge during the learning processes in small-group discussions (H1b). Also for the outcome, i.e., written case analyses, we hypothesize that providing multiple perspectives in a learning environment would have a positive effect on pre-service teachers' immersion in multiple perspectives (its quality and type) in written case analyses (H2a) while providing conceptual knowledge would have a positive effect on the application of conceptual knowledge in written case analyses (H2b). We further hypothesized that (H3) pre-service teachers would be overwhelmed by being provided with combined instructional support, leading to an interaction of the two experimental factors so that immersion in multiple perspectives and application of conceptual knowledge are each hindered in the processes (H3a) as well as in the outcomes (H3b).

Method

Participants

One hundred pre-service teachers participated in this field study in four experimental groups (see the section "Procedure" for more details on these groups). All of them studied English as a foreign language at a university in southern Germany, with the goal of becoming teachers at the upper secondary school ("Gymnasium") level. On average, they were 24 years of age ($M = 23.62$, $SD = 3.14$) studying in their sixth semester ($M = 5.71$, $SD = 1.84$), and only a minority of them (13 %) had prior teaching experience, mostly private tutoring (languages, piano, history). Seventy-seven percent of the participants were female and 23 % were male, a proportion that can be considered typical for this population in Germany (see Roters et al. 2011).

Materials and Learning Environment

The case material for the study was videotaped with two cameras, allowing the viewer to focus on the group of students as well as on the teacher on a split screen at a later time (see Fig. 1). Both cameras were purposefully static and did not zoom in and out, to avoid the appearance of specifically emphasizing certain aspects of the situation. The videotaped material derived from regular English lessons for intermediate learners from several different institutions in southern Germany. All teachers and students had individually agreed to be filmed during their classroom

interaction. They also voluntarily consented to interviews after the classes were completed. According to these interviews, most teachers and students forgot about the camera after the first several minutes of filming and did not feel that this classroom situation differed from their usual lessons.

From the more than 23 h of videotape, 16 sequences were identified, all containing listening comprehension exercises. This topic was singled out by an expert committee comprising teacher educators, pedagogical content knowledge experts of English as a foreign language, and researchers in the field of learning and instruction and instructional design (thus not by the authors alone). The eight members of the expert committee were chosen due to their excellent reputations as leading experts in their respective fields in Germany. The reasons for choosing the topic of listening comprehension included: (1) it is a genuine task in language learning, (2) it is helpful to reduce variance among the cases, and (3) it can easily be supplemented with potentially relevant conceptual knowledge.

The experts independently rated the 16 complex sequence cases and selected the best six, each lasting 10–15 min, based on their overall typicality, their comparable ambiguity, and their complexity and connectivity to conceptual knowledge. Two structurally similar cases were chosen to function as a pre-test and a post-test. In line with the participatory design idea, small pilot-testing with educational science students and future English teachers who did not participate in the actual study confirmed the experts' results; the students considered all selected videos to be “very interesting to analyze and discuss” and judged that they revealed no scenes (e.g., eye-catching clothing, controversial statements) that might possibly distract from the pedagogical content of the cases.

To conduct the experiment, content for two types of hyperlinks—multiple perspectives and conceptual knowledge (see Fig. 1)—had to be developed. Teachers and students had been interviewed separately on their perceptions of the recorded sequence. Multiple perspectives were created for each case by selecting six authentic interview comments by the teacher and different students shown in the respective videos. Student and teacher statements were chosen based on their value added. A value was considered “added” if the statement revealed more concerning learning and instruction than what was already given in the video itself. In doing so, participatory design principles were implicitly taken into account by explicitly using divergent teacher and student perspectives—not on the design process itself, but as integrated learning material commenting the classroom situations. Thus, distinct stakeholders are included as indirect design partners in instructional design by using their embedded interview comments in the hyperlinks as a varied way to account for differences between stakeholders' perspectives,

and hence to provide an opportunity to better understand somebody else's perceptions by design. In addition, the expert committee selected conceptual knowledge potentially insightful to all cases (e.g., general pedagogical knowledge such as "Cognitive Apprenticeship Model" or pedagogical content knowledge such as "Focus on Meaning—Focus on Form").

Six authentic videos were implemented in a computer-supported learning environment that was developed for this study (Olleck 2010), also in line with CFT principles; a "crisscrossed landscape" (Spiro and Jehng 1990) was realized in the user interface of the learning environment with its integrated hypertexts. Thus, the learning environment enabled the learner to self-directedly access a complex field of knowledge not by linear, step-by-step instructions, but by crisscrossing the knowledge landscape (see Fig. 1, in which the circular layout of the hyperlink-buttons avoids any priority or order). The learning environment allowed the participants to work with the video cases flexibly via pause, fast-forward, and rewind functions, as well as the option to annotate the case videos with markers (flags placed above the time bar; see Fig. 1). With each annotation, a time stamp appeared automatically in the memo field, where related remarks could be filled in directly. If a participant clicked on a hyperlink, a pop-up window appeared that displayed the selected conceptual knowledge or one of the multiple perspectives; simultaneously, the video froze and shaded to avoid split attention effects (Chandler and Sweller 1992).

Fig. 1 The learning environment in the experimental condition with hyperlinks to both multiple perspectives and conceptual knowledge.

Insert figure 1 about here

Procedure

The study lasted 30 h, extended over four days, and was realized as a regular university course offered in cooperation with the Department of English at a university in southern Germany. The person conducting a total of four courses within the 2×2 factorial design experiment was a professional trainer for pre- and in-service teachers in school and adult education. He was trained on the basis of a facilitator script ensuring standardized proceedings for all groups. Two weeks before the training started, all participants received two reading assignments. One assignment focused on the significance of perspective-taking (i.e., immersion) for understanding the processes of learning and instruction. The other assignment introduced pedagogical models and theories of learning and instruction relevant to the cases and chosen by the team of experts. In all training sessions, we provided every participant with a laptop. The

trainer provided instruction via modeling on how to work with the cases and the learning environment. After that, we gathered data on the control variables (e.g., demographic data and relevant learning prerequisites, such as age, gender, semester, and teaching experience). Thereafter, the participants individually wrote case analyses without instructional support, relying only on their perceptions of the case they watched in the learning environment (pre-test, case A; see Fig. 2).

To support the participants in developing a written text, we provided four guiding but open questions, such as, “In which phases or parts would you subdivide the case?” and “Which aspects of the case do you consider significant?” To counteract one of the disadvantages of the video medium—that it can hardly convey context information such as setting, previous and following learning activities, and so forth—for each new case, we provided context information to the participants on paper, explaining those contextual details (e.g., course level, number of course participants, general topic of the course lesson, brief information on what happened before and after the sequence shown in the case).

For the following four training cases on days 2 and 3, the experimental conditions of the 2×2 factorial design were realized: The four experimental groups (for the n of each group, which varies due to field circumstances, see Tables 2, 3) differed in the form of their instructional support. The factor “multiple perspectives” was varied by providing or not providing hyperlinks to authentic interview comments given by the teacher and students shown in the video (see Fig. 1, circle of buttons on the left). The factor “conceptual knowledge” was varied by providing or not providing hyperlinks to short descriptions of several theories of learning and instruction and pedagogical concepts (see Fig. 1, circle of buttons on the right).

With each case, we asked the participants to analyze the authentic video individually (40 min) using colored annotations and the memo field to draft preliminary analyses of their own. Afterwards, participants were asked to discuss the case in small groups of three (65 min) on the backdrop of their individual case analyses and with the aforementioned guiding questions in mind. For that purpose, the individual annotations and memo field entries of the three small group participants were made collectively visible on one laptop screen for each group at the beginning of each collaboration phase. The individual annotations and memo field entries were still distinguishable through the different colors for each group member. All of these small group interactions were video recorded by webcams to examine the learning processes. On the fourth day, the post-test (written analysis of case F) was conducted analogously to the pre-test (case A) without any form of additional instructional support (see Fig. 2).

Fig. 2 Procedure of the training, (study).

Insert figure 2 about here

Data sources and instruments

We developed a coding scheme for measuring the analytical competence of the participants, incorporating components conceptualized on the background of the theoretical approaches presented above (see also Zottmann et al. 2012). The coding scheme contained the categorization of the quality of immersion in multiple perspectives (reflective or non-reflective), the type of immersion in multiple perspectives (student or teacher), as well as the application of conceptual knowledge (see Table 1 for a detailed description of the dimensions and the respective categories). The coding scheme was first developed for coding written data (i.e., analyzing the content of the written pre- and post-tests) and subsequently adapted for coding oral data (for analyzing the content of oral small group discussions).

Insert table 1 about here

Content analysis of the learners' oral collaboration in small groups

For each of the training cases, the interactions in the small learning groups were recorded on video. To gain insight into the learning processes of the whole sample of participants, we needed a content analysis of the small group discussions that contained the whole sample of participants. Given that the analysis of oral collaboration data requires substantial resources, an economic amount of data was sampled from the total amount of process data available. Thus, for the content analyses of the collaborative learning processes, three 4 min time samples were taken from each of the 34 small group interactions dealing with the last training case (case E). We offered the participants a maximum of 65 min to discuss the last training case in small groups, but the average amount of time actually spent on the task was about 40 min for case E. The three 4 min time samples were taken from the first 30 min of the collaboration (the very beginning of the small group discussions, after 10 min, and finally after 20 min). Thus, it was possible to analyze the content of a substantial percentage of each of the small group interactions (30 % of the discussions, on average). The coding scheme was slightly modified for the analysis of collaborative oral communication, which has specific affordances regarding the segmentation as well as the coding rules and examples for the categorization of

each dimension. We used the video content analysis tool Videograph (Rimmele 2004) for the segmentation and the subsequent coding of segments. For the segmentation, the verbal data of the small group interactions was portioned into units of meaning in order to obtain manageable units of analysis suitable for this kind of data (see Chi 1997). Each unit of meaning integrated consecutive expressions of one participant until a new sentence began or another participant interfered (turn-taking).

For measuring the dimension quality of immersion in multiple perspectives in the process, segments were coded as either reflective or non-reflective perspective-taking. For measuring the dimension application of conceptual knowledge, segments were coded with respect to the discussion or application of theoretical concepts during the small group discussion of the training case.

Two coders were trained for the coding of the dimensions outlined above. The coder training consisted of an initial joint coding of a small group discussion sample followed by five cycles of alternately independent coding of further group discussion samples (containing about 200 segments each), and then jointly discussing the coding as well as revising and extending the coding rules and examples in the coding scheme. Training took about four weeks, and the coders improved their inter-rater agreement from starting values below 50 % (Cohen's $\kappa < 0.40$) to values above 80 % (Cohen's $\kappa > 0.60$). After the training, the two coders independently coded 684 new segments (>10 % of all coded segments) taken from small group discussions of each experimental condition, and these data were used to determine inter-rater reliability. According to several methodological publications on which we relied (e.g., Cicchetti and Sparrow 1981; De Wever et al. 2006; Strijbos et al. 2006), the inter-rater reliability values achieved were acceptable—according to some of the publications, fair agreement starts at a Cohen's κ of 0.40, good agreement at 0.60, and excellent agreement at 0.75.

Inter-rater agreement reached a sufficient level for the dimension quality of immersion in multiple perspectives, with 89.5 % agreement (Cohen's $\kappa = 0.64$); and for the dimension application of conceptual knowledge, with 95.3 % agreement (Cohen's $\kappa = 0.68$). When the coding of the two categories within the dimension quality of immersion in multiple perspectives was calculated independently, the inter-rater agreement regarding reflective perspective-taking also reached a sufficient level (Cohen's $\kappa = 0.69$).

However, for the category non-reflective perspective-taking, only a moderate inter-rater agreement could be reached (Cohen's $\kappa = 0.57$). This value was below the aimed benchmark of $\kappa = 0.60$ and may have been caused by general difficulties that result from the ambiguity of natural language when identifying non-reflective perspective-taking in oral communication.

Non-reflective perspective-taking often consisted of paraphrasing actual or imagined statements of others (e.g., “a teacher would say...”), which had not been introduced explicitly, but rather implicitly ascribed to the expression of some other person. Thus, non-reflective perspective-taking, being more open for interpretation than the other categories, was more difficult to code objectively. As a consequence, the interpretation of non-significant results regarding non-reflective perspective-taking in the learning process has to be done especially carefully because a low objectivity increases the probability of type-II errors and reduces the study power.

Content analysis of the learners' written case analyses

In order to determine the immersion in multiple perspectives and the application of conceptual knowledge in the written analyses, all analyses were transferred to the qualitative data analysis software MaxQDA (Kuckartz 2007). Each line of an analysis was coded as one unit by using the code categories mentioned above (see Table 1). The manual was specified with a definition for line length, coding rules for line break, and so on. The codes representing the categories were quantified for each pre- and post-test analysis. Two independent raters who had been trained for four weeks in advance each coded all analyses separately while the development of percentage agreement as well as Cohen's κ were monitored consistently after each “package” of around 15–20 analyses, although results showed stability. All codings regarding immersion into perspectives never fell below an average inter-rater agreement of 92.1 % on all these measurements. For immersion into multiple perspectives, Cohen's κ reached a sufficient level of κ mean = 0.66 without notable variance between the sub-codes; for application of conceptual knowledge, κ = 0.63 with an average inter-rater agreement of 84.7 %. After calculating these reliability scores, differing coding decisions were discussed, and in cases of doubt were resolved by a supervisor.

Results

Baseline comparisons

We performed a series of 1×4 ANOVAs to examine whether learners in the four experimental groups (hyperlinks to multiple perspectives given versus not given and hyperlinks to conceptual knowledge given versus not given) differed significantly at the beginning of the training with respect to the immersion in multiple perspectives and the application of conceptual knowledge (see Table 2). Regarding the immersion in multiple perspectives, we found no differences between the groups with respect to the quality of immersion in the pre-test case for non-

reflective immersion of learners, $F(3,96) = 0.02$, $p = 0.997$, nor for reflective immersion of learners, $F(3,96) = 0.50$, $p = 0.680$. Additionally, we found no prior differences regarding the type of immersion. The groups did not differ with respect to immersion in the teacher perspective $F(3,96) = 0.37$, $p = 0.776$, nor in the perspective of the students from the case, $F(3,96) = 1.34$, $p = 0.267$. Equally, the groups did not differ significantly with respect to the application of conceptual knowledge in the pre-test case, $F(3,96) = 0.91$, $p = 0.439$.

Insert table 2 about here

Effects of instructional support on learning processes

At the beginning of the process analyses, we compared the experimental groups (using a 1×4 ANOVA) with respect to the participation of the learners in the small group discussions (see Table 3). The analysis revealed a significant difference among the groups, $F(1,96) = 2.92$, $p = 0.038$, partial $\eta^2 = 0.08$. To control this inequality, subsequent process analyses were conducted with relative values (i.e., percentages of verbal contributions instead of absolute values).

Insert table 3 about here

We investigated the effects of different types of instructional support (i.e., hyperlinks to multiple perspectives and hyperlinks to conceptual knowledge) on the quality of immersion in multiple perspectives in small group discussions with a MANCOVA (see Table 3). Non-reflective immersion and reflective immersion in multiple perspectives in the pre-test served as covariates for the analysis. In line with hypothesis H1a, there was a large positive main effect of instructional support with hyperlinks to multiple perspectives on immersion, Pillai's Trace = 0.18, $F(2,93) = 10.47$, $p < 0.001$, partial $\eta^2 = 0.18$. However, the main effect of hyperlinks to conceptual knowledge was not significant, Pillai's Trace = 0.00, $F(2,93) = 0.09$, $p = 0.916$, partial $\eta^2 = 0.00$. Against the hypothesis H3a, the interaction effect of both types of instructional support was not significant, Pillai's Trace = 0.00, $F(2,93) = 0.13$, $p = 0.876$, partial $\eta^2 = 0.00$. Regarding the single variables, the hyperlinks to multiple perspectives had a large positive effect on non-reflective immersion, $F(1,94) = 16.58$, $p < 0.001$, partial $\eta^2 = 0.15$, and a medium positive effect on reflective immersion, $F(1,94) = 6.84$, $p = 0.010$, partial $\eta^2 = 0.07$.

To test the effects of the different types of instructional support on the application of conceptual knowledge in the process, we calculated a 2×2 ANCOVA with application of conceptual knowledge in the pre-test as the covariate. Regarding the application of conceptual

knowledge, hyperlinks to multiple perspectives had a small negative effect, $F(1,95) = 3.92$, $p = 0.051$, partial $\eta^2 = 0.04$, and—with regard to the hypothesis H1b—the hyperlinks to conceptual knowledge had a small positive effect, $F(1,95) = 3.59$, $p = 0.061$, partial $\eta^2 = 0.04$. Both of these effects, however, were only marginally significant. Concerning the hypothesis H3a, there was again no significant interaction effect regarding application of conceptual knowledge in the process, $F(1,95) = 1.33$, $p = 0.252$, partial $\eta^2 = 0.01$.

Effects of instructional support on learning outcomes

We conducted a MANCOVA to examine the effects of hyperlinks to multiple perspectives and hyperlinks to conceptual knowledge on the quality of immersion in multiple perspectives, using non-reflective and reflective perspective-taking in the pre-test as covariates (see Table 4). As hypothesized (H2a), the main effect of hyperlinks to multiple perspectives on the quality of immersion was positive and large, Pillai's Trace = 0.15, $F(2,93) = 8.34$, $p < 0.001$, partial $\eta^2 = 0.15$. However, we found no significant main effect of hyperlinks to conceptual knowledge, Pillai's Trace = 0.04, $F(2,93) = 1.78$, $p = 0.174$, partial $\eta^2 = 0.04$, nor a significant interaction effect as assumed in H3b, Pillai's Trace = 0.03, $F(2,93) = 1.27$, $p = 0.285$, partial $\eta^2 = 0.03$. Regarding the single variables, the hyperlinks to multiple perspectives on reflective perspective-taking had a large positive effect, $F(1,94) = 16.69$, $p < 0.001$, partial $\eta^2 = 0.15$, but no significant effect on non-reflective perspective-taking, $F(1,94) = 1.71$, $p = 0.194$, partial $\eta^2 = 0.02$.

Insert table 4 about here

With respect to the type of immersion participants showed in the post-test case analysis, a 2×2 ANCOVA with the teacher and student perspectives in the pre-test as covariates revealed that the hyperlinks to conceptual knowledge had no significant effect on either immersion in the teacher perspective, $F(1,95) = 2.13$, $p = 0.148$, partial $\eta^2 = 0.02$, or immersion in the student perspective, $F(1,95) = 0.13$, $p = 0.719$, partial $\eta^2 = 0.00$. Again in line with hypothesis H2a, a small positive effect of the support with hyperlinks to multiple perspectives on immersion in teacher perspectives was marginally significant, $F(1,95) = 3.13$, $p = 0.080$, partial $\eta^2 = 0.03$. Hyperlinks to multiple perspectives had a medium positive effect on immersion in the student perspective, $F(1,95) = 10.40$, $p = 0.002$, partial $\eta^2 = 0.10$. Against H3b, we found no significant interaction effects regarding immersion in the teacher perspective, $F(1,95) = 2.27$,

$p = 0.135$, partial $\eta^2 = 0.02$, and immersion in the student perspective, $F(1,95) = 1.20$, $p = 0.276$, partial $\eta^2 = 0.01$.

Application of conceptual knowledge in the post-test case analyses was examined with a 2×2 ANCOVA with application of conceptual knowledge in the pre-test as the covariate. There was a small negative main effect of the hyperlinks to multiple perspectives that was marginally significant, $F(1,95) = 3.64$, $p = 0.060$, partial $\eta^2 = 0.04$, as well as a medium positive main effect of the hyperlinks to conceptual knowledge, $F(1,95) = 10.14$, $p = 0.002$, partial $\eta^2 = 0.10$ in line with hypothesis H2b. Against H3b again, we found no interaction effect regarding application of conceptual knowledge in the post-test, $F(1,95) = 0.24$, $p = 0.623$, partial $\eta^2 = 0.00$.

Finally, we calculated bivariate correlations between the central process and outcome variables of the study. We applied one-tailed tests of significance because we assumed positive correlations. Reflective perspective-taking in the post-test was significantly related to reflective perspective-taking in the process measures, $r = 0.20$, $p = 0.02$, one-tailed. The correlation between non-reflective perspective-taking in the post-test and non-reflective perspective-taking in the process was not significant, $r = 0.10$, $p = 0.16$, one-tailed. Additionally, we found correlations between application of conceptual knowledge in the post-test and application of conceptual knowledge in the process measures, $r = 0.35$, $p < 0.00$, one-tailed.

Discussion and Conclusions

Previous research has emphasized that beyond knowledge application, expert teachers' classroom behaviors are based on critical decision making that relies on their "reading" of a given pedagogical situation (i.e., "sizing up students' ideas and responding"; Ball et al. 2001, p. 453). To learn this kind of reading with case-based learning requires instructional support (see Kirschner et al. 2006). Results of this study provide evidence that instructional support in the form of hyperlinks to multiple perspectives and conceptual knowledge can enhance pre-service teachers' ability to immerse into students' perspectives and to use knowledge for their reading of cases; this means that specific components of analytical competence can be furthered—a competence that is considered crucial for teachers' professional performance and development (Minnameier 2009).

Our study provided evidence for the hypotheses on the learning processes (H1a and H1b) and outcomes (H2a and H2b) regarding analytical competence components. Providing multiple perspectives in the learning environment did have a strong positive effect on the quality of immersion of pre-service teachers in multiple perspectives in the process of oral case

discussion in groups of three as well as in the outcome as measured by written case analyses individually created by the participants. This holds especially true for the highest-quality level of immersion, namely, reflective perspective-taking. Observer awareness and a stance of investigating rather than “knowing for sure” could be fostered among pre-service teachers. This is not trivial, as previous research has demonstrated that with less time and a smaller amount of hyperlinks to multiple perspectives, this effect is unlikely to show up (Zottmann et al. 2012), indicating that elaboration time and the quantity of perspectives probably may play important roles in promoting perspective-taking as well.

With regard to the type of immersion, providing multiple perspectives had a strong positive effect, particularly on adopting the student perspective in the post-test case. Analogously, providing conceptual knowledge had positive effects on the application of conceptual knowledge with respect to process and outcome.

With respect to hypothesis 3 (H3), we did not find an interaction of the two experimental factors. We had expected such an interaction effect since instructional support based on the principles of CFT may lead to cognitive overload. However, the amount of instructional support in the combined condition was apparently not at a detrimental level for the learners (see Dillenbourg 2002). In other words, the participating pre-service teachers were seemingly not overwhelmed or “overloaded” (as defined by Kalyuga 2011) by being provided with both types of instructional support at the same time in the learning environment. Neither immersion in multiple perspectives nor the application of conceptual knowledge was hindered. However, the application of conceptual knowledge seemed to have been slightly impaired when hyperlinks to multiple perspectives were provided in the learning environment, suggesting that the combined condition may not be the ideal choice when the focus of case-based training is on the aspect of conceptual knowledge. Further research might investigate whether a training in sequences (e.g., providing instructional support with hyperlinks to conceptual knowledge before adding hyperlinks to multiple perspectives, or vice versa) could be more beneficial for case-based learners than a combined condition in which both types of instruction are provided simultaneously (see van Zundert et al. 2012).

Several conclusions can be drawn from these findings, as summarized below. First, from a participatory design point of view, training teachers to become immersed in the student perspective can be considered as an alternative for direct involvement of students in the design process. The literature shows that teachers are not particularly able to imagine the student perspective and they are not naturally good at considering and explaining their motivations and

thoughts (Harrington 1995; Oser and Baeriswyl 2000). This study, however, shows that teachers can be trained to recognize and immerse in student perceptions.

Second, looking at the validity of the different components of analytical competence—immersion in multiple perspectives (i.e., perspective-taking) and application of conceptual knowledge—empirical results substantiate the theoretical concept of analytical competence drawn from the teacher expertise literature. Different factors promote distinguishable but equally important components of this competence, which is considered to be an appropriate starting point for the facilitation of teachers' professional performance. Only four days of training fostered the ability of the pre-service teachers to use “abstracted knowledge in concrete situations, or vice versa, [by recognizing] in such situations which elements from the pool of knowledge might be relevant” (Tietgens 1988, p. 37), as well as the ability to set aside “one's own view and to recognize and understand the thoughts, feelings, and motives” (Menna and Cohen 1997, p. 189) of students in particular.

Third, regarding the effectiveness of (video) case-based learning, results support the previous assumption that the usage of cases plays a role in facilitating analytical skills, and—first and foremost—that instructional support is crucial. Only if hyperlinks to multiple perspectives or conceptual knowledge were provided could the corresponding component of analytical competence be facilitated. Thus, this study provides further empirical evidence that the implementation of cases alone does not guarantee optimal learning processes and outcomes (e.g., Brophy 2004; Fitzgerald et al. 2009; Moreno and Valdez 2007).

Fourth, our findings may also be interpreted as instructionally supported growth in cognitive flexibility because we used a learning environment in line with CFT principles, and participants were asked to criss-cross a hypermedia landscape (Spiro and Jehng 1990). One might have expected this growth for the learning processes in which instructional support via hyperlinks was constantly available to the learners during the discussion in small groups. However, the outcomes from the post-test—written individually without any instructional support given (as is the case in many actual pedagogical situations)—also revealed an ecologically valid increase of cognitively flexible perspective-taking and knowledge application.

Fifth, the results were obtained from a highly standardized quasi-experimental pre-post intervention field study conducted in the context of regular university courses. Therefore, the study can be considered as having internally and externally valid findings.

The sixth and final conclusion is that these externally valid effects can also be interpreted as supporting the approach to develop a learning environment in a participatory

design process, which combines perspectives of different stakeholders (e.g., designers, teachers, students; see Könings et al. 2005) on a twofold level. Each level contributes to the external validity of the study and lays the foundation for successful learning—one on the level of assembling congruent learning material (collaborative selection of video topic and sequences, theoretical models, and perspectives by the expert committee), and the other on the micro-level of instructional support in form of (thought-provoking, but not always congruent) multiple perspectives from those teachers and students being shown in the video. Having different stakeholders participate in the instructional design process as well as contribute multiple perspectives to the learning process itself provides for a learning environment that the participants perceive as highly supportive for their learning and study behavior, according to evaluations (Schrader et al. 2010). This, in turn, influences the learning outcomes according to the participatory design “combination-of-perspective model” (see Könings et al. 2005).

Still, threats to internal validity might exist; for example, there was no possibility for a double-blind study because the trainer conducting the courses knew the condition to which each participant belonged (but was not aware of the hypotheses). Another possible limitation of this study is that the small group interactions were primarily analyzed in a quantitative way. A different, more qualitative coding approach (e.g., a selection of small group discussions that are coded as a whole instead of time samplings from all small groups) might have yielded in-depth information regarding the quality of the conversations and interactions in the collaborative phases of case-based learning.

Interestingly, providing hyperlinks to multiple perspectives in this study with sixth-semester pre-service teachers resulted in a medium effect on student perspective-taking, but only a marginal effect on teacher perspective-taking in the post-test. One reason for this could be that the student perspective was still closer to these participants, who had been out of school for only three years on average and predominantly lacked teaching experience on their own. Another explanation is not grounded in the learning prerequisites but on the added value of the hyperlinks to student perspectives themselves. Perhaps participants experienced them as more beneficial for understanding processes of learning and instruction in the video and therefore preferred adopting the student perspective over the teacher perspective in the outcome.

Currently, we are conducting analogous research with experienced teachers to test these explanations. Including experienced teachers in the sample will also allow for addressing the question of whether different types or qualities of instructional support are required for case-based learners with higher and lower levels of teaching expertise. In addition, we will conduct an experimental field study on the transfer question regarding the degree to which improved

analytical competence in teacher training may enhance professional performance when teaching in class. In this field study, we will also address an ecologically invalid limitation of the present study—the standardized, non-crucial role of the facilitator—by systematically varying the degree of autonomy the facilitators are granted while conducting the video case-based courses for pre-service teachers.

In summary, the study presented here provides evidence that learning with video cases can support future teachers in applying conceptual knowledge and, in particular, in adopting the perspectives of learners. “If the teacher’s lens can be changed to seeing learning through the eyes of students, this would be an excellent beginning” (Hattie 2009, p. 252). This “excellent beginning” in developing skills related to teacher expertise does not come simply from working with cases in teacher education, but requires additional instructional guidance. The study showed how hyperlinks to multiple perspectives (and likewise conceptual knowledge) have the potential to enhance these emerging skills.

Acknowledgments

This research has been funded by the German Research Foundation [Deutsche Forschungsgemeinschaft (DFG)].

References

- Ayres, R., & Sweller, J. (2005). The split-attention principle in multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 135–146). New York: Cambridge University Press.
- Ball, D. L., & Cohen, D. K. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional education. In G. Sykes & L. Darling-Hammond (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 3–32). San Francisco: Jossey-Bass.
- Ball, D. L., Lubienski, S., & Mewborn, D. (2001). Research on teaching mathematics: The unsolved problem of teachers’ mathematical knowledge. In V. Richardson (Ed.), *Handbook of research on teaching* (4th ed., pp. 433–456). New York: Macmillan.
- Berliner, D. C. (1991). Perceptions of student behavior as a function of expertise. *Journal of Classroom Interaction*, 26(1), 1–8.
- Berliner, D. C. (1994). Teacher expertise. In T. Husen & T. N. Postlethwait (Eds.), *The*

- international encyclopedia of education* (pp. 6020–6026). London: Pergamon Press.
- Berliner, D. C. (2001). Learning about and learning from expert teachers. *International Journal of Educational Research*, 35(5), 463–482. DOI: [http://dx.doi.org/10.1016/S0883-0355\(02\)00004-6](http://dx.doi.org/10.1016/S0883-0355(02)00004-6)
- Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher*, 33(8), 1–49. DOI: <http://dx.doi.org/10.3102/0013189X033008003>
- Borko, H., & Livingston, C. (1989). Cognition and improvisation: Differences in mathematics instruction by expert and novice teachers. *American Educational Research Journal*, 26(4), 473–498. DOI: <http://dx.doi.org/10.3102/00028312026004473>
- Boshuizen, H. P. A., Bromme, R., & Gruber, H. (Eds.) (2004). *Professional learning: Gaps and transitions on the way from novice to expert*. Dordrecht: Kluwer Academic Press.
- Bromme, R. (1987). Teachers' assessments of students' difficulties and progress in understanding in the classroom. In J. Calderhead (Ed.), *Exploring teachers' thinking* (pp. 125–146). Salisbury: Cassell Education.
- Brophy, J. (Ed.) (2004). *Using video in teacher education*. Oxford: Elsevier.
- Carter, K., Cushing, K., Sabers, D., Stein, P., & Berliner, D. C. (1988). Expert-novice differences in perceiving and processing visual class-room information. *Journal of Teacher Education*, 39(3), 25–31. DOI: <http://dx.doi.org/10.1177/002248718803900306>
- Chandler, P., & Sweller, J. (1992). The split-attention effect as a factor in the design of instruction. *British Journal of Educational Psychology*, 62(2), 233–246. DOI: <http://dx.doi.org/10.1111/j.2044-8279.1992.tb01017.x>
- Chi, M. T. (1997). Quantifying qualitative analyses of verbal data: A practical guide. *Journal of the Learning Sciences*, 6(3), 271–315. DOI: http://dx.doi.org/10.1207/s15327809jls0603_1
- Choi, H. (2007). College students' perceptions of learning and knowledge transfer in problem-based video instruction: A case study. *Journal of Learning Design*, 2(2), 105–115. DOI: <http://dx.doi.org/10.5204/jld.v2i2.44>
- Choi, H., & Yang, M. (2011). The effect of problem-based video instruction on student satisfaction, empathy, and learning achievement in the Korean teacher education

- context. *Higher Education*, 62(5), 551–561. DOI: <http://dx.doi.org/10.1007/s10734-010-9403-x>
- Cicchetti, D. V., & Sparrow, S. A. (1981). Developing criteria for establishing interrater reliability of specific items: Applications to assessment of adaptive behaviour. *American Journal of Mental Deficiency*, 86(2), 127–137.
- Cochran-Smith, M., & Zeichner, K. (Eds.) (2005). *Studying teacher education: The report of the AERA panel on research and teacher education*. Mahwah, NJ: Erlbaum.
- Darling-Hammond, L. (2000). How teacher education matters. *Journal of Teacher Education*, 51(3), 166–173. DOI: <http://dx.doi.org/10.1177/0022487100051003002>
- De Jong, T., & Ferguson-Hessler, M. G. (1996). Types and qualities of knowledge. *Educational Psychologist*, 31(2), 105–113. DOI: http://dx.doi.org/10.1207/s15326985ep3102_2
- De Wever, B., Schellens, T., Valcke, M., & van Keer, H. (2006). Content analysis schemes to analyze transcripts of online asynchronous discussion groups: A review. *Computers & Education*, 46(1), 6–28. DOI: <http://dx.doi.org/10.1016/j.compedu.2005.04.005>
- Derry, S. J., Hmelo-Silver, C. E., Nagarajan, A., Chernobilsky, E., & Beitzel, B. D. (2006). Cognitive transfer revisited: Can we exploit new media to solve old problems on a large scale? *Journal of Educational Computing Research*, 35(2), 145–162. DOI: <http://dx.doi.org/10.2190/0576-R724-T149-5432>
- Dillenbourg, P. (2002). Over-scripting CSCL: The risks of blending collaborative learning with instructional design. In P. A. Kirschner (Ed.), *Three worlds of CSCL. Can we support CSCL?* (pp. 61–91). Heerlen, Netherlands: Open University.
- Elen, J., & Lowyck, J. (1999). Metacognitive instructional knowledge: Cognitive mediation and instructional design. *Journal of Structural Learning & Intelligent Systems*, 13, 145–169.
- Elen, J., Lowyck, J., & Bamps, H. (1998). The relation between student's perceptions of problem-based learning and learning style components. In J. J. G. van Merriënboer & G. Moerkerke (Eds.), *Instructional design for problem-based learning: Proceedings of the third workshop of the EARLI SIG instructional design* (pp.281-290). Maastricht, The Netherlands: University of Maastricht.
- Entwistle, N. J. (1991). Approaches to learning and perceptions of the learning environment. *Higher Education*, 22, 201–204. DOI: <http://dx.doi.org/10.1007/BF00132287>

- Ericsson, K. A. (2009). *Development of professional expertise: Toward measurement of expert performance and design of optimal learning environments*. Leiden, Netherlands: Cambridge University Press.
- Fennema, E., Carpenter, T., Franke, M., Levi, L., Jacobs, V., & Empson, S. (1996). A longitudinal study of learning to use children's thinking in mathematics instruction. *Journal for Research in Mathematics Learning*, 27(4), 403–434. DOI: <http://dx.doi.org/10.2307/749875>
- Fitzgerald, G., Koury, K., Mitchem, K., Hollingshead, C., Miller, K., Park, M. K., & Tsai, H. (2009). Implementing case-based instruction in higher education through technology: What works best? *Journal of Technology and Teacher Education*, 17(1), 31–63.
- Goldman, R., Pea, R. D., Barron, B., & Derry, S. (Eds.) (2007). *Video research in the learning sciences*. Mahwah, NJ: Erlbaum.
- Goldsmith, L. T., & Seago, N. (2011). Using classroom artifacts to focus teachers' noticing: Affordances and opportunities. In M. G. Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics teacher noticing: Seeing through teachers' eyes* (pp. 169–187). New York: Routledge.
- Grossman, P. L. (1990). *The making of a teacher: Teacher knowledge and teacher education*. New York: Teachers College Press.
- Hansen, A. J. (1987). Reflections of a casewriter: Writing teaching cases. In C. R. Christensen & A. J. Hansen (Eds.), *Teaching and the case method* (pp. 264–270). Boston: Harvard Business School Press.
- Harrington, H. L. (1995). Fostering reasoned decisions: Case-based pedagogy and the professional development of teachers. *Teaching and Teacher Education*, 11(3), 203–214. DOI: [http://dx.doi.org/10.1016/0742-051X\(94\)00027-4](http://dx.doi.org/10.1016/0742-051X(94)00027-4)
- Hattie, J. A. (2009). *Visible learning. A synthesis of over 800 meta-analyses relating to achievement*. New York: Routledge.
- Hodges, S. D., Clark, B. A. M., & Myers, M. W. (2011). Better living through perspective taking. In R. Biswas-Diener (Ed.), *Positive psychology as social change* (pp. 193–218). New York: Springer Science + Business Media.
- Hogan, T. M., Rabinowitz, M., & Craven, J. A. (2003). Representation in teaching: Inferences from research of expert and novice teachers. *Educational Psychologist*, 38(4), 235–247. DOI : http://dx.doi.org/10.1207/S15326985EP3804_3

- Jacobs, V. R., Lamb, L. L. C., & Philipp, R. A. (2010). Professional noticing of children's mathematical thinking. *Journal for Research in Mathematics Education*, 41(2), 169–202.
- Jacobs, V. R., Lamb, L. L. C., Philipp, R. A., & Schappelle, B. P. (2011). Deciding how to respond on the basis of children's understandings. In M. G. Sherin, V. R. Jacobs & R. A. Philipp (Eds.), *Mathematics teacher noticing: Seeing through teachers' eyes* (pp. 97–116). New York: Routledge.
- Jacobson, M. J., & Archodidou, A. (2000). The design of hypermedia tools for learning: Fostering conceptual change and transfer of complex scientific knowledge. *The Journal of the Learning Sciences*, 9(2), 149–199. DOI: http://dx.doi.org/10.1207/s15327809jls0902_2
- Kalyuga, S. (2011). Cognitive load theory: How many types of load does it really need? *Educational Psychology Review*, 23(1), 1–19. DOI: <http://dx.doi.org/10.1007/s10648-010-9150-7>
- King, A. (2007). Scripting collaborative learning processes: A cognitive perspective. In F. Fischer, H. Mandl, J. M. Haake & I. Kollar (Eds.), *Scripting computer supported communication of knowledge: Cognitive, computational and educational perspectives* (pp. 13–37). New York: Springer.
- Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, 41(2), 75–86. DOI: http://dx.doi.org/10.1207/s15326985ep4102_1
- Könings, K. D., Brand-Gruwel, S., & van Merriënboer, J. J. G. (2005). Towards more powerful learning environments through combining the perspectives of designers, teachers and students. *British Journal of Educational Psychology*, 75, 645–660. DOI: <http://dx.doi.org/10.1348/000709905X43616>
- Könings, K. D., van Zundert, M. J. Brand-Gruwel, S., & van Merriënboer, J. J. G. (2007). Participatory design in secondary education: Its desirability and feasibility according to teachers and students. *Educational Studies*, 33, 445–465. DOI: <http://dx.doi.org/10.1080/03055690701423648>
- Koury, K., Hollingsead, C., Fitzgerald, G., Miller, K., Mitchem, K., Tsai, H., & Zha, S. (2009). Case-based instruction in different delivery contexts: The impact of time in cases. *Journal of Interactive Learning Research*, 20(4), 445–467.

- Le Fevre, D. M. (2004). Designing for teacher learning: Video-based curriculum design. In J. Brophy (Ed.), *Using video in teacher education* (pp. 235–258). Oxford: Elsevier.
- Lin, T., & Anderson, R. (2008). Reflections on collaborative discourse, argumentation, and learning. *Contemporary Educational Psychology*, 33(3), 443–448. DOI: <http://dx.doi.org/10.1016/j.cedpsych.2008.06.002>
- Lundeberg, M. A., & Scheurman, G. (1997). Looking twice means seeing more: Developing pedagogical knowledge through case analysis. *Teaching and Teacher Education*, 13(8), 783–797. DOI: [http://dx.doi.org/10.1016/S0742-051X\(97\)00020-6](http://dx.doi.org/10.1016/S0742-051X(97)00020-6)
- Menna, R., & Cohen, N. J. (1997). Social perspective taking. In M. McCallum & W. E. Piper (Eds.), *Psychological mindedness: A concept in search of meaning* (pp. 189–220). Hillsdale, NJ: Erlbaum.
- Merseth, K. K. (1996). Cases and case methods in teacher education. In J. Sikula, T. J. Buttery, & E. Guyton (Eds.), *Handbook of research on teacher education* (2nd ed., pp. 722–744). New York: Macmillan.
- Miller, K. K. (2001). Teacher perspective-taking: Developmental and individual differences. *Educational Research Quarterly*, 25(2), 22–33.
- Minnameier, G. (2009). Kognitive Voraussetzungen der Entwicklung von pädagogischer Professionalität [Cognitive preconditions for the development of pedagogical professionalism]. In O. Zlatkin-Troitschanskaia, K. Beck, D. Sembill, R. Nickolaus & R. Mulder (Eds.), *Lehrerprofessionalität. Bedingungen, Genese, Wirkungen und ihre Messung* (pp. 333–344). Weinheim: Beltz.
- Moreno, R., & Valdez, A. (2007). Immediate and delayed effects of using a classroom case exemplar in teacher education: The role of presentation format. *Journal of Educational Psychology*, 99(1), 194–206. DOI: <http://dx.doi.org/10.1037/0022-0663.99.1.194>
- Nemirovsky, R., & Galvis, A. (2004). Facilitating grounded online interactions in video case-based teacher professional development. *Journal of Science Education and Technology*, 33(1), 67–97. DOI: <http://dx.doi.org/10.1023/B:JOST.0000019639.06127.67>
- Nussbaum, E. (2008). Collaborative discourse, argumentation, and learning: Preface and literature review. *Contemporary Educational Psychology*, 33(3), 345–359. DOI: <http://dx.doi.org/10.1016/j.cedpsych.2008.06.001>

- OECD (2005). *Teachers matter. Attracting, developing and retaining effective teachers*. Paris: OECD.
- Olleck, R. (2010). Mediengestützte Fallarbeit in computerunterstützten Lernumgebungen: Technische Anforderungen und Funktionalitäten für Einzelarbeit, Gruppenarbeit und Blended-Learning-Szenarien [Computer-supported video case-based learning environments: Technical requirements and functionalities for individual work, group work and blended learning scenarios]. In J. Schrader, R. Hohmann, & S. Hartz (Eds.), *Mediengestützte Fallarbeit – Konzepte, Erfahrungen und Befunde zur Kompetenzentwicklung von Erwachsenenbildnern* (pp. 191–207). Bielefeld: Bertelsmann.
- Oser, F. K., & Baeriswyl, F. (2000). Choreographies of teaching: Bridging instruction to learning. In V. Richardson (Ed.), *Handbook of research on teaching* (4th ed., pp. 1031–1065). New York: Macmillan.
- Piaget, J. (1932). *The moral judgement of the child*. New York: Routledge & Kegan Paul.
- Rodgers, C. R. (2002). Seeing student learning: Teacher change and the role of reflection. *Harvard Educational Review*, 72(2), 230–253.
- Rosaen, C. L., Lundeberg, M., Cooper, M., Fritzen, A., & Terpstra, M. (2008). Noticing noticing: How does investigation of video records change how teachers reflect on their experiences? *Journal of Teacher Education*, 59(4), 347–360. DOI: <http://dx.doi.org/10.1177/0022487108322128>
- Rosier, R. H. (1995). *The competency model handbook* (Vol. 2). Boston: Linkage.
- Roters, B., Nold, G., Haudeck, H., Keßler, J.-U., & Stancel-Piatak, A. (2011). Professionelles Wissen von Studierenden des Lehramts Englisch [Professional knowledge of pre-service English teachers]. In S. Blömeke, A. Bremerich-Vos, H. Haudeck, G. Kaiser, G. Nold, K. Schwippert, & H. Willenberg (Eds.), *Kompetenzen von Lehramtsstudierenden in gering strukturierten Domänen – Erste Ergebnisse aus TEDS-LT* (pp. 77–99). Münster: Waxmann.
- Rothe, H. J., & Schindler, M. (1996). Expertise und Wissen [Expertise and knowledge]. In H. Gruber & A. Ziegler (Eds.), *Expertiseforschung: Theoretische und methodische Grundlagen* (pp. 35–57). Opladen: Westdeutscher Verlag.
- Santagata, R., Zannoni, C., & Stigler, W. J. (2007). The role of lesson analysis in pre-service teacher education: An empirical investigation of teacher learning from a virtual video-

- based field experience. *Journal of Mathematics Teacher Education*, 10(2), 123–40. DOI: <http://dx.doi.org/10.1007/s10857-007-9029-9>
- Schoenfeld, A. H. (2011). Noticing matters: A Lot: Now what? In M. G. Sherin, V. R. Jacobs & R. A. Philipp (Eds.), *Mathematics teacher noticing: Seeing through teachers' eyes* (pp. 223–238). New York: Routledge.
- Schrader, P. G., Leu, D. J., Jr., Kinzer, C. K., Ataya, R., Teale, W. H., Labbo, L. D., & Cammack, D. (2003). Using internet delivered video cases, to support pre-service teachers' understanding of effective early literacy instruction: An exploratory study. *Instructional Science*, 31(4–5), 317–340. DOI: <http://dx.doi.org/10.1023/A:1024690111227>
- Selman, R. L. (1980). *The growth of interpersonal understanding*. New York: Academic Press.
- Sherin, M. G., Jacobs, V. R., & Philipp, R. A. (Eds.) (2011). *Mathematics teacher noticing: Seeing through teachers' eyes*. New York: Routledge.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4–14. DOI: <http://dx.doi.org/10.3102/0013189X015002004>
- Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57(1), 1–22.
- Shulman, J. H. (Ed.) (1992). *Case methods in teacher education*. New York: Teachers College Press.
- Spiro, R. J., & Jehng, J. (1990). Cognitive flexibility and hypertext: Theory and technology for the non-linear and multidimensional traversal of complex subject matter. In D. Nix & R. Spiro (Eds.), *Cognition, education, and multimedia: Exploring ideas in high technology* (pp. 163–204). Hillsdale, NJ: Erlbaum.
- Steins, G., & Wicklund, R. A. (1993). Zum Konzept der Perspektivenübernahme: Ein kritischer Überblick [The concept of perspective-taking: A critical review]. *Psychologische Rundschau*, 44(2), 226–239.
- Strijbos, J. W., Martens, R. L., Prins, F. J., & Jochems, W. M. G. (2006). Content analysis: What are they talking about? *Computers & Education*, 46(1), 29–48. DOI: <http://dx.doi.org/10.1016/j.compedu.2005.04.002>

- Tietgens, H. (1988). Professionalität für die Erwachsenenbildung [Professionalism for adult education]. In W. Gieseke (Eds.), *Professionalität und Professionalisierung* (pp. 28–75). Bad Heilbrunn: Klinkhardt.
- van den Berg, E. (2001). An exploration of the use of multimedia cases as a reflective tool in teacher education. *Research in Science Education*, 31(2), 245–265. DOI: <http://dx.doi.org/10.1023/A:1013193111324>
- van Es, E. (2011). A framework for learning to notice student thinking. In M. G. Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics teacher noticing. Seeing through teachers' eyes* (pp. 134–151). New York: Routledge.
- van Zundert, M. J., Sluijsmans, D. M. A., Könings, K. D., & van Merriënboer, J. J. G. (2012). The differential effects of task complexity on domain-specific and peer assessment skills. *Educational Psychology*, 32, 127–145. DOI: <http://dx.doi.org/10.1080/01443410.2011.626122>
- Webb, N. M., Trooper, J. D., & Fall, R. (1995). Constructive activity and learning in collaborative small groups. *Journal of Educational Psychology*, 87(3), 406–423. DOI: <http://dx.doi.org/10.1037/0022-0663.87.3.406>
- Weinberger, A., & Seyfried, C. (2009). RIFE: Reflection Instrument for Education. *Salzburger Beiträge zur Erziehungswissenschaft*, 13, 83–94.
- Willis, J., & Wright, K. E. (2000). A general set of procedures for constructivist instructional design: The new R2D2 model. *Educational Technology*, 40(2), 5–20.
- Wolfe, J. (2008). Annotations and the collaborative digital library: Effects of an aligned interface on student argumentation and reading strategies. *International Journal of Computer-Supported Collaborative Learning*, 3(2), 141–164. DOI: <http://dx.doi.org/10.1007/s11412-008-9040-x>
- Zottmann, J. M., Goeze, A., Frank, C., Zentner, U., Fischer, F. & Schrader, J. (2012). Fostering the analytical competency of pre-service teachers in a computer-supported case-based learning environment: A matter of perspective? *Interactive Learning Environments*, 20(6), 513–532. DOI: <http://dx.doi.org/10.1080/10494820.2010.539885>