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How problem-based or direct instructional case-based learning environments influence secondary school pre-service teachers' cognitive load, motivation and emotions: A quasi-experimental intervention study in teacher education

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Abstract

This study examines the effects of "problem-based"(PBL) and "direct instructional"(DI) case-based learning on secondary school pre-service teachers'(n=641) cognitive load and motivational and emotional factors during the learning process and addresses the inter-relationships. Topic of the case-based environments was classroom-management. The results showed that the students feel greater immersion and increased pleasure in the PBL courses. DI courses are also motivating and they reveal a higher level of anger among the students. In both groups, similar inter relationships between cognitive load, motivation, and emotion were found. Our findings show that case-based learning is effective in both environments but it is better suited to PBL courses.

Keywords: Case-based learning, Videos, Problem-based learning, Direct instructional learning, Cognitive load, Motivation

In teacher education programs dealing with complexity and transferring scientific theory into practice are two major challenges. Case-based learning presents a possibility of meeting these challenges in an effective way (Brouwer & Korthagen, 2005; Korthagen & Kessels, 1999; Rovegno, 1993).However, the implementation of case-based learning in practice proves to be heterogeneous (Moreno &Valdez, 2008).Even today, using case-based learning in teacher education to foster high motivation, activate emotions, and provide a manageable cognitive load is underexplored. Therefore, this study systematically investigated the differential effects of two case-based learning approaches, problem-based (PBL) vs. direct instructional (DI)on the cognitive load of secondary school pre-service teachers and their motivational-emotional responses while working with video or text cases. The aim of this paper is to examine the learning process using case studies, and derive recommendations for a successful case-based teacher education.

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1. Perspectives

Case-based learning can be described as a knowledge-driven process (see also paragraph 1.1; Sherin, 2007). We assume that this knowledge-driven process is influenced by motivational and emotional processes (Kleinknecht & Schneider, 2013; Koehler, Yadev, Philips, & Cavazos-Kotke, 2005; Yadev et al., 2011; Pekrun 1992). To our knowledge, no previous empirical studies and results have focused on cognitive load, motivation, and emotional processes during case-based learning in different learning environments of pre-service teacher education programs (with novice students in their first semesters of studying). This research gap will be addressed in this study.

1.1 Case-based learning in pre-service teacher education

Teacher education programs face the challenge of enabling pre-service teachers to focus on transferring scientific theory into practice within the complexity of classroom situations (Stokking, Leenders, Jong, & van Tartwijk., 2003). The practical relevance of pre-service teacher education is often criticized (Cochran-Smith & Zeichner, 2005).To meet these challenges, situated and case-based learning environments are used as an important connection between theory-based education and school practice (Kolodner, 1993). Case-based learning allows the classroom actions, teachers' behavior, and pupils' learning processes to be analyzed (Harrington, 1995; Stenhouse, 1985).For example, observing video or text cases enables a theory-based analysis of complex situations (Syring et al., 2015). The cases are not meant to be used merely for illustration purposes, but to raise problems and initiate problem-solving processes (Zumbach, 2003). Several studies have reported that analyzing videos fosters pre- and in-service teachers' abilities to evaluate videos of their own or others' teaching (Brouwer, 2012). However, simply exposing school practice to pre-service teachers may not lead to learning in the intended way, since participants tend to focus on superficial features (Krull, Oras, &Sisask, 2007). Therefore, the practice of using cases in teaching needs to be analyzed in a structured, professional way. Currently, numerous attempts have been made to foster reflection using case-based learning scenarios in teacher education (e.g. Shulman, 1992; Tripp & Rich, 2012).Classroom videos have become an important reflective tool in teacher education almost everywhere (Brouwer & Korthagen, 2005). Several studies have reported that analyzing videos fosters pre- and in-service teachers' abilities to evaluate videos of their own or others' teaching (Tripp & Rich, 2012; Borko, Koellner, Jacobs, & Seago, 2011; Sherin& van Es, 2009). Case-based learning with texts or videos allows analysis of classroom actions, teachers' behavior, and pupils' learning processes (Stenhouse, 1985).

Yet, studies that systematically compare the effects of different case-based learning environments are still rare, especially those focusing on the motivational, emotional, and cognitive aspects that influence learning in different case-based learning environments. In addition, most studies focus on the professional development of teachers rather than pre-service teacher education (for overviews of studies see Blomberg et al., 2013). In this study, we aim to contribute to this research gap by comparing the effects of different case-based learning environments on motivation, emotion, and cognitive load during the learning process. Since the two challenges, complexity of classroom situations and transfer of scientific theory into practice, especially apply to teachers entering school practice, our study investigates different case-based learning environments in university courses as part of pre-service teacher education. To counter the criticism of the non-practical relevance of university courses, we assume a potential of case-based courses. A higher personal and motivational involvement is to be expected (Kaiser, 1983) Therefore, we also investigate whether the perception of the practical relevance of the pre-service teacher course could be improved through case-based learning.

In our interventions, we focus on classroom management, which represents an important part of pedagogical knowledge (Shulman, 1986; Voss, Kunter, &Baumert, 2011; Syring et al., 2013). Teachers have to know how to organize and manage the classroom while ensuring all students are on task (Voss et al., 2011). Knowledge of classroom management is mainly procedural in nature (Rokeach, 1968) and highly situational (Leinhardt, McCarthy Young, & Merriman, 1995). As it is difficult to acquire such knowledge in theoretical courses at university, beginning teachers often feel ill prepared to manage classrooms effectively (e.g., Jones, 2006; Veenman, 1984; Voss, Kunter, &Baumert, 2011). Current research shows that classroom management and reflection of relevant classroom situations can be learned through case-based learning in pre-service teacher education programs (Piwowar, Thiel, & Ophardt, 2013; Sherin, 2007; James, 1991).

1.2 Cognitive load, motivational, and emotional processes during casework

Cognitive load. The concept of cognitive load derives from Cognitive load theory (Sweller & Cooper, 1985), which explains how and why mental stress or strain may arise (Paas, 1992; Marcus, Cooper, &Sweller, 1996), and how these can be reduced to enable optimal learning. Three types of cognitive load, which occur during learning, can be distinguished (Sweller, 2007): intrinsic cognitive load, extraneous cognitive load, and germane cognitive load. *Intrinsic cognitive load* depends on the difficulty or complexity of the learning material or the task itself. Since this strain is caused by the interaction between the students and the learning material, it cannot be influenced from outside. *Extraneous cognitive load* is caused predominantly by the design of the learning environment, which can be changed by the lecturer to reduce the load (Sweller, van Merrienboer, &Paas, 1998). The actual learning of a teacher student (working with the learning materials, dealing with the learning subject, the processing of the task) causes the *germane cognitive load*. According to van Merriënboer and Sweller (2010), all three types of stress accumulate. However, Sweller (1994) assumed that the goal of an optimal didactical arrangement for successful learning is to keep the external cognitive load low. Thus, the learner retains the necessary capacity to concentrate on the actual learning. This is especially important for novices, as they already have a high intrinsic cognitive load caused by addressing the learning tasks (Kirschner, Sweller, & Clark 2006; Hmelo-Silver, Duncan, & Chinn, 2007).

Motivation and Immersion. Motivation is conceptualized as a process used for initiation, direction, and maintenance of mental activities (Gerrig & Zimbardo 2008). This process is influenced by expectations and values (Eccles et al., 1983; Wigfield & Eccles, 2000). Rheinberg and colleagues (2001) developed an action-theoretical model for the concept of motivation in learning processes, which is also used in this paper. Thus, a high level of motivation is characterized by a high situational interest, a high probability of success, a manageable challenge, and a low fear of failure.

Immersion seems to be considered a further aspect of motivation, which comes from the field of video-based learning (Goldman et al., 2007; Seidel et al., 2011). According to Goldman (2007), immersion refers to the teachers' degree of engagement and involvement during case-based learning (Syring et al., 2013). Immersion focuses on how much students dip into a case, become involved with the casework and also how long they like to work on the case.
Motivation and emotion are closely related concepts in the learning process. In educational psychology, learning emotions are often studied as an aspect of comprehensive theories of motivation (Pintrich & Schunk, 1996). For example, motivation may be influenced by emotions that present during learning.

Learning emotions. Emotions are relatively specific, identifiable, and mostly attributed to a trigger, e.g. an action of the teacher or a pupil in a presented case. In addition to the affective component (how the learner feels), emotions have a cognitive and a motivational component, which make the aspect of emotions in the learning process important. Emotions can be classified according to their valence (unpleasant, pleasant) and to the degree of arousal (activating, deactivating) (Pekrun & Frenzel, 2009). Relevant emotions for learning include joy, anger, and boredom (Möller & Koller, 1996; Pekrun 1992).The "circumplex model" (Barrett & Russell, 1999) orders emotions in a coordinate system with the axes "valence" and "arousal", which show fear and anger (unpleasant, but activating) and pleasure (pleasant and activating) as activating emotions and boredom, shame, and guilt (unpleasant) as non-activating emotions. In particular, a positive valence encourages creative ways of thinking, while a negative valence focuses on details rather than an analytical style of thinking (Bless & Fiedler, 1999).

1.3 Problem-based learning (PBL) vs. direct instructional (DI) approaches

Cases alone do not initiate and promote learning. However, the didactic-methodological integration of cases is important for the effectiveness of learning (Seidel, Blomberg, & Renkl, 2013).Thus, empirical studies show that case-based learning without a clear aim and task leads to significantly lower exposures to learning than when students are presented with a concrete task to perform, and the effectiveness of the case is limited (Brophy, 2004). Zottmann et al. (2012) highlighted the importance of instructional support to learners on case-based learning courses. Multiple pre-service teacher education programs implement different instructional approaches for case-based learning (Yadev et al., 2011). Oser and Baeriswyl (2001) modeled twelve approaches of learning, two of which are suitable for case-based learning on university courses: a model of PBL learning (focus on the learner) and a model of direct instruction (focus on the lecturer).

Both approaches recognize the value of working with authentic cases from real classroom action that provide complexity for learners. However, these two approaches use cases as a valuable resource for learning in different ways.

Problem-based learning (PBL). Video- or text-based cases in pre-service teacher education programs are often used in problem-oriented, situated scenarios (Yadev et al., 2011). The idea behind learning from a situated viewpoint is that knowledge is grounded in the contexts and constraints of practice (Lave & Wenger, 1991). PBL learning proceeds in five steps, namely: genesis of problems, clarification of problems, possible solutions, checking solutions, integration, and transfer of problems to other classes (Oser & Baeriswyl, 2001; also see: Barrows, 1986).PBL learning approaches focusses on individual inquiry processes (Hmelo-Silver, Duncan, & Chinn, 2007). Prompts and other specific facilitative actions tend to be more indirect and restrained. In PBL learning, the risk of focusing only on problem-solving skills including simple strategies, techniques and methods is high. In terms of motivational effects and acceptance of PBL teaching and learning, consistent positive effects were found (Reusser, 2005; Zumbach, 2003). As yet, current research has not made general statements on the efficacy of PBL teaching and learning. A meta-analysis of Dochy, Segers, Van den Bossche, and Gijbels (2003) pointed to a more positive evaluation of PBL learning. It could be said that PBL learning, at least in the medical formation field, has a small but positive effect on the acquisition of practical knowledge and related professional skills. Overall, the findings on the learning effectiveness of PBL learning are inconsistent. Thus, there is a need for more research on the motivational potential of PBL learning environments (Schmidt, Rotgans, &Yew, 2011).

Direct Instructional Learning (DI). In DI approaches, the lecturer places great importance on the learning process of students (Santagata & Guarino, 2011). DI aims to achieve five different steps (Oser & Baeriswyl 2001): Expatiate and explain the knowledge, work on a prototypical case, describe the essential objects and principles, actively use the new concept, and integrate with established knowledge (Oser & Baeriswyl, 2001). It is likely that novices at the beginning of their studies, in particular, need structured courses and material and strong support from the lecturer when learning with cases (Santagata & Guarino, 2011). According to Gräsel and Mandel (1993), targeted instructions lead to a more focused method of dealing with the learning content. In the study Follow Through (Becker et al., 1981), different teaching methods have been empirically evaluated. Teaching methods based on the principles of direct instruction were better than learner-centered methods, not only in terms of cognitive abilities of the learners, but also in social and emotional processes. Some other studies showed the effectiveness of direct instruction (e.g. Evertson, Emmer, & Brophy, 1980; Good, Grouws, & Ebmeier, 1983). Seidel, Blomberg, and Renkl (2013) investigated instructional strategies for using video in teacher education as both an illustrative example (rule-example) and an anchor (example-rule). Their findings show a positive effect of using videos in both conditions, but differences depend on the specific learning goal. The "rule-example" group scored higher in factual knowledge and class observation, while, the "example-rule" group scored higher in identifying challenges in lesson planning. In addition, further findings indicate that direct instruction is more closely related with motivating and activating teaching than learner-centered methods (Moser, 1997). Unfortunately, little empirical research exists on the effectiveness of various learning environments in pre-service teacher education. In our study, we investigate whether the presented results for PBL and DI learning in school classes can be transferred to teacher education courses.

2 Research Questions

Prior studies on case-based learning and its effects on students' reflection as a cognitive ability are rare (primarily on learning with videos; for summary see Blomberg et al., 2013),and are mainly design-based focusing solely on one approach or media. These studies show little systematic variation regarding learning environments. Little empirical evidence shows how different learning environments influence pre-service teachers' reflections. In addition, little is known about the interplay of cognitive load and emotional and motivational processes in case-based learning settings. The aim of this study is to close the research gaps using data about cognitive as well as motivational and emotional processes during learning (process data), which was collected to answer the following four research questions:

1. How do the learning environments (PBL vs. DI) affect the cognitive load of the students during case-based learning, and which changes arise during the progress of the intervention?
2. How do the learning environments (PBL vs. DI) affect motivational processes (motivation, immersion) and emotional processes (learning emotions related to the case and the course), and what changes arise during the progress of the intervention?

3. Is there a substantial relationship (correlation) between cognitive load and motivational and emotional processes during case-based learning, and are there differences between the learning environments?
4. How do participants perceive the practical relevance of the case-based courses (compared to the control group)?

We expect PBL learning to cause a higher cognitive load than DI, and for the cognitive load to decrease in all courses over time. Furthermore, we assume that the motivation and immersion in PBL courses will be higher than in DI courses (Reusser, 2005; Zumbach, 2003). Based on previous studies (e.g. Becker et al., 1981), we assume that positive emotions dominate the DI courses, and we expect a relationship to exist between the measured variables. Therefore, we believe that the perception of the practical relevance can be increased with case-based learning.

3 Methods

3.1 Data Collection, Sample, and Design

Data collection took place in June 2013 as part of the secondary school teacher education at University Tübingen (Germany). Students visited a parallel repeatedly offered seminar in their second semester, covering two sessions on the subject of "Classroom Management". All students were already attending the seminar and we were able to take over the seminar for the purposes of this study. The different case-based learning environments (interventions) were implemented in 21 courses given by six different lecturers: Eleven seminars were assigned to the condition "PBL learning" (PBL) and ten seminars to the condition "direct instruction" (DI). A total of n=641 pre-service teachers took part in the two interventions, which was a very large sample for this research field (find an overview of studies in Blomberg et al., 2013).

Overall, the mean age of the participants was 21.2 (SD=2.54), and 66.3% were female. In the previous semester, we conducted a control group (students in a later semester) in four different courses with n=42 students on the same subject (Classroom Management), but without casework. The pre-service teachers of all three groups differ in their subject background. The students had little experience with video cases (Mean=2.6; SD=2.5) and text cases (Mean=1.3; SD=2.1).We performed bivariate MANOVA and Chi-square tests to test the validity of the samples. There are no significant differences between the subsamples "direct instructional" (n_{DI}=302) and PBL learning (n_{PBL}=339) in terms of age (F(1)=.72, *p*=.39), gender (Chi-square = 2,71, *p*=.607), number of semesters (F(1)=.47, *p*=.49), previously visited courses using video cases (F(1)=2,560, *p*=.78) or text cases (F(1)=1,68, *p*=.19), and the self-perceived knowledge about classroom management (F(1)=2,895, *p*=.06).

To minimize the impact of the lecturer on the results, the six lecturers were distributed evenly over the two different interventions. In addition, the lecturers exercised the interventions intensively in several workshops and had lecturer guidelines and an exact teaching script for their intervention. To comply with this guidelines and script, the courses were reviewed in each session by an observer in the form of treatment checks. In all courses, a high accord between lecturer behavior and the script was observed.

3.2 Independent variable, Interventions, and Control group

Independent variable (PBL vs. DI) and Interventions. The two case-based learning settings differed only in terms of the learning environments: PBL or DI (for more information see also Syring et al., 2013). During the treatment, students analyzed four sequences (cases) that showed regular classroom lessons each lasting between 4:35 and 5:37 minutes (for videos) and approximately 3,500-4,500 signs(for texts). Participants in the PBL group were given only a little guidance on request during their work on the sequences. Working in groups of four to five participants (collaborative discussion) the students analyzed the cases in a problem-oriented setting. Participants in the DI group worked on tasks with direct instructions from the lecturer (Table 1).

Table 1: Interventions: Two basic models of seminars with the variation *text* or *video*.

	Problem-based learning model (PBL)	Direct Instruction model (DI)
	Lecturer: Theories of Classroom Management (CM)	
	Lecturer: Explanation of the importance and steps of systematic analysis	
Session 1 1.5 h	Students analyze a case (text or video) in the group; Collaborative discussion of two representative examples from the case (text or video) moderated by the lecturer.	Lecturer analyzes a case (text or video) step by step and answers inquiries; Students complete their task.
	Questionnaire B1	
Homework 1h	Analysis of a case (text or video) using the steps of systematic analysis Questionnaire B2	
	Lecturer/Students: Comparison of the work order using an example from the case	
Session 2 1.5 h	Students analyze two cases (text or video) using the steps of systematic analysis in group work; the two cases serve to contrast; Discussion of an example from each case (text or video) in plenum.	Lecturer analyzes a case (text or video) step by step and answers inquiries; Students complete their task; The second case (text or video) is analyzed similarly, but before the students became familiar with the case.
	Questionnaire B3	

Control group. The courses of the control group were designed in comparison to the courses of the intervention groups. Instead of casework, the students dealt with scientific texts on classroom management in plenary or in small groups. The control group was not assigned homework, only except prepare a theoretical text.

3.3 Instruments and dependent variables

The dependent variables followed a repeated-measures design on three occasions during the casework directly in the learning process: In the first session after the casework (B1), after the homework (B2), and in the second session after the casework (B3).The short questionnaires (two pages) were handed to the students each time they finished analyzing a classroom sequence to capture the students' emotion, motivation, and cognition during the case-based learning. The scale to measure learning emotions was used twice; the students were asked to indicate how they felt in relation to both the concrete presented case and the case-based learning of the seminar. Participants in the control group answered the questionnaire after the discussion of theoretical texts in both sessions. There was no questionnaire after the homework, as homework was not assigned (B2). The practical relevance of the course was measured in a web-based pre-posttest one week before (T1) and one week after (T2) the intervention.
The adapted scales (see Tables 2 and 3) are from established instruments of teaching and teacher education research. Because of an insufficient fit to the sample (pre-service teachers) or on the subject matter (case-based learning), some scales were supplemented by even developed items.

Table 2: Variables used in the questionnaires (measuring points B1, B2, B3) and the pre-posttest (measuring points T1, T2)

Variable	Source	Items	Measurement*	Cronbach's α
Cognitiveload (intrinsic)	Paas, 1992	4	9-point Likertscale	.79
Cognitive load (extraneous)	Marcus et al., 1996	1	9-point Likertscale	-
Motivation	Rheinberg et al., 2001	14	4 x 7-point Likertscale	.64- .82
Immersion	Goldman, 2007; Kleinknecht & Schneider, 2013	7	4-point Likertscale	.,84
Emotion in the course	Bradley & Lang, 1994	1	3 x 9-point Likert scale	-
Learning emotions in context of the case	Pekrun et al., 2002; own development	16	6 x 4-point Likertscale	.54-.71
Learning emotions in context of the course	Pekrun et al., 2002; own development	16	6 x 4-point Likertscale	.57-.73
Practical relevance of the course	PISA, 2003	5	4-point Likert scale	.84

* Low value: low expression; high value: high expression.

Table 3: Variables and examples of items

Variable	Examples of items
Cognitive load (intrinsic)	How high was your mental stress while explaining a situation in the case during the last phase of the course?
Cognitive load (extraneous)	How difficult was it to follow the last phase of the course?
Motivation	I like those tasks.
	I can cope with the difficulty of this task.
Immersion	I was fully involved while working on this case.
	While working on this case, I would have put the case away.
Emotion in the course	Please indicate how your valence was in the last part of the seminar.
Learning emotions in context of the case	While working on this case I had fun.
	The behavior of the school teacher in this case made me angry.
Learning emotions in context of the course	While working on the course I felt uncomfortable.
	While working on the course I was bored.
Practical relevance of the course	On this course, we deal with tasks that are of practical use.

3.4 Analysis

The effects of *learning environment* were analyzed by two-factor ANCOVA (factors learning environment and lecturer). The factor "lecturer" acted as a covariate to control. The conditions of the ANCOVA were fulfilled in all calculations. To determine the *changes over time* in the seminar between the accompanying questionnaires as well as in pre-posttests, single factor ANOVAs with repeated measures were performed. For the calculations, the factor "learning environment" was used. Again, the conditions for ANOVA with repeated measures were fulfilled. To verify *relations* and their direction between the measured constructs, correlations by Pearson were calculated.

4 Results

4.1 Results for the Cognitive Load

The intrinsic cognitive load was slightly higher in both groups than the midpoint (4.5) of the scale (see Table 4). At all three measurement points in the seminar (B1, B2, B3), no significant differences were found between the groups. The external cognitive load, that is, stress created by the learning environment of the course, was always higher in the DI courses than in the PBL courses (see Table4). This difference was significant in the first session (B1) ($F(2)=5.57$, $p=.004$, $\eta^2=.02$), but the effect is very little. The higher external cognitive load in the DI course also has an effect on the total cognitive load, which showed to be consistently higher in the DI courses than in the PBL courses, and here again, the difference is significant only in the first session (B1)($F(1)=5.8$,$p=.016$, $\eta^2=.1$).

Table 4: Means and SD (in parentheses) for the intrinsic, external, and total cognitive load

	Session 1 (B1)			Homework (B2)		Session 2 (B3)		
	DI	PBL	CG	DI	PBL	DI	PBL	CG
intrinsic	4.96 (1.34)	4.93 (1.44)	-	4.68 (1.43)	4.50 (1.34)	4.68 (1.43)	4.50 (1.34)	-
extraneous	3.53 (1.75)	3.14 (1.60)	3.70 (2.01)	3.55 (1.70)	3.25 (1.63)	3.23 (1.99)	3.11 (1.94)	3.16 (2.09)
total	8.50 (2.41)	8.07 (2.39)	-	8.23 (2.58)	7.73 (2.47)	7.93 (2.61)	7.58 (2.46)	-

The development of the total cognitive load shows a significant decrease in DI courses over the entire period ($T(184)=2.19$, $p=.03$, $d=.23$),which is mainly due to the significant decrease of the internal cognitive load($T(198)=3.18$, $p=.002$, $d=.2$).The external cognitive load also decreases, but not significantly. The result was similar in the PBL courses: Here, the total cognitive load also decreased significantly over the entire period ($T(192)= 2.12$, $p=.036$, $d=.2$), which is attributable to the significant decrease of the internal cognitive load ($T(217)=4.29$, $p<.001$, $d=.31$).In the control group, the external cognitive load decreased significantly over the whole period ($T(33)=3.30$, $p=.002$, $d=.27$).

4.2 Results for motivational and emotional processes

Motivation and Immersion. The total motivation in all courses is above the midpoint of scale (3.5), and only differs slightly between the intervention groups (see Table 5). A significant difference is only found ($F(2)=3.81$, $p=.02$, $\eta^2=.01$)in the first session (B1). A closer look at the different aspects of motivation reveals why only a small difference was found between the intervention groups and in comparison with the control group. The *interest* and *challenge* do not differ significantly between the three groups at all three measurement points. The students of the PBL courses estimate a higher *probability of success* at all measurement points than the students of the DI courses (see Table 5). For this, in the first session (B1), a significant difference between the groups can be found ($F(2)=3.93$, $p=.02$, $\eta^2=.01$). Exactly the opposite applies to the *fear of failure*, which is higher in the DI courses at all measurement points than in the PBL courses. A significant difference between the groups is only found in the first session (B1)($F(2)=6.64$, $p=.001$, $\eta^2=.02$).

Table 5: Means and SD (in parentheses) for total motivation, the different aspects of motivation, and immersion

	Session 1 (B1)			Homework (B2)			Session 2 (B3)		
	DI	PBL	CG	DI	PBL	CG	DI	PBL	CG
Motivation (total)	4.91 (0.67)	5.00 (0.63)	5.05 (0.64)	4.00 (1.11)	4.10 (1.22)	-	4.99 (0.68)	5.02 (0.71)	4.98 (0.70)
Interest	4.05 (1.23)	4.11 (1.18)	4.15 (1.21)	3.75 (1.33)	3.90 (1.30)	-	3.98 (1.36)	4.01 (1.27)	4.08 (1.23)
Probability of success	5.97 (0.75)	6.10 (0.78)	6.19 (0.79)	4.12 (2.11)	4.29 (2.34)	-	6.12 (0.78)	6.24 (0.86)	5.89 (0.88)
Fear of failure	2.54 (1.22)	2.31 (0.78)	2.17 (1.13)	3.71 (2.12)	3.61 (2.22)	-	2.00 (1.09)	1.91 (1.09)	2.01 (1.09)
Challenge	4.25 (1.22)	4.16 (1.16)	4.07 (1.41)	3.79 (1.19)	3.75 (1.23)	-	3.86 (1.30)	3.79 (1.23)	3.94 (1.42)
Immersion	2.88 (0.57)	2.87 (0.54)	-	2.70 (0.60)	2.77 (0.60)	-	2.95 (0.64)	3.00 (0.59)	-

The total motivation does not change significantly in the intervention groups or in the control group over the whole period. However, in the intervention groups, the motivation initially decreases significantly for homework (DI: $T(197)=10.26$, $p<.001$, $d=1$; PBL: $T(217)=9.49$, $p<.001$, $d=.93$) and then (B2 to B3) increases significantly (DI: $T(200)=-11.23$, $p<.001$, $d=1.08$; PBL: $T(217)=-8.91$, $p<.001$, $d=.92$).

The *immersion*, the degree of involvement, is always higher in the PBL courses than in the DI courses (see Table 5). Therefore, a significant difference is found between the groups during the homework (B2) and in the second session (B3) (B2: $F(1)=3.84$, $p=.05$, $\eta^2=.01$; B3: $F(1)=5.96$, $p=.02$, $\eta^2=.01$).The immersion increases slightly in the DI courses over the whole period, but not significantly. In the PBL courses, the immersion also increases, but here, the difference between the two sessions (B1 and B3) is significant ($T(227)=-2.54$, $p=.012$, $d=.23$).

Learning emotions. All three groups show a clear positive *valence* (see Table 6), which is higher in the PBL-group at all measurement points than in the other groups. However, a significant difference between the groups can only be determined in the second session (B3) ($F(2)=4.00$, $p=.02$, $\eta^2=.02$).The degree of *arousal* triggered by this valence is low in all groups at all measurement points (see Table 6) and differs significantly between the DI-group and the other groups for homework (B2), and in the second session (B3) (B2: $F(1)=3.90$, $p=.05$, $\eta^2=.01$; B3: $F(2)=2.90$, $p=.054$, $\eta^2=.009$). The *dominance* of the valence is in all groups and at all measurement points around the midpoint of scale, and differs between the groups only to the first measured point (B1), significantly ($F(2)=4.04$, $p=.02$, $\eta^2= .01$).In the DI-group, valence and arousal do not change over the entire period; however, the dominance decreased significantly ($T(236)=1.99$, $p=.047$, $d=.12$).In the PBL group, the valence remains constant, but the degree of arousal ($T(225)=3.48$, $p=.001$, $d=.18$) and dominance ($T(226)=2.18$, $p=.031$, $d=.19$) decreased significantly. In the control group, no significant changes occur.

A close look at the different emotions revealed some significant differences between the groups (see Table 6). First, the *emotions in relation to the concrete case* are examined. *Pleasure* is higher in the PBL-group than in the DI-group and differs significantly at all three measuring points(B1: F(1)=4.60, p=.03, η^2=.01; B2: F(1)=5.09, p=.03, η^2=.01; B3: F(1)=6.06, p=.01, η^2=.01).Conversely, *anger* is higher in the DI-group and differs significantly in the homework (B2) and second session (B3) (B2: F(1)=5.06, p=.03, η^2=.01, B3: F(1)=8.73, p=.003, η^2=.02). *Fear*, *shame* and *feeling of guilt* are only very slightly pronounced (see Table 6), where in the DI-group felt more fear and shame at all times. The intervention groups differ significantly from each other in terms of *fear* (F(1)=4.22, p=.04, η^2=.01) and *shame* (F(1)=3.95, p=.05, η^2=.01) in the second session (B3).For *boredom,* no significant differences can be reported.

Table 6: Means and SD (in parentheses) for the total emotion and the learning emotions regarding the case and the operation in the course

	Session 1 (B1)			Homework (B2)			Session 2 (B3)		
	DI	PBL	CG	DI	PBL	CG	DI	PBL	CG
Total Emotion									
Valence	6.09	6.37	5.74	5.65	5.72	-	6.20	6.51	5.98
	(1.74)	(1.69)	(1.93)	(1.87)	(1.86)		(2.02)	(1.88)	(1.86)
Arousal	2.96	3.07	2.51	2.62	2.29	-	3.11	2.74	2.18
	(1.72)	(1.79)	(1.84)	(1.71)	(1.54)		(2.04)	(1.85)	(1.67)
Dominance	5.10	5.21	4.28	4.18	4.11	-	4.83	4.78	4.14
	(2.09)	(2.01)	(2.05)	(2.28)	(2.28)		(2.32)	(2.44)	(2.41)
Case									
Pleasure	2.93	2.98	-	2.77	2.85	-	2.97	3.03	-
	(0.50)	(0.47)		(0.56)	(0.50)		(0.56)	(0.52)	
Anger	1.27	1.25	-	1.33	1.30	-	1.40	1.30	-
	(0.45)	(0.43)		(0.52)	(0.52)		(0.59)	(0.53)	
Fear	1.35	1.29	-	1.34	1.28	-	1.31	1.23	-
	(0.44)	(0.36)		(0.47)	(0.39)		(0.43)	(0.38)	
Boredom	2.52	2.55	-	2.50	2.55	-	2.53	2.57	-
	(0.40)	(0.40)		(0.43)	(0.42)		(0.42)	(0.40)	
Shame	1.07	1.04	-	1.07	1.03	-	1.13	1.07	-
	(0.30)	(0.22)		(0.30)	(0.20)		(0.45)	(0.31)	
Feeling of guilt	1.08	1.04	-	1.08	1.05	-	1.09	1.06	-
	(0.36)	(0.25)		(0.36)	(0.27)		(0.32)	(0.30)	
Way of Working in the Course									
Pleasure	2.94	3.06	2.96	2.77	2.88	-	2.99	3.05	2.94
	(0.51)	(0.51)	(0.51)	(0.53)	(0.53)		(0.57)	(0.55)	(0.59)
Anger	1.26	1.21	1.19	1.37	1.29	1.32	1.27	1.24	1.23
	(0.44)	(0.36)	(0.51)	(0.56)	(0.51)	(0.53)	(0.46)	(0.44)	(0.41)
Fear	1.36	1.30	1.33	1.36	1.29	-	1.29	1.26	1.18
	(0.43)	(0.38)	(0.51)	(0.45)	(0.39)		(0.41	(0.43)	(0.30)
Boredom	2.52	2.52	2.61	2.52	2.56	2.54	2.54	2.58	2.57
	(0.41)	(0.41)	(0.42)	(0.41)	(0.41)	(0.41)	(0.40)	(0.41)	(0.39)
Shame	1.07	1.05	1.05	1.09	1.04	1.06	1.08	1.08	1.07
	(0.30)	(0.24)	(0.31)	(0.35)	(0.26)	(0.31)	(0.34)	(0.36)	(0.34)
Feeling of guilt	1.07	1.02	1.07	1.07	1.03	1.05	1.07	1.07	1.07
	(0.36)	(0.22)	(0.26)	(0.32)	(0.23)	(0.28)	(0.34)	(0.32)	(0.25)

Students responses concerning their emotions related to the *way of working in the course* indicated that the PBL-group felt greater *pleasure* than the DI-group and the control group.

A significant difference was found between the conditions in the first session (B1: : F(2)=3.69, p=.025, η^2=.01) and homework (B2: F(1)=4.42, p=.036, η^2=.01).Further, in relation to the seminar, students of the DI-group reported *anger* and *fear* more frequently(see Table 6). The difference is significant for *anger* in the first session (B1:F(2)=3.42, p=.033, η^2=.01) and homework (B2: F(1)=6.82, p=.009, η^2=.02); as well as for *fear* (B1: F(2)=4.73, p=.009, η^2=.02; B2: F(1)=3.51, p=.062, η^2=.01).However, the *fear* decreased significantly during the intervention in the DI-group (T(234)=2.82, p=.005, d=.17) and in the PBL-group (T(228)=3.21, p=.002, d=.1).Regarding *boredom*, *shame,* and *feeling of guilt*, no significant differences were found to exist between the groups. In contrast, *boredom* increased significantly in the PBL-group (T(229)=-2.75, p=.006, d=0.15).

4.3 Correlations between the collected variables

The correlations for the first measurement (B1) (see Table 7) indicate a positive correlation between the valence in the case-based courses and the level of arousal, which accompanies it. Similarly, a positive correlation between this valence and the levels of immersion and motivation are observed. The correlation between the valence and the motivation was stronger in the DI courses (.54) than in PBL courses (.45). On the other hand, a negative correlation was found between the valence and the external total cognitive load. The correlation between valence and external cognitive load was stronger in the PBL group (-.43) than in the DI group (-.36). Further, only a very weak, or even no, negative correlation was found between the intrinsic cognitive load and the immersion and motivation. Much clearer is the negative relationship between the external cognitive load and the immersion and motivation. The degree of involvement and engagement (immersion) and the level of motivation are positively related.

Table 7: Pearson correlations between the collected variables (both conditions)

	1	2	3	4	5	6	7
1. Emotion -Valence	1	.16**	-.40**	-.02	-.14**	.57**	.51**
2. Emotion - arousal		1	.02	.18**	.18**	.24**	-.05
3. Extraneous cognitive load			1	.22**	.51**	-.32**	-.40**
4. Intrinsic cognitive load				1	.96**	.08	-.13**
5. Cognitive load (total)					1	-.02	-.26**
6. Immersion						1	.55**
7. Motivation (total)							1

** Correlation is significant at the level of 0.01 (2-sided).

4.4 Practical relevance of the course

In terms of evaluating the practical relevance of the course, between the two intervention groups and in contrast to the control group, no significant differences were found before and after the intervention (see Table 8). However, the practical relevance of the PBL-group increased significantly (T(256)=-2.14, p=.033, d=.13). Neither the DI-group nor the control group showed significant changes in the reported practical relevance (DI: T(224)=-.76, p=.45; CG: T(35)=-.84, p=.41).

Table 8: Means and SD (in parentheses) for the practical relevance in the Pre- and Post-Test

	Pre (T1)			Post (T2)		
	DI	PBL	CG	DI	PBL	CG
Practical relevance	2.56 (0.44)	2.50 (0.44)	2.60 (0.43)	2.59 (0.43)	2.56 (0.47)	2.59 (0.54)

5 Discussion and Implications

This intervention study examined a variety of effects of case-based learning in a PBL learning environment and a DI environment on the cognitive load of the students as well as motivational and emotional processes during learning. Differences were found between the intervention groups and between the two intervention groups and the control group. In addition, there were changes within the groups over time.

5.1 Cognitive load, motivational, and emotional processes

The two first questions where how the learning environments (PBL vs. DI) affect the cognitive load, motivational and emotional processes of the students during case-based learning, and which changes arise during the progress of the intervention.

Higher cognitive load in the DI-group. Contrary to theoretical assumption (Seidel, Blomberg, & Renkl, 2013), a higher extraneous cognitive load was reported in the DI-group in contrast to the PBL-group. Thus, a higher total cognitive load was found in the DI-group. To clarify, the cognitive load is not to be equated with more successful learning(in the study of Seidel, a higher noticing ability).One explanation could be that the students had to be more careful in the DI courses regarding following the lecturers, which caused a higher level of concentration, and thus, a higher cognitive load. In addition, the students in the DI-group could not attempt the analysis by themselves. In all groups, the cognitive load decreased, which is due, in the DI-group and the PBL-group, to the decrease of the intrinsic cognitive load. The decrease of the intrinsic cognitive load shows that the students became accustomed to the analysis task, the learning material, and learning environment, and found them less onerous in the second session. Therefore, we conclude that they could learn case-based learning.

Similar motivation in both intervention groups. Both learning environments as forms of case-based learning are motivating. However, the PBL-group reported slightly higher motivation. Therefore, results of previous motivation research in learning environments in schools and other domains (Reusser, 2005; Zumbach, 2003) could not be confirmed for the sector of pre-service secondary school teacher education. The slightly increased motivation in the PBL-group could be attributed to the reported higher probability of success and the lower fear of failure. Thus, it could be said that because the PBL-group of students could actively analyze the case, the probability of success increased in contrast to the passively receiving" DI-group. Case-based learning environments did not lead to an increase in motivation, rather they remained constant in all groups. The lack of motivation for homework can be explained by a low general interest in homework and would be expected to occur in the control group.

Higher immersion in PBL courses at all times. Immersion was higher in the PBL courses than in the DI-group and increased in the PBL-group significantly over the period, which could be because the students' analyses of the cases and the group work in the PBL courses led to higher involvement and increased engagement. Working with the case in the PBL-conditions also allowed a repeated viewing of the case, wherein immersion can increase and different perspectives are possible (also shown in the study of Beck, King, & Marshall, 2002).

Greater pleasure in PBL-group, more anger and fear in DI-group. Firstly, all participants perceived a positive valence, but it was highest in the PBL-group (however not found in previous studies from Becker et al., 1981). This is consistent with the finding that students in the PBL group, both in relation to the case and to the way of working in the course, felt more *pleasure* than students of the DI-group or the control group. It is considered that the self-reflection and the discursive analysis that occurred in small groups led to more pleasure. In contrast, the DI-group felt more *anger* in respect to the cases and how they worked with them in the course, which could be related to the fact that PBL learning is perceived as more interesting, as it allowed the students to dip into the classroom situation through their own analysis and contribute their own experiences and alternatives. Such involvement is likely to lead to more pleasure and less anger in learning with cases. DI learning with cases is a learning environment that only slightly differs from "traditional" university courses, which could explain why the students felt more anger while learning. However, arousal, which is triggered by the emotions and dominance of these feelings, decreased. According to Bless and Fiedler (1999), positive emotions in PBL courses lead to creative thinking, which is shown in their reflection skills. In contrast, the negative emotions in the DI group lead to analytical thinking. This causal chain will be revised in connection with the further sub-project of this study (see Limitations). Furthermore, although students in the DI-group felt little *fear*, compared to the other students they experienced more fear during the learning process, which could be because the students in the DI-group could attempt very little analysis, and thus, the analytical work of a case was perceived as something difficult and frightening at first. Over time, the fear significantly subsided. Another finding is that in the PBL-group, *boredom* increased over time, which could be due to the nature of repetitive tasks in the same groups during case-based learning. Despite these slight differences in the valence and learning emotions, the learning emotions *pleasure* (in PBL) and *anger* (in DI) are both activating and can therefore have a positive effect on the learning process ,according to the theory of Barrett and Russell (1999).

Relations between cognitive load and motivational and emotional processes. The third question was whether there is a substantial relationship between cognitive load and motivational and emotional processes during case-based learning, and if there are differences between the learning environments? A positive valence correlates with high immersion and motivation, and with a low cognitive load. Only a very small negative correlation exists between the specific learning task (intrinsic cognitive load), here the case-based learning, and the immersion and motivation. The negative correlation between motivation and immersion and the external cognitive load caused by the learning environment is more significant. This may be interpreted as a positive sign, because the external cognitive load can be influenced by the lecturers. For example, by choosing the learning environment, lecturers can influence students' motivation and immersion levels.

Perception of practical relevance can be increased in PBL courses. Finally, the broad question we asked is whether the perception of the practical relevance of university courses on teacher education can be improved through case-based learning. Only the PBL courses showed a significantly improved perception (see Table 8), which might be because DI courses are similar to usual university courses, and are considered less relevant and less useful by the students (Cochran-Smith & Zeichner, 2005). An increased use of PBL learning with cases offers students the opportunity to improve their perception of how relevant and practical they find the courses.

5.2 Limitations

The findings of the study are limited to students in the second semester (novices) and pre-service teachers of secondary school. Different results would be expected from students in later semesters, in-service teachers (beginners, first years in schools), and professional teachers (experts, more than 5 years in schools). The study is also limited to the subject of classroom management. Thus, it remains unclear whether the results would also apply to working with cases in other pedagogical-psychological issues, or even in the subject didactics. In addition, the intervention was relatively brief. Most video-based interventions take much longer (e.g. 25 hours in the study of Piwowar, Thiel, & Ophardt, 2013).The results show the effects of learning environments on the learning process in cases-based courses. The students could, at the cognitive level, acquire knowledge about the subject "Classroom Management" and reflection. Whether effects of the learning environment on this knowledge and competence development exist is currently being investigated in a second sub-project to this study. We will then examine whether the cognitive load and the motivational and emotional processes have moderating effects on the growth of knowledge in the domain of "classroom management" and the development of reflection.

6 Conclusion

Both groups of student teachers benefit from the interventions regarding cognitive load and motivation. Only minor differences present between the groups in terms of immersion and joy. Therefore, using cases in courses for secondary school pre-service teacher education increases the motivation of students in university courses, and we recommend cases to be incorporated more often in teacher education. Notably, motivation for homework in both interventions was low. Case-based learning as a challenging cognitive process should take place in the courses accompanied by lecturers. The advantage of PBL courses with cases lies in the greater level of immersion and increased pleasure the students experience due to a lower cognitive load. Other studies showed that the discussion in PBL courses has a positive effect on case-based learning (Levin, 1995).Nevertheless, cases could be used in DI settings (e.g. lectures, presentations) and achieve an equally high level of motivation. We recommend that lecturers pay particular attention to avoiding boredom in PBL courses by implementing a regular change in the group composition, or by alternating teaching methods with DI phases. Moreover, university lecturers should be aware that the anger and fear that arises when learning with cases in DI courses is activating and does not lead to resignation by the students.

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References

Barrett, L.F. & Russell, J.A. (1999). The structure of current affect: Controversies and emerging consensus. *Current Directions in Psychological Science*, *8*(1), 10-14.

Barrows. H.S. (1986). A taxonomy of problem-based learning methods. *Medical Education*.*20*(6).481-486.

Beck, R.J., King, A., & Marshall, S.K. (2002). Effects of video case construction on preservice teachers' observations of teaching. *The Journal of Experimental Education*, *70*(4), 345-361.

Becker, W.C., Engelmann, S., Carnine, D.W., &Rhine, W.R. (1981).Direct instruction model. In W. R. Rhine (Ed.), *Making schools more effective. New directions from follow through* (pp. 95-154).New York: Academic Press.

Bless, H. & Fiedler, K. (1999). Förderliche und hinderliche Auswirkungen emotionaler Zustände auf kognitive Leistungen im sozialen Kontext. [Conducive and hindering effects of emotional states on cognitive performance in a social contexts] In M. Jerusalem& R. Pekrun (Eds.), *Emotion, motivation und Leistung* (pp. 9-25). Göttingen: Hogrefe.

Blomberg, G., Renkl, A., Sherin, M.G., Borko, H., & Seidel, T. (2013). Five research-based heuristics for using video in pre-service teacher education. *Journal for Educational Research Online*, *5*(1), 90-114.

Borko, H., Koellner, K., Jacobs, J., & Seago, N. (2011).Using video representations of teaching in practice-based professional development programs. *Zentralblatt für Didaktik der Mathematik*, *43*(1), 175-187.

Bradley, M.M. & Lang, P.J. (1994). Measuring emotion: The self-assessment manikin and the semantic differential. *Journal of Behavior Therapy and Experimental Psychiatry*, *25*(1), 49-59.

Brophy.J. (ed.) (2004). *Using video in teacher education*. Oxford: Elsevier.

Brouwer, N. (2012, April). *Self-viewing with structured video guide.* Paper presented at the annual meeting of the American Educational Research Association, Vancouver.

Brouwer, N. & Korthagen, F. (2005). Can teacher education make a difference? *American Educational Research Journal*, *42*(1), 153-224.

Cochran-Smith, M., & Zeichner, K. M. (2005). *Studying Teacher Education*: *The Report of the AERA Panel on Research and Teacher Education*. Mahwah, NJ: Lawrence Earlbaum Associates.

Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D. (2003): Effects of problem-based learning: a meta-analysis. *Learning and Instruction, 13*(5), 533-568.

Eccles, J., Adler T.F., Futterman, R., & Goff, S.B. (1983). Expectancies, values. and academic behaviors. In J.T. Spence (Ed.), *Achievement and Achievement Motivation* (pp. 75-146). San Francisco: Freeman.

Evertson, C.M., Emmer, E.T., & Brophy, J.E. (1980).Predictors of effective teaching in junior high mathematics classrooms. *Journal of Research in Mathematics Education,2*(3), 167-178.

Goldman, R., Pea, R., Barron, B., & Derry, S.J. (Eds.) (2007). *Video research in the learning sciences*. Mahwah: Lawrence Erlbaum.

Good, T.L., Grouws, S.A., & Ebmeier, H. (1983).*Active mathematics teaching*. New York: Longman.

Gräsel, C.,&Mandl, H. (1993). Förderung des Erwerbs diagnostischer Strategien in fallbasierten Lernumgebungen.[Promoting the acquisition of diagnostic strategies in case-based learning environments] *Unterrichtswissenschaft*, *21*(4), 355-370.

Harrington, H. (1995). Fostering reasoned decisions: Case-based pedagogy and the professional development of teachers. *Teaching and Teacher Education, 11*(3), 203–214.

Hmelo-Silver, C.E., Duncan, R., & Chinn, C.A. (2007). Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist*, *42*(2), 99-107.

James, F. (1991). *An analysis of case-based instruction*. Unpublished doctoral dissertation, University of Virginia, Charlottesville.

Jones, V. (2006). How do teachers learn to be effective classroom managers? In C.M. Evertson & C.S. Weinstein (Eds.), *Handbook of classroom management: Research, practice, and contemporary issues* (pp. 887–907).Mahwah, NJ: Erlbaum.

Kaiser, F.-J. (1983). *Die Fallstudie.* [The Case Study]. Bad Heilbrunn: Klinkhard.

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.

Kleinknecht, M. & Schneider, J. (2013). What do teachers think and feel when analyzing videos of themselves and other teachers teaching? *Teaching and Teacher Education*, *33*(1), 13-23.

Kolodner, J. L. (1993). *Case-based reasoning*. San Mateo: Morgan Kaufman.

Koehler, M.J., Yadav, A., Phillips, M.M., & Cavazos-Kottke, S.C. (2005). What is video good for? Examining how media and story genre interact. J*ournal of Educational Multimedia and Hypermedia*, *14*(3), 249-272.

Korthagen, F. A. J., & Kessels, J. P. A. M. (1999). Linking theory and practice: Changing the pedagogy of teacher education. *Educational Researcher*, *28*(4), 4-17.

Krull, E., Oras, K., & Sisask, S. (2007). Differences in teachers' comments on classroom events as indicators of their professional development. *Teaching and Teacher Education*, *23*, 1038–1050.

Lave, J. & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

Leinhardt, G., McCarthy Young, K., & Merriman, J. (1995).Integrating professional knowledge: The theory of practice and the practice of theory. *Learning and Instruction*, *5,* 401-408.

Levin, B.B. (1995). Using the case method in teacher education: The role of discussion and experience in teachers' thinking about cases. *Teaching and Teacher Education, 11*, 63-79.

Marcus, N., Cooper, M. & Sweller, J. (1996). Understanding Instructions. *Journal of Educational Psychology*, *88*(1), 49-63.

Möller, J. & Köller, O. (Hrsg.) (1996). *Emotionen, Kognitionen und Schulleistung*. [Emotion, Cognition, and School performance] Weinheim: Beltz.

Moreno, R. & Ortegano-Layne, L. (2008). Do classroom exemplars promote the application of principles in teacher education? A comparison of videos, animations, and narratives.*Educational Technology Research and Development*, *56*(4), 449-465.

Moser, U. (1997): Unterricht, Klassengröße und Lernerfolg. [Instruction, class size, and learning success]In U. Moser, E. Ramseier, E. Keller, M. Huber (Eds.). *Schule auf dem Prüfstand*. Ruegger/Chur/Zürich, 182-214.

Oser. F. & Baeriswyl. F.J. (2001). Choreographies of teaching: Bridging instruction to learning. In V. Richardson (Ed.).*AERA's Handbook of Research on Teaching* (pp. 1031-1065). Washington: American Educational Research Association.

Paas, F.G.W.C. (1992). Training strategies for attaining transfer of problem-solving skill in statistics: A cognitive-load approach. *Journal of Educational Psychology*, *84*(4), 429-434.

Pekrun. R. (1992). The impact of emotions on learning and achievement: Towards a theory of cognitive/motivational mediators. *Applied Psychology*, *41*(4), 359-376.

Pekrun, R., & Frenzel, A.C. (2009). Persönlichkeit und Emotion. [Personalityand Emotion] In V. Brandstätter, & J. H. Otto (Eds.), *Handbuch der Allgemeinen Psychologie* (pp. 686-696). Göttingen: Hogrefe..

Pekrun, R., Götz, J.S., Jullien, S., Zirngibl, A., Hofe, R.v., & Blum, W. (2002). *Skalenhandbuch PALMA: 1. Messzeitpunkt (5. Klassenstufe)*. [Scales Manual PALMA: First time ofmeasurement (5th grade level)] Universität München: Institut für Psychologie.

Pintrich, P. & Schunk, D. (1996).*Motivation in education: Theory, research & applications*. Englewood Cliffs: Prentice-Hall.

PISA-Konsortium Deutschland (Eds.) (2006): *PISA 2003. Dokumentation der Erhebungsinstrumente*. [Documentation of the survey instruments] Münster: Waxmann-Verlag.

Piwowar, V., Thiel, F., & Ophardt, D. (2013). Training inservice teachers' competencies in classroom management: A quasi-experimental study with teachers of secondary schools. *Teaching andTeacher Education*, *30*(1), 1-12.

Reusser, K. (2005): Problemorientiertes Lernen. Tiefenstruktur, Gestaltungsformen, Wirkung. [Problem-based learning: Structure, forms, and effects] *Beiträge zur Lehrerbildung*, *23*(2), 159-128.

Rheinberg, F., Vollmeyer, R., & Burns, B.D. (2001). *QCM: A questionnaire to assess current motivation in learning situations*. Retrieved from University of Potsdam website: http://www.psych.uni-potsdam.de/people/rheinberg/messverfahren/FAMLangfassung.pdf (08.02.2016).

Rokeach, M. (1968). *Beliefs, attitudes, and values: A theory of organization and change*. San Francisco: Jossey-Bass.

Rovegno, I. (1993). Content-knowledge acquisition during undergraduate teacher education: Overcoming cultural templates and learning through practice. *American Educational Research Journal*, *30*(3), 611-642.

Santagata, R. & Guarino, J. (2011).Using video to teach future teachers to learn from teaching.*The International Journal of Mathematics Education ZDM*, *43*(1), 133-145.

Schmidt, H.G., Rotgans, J.I., & Yew, E.H.J. (2011).The process of problem-based learning: What works and why. *Medical Education, 45*(8), 792–806.

Seidel, T., Stürmer, K., Blomberg, G., Kobarg, M., &Schwindt, K. (2011). Teacher learning from analysis of videotaped classroom situations: Does it make a difference whether teachers observe their own teaching or that of others? *Teaching and Teacher Education*, *27*(2), 259-267.

Seidel, T., Blomberg, G. &Renkl, A. (2013). Instructional strategies for using video in teacher education, *Teaching and Teacher Education*, *34*(1), 56-65.

Sherin, M.G. (2007). The development of teachers' professional vision in video clubs. In R. Goldman, R. Pea, B. Barron, & S. J. Derry (Eds.), *Video research in the learning sciences* (pp. 383-395). Mahwah: Lawrence Erlbaum.

Sherin, M.G. & van Es, E. (2009). Effects of video club participation on teacher's professional vision. *Journal of Teacher Education*, *60*(1), 20-37.

Shulman, J.H. (Ed.). (1992). *Case methods in teacher education*. New York: Teachers College Press.

Shulman, L.S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), 4-14.

Stenhouse, L. (1985). Case Study Methods. In T. Husen & T. Neville Postlethwaite (Hrsg.), The International Encyclopedia of Education Research and Studies. Vol.2, Oxford: Pergamon Press, 645-650.

Stokking, K., Leenders, F., Jong, J. de, & van Tartwijk, J. (2003). From student to teacher: Reducing practice shock and early dropout in the teaching profession. *European Journal of Teacher Education, 26*(3), 329–350.

Sweller, J. (1994). Cognitive load theory, learning difficulty and instructional design. *Learning and Instruction*, *4*(4),295-312.

Sweller, J. (2007). Human Cognitive Architecture. In J. M. Specto & P.A. Harris (Eds.), *Handbook of Research on Educational Communications and Technology* (pp. 369-381). Oxford: Routledge Chapman & Hall.

Sweller, J. & Cooper, G. A. (1985). The use of worked examples as a substitute for problem solving in learning algebra. *Cognition and Instruction*, *2*(1), 59-89.

Sweller, J., van Merrienboer, J.J.G. & Paas, F.G.W.C. (1998).Cognitive Architecture and Instructional Design. *Educational Psychology Review*, *10*(3), 251-296.

Syring, M., Bohl, T., Kleinknecht, M., Kuntze, S., Rehm, M., & Schneider, J. (2016). Videos oder Texte in der fallbasierten Lehrerbildung? Effekte unterschiedlicher Medien auf die kognitive Belastung und die motivational-emotionalen Prozesse beim Lernen mit Fällen. [Videos or texts in case-based teacher education? Effects of different media on cognitive load and motivational-emotional processes in learning with cases] *Zeitschrift für Erziehungswissenschaft*, *18*(4), 667-685.

Syring, M., Reuschling, A., Bohl, T., Kleinknecht, M., Kuntze, S., & Rehm, M. (2013). Classroom-Management lehren und lernen. Zur Bedeutung des Konzepts im Unterricht und dessen Vermittlung in fallbasierten Seminaren in der Lehrerbildung. [Teaching and learning classroom management. On the importance of the concept in the classroom and its mediation in case-based seminars in Teacher Education] In R. Arnold, C. G. Tutor & C. Menzer (Eds.), *Didaktik im Fokus* (pp. 75-91), Hohengehren: Schneider Verlag.

Tripp, T. & Rich, P. (2012). Using video to analyze one's own teaching. *British Journal of Educational Technology*, *43*(4), 678-704.

Van Merriënboer, J.G. & Sweller, J. (2010). Cognitive load theory in health professional education: Design principles and strategies. *Medical Education*, *44*(1), 85-93.

Veenman, S. (1984). Perceived problems of beginning teachers. *Review of Educational Research*, *54*, 143–178.

Voss, T., Kunter, M., & Baumert, J. (2011). Assessing teacher candidates' general pedagogical/psychological knowledge: Test construction and validation. *Journal of Educational Psychology*, *103*(4), 952–969.

Wigfield, A., & Eccles, J. S. (2000).Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology*, *25*(1), 68-81.

Yadav, A., Phillips, M., Lundeberg, M., Koehler, M., Hilden, K., &Dirkin, K. H. (2011). If a picture is worth a thousand words, is video worth a million? Differences in affective and cognitive processing of video and text cases. *Journal of Computing in Higher Education*, *23*(1), 15-37.

Zottmann, J.M., Goeze, A., Franka, 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.

Zumbach, J. (2003). *Problembasiertes Lernen*. [Problem-based Learning]. Münster: Waxmann.