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EDITED BY
Cheryl J. Craig,
Texas A and M University, United States

REVIEWED BY
Susanne Narciss,
Technical University Dresden, Germany
Jill Ardley,
Norfolk State University, United States

*CORRESPONDENCE
Max Bauer
✉ max.bauer@ph-karlsruhe.de

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The growth of knowledge and self-perceived competence during long-term internships: comparing preparatory versus accompanying seminars in teacher education programs

Max Bauer[1]*, Silke Traub[1] and Olga Kunina-Habenicht[2]

[1]Institute for School and Teaching Development, University of Education Karlsruhe, Karlsruhe, Germany, [2]Institute for Psychological Assessment, TU Dortmund University, Dortmund, Germany

Pedagogical field experiences offer valuable learning opportunities in teacher education programs. While most previous studies have exclusively addressed self-perceived competencies, less is known about the extent to which competence objectively changes during internships. With this in mind, this study aims to examine the development of knowledge on instruction, self-perceived competence, teacher self-efficacy, and their interrelationship during a long- term internship with accompanying or preparatory seminars in educational sciences. Therefore, 275 student teachers were surveyed and structural equation modelling, IRT scaling, and analyses of variances were used as analytical methods. Results of the study revealed a significant change in self-perceived competence and teacher self-efficacy, but only a minimal change in knowledge. The results also showed that accompanying seminars lead to a substantial increase in knowledge relative to preparatory seminars. Furthermore, it turned out that self-perceived competence and its change are less related to knowledge as an objective measure of competence than future teachers' self-efficacy. Based on these findings, the results from previous studies on student teaching and its effectiveness need to be interpreted more cautiously.

KEYWORDS

pedagogical field experiences, practicums, school internships, seminar pedagogical knowledge, self-perceived competencies, teacher self-efficacy, latent-structure-modeling over time

1 Introduction

Pedagogical field experiences provide valuable opportunities in teacher education programs (Kunina-Habenicht et al., 2013; Besa and Büdcher, 2014; Hascher and Kittinger, 2014; Ulrich et al., 2020). Students and experts of teacher training programs have high expectations while entering into these programs. On one hand, students are expected to combine scientific theories and knowledge with their practical experiences. On the other hand, students should reflect on their career choice and enhance their professional skills (Hascher, 2006, 2012; Rothland and Boecker, 2015; Ulrich et al., 2020). In line with these expectations, Germany has witnessed a growing demand for internships that are more extensive, longer in

duration, and more intensive. Consequently, in recent years, long-term internships have been established in teacher education programs across the country (Gröschner et al., 2015; Rothland and Boecker, 2015). All these endeavors have aimed to train students to become skilled teachers and to develop an expertise at an early stage. It must be noted that expertise does not come from simply obtaining a degree; rather, expertise requires practical experience, professional development, and a flexible repertoire of alternative actions in the sense of a flexible expertise (Anthony et al., 2015; Swan et al., 2020). Internships could provide a method to generate first steps towards a flexible repertoire of diverse actions, especially when the seven Elements of Effective Professional Development are appropriately considered in the conception of the internships and pedagogical field experiences (Bates and Morgan, 2018).

Empirical research is increasingly focusing on the effectiveness of prospective teachers' pedagogical field experiences (Besa and Büdcher, 2014; Ulrich et al., 2020). However, most studies have exclusively addressed self-perceived competencies from a subjective perspective of one's own experiences associated with critical methodological limitations (Schulze-Stocker et al., 2016; Ulrich et al., 2020). Thus, there is a need for objective measures that will enable more reliable research findings on the effectiveness of internships (Hascher, 2006, 2012; Besa and Büdcher, 2014; Bauer et al., 2020; Ulrich et al., 2020). One method of measuring competences more objectively is to use knowledge tests (Voss and Kunter, 2013; Lohse-Bossenz et al., 2015; Voss et al., 2015; Guerriero, 2017a; Kunina-Habenicht et al., 2020; Wiens et al., 2022). It has been well-established that pedagogical knowledge is a crucial component of professional competence and has a positive influence on the quality of teaching (Voss and Kunter, 2013; Baumert and Kunter, 2013b; Lohse-Bossenz et al., 2015; Voss et al., 2015; Blömeke, 2017; Guerriero, 2017a; Kunina-Habenicht, 2020). However, very little research has been devoted to the gain knowledge of prospective teachers in the context of pedagogical field experiences (Hegender, 2010; Besa and Büdcher, 2014; Ulrich et al., 2020).

Against this background, this study aims to examine the knowledge gains of two groups of prospective teachers during an intensively supervised long-term internship. During the internship, each group of students attends theoretical classes at a university and teaches at one or two schools independently. In schools, participants are supervised by university lecturers, and in-service teachers act as their mentors. In the current study, the gains between objectively measured knowledge and self-rated competence during the internship are compared. Further, the impact of concurrent versus preparatory seminars in university education courses on gains in objectively measured knowledge or self-assessed competence are examined to shed more light on the effects of input and process variables in the context of pedagogical field experiences (Ulrich et al., 2020).

2 Knowledge: the core of professionalism

According to the established approach of Baumert and Kunter (2013a), knowledge represents the core facet of teachers' professional competence. The basic assumption of the approach is that professional knowledge impacts the perception and interpretation of professional situations as well as the decision for professional actions (Baumert and Kunter, 2013a; Voss et al., 2015; Stürmer and Seidel, 2017; Guerriero, 2017a,b). In addition to knowledge, Baumert and Kunter (2013a) consider job-related beliefs and values, self-regulation skills, and motivational orientations, and beliefs as additional essential aspects of teachers' professional competencies that affect professional action and student achievement (Klusmann, 2013; Kunter, 2013; Voss et al., 2013). Furthermore, the quality or level of professionalism or expertise is concerned with the type of knowledge that has been already acquired. Swan et al. (2020) analyzed different models of expertise and developed their four-level model. The four levels of expertise are procedural, functional, adaptive, and general expertise. Each level is primarily associated with a different type of knowledge, from procedural knowledge to conditional knowledge to conceptual knowledge to a combination of all types of knowledge. A person with the first level of expertise knows the basic procedures and the algorithms (procedural knowledge). Conditional knowledge has already been schematized, and prospective experts know when and in which condition they have to apply their knowledge. The level of conceptual knowledge is reached when the knowledge can be applied to new and complex challenges. A higher level of knowledge cannot be developed by reading a book, but require personal experience and reflection.

Based on Shulman (1986, 1987), the distinction between content knowledge, pedagogical content knowledge, and general pedagogical knowledge has become widely accepted in the discourse of professional knowledge of teachers (Baumert and Kunter, 2013a; Voss et al., 2015; Guerriero, 2017b; Kunina-Habenicht, 2020). Content knowledge is considered as both school-related and in-depth specialized background knowledge of teachers. Pedagogical content knowledge includes teaching-related and learning-process-related aspects, precise explanatory knowledge, knowledge of students' thinking and their misconceptions, and knowledge about tasks that promote cognitive activation and learning (Baumert and Kunter, 2013a; Guerriero, 2017b; Kunina-Habenicht, 2020). In contrast, generic pedagogical knowledge, according to Baumert and Kunter (2013a,b), focuses on knowledge of student assessment, learning processes, and effective classroom management. This narrow understanding of pedagogical knowledge, which is primarily limited to instruction and instruction-related areas, has been expanded to a broader construct of the educational knowledge, which also includes topics that are only indirectly related to teaching (König and Seifert, 2012; Kunina-Habenicht et al., 2012; Terhart et al., 2012; Voss et al., 2015; Seifert et al., 2018). In the BilWiss[1] project (Kunter et al., 2020), the authors identified the following six domains of educational knowledge using the Delphi method: Instruction, Learning and Development, Diagnostics and Evaluation, Education Theory, School as an Educational Institution, Teaching as a Profession (Kunina-Habenicht et al., 2012, 2019, 2020; Terhart et al., 2012; Kunina-Habenicht, 2020).

Empirical findings suggest that pedagogical content knowledge has a positive impact on the quality of teaching (e.g., Baumert and Kunter, 2013b; Förtsch et al., 2016; Mahler et al., 2017). However, there is a paucity of research on educational knowledge. The

1 BilWiss (Bildungswissenschaftliches Wissen und der Erwerb professioneller Kompetenz in der Lehramtsausbildung) is a research project that focuses on developing educational knowledge in teacher education in Germany.

educational knowledge is associated with a higher perceived quality of teaching by their students, thus higher perceived student support or a more effective classroom management (Pflanzl et al., 2013; Voss and Kunter, 2013; Voss et al., 2015; König and Pflanzl, 2016; Gindele and Voss, 2017; Guerriero, 2017b). Furthermore, there is preliminary empirical evidence that higher educational knowledge correlates with lower emotional exhaustion and greater job satisfaction at the beginning of a teaching career (Klusmann, 2013; Dicke et al., 2015).

3 Self-perceived competence versus objective knowledge tests

Regarding the query of equating the development of self-perceived competence with actual competence development, Schulze-Stocker et al. (2016) showed that there is a low correlation between these two measures. This result could be due to the fact that inexperienced people are unable to adequately assess their own competences as they tend to over- or underestimate these measures. Another possible explanation could be that they involve their self-confidence too much in the guessing process, or that they are affected by halo effects (Kuh, 2003). Therefore, the connection between actual competence and self-perceived competence should be examined more closely in the research area of pedagogical field experiences. If the results of Schulze-Stocker et al. (2016) can be replicated, this should be considered when interpreting previous studies in the field of pedagogical field experiences which are mainly based on self-assessment.

4 Pedagogical field experiences as learning opportunities

As part of the conception of competence model by Baumert and Kunter (2013a), Kunter et al. (2013) proposed another model that describes the development of teachers' professional competence and its determinants and consequences. The central assumption of the model is that the professional competence of a teacher is learnable, malleable, and does not represent a personal disposition. In line with this, Bates and Morgan (2018) have identified seven elements of effective professional development that highlights the development of professionalism and the elements that play a major role in that development. The seven elements are (1) Focus on Content, (2) Active Learning, (3) Support of Collaboration, (4) Models of Effective Practice, (5) Coaching and Expert Support, (6) Feedback and Reflection, and (7) Sustained Durations.

Following Helmke's (2009) model of learning opportunities, it is assumed that competence is determined by contextual factors, such as social support, and personal requirements including the individual use of learning opportunities (Kunina-Habenicht et al., 2013; Kunter et al., 2013). Hascher and Kittinger (2014) have further developed a specific model for learning in pedagogical field experiences. This model emphasizes the special and meaningful learning opportunities in practical training. The potential is not only in the high number of practical experiences students gain but also in the (guided) reflection of these experiences, the opportunities for social learning, and the supervision by in-service teachers and the university. Regarding the seven elements of effective professional development, internships and pedagogical field experiences can provide meaningful learning opportunities.

There has been an increasing number of demands in Germany for more, longer, and more intensive internships for students and education policy representatives to improve teacher education, which has led to the introduction of long-term internships throughout Germany (Gröschner et al., 2015; Ulrich et al., 2020). Whether the long-term internships can meet the high expectations of students, teachers and policy makers, it has become the subject of empirical educational research in Germany (Ulrich et al., 2020). As an initial significant finding, the preliminary research shows that the increase in time spent in schools does not necessarily maximize the effectiveness of internships (Müller, 2010; Hascher, 2012; Rothland and Boecker, 2015). Further, the literature shows that the quality of internships is dependent on the quality of learning opportunities within the internship. In other words, the quality of internships can be improved by learning tasks and the supervision of in-service teachers and the university, not just the duration of the internship (Hascher, 2012; Besa and Büdcher, 2014; Rothland and Boecker, 2015; Ulrich et al., 2020).

5 Development of professional competence in the context of pedagogical field experiences

The research on pedagogical field experiences is predominated by subjective self-assessments as the applied evaluation method. Previous studies have indicated that internships, as an opportunity to learn and professionalize, can increase students' self-perceived competence (Hascher, 2012; Gröschner et al., 2013; Bach et al., 2014; Besa and Büdcher, 2014; Rothland and Boecker, 2015; Ulrich et al., 2020) and enhance the development of self-efficacy of teachers during their internships (Bach, 2013; Seifert and Schaper, 2018; Bauer et al., 2020; Ulrich et al., 2020). Although these results provide an optimistic view on the effectiveness of internships and their role in professionalization of future teachers, it cannot be equated with objectively measured competence development. Supporting this, Hascher (2012) demonstrated that students initially rate their internships very highly with regard to their competence. However, three years later, as they gain more work experience, they are much more critical of the usefulness and effectiveness of their internships.

To date, only few studies have used objective measures of competence, such as knowledge tests, to evaluate the effectiveness of pedagogical field experiences (Besa and Büdcher, 2014; Ulrich et al., 2020). Still, preliminary evidence suggests that low to moderate knowledge gains are possible in long-term internships (Ulrich et al., 2020). For example, Westphal et al. (2018) and Schlag and Glock (2019) reported an increase in knowledge related to classroom management. König et al. (2018) and Seifert et al. (2018) showed a slight increase in generic pedagogical knowledge ($d = 0.21$) during long-term internships. However, they emphasized that these differences were only significant in the cognitive area of creating and not in remembering and understanding, thus, not in declarative and procedural knowledge but only in strategic knowledge (König et al., 2018). This means that knowledge is primarily promoted at the practical level and in the action-oriented area during internships. Furthermore, König et al. (2018) showed that the self-perceived

quality of teaching was not related to prior knowledge before internships, but to knowledge at the end of internships. They further argued that the self-perceived quality is chiefly related to obtained knowledge at the end of the internship, not to the beginning. However, they noted that teachers' own quality of teaching may act as a kind of learning opportunity that affects the knowledge at the end. The authors concluded that an exact causal relationship cannot be still conclusively assessed (König et al., 2018). Seifert et al. (2018) examined teaching-related knowledge and broader educational-scientific knowledge as well as the way they are related to self-perceived competence. Their results showed that the knowledge gain was lower when the test combined a broader understanding of generic pedagogical knowledge than when only teaching-related knowledge was tested (pedagogical knowledge: $d = 0.21$; educational-scientific knowledge: $d = 0.14$), although both differences were significant. In contrast, in all areas of self-perceived competence, significant differences were observed between the time before and after the internship ($0.44 < d < 0.76$). Regarding the connection between knowledge and self-perceived competence, their results showed no or small correlations between them, and the cross-lagged models revealed the same results (no or only a slight influence of self-perceived competence on knowledge or vice versa). Overall, the authors argued that internships can enrich the fundamental knowledge of teaching and action, which has little in common with self-perceived competence in the areas of teaching, assessing, educating, and innovating.

According to Hascher and Kittinger's (2014) model of learning opportunities in pedagogical field experiences, process-related variables, such as supervision or accompanying seminars at the university, are relevant factors for pedagogical field experiences (see also Ulrich et al., 2020). For example, the quality of care and social support provided by mentors (in-service teachers) has a positive effect on the self-perceived increase in competence, professional self-confidence, self-efficacy, and job satisfaction (Hobson et al., 2009; Bach et al., 2014; Besa and Büdcher, 2014; Ulrich et al., 2020). In addition, Gröschner et al. (2013) showed the importance of university-based learning-support compared to learning support by in-service teachers. During their internship, students rated their learning support from in-service teachers more favorably than their university-based learning support. However, only the university-based learning support was found to be effective for developing self-perceived competence in multiple regression analyses. Bauer et al. (2020) reported the same results for teacher self-efficacy. While the social support from mentors and fellow students had no effect on development, opportunities for reflection in the accompanying educational science seminars showed a small effect in a latent change model of teacher self-efficacy during a long-term internship.

6 Research questions and hypothesis

With regard to the high expectations of internship effectiveness, the purpose of the present study is to investigate the development of self-perceived competence and knowledge about instruction as a more objective measure of competence during an intensively supervised long-term internship. In particular, the following research questions were posed:

(RQ1) How are the knowledge of instruction, self-perceived competence, and self-efficacy developed during the long-term internship?

(RQ2) To what extent is knowledge of instruction related to self-perceived competence during the internship and their development?

(RQ3) What role do preparatory or accompanying educational science seminars play in the developments of knowledge, self-efficacy and self-perceived competence during the internship?

Consistent with the results of Gröschner et al. (2013), König et al. (2018), Seifert and Schaper (2018), and Ulrich et al. (2020), we assume that both knowledge and self-perceived competence increase during internships (Hypothesis 1). However, as shown in the study by Seifert et al. (2018), we hypothesize that self-perceived competence would increase more than knowledge. Their study found no to low correlation between knowledge and self-perceived competence and their developments in cross-lagged models. This study aims to replicate these results, so low correlations in cross-lagged models were expected (Hypothesis 2). Additionally, we expected (a) low correlations between knowledge and self-perceived competence and (b) moderate to high correlations between self-perceived competence and self-efficacy. Following the findings of Schulze-Stocker et al. (2016) and Kuh (2003), we assume that self-perceived competence is a motivational factor rather than an objective measure of competence. To optimize the length of the test instrument, this study focuses on instruction only as this topic is covered in most internships. Furthermore, as noted by Hascher and Kittinger (2014), the role of the process-related variable of accompanying educational science seminars is analyzed. Considering the results of Gröschner et al. (2013) and Bauer et al. (2020), a positive effect of accompanying seminars on knowledge in comparison to preparatory seminars is assumed (Hypothesis 3).

7 Materials and methods

7.1 Design, intervention, and sample

To answer the research questions, 275 teacher students were surveyed in two different but quite similar long-term internships (one semester) at the University of Education Karlsruhe (see Table 1). The first group comprised future primary school teachers in their Bachelor's program, and the second involved future middle school teachers in their Master's program. Both groups taught in schools three days a week for an entire semester. Participants were supervised by lecturers on two of the three days. On the third day, student-teachers observed their in-service mentors. The main task of the future teachers in these internships is to teach based on structured lesson planning and reflection on their actions. They also need to observe and reflect on lessons, especially on student and teacher behavior. In total, they need to teach approximately 30 lessons, observe 90 lessons, and record their findings (e.g., the personal conclusions of their reflection, supervision, and feedback, or also

TABLE 1 Sample description.

	Total	Long term internship		Significant differences
		PS (B.A.)	MS (M.Ed.)	
n	275	132	141	
Male (in %)	26 (9.5)	5 (3.8)	21 (14.9)	*
Female (in %)	224 (81.5)	122 (92.4)	102 (72.3)	*
Average age (SD)	22.5 (3.2)	21.8 (1.9)	23.9 (3.6)	*
Drop-out (in %)	86 (31.3)	53 (39.6)	33 (23.4)	*
Missing persons at first measurement (in %)	20 (12.9)			–

PS, Primary School; B.A., Bachelor of Arts; n.s. = not significant; MS, Middle School; M.Ed., Master of Education; SD, Standard Deviation.
*significant with $p < 0.05$; n.s., not significant.

their precise written lesson plans and so on) in a portfolio. On the other days, participants attended accompanying seminars in didactics and pedagogical content knowledge at the university. The only difference between the groups, except for the timing of the internship, was that future middle school teachers attended preparatory seminars in educational science to teach generic pedagogical knowledge during one semester prior to their internship, while future primary school teachers attended accompanying seminars. The content and tasks of the seminars were the same for both groups and covered the following topics: learning in the classroom, learning between instruction and construction, teaching quality, motivation in the classroom, handling heterogenous learning groups, didactics and lesson planning and designing. The seminar aims to connect scientific theory with practical acting to improve the prospective teachers' professional competencies. Therefore, the students use methods appropriate for the context of schools to learn and reflect on topics and their personal experiences. It is the aim of the internship and the accompanying seminar to use all elements of effective professional development (Bates and Morgan, 2018) to help the preservice teachers increase their expertise.

The difference between the two types of seminars is that future primary school teachers attend the accompanying seminars in Bachelor, which take place concurrently with the internship, while future middle school teachers attend the preparatory seminar in Master before the internship begins. Accompanying seminars can more easily combine personal experience with theory. The discussions in accompanying seminars are based on teachers' experiences during their actual internship which allow them to immediately use newly attained knowledge offered in the seminars.

Special features of the sampling procedure emerged in terms of gender and average age of the students, and the drop-out rate between the two internships. However, the gender relations were typical for future primary (3.8% male students) and middle school teachers (14.9% male students). Additionally, the differences in the average age were plausible because the internship for future primary school teachers took place in the fourth or fifth semester of the Bachelor's degree, while the other internships occurred in the second or third semester of the Master's program. Although some withdrawal of participants at the second measurement point is typical characteristic of longitudinal studies, this study observed a high number of missing values, particularly in the subsample of the future primary school teachers (53 persons). One reason for the higher drop-out rate was that an entire seminar group of approximately 40 persons could not be surveyed during their final session due to unforeseen changes in the semester schedule. However, drop-out analyses indicated no significant differences between knowledge and teacher self-efficacy at the first measurement, but did reveal significant differences between self-rated competence measures.

7.2 Instruments

The questionnaires used in this study were a brief version of the teacher's self-efficacy scale of Schwarzer and Schmitz (1999), a self-assessment of competence, and the short version of the BilWiss-Test about knowledge about instruction (Kunina-Habenicht et al., 2020; Kunter et al., 2020). The teacher's self-efficacy scale (7 items) and the self-assessment (16 items) scale use a four- and five-point Likert-scale, respectively. The knowledge test is a validated multiple-choice test with 15 questions (Kunina-Habenicht et al., 2019, 2020). It includes items on the following topics: cooperative learning, project work, learning from a constructivist point of view, dealing with mistakes, dealing with disturbances, and positive learning climate. In the knowledge test, for each item, students were required to rate four statements as correct or incorrect. 10 out of the 15 items were complex multiple-choice questions with several possible correct answers, while 5 items were single-choice items with only one correct answer. The coding of the items was accomplished by evaluating whether the cross was set in the proper place (1) or not (0). This resulted in 45 coded items used for item response theory (IRT) modeling. At the first measurement time point, the item difficulties and the person parameters were estimated using a 2-PL-IRT-Model (2 parameter logistic IRT-Model). At the second measurement time point, only the person parameters were freely estimated in the 2-PL-model, because the item difficulties at the first measurement time point were used as anchor values for the estimation of person parameters. Regarding reliability (see Table 2, Cronbach's alpha and Expected *A Posteriori* (EAP) Score), all the instruments had acceptable to high values. The self-perceived competence scale assessed the self-rated levels of several skills (i.e., classroom management, cognitive activation, student support, and general teaching competence) by asking about four subdomains of those skills. For example, the subdomain of 'student support' was 'individual student support'. For each of these subskills, five statements were provided with a range from "-" (very low) to "++" (very high). For example, the response categories for the self-perceived competencies in providing individualized student support were

TABLE 2 Scales.

Scale (number of items)		PS		MS		α	EAP—reliability
		M	SD	M	SD		
Teacher self-efficacy (7)	T1	3.1	0.31	3.3	0.35	0.67	–
	T2	3.6	0.26	3.4	0.38	0.72	–
Self-perceived competence (16)	T1	3.6	0.27	3.0	0.53	0.92	–
	T2	4.0	0.34	3.9	0.32	0.81	–
Pedagogical knowledge (15)	T1	−0.17	0.90	0.17	0.77	–	0.74
	T2	0.21	0.86	0.14	0.79	–	0.72

T, Time of Measurement; PS, future Primary School Teachers; MS, future Middle School Teachers; M, Mean; SD, Standard Deviation; ±, Cronbachs ±; EAP, expected a posteriori. Teacher self-efficacy—scale 1 to 4, Self-perceived-competence—scale 1 to 5.

labeled as follows: -- "No individualized learning support through feedback"; – "little feedback on learning activities"; o "various relevant feedback is given"; + "regular relevant feedback is given"; ++ "Precise feedback is given at the individual learning level". Students had to decide which of these statements best described them. The scale of self-efficacy consisted of 7 items (e.g., "I know that I am capable to teach even the most problematic students what is relevant to the exam."). The students rated these items from 1 (strongly disagree) to 4 (strongly agree).

7.3 Analyses

To answer the research questions, latent modeling approaches were used to conduct analyses. While the software MPlus (Muthén and Muthén, 1998) and the maximum Likelihood (ML) estimator were used for the structural equation modeling (SEM) analysis, the IRT-based analyses were executed with the software R (R Core Team, 2021) using the TAM package (Robitzsch et al., 2022). To achieve acceptable model fits, despite complex modeling and a small sample size, theoretically meaningful residual correlations and partial parcels were used.

To answer the first research question, latent state and latent change models were used to examine the stability and variability over time during the internship. The latent state models specified the interindividual stability over time with a correlation between the two latent state factors of each time of measurement (Sörbom, 1975; Geiser, 2010). The higher the correlation, the higher the stability. Further, there was no need to use latent models for knowledge because the person parameters were based on IRT models. Since the latent stability coefficients did not provide any information about the actual strength of the increase or decrease, latent change models were subsequently modeled as variability models (Geiser, 2010). These are characterized by the change over time specified by a latent difference variable. As a prerequisite for the latent change models, measurement invariance over time was evaluated (see Appendix A). As suggested by Cheung and Rensvold's (2002), the self-efficacy model presented problems with measurement inconsistencies (CFI > 0.02). However, since the actual model fit was acceptable, the latent-change model was cautiously included in the analyses. For the IRT-based person parameters of knowledge, *t*-tests of mean differences for repeated measurements were used.

To answer the second research question, latent cross-lagged models were estimated to examine the interplay between knowledge, teacher's self-efficacy and self-perceived competence, and its development during the internship. One of the main ideas of these models is that the best way to explain current behavior and experience is the previous behavior and experience. In order to represent the interplay between two constructs, the autoregressions were supplemented by cross regression paths to examine the mutual influence on development and by correlations of the state factors at each time of measurement. The higher these correlations and cross-lagged regression pathways are, the higher the interplay between them.

To answer the last research question about the role of accompanying seminars compared to preparatory seminars in educational science, Analyses of Variances for repeated measurements were used. For this purpose, the interaction effect of group and time is of special interest, indicating different developments in both groups over time.

8 Results

8.1 Changes during the internship

To answer the first research question (e.g., how knowledge about instruction, self-perceived competence, and self-efficacy are developed during the internship), latent analyses were conducted for both mean differences and the interpretation of interindividual stability over time. Model fit indices indicated a good model fit for the latent state models (see Table 3) while using theoretically meaningful residual correlations and parcels for the construct of self-perceived competence. The four parcels of self-perceived competence were theoretically developed. There was a parcel of generic didactic competence and one for each competence to consider the fundamental dimension of teaching quality (cognitive activation, student support, and classroom management, Preatorius et al., 2018). With regard to the stability coefficients (Table 3), the latent state models showed high stability for teacher self-efficacy ($r = 0.52$), moderate for self-perceived competence ($r = 0.32$), and small stability for knowledge ($r = 0.15$). All stability coefficients were statistically significant.

Since the latent stability coefficients do not provide any information about the strength of the coefficients, it was necessary to examine mean differences. Therefore, the latent state models were extended to latent change models (see Table 4), revealing a moderate effect for teacher self-efficacy, a large effect for self-perceived competence, and a small effect for pedagogical knowledge. All mean differences were statistically significant, although the model fit indices of the latent change model for self-perceived competence showed

TABLE 3 Latent state models.

	χ^2	df	*p*	CFI	RMSEA	SRMR	Stability coefficient (*r*)
Teacher self-efficacy	93.9	69	0.024	0.942	0.036	0.056	0.522*
Self-perceived competence	27.3	15	0.026	0.985	0.055	0.052	0.317*
Pedagogical knowledge[a]	–	–	–	–	–	–	0.154*

χ^2, Chi-Square of the model; df, degrees of freedom; *p*, *p*-value; CFI, Comparative Fit Index; RMSEA, Root of Mean Square Error of Approximation; SRMR, Standardized Root Mean Square Residual; *significant with $p < 0.05$. [a]Analyses did not use latent models, instead Pearson's *r* of IRT-based person parameters was used.

TABLE 4 Latent change models: latent difference in mean value before and after the internship.

	χ^2	df	*p*	CFI	RMSEA	SRMR	$M_{T2\text{-}T1}$	*d*
Teacher self-efficacy	117	81	0.005	0.917	0.040	0.075	0.187	0.86*
Self-perceived competence	70.9	21	> 0.001	0.940	0.093	0.226	0.689	1.42*
Pedagogical knowledge[a]	–	–	–	–	–	–	0.239	0.22*

χ^2, Chi-Square of the model; df, degrees of freedom; *p*, *p*-value; CFI, Comparative Fit Index; RMSEA, Root of Mean Square Error of Approximation; SRMR, Standardized Root Mean Square Residual; T, Time of Measurement; *d*, Cohens *d*; *significant with $p < 0.05$.[a]Analyses did not use latent models, instead T-Test of mean differences of IRT-based person parameters was used.

conflicting results. While the CFI index was acceptable, the χ^2, RMSEA, and SRMR indices were very high.

In summary, the results showed significant changes during the internship for all the constructs, but they differed in strength and stability.

8.2 The interplay between pedagogical knowledge, self-perceived competence, and its development during the internship

To answer the second research question (e.g., to what extent self-perceived competence is related to pedagogical knowledge), three latent cross-lagged models were analyzed to examine the interplay between pedagogical knowledge, self-perceived competence, and its development during the internship. The higher the cross-regression pathways and the correlations between the state factors on each time of measurement are, the higher is the interplay. All three models had a good model fit (see Figures 1–3). We also estimated a SEM in which cross-lagged models for all the three constructs were considered simultaneously. This model had an acceptable model fit (χ^2 (228) = 318.6, $p < 0.001$; CFI = 0.93; RMSEA = 0.038; SRMR = 0.063) and provided very similar results as separate latent cross-lagged models. Therefore, for clarity, only the results of the separate cross-lagged models are reported. The complete Mplus output for the complex SEM with all the three constructs can be found in Appendix B.

The cross-lagged model of pedagogical knowledge and self-perceived competence (Figure 1) did not show any significant correlation or cross-regression pathway. Only the autoregression pathway of self-perceived competence was statistically significant, revealing a moderate effect of self-perceived competence at the beginning on the level at the end of the internship. Similarly, the model including teachers' pedagogical knowledge and self-efficacy (Figure 2) yielded no significant correlations or cross-regression pathways. In this model, only the autoregression pathways were statistically significant and revealed a higher effect on teacher self-efficacy at the end of the internship. The last latent cross-lagged model (Figure 3), however, revealed an interplay between self-perceived competence and teacher self-efficacy. Significant moderate cross-regression pathways ($0.29 < \beta < 0.32$) were found, which remained lower than the autoregression pathways ($0.30 < \beta < 0.50$). Although a high correlation between teacher self-efficacy and self-perceived competence was observed at the end of the internship ($\beta = 0.41$), there was no correlation at the beginning of it. All this could be ascribed to self-perceived competence which is less a reflection of real competence than a motivational orientation which is dependent on someone's self-efficacy.

8.3 The role of accompanying seminars in educational science in comparison to preparatory seminars for the development during internship

The final research question focused on the role of accompanying seminars in educational sciences compared to preparatory seminars for the development of knowledge, self-efficacy and self-perceived competence during the internship. At this, the internship of future primary school teachers was compared with the future middle school teachers'. While primary school teachers experience their internship during their Bachelor programs and with accompanying seminars in educational sciences, middle school teachers experience their internship in their Master programs with a preparatory seminar. To answer the question, Analyses of Variances for repeated measurements were used. These analyses revealed three types of effects: (1) a time effect for the change over time across the groups, (2) a group effect for the differences between internship types, and (3) an interaction effect (time*group), indicating the extent to which the changes over time are influenced by the group membership.

First, as can be seen in Table 5, the Analyses of Variances for repeated measurements of pedagogical knowledge revealed both a moderate time, and a moderate interaction effect, but no group effect. At baseline, a significant difference between the groups was observed (see Figure 4). While primary school teachers started with a lower level of knowledge and improved it significantly, future middle school teachers started with a significantly higher level and improved their knowledge only slightly. In summary, there is a change in knowledge

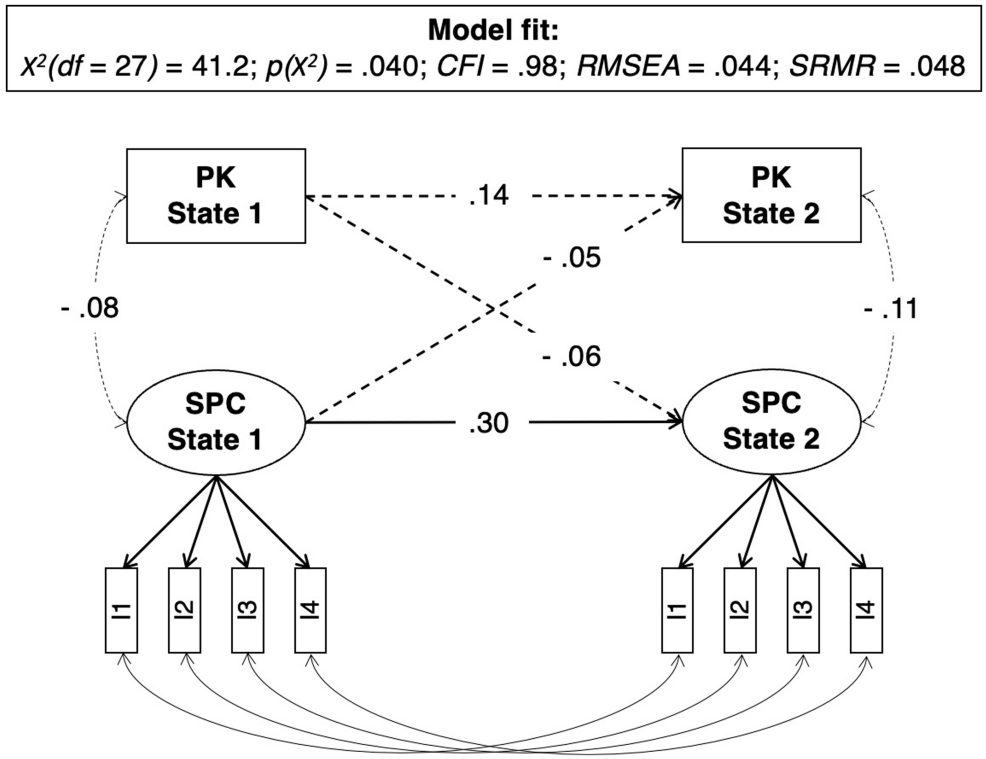

FIGURE 1
Cross-lagged model for pedagogical knowledge (PK) and self-perceived competence (SPC). Solid lines represent significant paths and dashed lines represent non-significant paths.

during the internship. However, the amount of changes differed between the two groups.

Second, the analyses regarding self-perceived competence revealed high effects for time, group, and interaction, but the time effect was very large (see Figure 4). Figure 4 shows that future middle school teachers start with lower self-perceived competencies but increase them significantly. However, both groups showed a high increase and have almost the same level at the end.

Finally, the analyses on teacher self-efficacy showed almost the same results as the analyses on knowledge but with higher effects. This is indicated by a significant interaction effect and a higher time effect. Primary school teachers start at a lower level but show the greater increase and have a significantly higher level at the end of the internship.

9 Discussion

> *(RQ1) How are the knowledge of instruction, self-perceived competence, and self-efficacy developed during the long-term internship?*

The results showed changes during the internship that differ in strength and stability. The highest increase was found in self-perceived competence, with moderate interindividual stability over time. Prospective teachers benefit from their many practical experiences with intense supervision during the internships. At the end of the internships, future teachers envision themselves as much more competent. This could also be an explanation for the moderate increase in teacher self-efficacy. Upon the completion of the internship, students are better able to handle challenging future situations in schools (see Bandura, 1997). Moreover, changes were similar across students, as evidenced by the high interindividual stability. This indicates a similar effect of the internship in terms of self-efficacy of students. These results of teacher self-efficacy and self-perceived are consistent with previous results for pedagogical field experiences (e.g., Besa and Büdcher, 2014; Seifert et al., 2018; Bauer et al., 2020; Ulrich et al., 2020). With regard to knowledge, we found only minor changes with low interindividual stability over time. This result is consistent with the studies conducted by Seifert et al. (2018) and Ulrich et al. (2020). The minor increase in knowledge during pedagogical field experiences can occur for many reasons. One possible reason could be the less development of real competence than self-perceived competence. Another reason could be attributed to pedagogical field experiences primarily targeting practical skills that require more procedural and strategic knowledge than declarative knowledge (Baumert and Kunter, 2013a), although knowledge tests are mostly concerned with declarative knowledge. Finally, as a third possibility, Seifert et al. (2018) argue whether tests of pedagogical knowledge are sensitive enough to track the development of competence in pedagogical field experiences. In line with test sensitivity issues, Malva et al. (2020) showed that different groups struggle with different topics. For example, preservice teachers struggled with topics that were not part of their study; in-service teachers had difficulties with questions related to specific theoretical knowledge; and teacher educators struggled more with practical situations.

Another remarkable result is the exceptionally low interindividual stability of pedagogical knowledge, likely due to highly differential factors related to using learning opportunities to increase knowledge during the internship. For example, future primary school teachers appear to benefit from accompanying

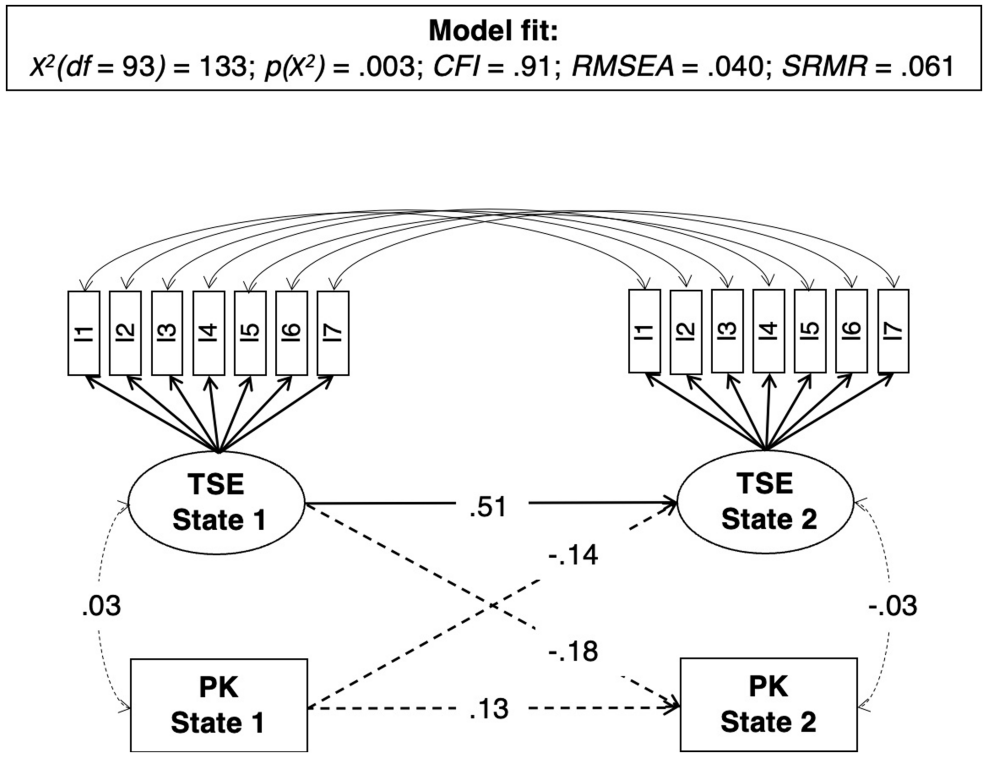

FIGURE 2
Cross-lagged model for pedagogical knowledge (PK) and teacher self-efficacy (TSE). Solid lines represent significant paths and dashed lines represent non-significant paths.

seminars in educational sciences more than future middle school teachers from their preparatory seminars. However, there could be many more reasons why knowledge increases in very individual ways during the internship, such as the effectiveness of supervision (Hascher and Kittinger, 2014). Hegender (2010) found that preservice teachers are heavily dependent on supervisors and the structure of their supervision. However, it must be taken into consideration that students complete their internships and seminars at different points in their studies and hence have different baseline scores on the knowledge test. This could be a statistical artifact. Finally, it must be pointed out that primary school students with lower initial scores have more space for development.

> *(RQ2) To what extent is knowledge of instruction related to self-perceived competence during the internship and their development?*

The interplay among knowledge, self-perceived competence, teacher self-efficacy, and their development was analyzed using latent cross-lagged models. The latent cross-lagged model of knowledge and self-perceived competence revealed no interplay between them which agrees with Seifert et al.'s (2018) study. In their study, the authors reported minor or no interaction between self-perceived competencies and knowledge in cross-lagged models. However, the model of self-perceived competence and teacher self-efficacy clearly indicated their interplay and their development. This could be due to the fact that self-perceived competence is less a reflection of objective competence or knowledge and could be more like a motivational orientation that is mostly associated with teacher self-efficacy. Self-perceived competence could thus be understood as an academic self-concept for teaching. Along the same lines, Dunning and Kruger (1999) stated that incompetent people tend to overestimate themselves. This overestimation occurred both in the self-perception of competence and the self-efficacy. These findings shed a different light on previous studies that equated self-perceived competence development with real competence development (Besa and Büdcher, 2014; Ulrich et al., 2020). Thus, there seems to be a significant gap in the research on the effectiveness of pedagogical field experiences with respect to the competence development of future teachers.

> *(RQ3) What role do preparatory or accompanying educational science seminars play in the developments of knowledge, self-efficacy, and self-perceived competence during the internship?*

With regard to teacher self-efficacy and knowledge of instruction, prospective primary school teachers seem to considerably benefit from their accompanying seminars. This aligns with previous studies and the seven elements of effective professional development that highlight the role of accompanying seminars or learning support from universities (e.g., Gröschner et al., 2013; Bauer et al., 2020; Ulrich et al., 2020), especially with regard to linking theory to practice. Collaboration, coaching and expert support, feedback, and immediate reflection along with seminars can allow teachers to have a deeper understanding of their actions and promote effective changes (Bates and Morgan, 2018). An important finding of this study is that a significant increase in self-perceived competence among prospective middle school teachers with preparatory seminars was observed. Additional research will be required before a complete understanding of this phenomenon occurs. The middle school teachers feel more prepared at the beginning, and they can use this feeling to improve their self-perception more effectively, but not to increase their knowledge.

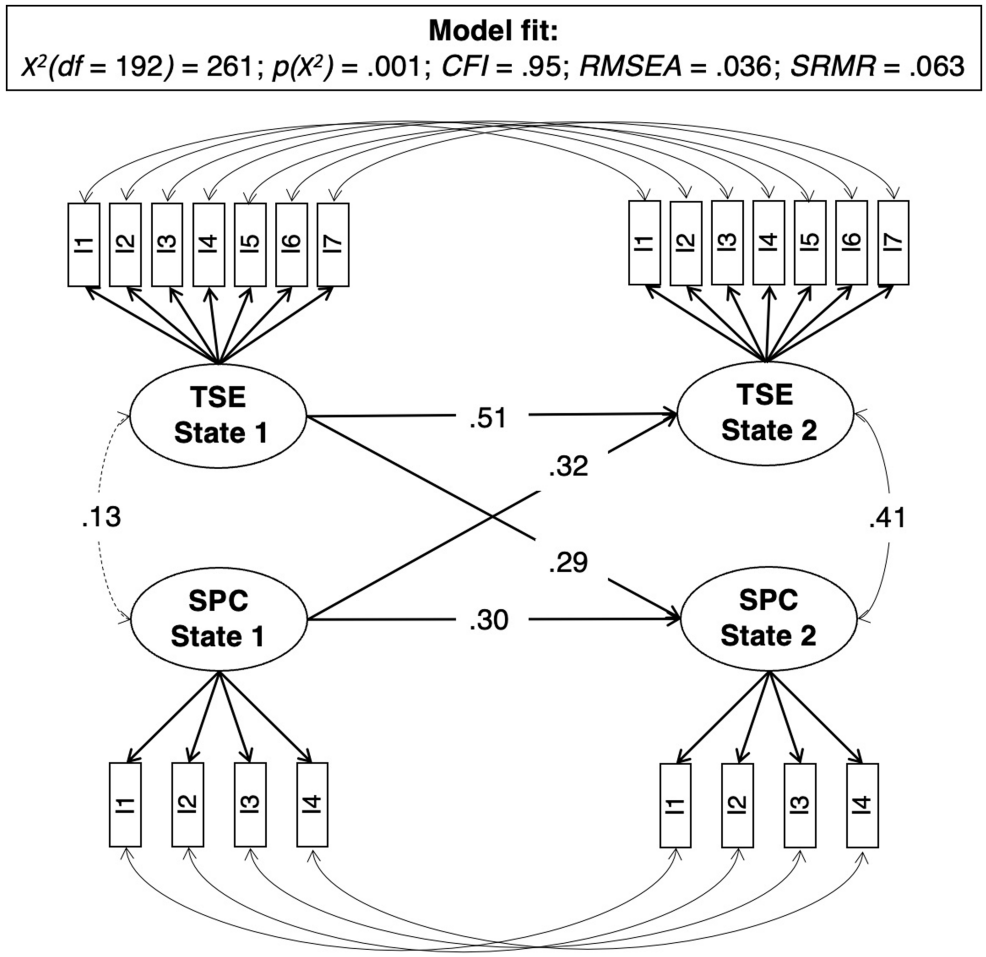

FIGURE 3
Cross-lagged model for teacher self-efficacy (TSE) and self-perceived competence (SPC). Solid lines represent significant paths and dashed lines represent non-significant paths.

TABLE 5 Analyses of variances for repeated measurements.

		F	df	df_F	*p*-value	$\eta_{partiell}^2$
Pedagogical knowledge	Time	9.70	1	163	**0.002**	**0.056**
	Group	3.15	1	163	0.052	0.023
	Time*Group	8.46	1	163	**0.004**	**0.049**
Self-perceived competence	Time	486.69	1	163	**< 0.001**	**0.749**
	Group	67.83	1	163	**< 0.001**	**0.294**
	Time*Group	68.79	1	163	**< 0.001**	**0.297**
Teacher self-efficacy	Time	83.79	1	165	**< 0.001**	**0.337**
	Group	1.04	1	165	0.309	0.006
	Time*Group	23.37	1	165	**< 0.001**	**0.124**

The bold values are significant with $p < 0.05$.

10 Conclusion

This study set out to investigate the development of knowledge on instruction, self-perceived competence, teacher self-efficacy, and their interrelationship during a long-term internship with accompanying or preparatory seminars in educational sciences. The results of the study showed that students considerably improved their teacher self-efficacy and self-perception of competence and even increased their knowledge of instruction during the internship. Although the results indicated that the self-perceived competence fails to fully reflect actual

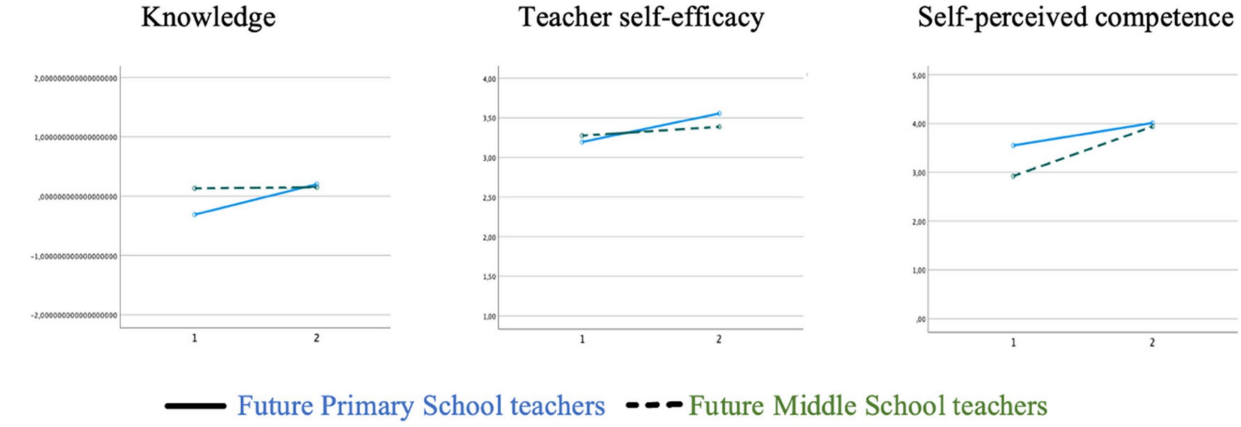

FIGURE 4
Line plots.

competence, it can represent a motivational orientation that is also important for teaching quality. This finding highlights the need for a more objectively assessment of the effectiveness of pedagogical field experiences. Furthermore, the results of the study underline the importance of a close link between theory and practice. Students with accompanying seminars in educational sciences seem to benefit more than students in preparatory seminars by increasing teacher efficacy and knowledge.

As in any research endeavor, a number of potential limitations in the present study need to be considered. First, in this quasi-experimental study, the comparison between the two groups was not practical due to different structural characteristics of the groups. The groups were not randomized and contained different types of students at different stages of their studies (accompanying seminars for future primary school teachers in Bachelor vs. preparatory seminars for future secondary school teachers in Master). Strictly speaking, the type of seminar attended (accompanying vs. preparing) is confounded with the time in study (Bachelor vs. Master) and also with the type of teaching profession (primary vs. secondary). Therefore, in theory, the differences found between the groups could also be explained by the other two factors, time in study and type of teaching profession.

Although randomization and comparison during the same semester is highly desirable, it was not possible to form such groups in real teacher education due to the structural requirements of the program organization, as all students are required to complete the internship during this semester. Nevertheless, comparisons could have provided added value to the study with regard to understanding relevant factors for the effectiveness of educational field experiences. Moreover, this study concentrated on only one university. The findings are generalizable for this university, but could provide general indications for a better understanding of the effectiveness of pedagogical field experiences. Nevertheless, the study has several strengths. First of all, it is quasi-longitudinal, using two groups to be compared with each other. Second, both objective measurements and self-reports were combined for a broader perspective. Third, latent modeling (SEM and IRT) was carried out on a suitably large sample. An interesting area for further research is replication studies with larger samples involving multiple universities. Finally, we totally agree with Seifert et al. (2018) who argue that there is a need for better test instruments to objectively measure professional competence and its development in the area of pedagogical field experiences. In particular, external evaluations of competence by supervising in-service teachers and lecturers (see Hascher, 2012) or video recordings of the lessons could be appropriate methods.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found here: https://www.dropbox.com/s/3rbacxvd70i38kc/DS_Wissen.dat?dl=0, Name of data set: DS_Wissen.dat.

Ethics statement

Ethical approval was not required for the studies involving humans because anonymized questionnaires were used, which do not allow any conclusions to be drawn about the individuals. The subjects were informed about this and participated in the survey voluntarily. The studies were conducted in accordance with the local legislation and institutional requirements.

Author contributions

MB and ST conceived and designed the study and collected the data. MB and OK-H performed the statistical analyses. MB, OK-H, and ST drafted and revised the manuscript. All authors reviewed and approved the final manuscript and have agreed to be accountable for all aspects of the work.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2024.1194982/full#supplementary-material

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