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**Ready to Teach? A Profile Analysis of Cognitive and Motivational-Affective
Teacher Characteristics at the End of Pre-service Teacher Education and the Long-term
Effects on Occupational Well-being**

Doris Holzberger*¹, Christina Maurer², Olga-Kunina-Habenicht³, & Mareike Kunter²

¹Centre for International Student Assessment, TUM School of Education, Technical
University of Munich, Munich, Germany

²Goethe University Frankfurt, Germany

³University of Education Karlsruhe, Germany

* Corresponding author. Doris Holzberger, Centre for International Student
Assessment, TUM School of Education, Technical University of Munich, Arcisstraße 21,
80333 Munich, Germany. Tel: +49-89-289-28278.

E-mail address: doris.holzberger@tum.de (Doris Holzberger).

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Abstract

The present study explores how multiple teacher characteristics (i.e., knowledge, beliefs, self-efficacy, and self-regulation) co-occur within 649 German teacher candidates at the end of pre-service teacher education and how these profiles are related to teachers' future occupational well-being. A latent profile analysis identified one highly knowledgeable and engaged profile, one profile with below average knowledge, and one profile with below average beliefs, motivation, and self-regulation. These profiles also differed in their emotional exhaustion and job satisfaction. The findings emphasize how teacher candidates differ qualitatively in their pattern of "starting competence" what may have consequences with regard to specific interventions.

Keywords: teacher characteristics, teacher education preparation, teacher competence, teacher knowledge, teacher beliefs, motivation

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In recent decades, there have been different approaches to how to define teacher success. One prominent approach is to define teacher success by the value-added scores of students' achievement (Hill, Kapitula, & Umland, 2011; Lincove, Osborne, Dillon, & Mills, 2014). Another approach takes teachers' behaviors, such as instructional quality, into account (Grossman, Loeb, Cohen, & Wyckoff, 2013; Hill, Umland, Litke, & Kapitula, 2012). Currently, success in teacher education programs is predominantly assessed via performance assessments of teacher candidates (e.g., Bastian, Patterson, & Pan, 2018; Noell, Burns, & Gansle, 2019). In addition, success cannot only be specified with regards to the effects on students and teaching but also teacher-related outcomes, such as teacher well-being (Putwain, 2019). Little research is concerned about the relevant teacher characteristics of "successful" teachers that possibly predict these student or teaching outcomes. While research has separately investigated cognitive (e.g., teacher professional knowledge) as well as motivational-affective teacher characteristics (e.g., self-efficacy), in the present study, a conjoint perspective on these teacher characteristics is applied to advance research on the multiplicity of teacher characteristics.

Moreover, the question is how these teacher characteristics are developed within teacher candidates by the end of pre-service teacher education. Brouwer and Korthagen (2005) propose the concept of "starting competence" as a requirement to enter the teaching profession successfully. "Starting" describes characteristics of teacher candidates at the end of pre-service teacher education with respect to how well teacher candidates are equipped for their future profession and their ability to develop these competences further during teaching (in-service competence). "Competence" encompasses abilities and skills that are required to

perform successfully in professionally relevant situations (Koeppen, Hartig, Klieme, & Leutner, 2008; Weinert, 2001).

In the present study, we draw on a theoretical model of competence specific to the teaching profession: Authors et al. (2013a) conceptualized professional competence for teachers as a multidimensional construct comprising both cognitive (professional knowledge and beliefs) and motivational-affective (motivational orientations and self-regulation) characteristics (Authors et al., 2013a; Authors et al., 2013d). More specifically, we examine the configuration of cognitive and motivational-affective characteristics within teacher candidates to reveal whether characteristics are shaped similarly in all teachers (e.g., high levels on all variables) or whether distinct patterns of teacher candidates can be found (e.g., candidates with high professional knowledge but low motivational characteristics).

Scholars have pressed for a conjoint investigation of multiple aspects of competence to identify favorable patterns (Depaepe & König, 2018; Moè, Pazzaglia, & Ronconi, 2010). The present study addresses this gap in research by examining how, at the end of pre-service teacher education, different teacher characteristics are organized within teacher candidates and whether subgroups of teacher candidates with a common pattern of characteristics can be identified. Finally, we not only describe starting patterns of teacher competence but also examine the relevance of these patterns for teacher success as indicated by teacher well-being. Therefore, using a longitudinal design, we examine how the patterns at the end of pre-service teacher education predict later teacher well-being. We investigate whether high levels of cognitive and motivational-affective characteristics are required for teacher well-being or whether teacher candidates can, for example, compensate for low levels of knowledge with high levels of motivation and still achieve well-being.

Cognitive Characteristics: Teachers' Professional Knowledge and Beliefs

One prominent characteristic in research on teaching and teacher education is teachers' professional knowledge (Blömeke & Delaney, 2012; Hill, Rowan, & Ball, 2005). Professional knowledge can be classified as subject-specific or generic knowledge. More specifically, Shulman (1986) distinguishes between teachers' subject-specific content knowledge, subject-specific pedagogical content knowledge, and generic psychological–pedagogical knowledge. Subject-specific knowledge has been shown to be related to student learning (Authors et al., 2010b; Hill et al., 2005; Keller, Neumann, & Fischer, 2016). Generic knowledge—also conceptualized as *educational knowledge*—addresses all of a teacher's subject-unrelated tasks and duties inside and outside the classroom (Authors et al., 2015a; Authors et al., 2015b; Authors et al., 2016).

The classroom-related part of generic knowledge is also known as psychological–pedagogical knowledge or general pedagogical knowledge, comprising knowledge on instruction and students' learning, development, and assessment (Depaepe & König, 2018; Authors et al., 2015a; Authors et al., 2011b). Parts unrelated to the classroom comprises knowledge on topics, such as educational theories and systems, school organization and development, and parent counseling (Authors et al., 2013a; Authors et al., 2015a; Shulman, 1986). Empirical evidence from several studies has indicated that aspects of educational knowledge are relevant not only for the quality of teaching (Depaepe & König, 2018; König et al., 2016) but also as a protection from symptoms of teacher burnout (Dicke, Elling, Schmeck, & Leutner, 2015; Lauermaun & König, 2016). These positive relationships with outcome variables emphasize the relevance of pre-service teacher education to the development of teachers' professional knowledge.

Aside from knowledge, teacher beliefs also include a cognitive component. Beliefs refer to teachers' attitudes or personal opinions about aspects of the school context, such as

beliefs about themselves as teachers, their subject matters, their students, learning processes, and teaching practices (Fives & Buehl, 2012; Authors et al., 2013b; Pajares, 1992). Those beliefs are understood to function as filters for teachers' perceptions and interpretations, frames for their tasks or problems, and guides for initiating the (subjectively assumed) appropriate actions (Fives & Buehl, 2012). A constructivist view of learning, for example, has been shown to be positively related to instructional quality regarding learning support and to students' achievement gains in mathematics (Staub & Stern, 2002; Authors et al., 2013b). Moreover, as teaching is increasingly regarded as a research-based profession, teachers' attitudes about evidence-based practice have also shifted into researchers and policy's center of interest (Cook & Odom, 2013; European Commission, 2012). Consequently, teacher education should not only focus on the development of professional knowledge but also on how these beneficial beliefs can be promoted.

Motivational-Affective Characteristics: Teacher Motivation and Self-Regulation

Apart from cognitive aspects, motivational-affective teacher characteristics are also under investigation in current teacher education research (e.g., Klassen et al., 2018). Hill, Charalambous, and Chin (2019) applied the term *mindset* as an additional component to teachers' cognitive characteristics. With regard to teacher motivation, teacher self-efficacy beliefs (herein: teacher efficacy) and teacher enthusiasm are among the most researched constructs.

Teacher efficacy signifies a teacher's belief in her or his capability to succeed in bringing about desired outcomes of education on the student level, such as student learning or engagement, even in the face of difficulties (Tschannen-Moran & Woolfolk Hoy, 2001). Teacher efficacy appears to be an important requisite for teachers, since it has been found to be positively related not only to student achievement (Caprara, Barbaranelli, Steca, & Malone, 2006; Zee & Koomen, 2016) but also to teachers' instructional behavior (Authors et

al., 2013c; Depaepe & König, 2018; Küsting, Neuber, & Lipowsky, 2016) and well-being (Caprara et al., 2006; Moè et al., 2010; Schwarzer & Hallum, 2008).

Teachers' experienced enthusiasm marks a teacher's habitual teaching-related excitement and enjoyment (Keller, Woolfolk Hoy, Goetz, & Frenzel, 2015). Empirical findings have supported the hypothesized link between teachers' experienced enthusiasm, their displayed enthusiasm—comprising visible behavior, such as vivid nonverbal expressiveness—and student motivation (Frenzel, Goetz, Lüdtke, Pekrun, & Sutton, 2009; Keller et al., 2015). In addition, in several studies, teacher enthusiasm was positively related to instructional quality, student achievement, and teachers' occupational well-being (for a review, see (Keller et al., 2015). As motivational-affective characteristics are conceptualized as malleable (Locke & Latham, 2004), teacher education has the potential to develop these positive, motivational-affective characteristics among teacher candidates.

Finally, self-regulation includes all of a person's "thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals" (Zimmerman, 2000, p.14). Following Kieschke and Schaarschmidt (2008), teachers' ability to responsibly manage their personal resources depends on occupational engagement and the ability to retain a professional distance and cope with failure (resilience). Authors et al. (2008) found that teachers with high engagement and high resilience showed higher instructional quality, student motivation, and indicators of teacher well-being. Aside from a balanced investment of engagement and resilience, the self-directed development of a person's knowledge and skills is also an important goal of executing self-regulatory processes (Sitzmann & Ely, 2011). Self-reflection has been proposed as a useful strategy not only in generic models of self-regulation (Schmitz & Wiese, 2006; Zimmerman, 2000) but also in the literature on teachers' professional development (Graham & Phelps, 2003; Hiebert, Morris, Berk, & Jansen, 2007; Korthagen & Vasalos, 2005). In line with this theoretical perspective, there is empirical

evidence showing that self-reflection is related to the development of teachers' professional knowledge and beliefs (Authors et al., 2015d; Authors et al., 2017a) as well as their teaching quality and job satisfaction (Mattern & Bauer, 2014; Wubbels & Korthagen, 1990). With this broad relevance of self-regulation, the question is how teacher candidates possess these characteristics at the end of pre-service teacher education.

A Conjoint Perspective of Cognitive and Motivational-Affective Characteristics

Considering all the various characteristics (knowledge, beliefs, motivation, and self-regulation) that may constitute a successful or competent teacher, the question is how these characteristics are organized within each individual teacher. For example, when we label a teacher as "competent," the underlying assumption may be that this teacher has high levels of all variables. To date, however, few studies have investigated multiple teacher characteristics at the same time, combining various cognitive and motivational-affective aspects and those who do, do so only with a variable-centered approach (Authors et al., 2013a; Authors et al., 2018; Hill et al., 2019; Keller et al., 2016; Rockoff, Jacob, Kane, & Staiger, 2008).

These variable-centered approaches have the potential to examine the specific effects of cognitive and motivational-affective characteristics; they are limited in their informative value on the interplay of teacher characteristics. For example, can high levels of cognitive characteristics compensate for low levels of motivational characteristics? We must conjointly examine the interplay of variables and, thus, adopt suitable person-centered approaches. Latent profile analyses are used to identify naturally occurring subgroups of teachers that share a similar pattern of variables and are capable of covering different interactive effects simultaneously (Bauer & Shanahan, 2007).

A few studies have identified different patterns among teachers or teacher candidates in person-centered approaches. However, these studies have mostly investigated different variables within either the cognitive or the motivational-affective domain (Kieschke &

Schaarschmidt, 2008; Nehls, König, Kaiser, & Blömeke, 2019; Watt & Richardson, 2008).

Some have instead investigated more complex relationships between different aspects of competence, but only in a highly specific sample of experienced mathematics teachers (Authors et al., 2010a; Blömeke, Suhl, & Döhrmann, 2012).

Watt and Richardson (2008) analyzed patterns of motivation among Australian teacher candidates with a focus on engagement, persistence, and aspirations toward their professional development and career. They found highly engaged persisters (with regard to their future career in teaching), highly engaged switchers, and lower engaged desisters. Kieschke and Schaarschmidt (2008) analyzed the interplay between engagement and resilience in a German sample, including not only teachers but also other professions. They found four different profiles: healthy ambitious, unambitious, excessively ambitious, and resigned. Blömeke et al. (2012) analyzed subject-specific knowledge and beliefs and identified two patterns: (1) cognitively ambitious and constructivist-oriented profile and (2) static and transmission-oriented profile. Finally, among experienced mathematics teachers in Germany Authors et al. (2010a) identified three distinct profiles: the model teacher (all aspects of competence above average except self-regulation), the problem teacher (all aspects of competence below average), and the self-regulated teacher (outstanding balance of high engagement and high resilience).

These studies indicate that not all patterns score either high or low on all variables. Instead, qualitatively different patterns were revealed (e.g., high engagement but switching to another career). These qualitatively different patterns are difficult to detect with variable-centered approaches, as they not only require the expected interaction to be defined in advance but also require the interaction to be investigated with regard to an outcome variable (Bauer & Shanahan, 2007).

Well-being as an Indicator of Teacher Success

Finally, the question is whether cognitive and motivational-affective characteristics at the end of pre-service teacher education can indeed predict future teacher success. Among the different indicators for teacher success, the present study focuses on occupational well-being as one outcome criterion (Authors et al., 2013d). Occupational well-being can be defined by job satisfaction and emotional exhaustion as one dimension of burnout (Authors et al., 2008). Research has shown that teacher well-being is not only a predictor for attrition (Grant, Jeon, & Buettner, 2017) but also affects student performance (Klusmann, Richter, & Lüdtke, 2016). As outlined above, educational knowledge, motivation, and self-regulatory abilities have separately been shown to be related to occupational well-being (Authors et al., 2008; Caprara et al., 2006; Dicke et al., 2015; Keller et al., 2015; Lauermaun & König, 2016; Mattern & Bauer, 2014; Moè et al., 2010).

The Present Study

In the present study, we offer a new scientific approach by conjointly examining how cognitive and motivational-affective teacher characteristics are organized within teacher candidates after graduation from pre-service teacher education. While previous studies predominantly selected single characteristics and related them to outcome criteria—such as student learning, instructional quality, and teacher well-being—these studies do not have the potential to detect whether certain teacher candidates show, for example, weakness in one area (e.g., motivation) but strength in others (e.g., knowledge). We adopt a person-centered perspective and explore comprehensive profiles of starting competence at the end of pre-service teacher education regardless of school types or subjects. Finally, we examine how these teacher profiles relate to teachers' development in occupational well-being. This comprehensive approach enables us to examine (1) whether teacher education might emphasize certain teacher characteristics and (2) whether—for teacher success—weaknesses

in some teacher characteristics (e.g., knowledge) may be compensated by strengths in others or whether all teacher characteristics were equally important for occupational well-being.

Research Question 1: Which teacher characteristic profiles do we find among beginning teachers at the end of pre-service teacher education?

First, we aimed to analyze beginning teachers' patterns of competence at the point of their full transition into practice. We considered cognitive and motivational-affective teacher characteristics simultaneously. In particular, we asked: do teacher profiles primarily differ in terms of quantity or quality? In light of the lack of evidence from previous research, we adopted an explorative approach without forming prior hypotheses. Moreover, to characterize the identified profiles further, we examined them in terms of teachers' gender, German as a native language, and final exam grade.

Research Question 2: Are the identified profiles related to teachers' occupational well-being two years after entering the teaching profession?

Second, it was of uttermost interest to investigate the impact of teacher competence profiles on outcome criteria, such as teachers' long-term well-being, at a later point in time. We deduced different hypotheses depending on whether the profile analysis revealed profiles that prioritized certain characteristics (qualitative differences) or only quantitative differences. Previous research revealed positive relations between knowledge, motivation, and self-regulation and teacher well-being. Consequently, when teacher candidates differed in the levels of quantity only, we hypothesized that teachers with high levels of all teacher characteristics would show positive development of occupational well-being two years later. With regard to potentially qualitative different profiles (e.g., teacher candidates with high levels of knowledge, but low levels of motivation), no specific hypotheses were formulated as previous research did not allow inferences on compensatory effects.

Method

Sample and Procedures

The survey data of the present study were collected within the context of the research project XX1 (Authors et al., 2017b) conducted in Germany. Six-hundred and forty-nine¹ teacher candidates from all main teaching subjects participated. They had already completed their university studies and were just about to complete their induction phase, the second and practical part of initial teacher education in Germany. Data were collected within 46 teacher education classes (*seminars*) that the candidates attended once a week during their induction phase at teacher training institutes in the federal state of North Rhine-Westphalia (NRW). Participation in the study was voluntary. Candidates were 28.1 years old on average ($SD = 3.2$); 77.2% of them were female; 92.9% of the sample spoke German as their native language. The average grade point average (GPA) from high school was 2.52 ($SD = 0.55$; 1-6; low values indicating good performance). Participants were enrolled in different tracks of induction programs, preparing them to teach at elementary schools (35.4%), vocational track schools (26.2%), or academic track schools (38.4%).

To investigate Research Question 2 data, we drew on a follow-up measurement point about two years later. Participation was voluntary. This time, data collection was conducted online. The participants were invited by e-mail and received an incentive for completing the follow-up measurement. Of the 386 participants who had originally agreed to be invited to the follow-up study by e-mail, 158 now active, in-service teachers participated again. Follow-up analyses are presented below.

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¹ Originally, 670 teacher candidates participated in the study. However, 21 of them had either not been enrolled in teacher-specific university studies or had not given enough information on this matter. They were excluded from all analyses, since we were interested only in those participants who completed both parts of initial teacher education.

Instruments

We included indicators covering all four aspects of professional competence, such as teachers' educational knowledge, beliefs, motivation, and self-regulation. For an overview of the specific number of items, reliability coefficients, and wordings of exemplary items for each measured construct, see Table 1. The intercorrelations for the variables under investigation can be found in Table A.1 in the appendix.

Educational knowledge. We measured beginning teachers' generic educational knowledge with a standardized test (Authors et al., 2015a). As the focus of the test was to assess knowledge of educational foundations during teacher education (Authors et al., 2015a; König, Blömeke, Paine, Schmidt, & Hsieh, 2011), it was comprised not only of instruction-related topics, including (1) classroom teaching, (2) learning and development, and (3) assessment and evaluation, but also context-related topics, including (4) creating school environments, (5) understanding educational foundations, and (6) teaching as a profession.

These six dimensions were tested with 56 multiple-choice items (Authors et al., 2015a). Based on the coded responses (0 = *incorrect answer*, 1 = *partial correct answer*, 2 = *correct answer*), person parameters were estimated for each dimension separately through six one-dimensional, two-parameter, partial credit models (Muraki, 1992). Item parameters (discrimination and difficulty parameters) were fixed to anchor values from a former calibration estimation of a representative sample of teacher education graduates (for detailed information, see Authors et al., 2015a). The scale of the person parameters was logits, referring to zero as the midpoint, which represented the mean performance of the calibration sample. Positive and negative scores on the scales indicated levels of knowledge above and below the average, respectively. Expected a priori (EAP) estimates indicated sufficient reliability measures for most of the test scales (see Table 1). Previous studies have examined the validity of the test.

For the psychological knowledge dimensions, learning, development, and assessment, Authors et al. (2015b) found that, in a longitudinal design, knowledge predicted a change in instructional behavior. Moreover, findings revealed that the test measured knowledge typically addressed in the teacher education program. For example, students at the beginning of their studies showed significantly lower values on the test than advanced students (Authors et al., 2015a). Finally, Authors et al. (2015c) found that higher knowledge of learning and development, assessment, instruction, and educational theory buffered the increase in emotional exhaustion typically observed during the induction phase.

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**** Insert Table 1 about here****

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Self-report scales were applied to assess teachers' beliefs, motivational orientations, and self-regulative skills. The self-report scales were on a four-point Likert scale (1 = *do not agree*, 4 = *agree*), and reliabilities were sufficient for all scales (see Table 1). Information on the validity of the scales can be found in the cited references for each scale.

Professional beliefs. We measured candidates' professional beliefs with regard to their belief in the extent to which students should take an active part in constructing their own learning (constructivist belief; adapted from Authors et al., 2013b). Moreover, we also developed a scale that measured candidates' beliefs on whether a teacher's practice should be based on scientific theories and findings (Authors et al., 2016).

Motivation. Teachers' self-efficacy was measured via the general teacher self-efficacy scale by Schwarzer and Jerusalem (1999), including interactions with students, parents, and colleagues, job performance, skill development, and coping with stress. We assessed teachers' enthusiasm toward the task of classroom teaching with four items, using the scale of Authors et al. (2011b).

Self-regulation. We also assessed how much the candidates usually enjoyed their work using four items from the Utrecht Work Engagement Scale (Schaufeli & Bakker, 2003). Moreover, we asked the candidates how well they employed their behavioral, emotional, and cognitive resources. Finally, we developed a scale with five items that measured the degree of self-reflection acquired from difficult situations (Authors et al., 2016).

Well-being. We measured emotional exhaustion as a key dimension of chronic job-related strain using a four-item German version of the Maslach Burnout Inventory (e.g. “*I often feel exhausted at work*”; Authors et al., 2008, adapted from Enzmann & Kleiber, 1989). The internal consistency at the end of pre-service teacher education was $\alpha = .75$ and $\alpha = .82$ at the two-year follow-up. As a second measure of occupational well-being, we assessed the teachers’ global job satisfaction using a four-item scale (e.g. “*If I were able to choose once more, I would instantly become a teacher again*”; Authors et al., 2008, adapted from Hackman & Oldham, 1975). The internal consistency at the end of pre-service teacher education was $\alpha = .84$ and $\alpha = .84$ at the two-year follow-up.

Teacher covariates. Gender (coded as 0 = *female*, 1 = *male*), German as a native language (1 = *German as native language*, 2 = *German not as native language*), and GPA from high school (self-reported, theoretically ranging from 1-6, low values indicating good performance) were used as covariates in the analyses.

Data Analysis

The statistical modeling program Mplus 8.2 was used for the main analyses presented in this article (Muthén & Muthén, 2015). Among the complete sample measured at the end of pre-service teacher education, the percentage of missing data ranged from 0 to 6.9% ($M = 1.8\%$). Missing data were estimated using a full-information-maximum-likelihood estimator (FIML) in all analyses. Since the knowledge test had a different response format than the questionnaire scales, we z-standardized all variables. The data can be retrieved from the

Research Data Centre (FDZ) at the Institute for Educational Quality Improvement (IQB),² Germany. The scripts of analyses are available via the Open Science Framework:

https://osf.io/q5wrn/?view_only=efbe9701126f4e61968e3a258e9cff96.

We conducted a latent profile analysis to investigate which profiles of teacher characteristics could be found among teacher candidates at the end of pre-service teacher education (Research Question 1). Latent profile analysis is a model-based clustering approach in which similar objects are classified into distinct latent classes (profiles) using a set of continuous indicators (Pastor, Barron, Miller, & Davis, 2007; Vermunt & Magidson, 2002). In a latent profile analysis, the number and forms of the latent profiles are unknown a priori. A set of information criteria and model tests are available to compare several models to decide which model best fits the data. The Bayesian information criterion (BIC), as well as the Lo-Mendell-Rubin likelihood-ratio test (LMR), were applied in the present study since they had shown good performance in simulation studies (Nylund, Asparouhov, & Muthén, 2007; Pastor et al., 2007).

Additionally, the measure of entropy and the posterior profile-membership probabilities were used to assess the quality of the model fit (Celeux & Soromenho, 1996; Vermunt & Magidson, 2002). After establishing the profile solution, we calculated post-hoc analyses with a Bonferroni-corrected error probability to investigate whether the profiles differed significantly from one another and performed latent profile analyses with covariates (Collins & Lanza, 2010) to examine the profile membership in more detail. We analyzed whether the profiles differed in gender, native language, and high school GPA.

To investigate whether profile membership at the end of teacher education predicted the teachers' perceived occupational well-being at the follow-up two years later (Research Question 2), we applied structural equation modeling (SEM). We calculated three models: (a)

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² <https://www.iqb.hu-berlin.de/xx2>

profile membership was used as a predictor for the emotional exhaustion and job satisfaction at the end of pre-service teacher education; (b) profile membership was used as a predictor for the emotional exhaustion and job satisfaction at the follow-up two years later; (c) teachers' perceived occupational well-being (emotional exhaustion and job satisfaction) at the end of pre-service education was included as a control variable, and well-being was predicted two years later to examine whether the development of occupational well-being differed depending on profile membership. As a requirement for the longitudinal analyses (Model c), we checked the measurement invariance for emotional exhaustion and job satisfaction (see Table A.2 in the Appendix).

Results

Latent Profile Analysis: Identifying Profiles of Teacher Characteristics at the End of Initial Teacher Education (Research Question 1)

Table 2 shows the results for the latent profile analyses of two, three, and four latent profiles, reflecting possible patterns of competence at the end of pre-service teacher education.

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**** Insert Table 2 about here****

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The LMR test was significant only for the solutions produced with two and three profiles. This signified that the model with two profiles fit the data better than the model with only one profile, and the model with three profiles fit the data better than the model with only two profiles. Based on the LMR test, the profile solution with four profiles did not explain the data significantly better than the solution with three profiles. We thus selected the solution with three profiles to represent our data best. The mean probability of profile membership ranged from 91% to 92% for this solution and was, thereby, highly satisfactory.

The z-standardized means of the three profiles for all indicators are illustrated in Figure 1. As depicted in Figure 1, three qualitatively different profiles were found. The profiles can be mainly characterized by distinct patterns of knowledge and motivational-affective characteristics. With 287 of the 649 teacher candidates (44.2%), the largest profile was a pattern that we named *highly knowledgeable and engaged* (Profile 1) as the teacher candidates in that group scored above the mean on all indicators.

With 236 classified teacher candidates (36.4%), the second profile comprised nearly as many candidates as the highly knowledgeable and engaged profile. This profile was primarily characterized by low values of beliefs, self-efficacy, enthusiasm, work engagement, and self-reflection (all scoring below average). By contrast, values on the knowledge subscales were above average and similar to the values from Profile 1. Therefore, we named the second profile *low mindset*.

Finally, the third profile was characterized by scores on educational knowledge that were clearly below average, whereas values on the beliefs, motivation, and self-regulation scales were close to average. Therefore, we named the third profile *less knowledgeable*. With 126 teacher candidates (19.4%), this profile was clearly less prevalent than the other two profiles.

Figure 1. Profiles of competence (three-profile model) with standardized means on all indicators.

To compare whether the profiles differed significantly from one another, we used the unstandardized values to evaluate differences based on the original metric of the scale (see Table 3). With the exception of teachers' beliefs about theory-based practice, the less knowledgeable profile (Profile 3) differed significantly from Profiles 1 and 2 in all variables. Teachers in Profiles 1 and 2, in turn, significantly differed in their level of beliefs, motivation, and self-regulation. However, with the exception of educational theory, the knowledge scores did not significantly differ between these two profiles.

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**** Insert Table 3 about here****

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After identifying the three teacher profiles, we performed latent profile analyses with covariates to investigate differences in gender, native language, and GPA. The probability of being classified in the highly knowledgeable and engaged profile (Profile 1) compared to the low mindset profile (Profile 2) was higher for female teacher candidates ($b(SE) = 0.835$ (0.14), $p < .05$) than male candidates. Profiles 1 and 2 did not differ with regard to German as a native language and final exam grade. Comparing the highly knowledgeable and engaged profile (Profile 1) with the less knowledgeable profile (Profile 3), teacher candidates with a better final exam grade were more likely to be classified in the highly knowledgeable and engaged profile ($b(SE) = 1.040$ (0.25), $p < .05$). Profiles 1 and 3 did not differ with regard to gender and German as a native language. Finally, comparing the low mindset profile (Profile 2) with the less knowledgeable profile (Profile 3), teacher candidates with German as a native language ($b(SE) = 1.216$ (0.49), $p < .05$) and with a better final exam grade ($b(SE) = 0.934$ (0.29), $p < .05$) were more likely to be placed in the low mindset profile. No difference between Profiles 2 and 3 was found for gender.

To sum up, at the end of pre-service teacher education, we found that there were three subgroups of teacher candidates with clear differences in their teacher characteristics. Profile 1 seems to be the ideal candidate with a good theoretical knowledge base, positive beliefs about teaching, and high motivation and self-regulation. An interesting contrast is the teachers from Profile 2, who were also well equipped with theoretical knowledge. However, a striking feature was their low scores on beliefs, motivation, and self-regulation. Compared to their peers, they apparently did not seem to like their job as much, had more doubts about their own teaching competence, and were less prepared to engage deeply. Finally, teachers in Profile 3 seemed to have gained little educational knowledge during their pre-service teacher education and, at the same time, achieved average scores regarding beliefs, motivation, and self-regulation.

Structural Equation Model: The Relationship between Identified Profiles and Teachers' Occupational Well-being (Research Question 2)

To investigate whether teachers from the three profiles at the end of pre-service teacher education develop differently with regard to their emotional exhaustion and job satisfaction two years later, we evaluated data from the follow-up measurement point. A follow-up analysis revealed that the composition of the 158 teachers (of the 649 from measurement point one) who participated again differed significantly from the composition of profile membership among the 491 participants who dropped out of the study ($\chi^2 = 9.07$, $df = 2$, $p = .01$).³ The comparison of the number of participants against the number of drop-outs indicates that a higher percentage of highly knowledgeable and engaged teachers (Profile 1; 47.5%, $n = 75$) and a lower percentage of less knowledgeable teachers (Profile 3; 10.1%, $n = 16$) remained in the study. No significant difference existed with regard to the group of low mindset teachers (Profile 2). Consequently, those who participated in the follow-up measurements seemed to be a positive selection with regard to their teacher characteristics.

To address the research question, we ran structural equation models. We first ran separate models for each measurement point (Figure 2a and 2b). Profile 1 (highly knowledgeable and engaged candidates) functioned as a reference category. Thus, we analyzed how deficiencies in motivation or knowledge affect teacher well-being. On average, teachers who had been classified as either low mindset or less knowledgeable candidates at the end of their teacher education reported higher emotional exhaustion and less job satisfaction than candidates who had been classified as highly knowledgeable and engaged both at the end of pre-service teacher education and two years later (the difference was not

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³ Composition of participants (follow-up vs. drop-out): 47.5% vs. 39.3% highly knowledgeable and engaged teachers, 42.4% vs. 40.3% low mindset teachers, 10.1% vs. 20.4% less knowledgeable teachers.

significant for the less knowledgeable profile and job satisfaction at the follow-up measurement point).

Finally, we included the values at the end of pre-service teacher education as covariates in the regression models to analyze whether the occupational well-being of teacher candidates developed differently depending on profile membership (Figure 2c). No significant difference was found in development based on profile membership.

Figure 2. Results of the SEM regressing well-being on profile membership. Figures differ in the included measurement points for the variables emotional exhaustion and job satisfaction. Standardized parameters are printed. Item-intercorrelations are not displayed. *n.s.* = not significant ($p > .05$).

Discussion

The aims of the present study were twofold: (a) to address a conglomerate of professional characteristics of teachers and identify patterns of starting competences in beginning teachers after graduation from pre-service teacher education, and (b) to investigate the relevance of the identified profiles for teachers' occupational well-being. The multidimensional model of professional competence by Authors et al. (2008) laid the theoretical groundwork for our investigation, considering the four dimensions of professional knowledge, beliefs, motivation, and self-regulation as a teacher's main prerequisites for professional behavior at school. While previous research predominantly examined single characteristics separately, in the present study, we not only included characteristics simultaneously but also analyzed how they are organized within teachers.

Starting Competence: Three Profiles

To address our first aim, we found three distinct profiles of competence at the end of pre-service teacher education in Germany. The first profile was *highly knowledgeable and highly engaged*, grouping teachers with overall desirable teacher characteristics. The second profile was labeled as *low mindset*, showing a relative deficit in teacher beliefs, motivation, and self-regulation. The third profile was labeled as *less knowledgeable*, showing a relative deficit in educational knowledge when compared to the grand average. While teachers with distinct deficits in teacher characteristics were identified, we found no overall alarming pattern of problem teachers scoring below the grand average on all teacher characteristics.

Our study extended previous research by including a large sample of teacher candidates (including different school tracks as well as different teaching subjects) at the end of pre-service teacher education and addressing all four dimensions of professional competence. Adopting a person-centered approach, the present study advances research on starting competence (Brouwer & Korthagen, 2005). On a theoretical level, the results of

different qualitative patterns point to the relevance of conceptualizing professional competence as a multifactorial construct in the sense of Authors et al. (2013a). The deficit profiles reveal that different processes during pre-service teacher education might occur for educational knowledge and for beliefs, motivation, and self-regulation.

Predicting Teacher Well-being

Our second aim was to investigate the relevance of the identified patterns for teachers' occupational well-being. Therefore, we assessed the teachers, asking about their emotional exhaustion and job satisfaction. We did so at the end of their pre-service education and again about two years later when they were already working in schools. Due to a considerable part of the sample dropping out of the study, the sample used to investigate Research Question 2 was smaller with overall competent teachers being overrepresented and less knowledgeable teachers being underrepresented.

This finding does not only indicate the practical relevance of the identified profiles but also reveals that the effect on development may potentially be underestimated due to the larger drop-out rate of less knowledgeable teachers. The findings of the two deficit profiles showed that these teachers already feel worse with respect to emotional exhaustion and job satisfaction at the end of their pre-service teacher education as well as—for emotional exhaustion—two years after entering the teaching profession. However, we did not find that the development of teachers differed depending on the profiles.

In conclusion, the data indicate an advantage for the highly knowledgeable and engaged teachers regarding their occupational well-being. This is also in line with empirical studies that have found single aspects of competence, such as knowledge, motivation, and self-regulation, to be positively related to aspects of occupational well-being (e.g., Authors et al., 2011a; Authors et al., 2015c; Caprara et al., 2006; Lauermann & König, 2016; Pietarinen, Pyhältö, Soini, & Salmela-Aro, 2013; Skaalvik & Skaalvik, 2016).

Limitations

Some limitations of the present study warrant consideration and offer avenues for future research. First, our latent profile analyses were rather exploratory in nature. Both quantitative and qualitative profiles were expected. Our retrieved qualitative profiles indicated that groups of teacher candidates qualitatively differed in their teacher characteristics, and the various teacher characteristics were not shaped similarly within teachers. We encourage future research to replicate our findings.

Second, while teachers' educational knowledge was assessed using standardized tests, all other indicators of teacher characteristics and their occupational well-being were measured via self-report. Consequently, a common method bias cannot be excluded (Podsakoff, MacKenzie, Jeong-Yeon, & Podsakoff, 2003). In particular, a halo effect as a global evaluation of a person that outshines the rating of all other variables cannot be excluded (Nisbett & Wilson, 1977). We could speculate that the almost uniform shape of the profiles with regard to the self-report measures of beliefs, motivation, and self-regulation may be an indicator of a halo effect on the non-knowledge variables, and a more differentiated pattern of these constructs may be masked.

Third, we must consider that no baseline of teacher characteristics at the beginning of teacher education was measured. Consequently, we cannot infer whether differences in the profiles already existed at the beginning of teacher education and how these profiles may have developed during pre-service teacher education.

Finally, we examined only one indicator of teacher success: well-being. Future research should examine whether the teachers with different profiles also differ with respect to student outcomes and instructional quality.

Conclusion and Directions for Practice and Further Research

This study showed that after pre-service teacher education, beginning teachers start their careers with different patterns of competence: a considerable number of beginning teachers seem “well equipped” and have acquired all the necessary knowledge and mindsets that teacher education aims to foster. Others seem to be of a more “intellectual” type that theoretically knows a lot, but seems to have developed a rather skeptical mind set. Those of a more “practical” type seem not to develop educational knowledge during teacher education.

In terms of occupational well-being, we found first validation for the relevance of the well-equipped starting competences, in a way that deficits in knowledge or mindset lead to lower occupational well-being. While the different profiles may, in part, reflect existing a priori differences between student teachers (and may thus have consequences on teacher recruitment; see Rockoff et al., 2008), our findings point to the fact that different processes of the learning environment may occur for knowledge and non-knowledge variables. This yields two implications: First, how can these deficits be avoided during teacher education? Second, can specific interventions be offered to make up for these deficits? Deficits in educational knowledge point to the content of the learning opportunity and the way the content is taught. In comparison, deficits in mindset may particularly point to the way the learning opportunities are designed or how others, such as peer teacher candidates, may be involved in the process.

A consequence for teacher education might be the identification of specific deficits or weaknesses in teacher candidates and the adaptation of subsequent learning opportunities, such as motivational training (cf. Depaepe & König, 2018), or, for example, a more intensive curriculum during teacher education for the less knowledgeable group. Moreover, future research now needs to examine how these deficits are not only reflected in teachers’ well-

being but also in instructional quality, whether deficits can be compensated for, and how the set of starting competences turns into in-service competence (Brouwer & Korthagen, 2005).

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Table 1

Characteristics of Latent Profile Indicators

Construct	Items	Reliability	Item example
<i>Educational Knowledge</i>			
Classroom teaching	12	EAP=.58	Group work is time-consuming. What should be avoided, so that students are able to utilize their time in phases of group-work as effectively as possible?
Learning and development	15	EAP=.64	Intelligence and prior knowledge are important predictors of learning success. Which of the following statements are correct?
Assessment and Evaluation	8	EAP=.70	Grades serve various social functions. Assess which of the statements that describe functions of grades are correct.
Creating school environments	10	EAP=.59	Which of the following statements on school climate are confirmed by empirical studies?
Understanding educational foundations	6	EAP=.78	The question of equity plays a major role in the education system. Which of the following facts expresses a form of inequity in education and training?

Teaching as a profession	6	EAP=.8	Empirical studies on teachers' health and stress show
	1		that ...

Beliefs

Constructivist view on learning	6	$\alpha=.76$	In class, the best way to achieve the learning objectives is for students to find their own methods for solving problems.

Theory-based practice	6	$\alpha=.75$	Teachers should also consider scientific knowledge in their practical work.

Motivation

Self-efficacy (teaching)	10	$\alpha=.79$	I am certain that I can develop creative ideas with which I can change unfavorable teaching structures.

Enthusiasm (teaching)	4	$\alpha=.80$	It is always fun to teach students new things.

Self-regulation

Work engagement	3	$\alpha=.81$	When I get up in the morning, I look forward to going to work.

Self-reflection	5	$\alpha=.73$	When problems arise, I think about how the situation could have been solved in another way.

Note. EAP = expected a priori reliability estimate; α = coefficient Cronbach's alpha; for item examples of educational knowledge only item stems are presented.

Table 2

Results of Latent Profile Analyses (Model Fit Parameters)

No. of profiles	BIC _{adj.}	Entropy	LMR _{adj.} LRT	<i>p</i>	Mean probability of profile membership
2	20249.1	.82	885.8	< .001	.93 / .96
3	20621.9	.80	660.4	< .001	.92 / .90 / .91
4	20531.9	.81	307.0	.081	.90 / .92 / .86 / .89

Note. BIC_{adj.} = sample-size adjusted Bayesian Information Criterion; LMR_{adj.} LRT = Lo-Mendell-Rubin adjusted likelihood ratio test; *p* = error probability of LMR_{adj.} LRT; final model printed in bold.

Table 3

Descriptive Statistics of the Latent Profiles (3-Profile Model)

	Profile 1: highly knowledgeable and engaged	Profile 2: Low mindset	Profile 3: Less knowledgeable
Indicator	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)
<i>Knowledge</i>			
Classroom teaching	0.27 ^a (0.52)	0.20 ^a (0.49)	-0.41 ^b (0.80)
Learning and development	0.31 ^a (0.58)	0.36 ^a (0.66)	-0.44 ^b (0.93)
Assessment and evaluation	-0.13 ^a (0.76)	0.03 ^a (0.70)	-1.00 ^b (0.66)
Educational theory	0.07 ^a (0.57)	0.28 ^b (0.43)	-0.61 ^c (0.79)
Creating school environments	0.30 ^a (0.54)	0.35 ^a (0.54)	-0.41 ^b (0.85)
Teaching as a profession	0.07 ^a (0.51)	0.14 ^a (0.46)	-1.25 ^b (0.98)
<i>Beliefs</i> ¹			
Constructivist learning	3.66 ^a (0.32)	3.26 ^b (0.45)	3.42 ^c (0.42)
Theory-based practice	2.89 ^a (0.52)	2.57 ^b (0.51)	2.59 ^b (0.37)
<i>Motivation</i> ¹			
Self-efficacy (teaching)	3.32 ^a (0.33)	2.88 ^b (0.35)	3.14 ^c (0.38)
Enthusiasm (teaching)	3.86 ^a (0.17)	3.25 ^b (0.45)	3.59 ^c (0.44)
<i>Self-regulation</i> ¹			
Work engagement	3.34 ^a (0.44)	2.62 ^b (0.54)	3.02 ^c (0.55)
Self-reflection	3.57 ^a (0.35)	3.13 ^b (0.42)	3.34 ^c (0.44)

Note. *M* = mean; *SD* = standard deviation; ¹ response format 1-4; ^a, ^b, ^c = different indices indicate significant differences in post-hoc analyses with a Bonferroni-corrected error probability of $p = .001$

Table A. 1

Intercorrelations Between Aspects of Professional Competence

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>Educational Knowledge</i>														
1. Classroom teaching	—													
2. Learning and development	.39*	—												
3. Creating school environments	.39*	.47*	—											
4. Understanding educational foundations	.32*	.48*	.43*	—										
5. Assessment and Evaluation	.35*	.27*	.29*	.27*	—									
6. Teaching as a profession	.28*	.21*	.26*	.26*	.41*	—								
<i>Beliefs</i>														
7. Constructivist view on learning	-.03	-.05	.01	-.05	-.01	.01	—							
8. Theory-based practice	.05	.12*	.11*	.07	.04	.05	.23*	—						
<i>Motivation</i>														
9. Self-efficacy (teaching)	-.04	-.07	-.07	-.15*	-.08*	-.06	.27*	.18*	—					
10. Enthusiasm (teaching)	.04	-.05	-.01	-.07	.01	-.02	.27*	.18*	.44*	—				

11. Work engagement	.02	-.06	-.04	-.13*	-.01	.01	.19*	.15*	.42*	.63*	—		
<i>Self-regulation</i>													
12. Effort	.11*	-.00	.05	-.09*	-.02	.01	.13*	.11*	.23*	.28*	.30*	—	
13. Adaptability	.02	.02	.02	-.02	.01	-.04	.24*	.23*	.52*	.41*	.37*	.24*	—
14. Self-reflection	.03	.03	.04	-.03	-.07	-.06	.26*	.27*	.41*	.29*	.28*	.32*	.37* —

Note. * $p < .05$.

Table A.2

Fit Indices for the Latent Measurement Models for Emotional Exhaustion and Job Satisfaction

Model	χ^2	df	<i>P</i>	CFA	RMSEA	SRMR (between)
Emotional exhaustion						
t1	12.95	2	.00	.98	.09	.02
t2	6.16	2	.05	.98	.11	.03
M1: Configural measurement ^a	34.03	15	.00	.98	.05	.04
M2: Metric invariance ^b	38.52	18	.00	.98	.04	.07
Difference between M1 and M2 $\Delta\chi^2 = (\Delta df = 3) = 4.49, p = .21$						
Job satisfaction						
t1	14.71	2	.00	.99	.10	.02
t2	11.39	2	.00	.96	.17	.03
M1: Configural measurement ^a	36.47	15	.00	.98	.05	.04
M2: Metric invariance ^c	39.06	19	.00	.99	.04	.05
Difference between M1 and M2 $\Delta\chi^2 = (\Delta df = 4) = 2.59, p = .63$						
Overall model						
t1	141.39	31	.00	.95	.08	.04
t2	88.67	31	.00	.91	.11	.06

t2 on t1	434.59	127	.00	.89	.06	.10

Note. CFI = comparative fit index; RMSEA = root-mean-square error of approximation; SRMR = standardized root-mean-square residual; M1 and M2 = Model 1 and Model 2. Difference test based on likelihood-ratio test, which generates corrected $\Delta\chi^2$ statistics when the maximum likelihood estimator MLR is used.

^aFactor loadings over time freely estimated. ^b Factor loadings constrained to be equal over time (with the exception for one item). ^c Factor loadings constrained to be equal over time.