

Basic needs satisfaction during a teaching practicum: an intraindividual perspective on preservice teachers' motivation and interindividual associations to mentoring

Miriam F. Jähne  · Mathias Dehne  · Susi Klaß  ·
Alexander Gröschner 

Received: 31 January 2022 / Revised: 23 July 2022 / Accepted: 28 July 2022 / Published online: 2 September 2022
© The Author(s) 2022

Abstract Learning in a teaching practicum is highly intraindividual. However, to date, this dynamic process has been investigated mainly through trait-like, interindividual (between-person) statistics, whereas a state-like intraindividual (within-person) perspective, especially regarding motivation, has been rarely applied. This study aimed to disentangle the basic needs of 115 preservice teachers into their trait-like, interindividual and state-like, intraindividual proportions using biweekly measurement occasions. This analytical approach allowed us to relate preservice teachers' situational basic needs satisfaction to specific learning occasions in the practicum. Applying a random intercept cross-lagged panel model, we found generally few carry-over effects from measurement occasion to measurement occasion. Furthermore, negative cross-lagged interrelations between competence and autonomy as well as competence and relatedness were found at the beginning of the teaching practicum. School mentoring predicted the general satisfaction of all three basic needs. Implications of this new analytical perspective for further research are discussed.

Miriam F. Jähne and Mathias Dehne share the first authorship of this publication.

Miriam F. Jähne (✉) · Mathias Dehne (✉) · Susi Klaß · Alexander Gröschner
Faculty of Social and Behavioral Sciences, Friedrich Schiller University Jena, Am
Planetarium 4, 07743 Jena, Germany
E-Mail: miriam.francesca.jaehne@uni-jena.de; mathias.dehne@uni-jena.de

Keywords Self-determination theory · Mentoring · Teaching practicum · Preservice teacher education · Cross-lagged analysis

Befriedigung von Grundbedürfnissen während des Praxissemesters: Intraindividuelle Perspektiven auf die Motivation von Lehramtsstudierenden und interindividuelle Zusammenhänge zum Mentoring

Zusammenfassung Lernen im Praxissemester ist im hohen Maße intraindividuell. Dieser dynamische Prozess wurde jedoch bisher vor allem durch interindividuelle statistische Verfahren untersucht, während eine intraindividuelle Perspektive, insbesondere hinsichtlich motivationaler Konstrukte, selten angewandt wurde. Ziel der Studie war es, psychologische Grundbedürfnisse von angehenden Lehrpersonen zu untersuchen, indem diese in ihre interindividuellen und intraindividuellen Bestandteile partitioniert werden. Hierzu wurden insgesamt 115 Lehramtsstudierende zweiwöchentlich während des Praxissemesters befragt. Dieser analytische Ansatz ermöglichte es, die situative Erfüllung psychologischer Grundbedürfnisse von Lehramtsstudierenden mit spezifischen Lernanlässen im Praktikum in Beziehung zu setzen. Analysen mithilfe eines Random Intercept Cross-Lagged Panel Modells zeigten insgesamt geringe Übertragungseffekte der Befriedigung der Grundbedürfnisse von Messzeitpunkt zu Messzeitpunkt. Darüber hinaus traten zu Beginn des Praxissemesters negative Zusammenhänge zwischen Kompetenz und Autonomie sowie zwischen Kompetenz und sozialer Eingebundenheit auf. Das Mentoring an den Praktikumschulen sagt die allgemeine Befriedigung aller drei Grundbedürfnisse voraus. Die Implikationen dieses neuen analytischen Ansatzes für die weitere Forschung werden diskutiert.

Schlüsselwörter Selbstbestimmungstheorie · Mentoring · Praxissemester · Lehrerbildung · Cross-Lagged Analyse

1 Introduction

Preservice teachers (PSTs) experience multiple learning situations (e.g., in class, with a mentor teacher, or with the school principal) during their teaching practica (Clarke and Collins 2007). Recently, research has focused on PSTs' motivations in various learning situations (Ranellucci et al. 2020; Ulrich et al. 2020). Considering possible sources of tension (e.g., first teaching experiences, incoherence between school and university mentoring, and multiple lesson preparations) that PSTs are confronted with in a teaching practicum, the question arises of how they experience self-determined motivation (Ryan and Deci 2000) during this time and if their motivations change. The influence of learning experiences on motivational outcomes has been widely acknowledged by motivation theories, such as social cognitive theory (Tschannen-Moran et al. 1998) and situated expectancy-value theory (Eccles and Wigfield 2020). Previous research has shown that learning opportunities that foster self-determined motivation—for instance, autonomy-supportive interventions

(Perlman 2011) or self-determination-supportive university courses (Karaarslan et al. 2014)—support PSTs' learning to teach as well as their intrinsic motivation and beliefs about themselves. Thus, school mentoring is relevant for strengthening PSTs' self-determined motivation and for satisfying their basic needs (Burger et al. 2021).

Learning is a highly intraindividual process (Molenaar 2004). Therefore, recent research highlights state-like, intraindividual dynamics (e.g., situated expectancy-value theory; Eccles and Wigfield 2020) in addition to the more common trait-like, interindividual perspective (Molenaar 2004). Within teacher education, researchers aim to monitor the state-like, intraindividual dynamics of learning, for example, in a teaching practicum (Rupp and Becker 2021). This is relevant for gaining knowledge on how to improve teaching practica as a powerful learning experience for novice teachers (Ulrich et al. 2020). In this context, there is increasing evidence of how mentoring affects PSTs' self-efficacy beliefs intra- and interindividually through contextual factors or discourse strategies (Klassen and Durksen 2014; Rupp and Becker 2021). From a methodological perspective, there is especially a need for longitudinal designs with multiple measurement occasions (Bardach and Klassen 2021), through which researchers can make assumptions about these state-like, intraindividual learning processes and interrelated motivational beliefs.

The present study contributes new evidence to the existing methodological research gap by applying a panel design with biweekly measurements to capture the state-like, intraindividual dynamics from previous and subsequent measurement occasions with regard to the three basic needs—competence, autonomy, and relatedness—over the course of a teaching practicum. Furthermore, this study explores the influence of the satisfaction of the three basic needs on each other on a state-like level. Additionally, we examine the influence of the overall perceived mentoring quality in the school and university on PSTs' generally experienced levels of the three basic needs. Thus, we aim to contribute new knowledge about PSTs' state-like, intraindividual learning processes and trait-like, interindividual learning outcomes in a teaching practicum.

2 Theoretical background

2.1 Self-determination theory

Self-determination theory (SDT) explains developmental and situational features of the interaction of socio-contextual factors and a person's motivation (Ryan and Deci 2000; Vansteenkiste et al. 2020). Self-determined motivation is enhanced when the three basic psychological needs—competence, autonomy, and relatedness—are satisfied (Ryan 1995). Basic Psychological Need Theory is referred to as a central mini-theory within SDT (Vansteenkiste et al. 2020) and its basic psychological needs are “assumed to represent the underlying motivational mechanism that energizes and directs people's behaviour” (Van den Broeck et al. 2010, p. 982). Besides their importance for self-determined motivation, basic psychological needs are believed to be beneficial to an individual's adjustment, integrity, and growth (Ryan 1995). Whether the basic needs are satisfied and what consequences arise from the extent

of the satisfaction largely depend on the social context. One pivotal aspect of SDT is that intrinsic motivation is viewed as a person's *situational capacity* (Ryan et al. 2021). In this regard—and as part of a burgeoning interest in basic psychological needs—studies have increasingly started to view basic needs in a dynamic and bidirectional interface (Vansteenkiste et al. 2020). With a few exceptions (e.g., Aldrup et al. 2017; Smit et al. 2021), dynamical interrelations have not yet been adopted in teacher education. Next, we summarize key findings on PSTs' basic psychological needs and extend the abovementioned claims of SDT to the teaching practicum. SDT has been connected to educational contexts, especially regarding students at school (Jang et al. 2012; Niemiec et al. 2010), where autonomy-supportive teaching enhances various personal facets and learning processes as well as outcomes (Reeve et al. 2004). In this context, spillover effects within basic needs satisfaction and perception have been reported (Jang et al. 2012). Although less studied, basic needs satisfaction has been revealed to be important for PSTs' and beginning teachers' own learning. Aldrup et al. (2017) showed that the satisfaction of competence and relatedness to their students mediates the relationship between stress exposure and well-being for beginning teachers on an intraindividual level.

Smit et al. (2021) investigated PSTs' feelings of competence and motivation in a teacher education course with the scope of preparing PSTs to conduct laboratory experiments in biology on a state-like, intraindividual level. Using a dynamic structural equation modeling approach, Smit et al. showed how PSTs' previous motivation related to their subsequent momentary motivation (carry-over effects) and how previous feelings of competence were negatively correlated with momentary motivation (spillover effects) within a course unit (beginning and end). The findings indicate that PSTs are likely to return to a situation with their set point of high or low momentary motivation. When PSTs, in turn, showed higher/lower competence, this led to subsequent lower/higher motivation on a state-like, intraindividual level. A sawtooth pattern was found based on negative autoregressive coefficients for competence, suggesting anti-persistence, which means that PSTs showed back-and-forth shifting in their momentary motivation. The authors concluded that every session provided new challenges for PSTs.

Similarly, studies by Korthagen and Evelein (2016) and Perlman (2011) revealed that PSTs' experience of basic needs satisfaction influences teaching behavior—for instance, motivating and effective behaviors—on a trait-like, interindividual level. Karaarslan et al. (2014) showed that interventions that are structured in light of SDT enhance PSTs' motivations for environmental contents. In the following paragraphs, we refer to these basic needs in more detail and relate them to preservice teachers' learning in the teaching practicum.

Competence, defined as the experience of effectiveness and mastery (Vansteenkiste et al. 2020), involves several ever-changing components during a teaching performance (Blömeke et al. 2015). Research on PSTs' competence fulfillment has shown a dynamic interplay between competence and motivation on a state-like, intraindividual level. This finding can be extended to the teaching practicum, where—as in Smit et al.'s (2021) study—explicit hands-on experiences are pivotal for gaining competence and needs fulfillment. However, experiences of mastery may not occur in a positive linear direction across different situations in the teaching practicum

(Rupp and Becker 2021). Rather, PSTs experience gains and losses, indicating that the teaching practicum provides different and sometimes challenging situations that make it difficult to develop stable competencies. This expected fluctuation also relates to mentoring style (Rupp and Becker 2021).

Research on *relatedness* has defined this basic universal need as an overall feeling of belonging (e.g., “I feel connected to my students”; Klassen et al. 2012). While different interpersonal relationship qualities should not be equated with the need for relatedness, poor relationships are harmful to teachers’ sense of relatedness (Spilt et al. 2011). One’s evaluations of interpersonal relationships are unique, dyadic, and thus related to *certain persons* rather than a whole community (Pianta et al. 2003). PSTs might, for instance, seek an affectional bond with their principal, impacting their professional and personal well-being (Peters and Pearce 2012). Teaching practica pose a much more challenging condition to the need for relatedness. Spilt et al. (2011) argued that “the time spent in the proximity of students probably triggers ... [a teacher’s] desire for unity and togetherness with students” (p. 465). Frequent changes to the classes in which PSTs teach during the teaching practicum, often in a relatively short period of time, are maladaptive for building a stable and secure base with colleagues, mentors, and students (cf. Spilt et al. 2011). As a result, we assume the fulfillment of the need for relatedness to be dynamic on a state-like, intraindividual level over time.

Autonomy is PSTs’ most prominent need in their teaching practicum. It is fulfilled when PSTs “experience that they can be authentic, have room for their own ideas and choices, and can develop accordingly” (Korthagen and Evelein 2016, p. 235) while teaching. Throughout the teaching practicum, PSTs increasingly strive for autonomy. From our experience, some PSTs have the opportunity very early to teach autonomously based on their interests and values, for instance, due to a lack of teachers for certain subjects. For other PSTs, however, this may take much longer. Besides these school-contextual factors, the role of mentoring styles must be considered (Mena et al. 2016). Constructivist mentoring lowers beginning teachers’ levels of emotional exhaustion by supporting their autonomy needs fulfillment, indicating that more collaborative mentors support mentees’ autonomy and mental health while they transition to the teaching profession (Burger et al. 2021). Adaptive mentoring, which can be seen as a primer for a more intraindividual perspective on PST learning, has drawn much attention in recent years (Van Ginkel et al. 2016). This perspective highlights the situational impact on PSTs’ needs fulfillment, especially when Vvan Ginkel et al.’s (2016) notion of the individual adaption toward PSTs’ emotional states or adapting the mentoring conversation to the mentee’s reflective capacity is considered (Kuhn et al. 2022). Specifically, the latter has been underpinned by a recent intraindividual study by Rupp and Becker (2021). Based on this evidence, we assume that autonomy fluctuates from situation to situation during the teaching practicum.

Although basic needs satisfaction has been studied in the early stages of the teaching career (e.g., Aldrup et al. 2017), there are, to our knowledge, no studies available that capture how basic needs satisfaction naturally develops over the course of a teaching practicum. With a random-intercept cross-lagged panel analysis, we build on Smit et al.’s (2021) relatively new approach to modeling carry-over and

spillover effects in teacher education and examined bidirectional influences of basic needs satisfaction during the teaching practicum.

2.2 Learning during a teaching practicum

A teaching practicum is a practical opportunity for teacher students to gather mastery and vicarious experiences and is widely integrated in teacher education curricula (Gröschner et al. 2015). More precisely, it aims at the development of competences, professional identity, and motivation in PSTs (Hascher and Hagenauer 2016). Those qualities can be developed both as learning in progress and as learning outcomes. Affective-motivational learning, especially regarding opportunities to learn to teach, is regularly rated highly by PSTs (Ulrich et al. 2020). With a look at how different variables affect PST learning, the offer-and-use model (Hascher and Kittinger 2014) shows that both external offers (e.g., mentoring quality and quantity of learning offers) and internal competences (e.g., motivational, emotional, and cognitive) to use these offers influence PSTs' learning outcomes in a teaching practicum. To support the use of both school and university offers, strong collaboration between all involved institutions is needed (Gröschner 2019).

The learning outcomes of a teaching practicum can be viewed from both state-like, intraindividual and trait-like, interindividual perspectives. Previous research thoroughly used trait-like, interindividual approaches, which are based on sample means, to explain learning in a teaching practicum (Lawson et al. 2015) as well as its enhancement through various interventions (e.g., collaborative coaching and video feedback; Kleinknecht and Gröschner 2016; Prilop et al. 2020). Regarding a differential learning perspective for PSTs in a teaching practicum (Festner et al. 2020), in the present study, we aimed at an expanded view by taking into account state-like, intraindividual aspects of PSTs' motivation as well as the influence of external offers on PSTs' learning.

2.3 The role of intraindividual learning processes

Every learning process is highly intraindividual, with variations in success and relationships with affective-motivational aspects. In order to design teaching practica and associated learning opportunities (e.g., school and university mentoring) appropriately, research needs to gain further knowledge on the development of PSTs' learning. This includes knowledge on the state-like, intraindividual dynamics of PSTs' learning and on the situations affecting these dynamics. Previous research has viewed those state-like, intraindividual learning processes mainly as processes that can be described through interindividual, *ergodic* means (i.e., averages such as differences and changes in sample-based means). The *nonergodic* approach stresses the need to explicitly model intraindividual variation on a state-like level. Otherwise, imprecise interpretations can arise, as interindividual analyses describe trait-like levels and, therefore, lead to substantially different results (Molenaar 2004) and a potential loss of credibility in research (Moeller 2021). Therefore, statistical approaches that clearly partition state-like, intraindividual and trait-like, interindividual variance (e.g., multilevel modeling) are needed. Furthermore, Bardach and Klassen

(2021) argued that intraindividual assumptions regarding teacher motivation need to be made from research designs “to map dynamics in teacher motivation ... [and gain] a more thorough understanding of the stability versus variability of teacher motivation” (p. 10).

Within teacher education, researchers have also come across various challenges. With a few exceptions (e.g., Rupp and Becker 2021), most studies aiming to disentangle inter- and intraindividual levels of analysis have focused mainly on trait-like, interindividual differences. The state-like, intraindividual variation of self-determined motivation has not yet been studied. More generally, PSTs’ state-like, intraindividual learning processes widely lack an adequate statistical control for trait-like, interindividual differences. Moreover, state-like, intraindividual learning perspectives have rarely been investigated longitudinally during a teaching practicum (see Festner et al. 2020). Thus, the present study applies a longitudinal panel design with biweekly measurements of PSTs’ basic needs satisfaction during a six-month teaching practicum.

2.4 The influence of mentoring on motivation

School and university mentoring are central to the effectiveness of a teaching practicum (Crasborn and Hennissen 2010; Gröschner et al. 2013; Ronfeldt and Reininger 2012). School mentoring is regarded as highly relevant for the development of skills needed in the future profession (Lawson et al. 2015). Its quality is reported to be related to dimensions of PSTs’ emotional and psychological well-being (e.g., perceived availability or levels of anxiety; Hobson et al. 2009) during a teaching practicum. In their mixed-methods study, Klassen and Durksen (2014) argued that interactions with the school mentor influence self-efficacy growth. Rupp and Becker (2021) supported this claim in their longitudinal study, which found that student-teacher orientation, as one discourse element of lesson conferences with school mentors, predicts fluctuations in PSTs’ self-efficacy. University mentoring has been especially shown to influence PSTs’ knowledge acquisition (König et al. 2018) and self-efficacy (Ulrich et al. 2020). Beyond this, results concerning the impact of university mentoring on preservice teachers’ learning are less consistent.

With regard to basic needs satisfaction, Korthagen and Evelein (2016) claimed that less pressure by both university mentors and mentor teachers at placement schools, small but stimulating tasks, and assistance with building positive relationships with students may positively affect PSTs’ experiences of autonomy, competence, and relatedness. Further research claims that mentoring quality and style affect PSTs’ experiences of empowered motivation (Lin et al. 2019) and autonomy (Burger et al. 2021), respectively, as well as a feeling of belonging with all parties involved in a teaching practicum (Jähne and Gröschner 2021). Furthermore, PSTs tend to use their mentors as role models for their teaching (Boecker 2017). The success and aptness of this role taking may influence whether PSTs feel competent in their own teaching. However, the contribution of both university and school mentoring on PSTs’ basic needs satisfaction has not yet been studied. The present study examines how the generally experienced mentoring quality affects the general trait-like satisfaction of PSTs’ basic needs.

2.5 Aim of the study

The aim of the present study is to investigate both state-like, intraindividual learning processes and trait-like, interindividual learning outcomes (by mentoring at school and in the university) during a teaching practicum. This study focuses on the under-explored role of basic needs satisfaction among PSTs and seeks to gain knowledge of the interrelationships between the three basic needs. The following research questions are addressed:

- (RQ1) During a teaching practicum, how much do PSTs differ in their basic needs satisfaction on a state-like, intraindividual level compared to a trait-like, interindividual level?
- (RQ2) How does the satisfaction of PSTs' basic needs relate on a state-like, intraindividual level with regard to carry-over and spillover effects in basic needs? *We expect the satisfaction of basic needs to rather fluctuate (i.e., to find only a few carry-over or spillover effects). (Hypothesis a)*
- (RQ3) How does the quality of school and university mentoring affect PSTs' basic needs satisfaction on a trait-like, interindividual level? *We expect effects of school-based mentoring on a trait-like, interindividual level on the satisfaction of basic needs. (Hypothesis b)*

3 Method

3.1 Sample

The sample consisted of 115 PSTs ($M_{\text{age}} = 22.22$, $SD = 3.27$; 50.5% female; 77.86% of the full cohort) in their third academic year who attended a six-month teaching practicum in a German secondary teacher education program. Data were gathered in the winter term of 2018/19. Our sample comprised PSTs studying all available subjects (i.e., STEM, language arts, music education, and physical education).

The teaching practicum lasted six months from the end of August until February. For this, PSTs were assigned to one placement school each for the entire teaching practicum. There was usually a maximum of two or three PSTs assigned to one school. Following an initial introductory session in August, PSTs had a two-month run-in period in which they only taught (without taking accompanying campus courses in educational sciences; Fig. 1). After this (Week 0), PSTs spent four days a week teaching, and they attended biweekly campus courses in educational sciences. One of the courses focused on teacher-student interactions for all student teachers. In addition, during weeks without courses in educational sciences, PSTs attended subject-specific courses and courses that provided an introduction to the school context. PSTs completed different online assignments over the course of the teaching practicum for each session and submitted a portfolio at the end of the teaching practicum. While on campus, PSTs attended two courses with an approximate duration of two hours each.

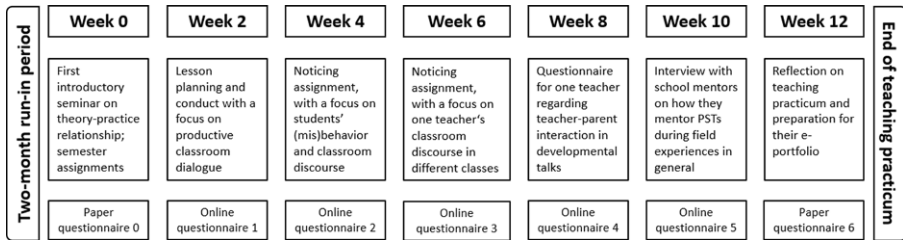


Fig. 1 Study Design Over the Course of PSTs' Teaching Practicum

3.2 Data collection and instruments

Data collection was authorized by the Thuringian Ministry of Education and carried out during winter semester 2018/19. We collected data on PSTs' basic needs in each of the biweekly campus courses with seven measuring points. Additionally, we collected time-invariant covariates (such as school and university mentoring quality) at the end of the teaching practicum. The first and the last surveys were filled out via a paper-and-pencil questionnaire. The five middle surveys were conducted using an online questionnaire (Fig. 1). Links to the questionnaires were presented to the PSTs on a presentation slide at the end of the campus sessions.

3.2.1 Basic needs

Basic needs satisfaction during the last week of each measurement occasion was assessed by an established instrument (Korthagen and Evelein 2016). PSTs were instructed to rate their basic needs satisfaction during the final week using a 1 (*does not apply at all*) to 5 (*applies exactly*) scale. Internal consistencies (Cronbach's α) were satisfactory for competence (five items, "I feel that I was successful in completing difficult tasks," Cronbach's $\alpha_{T0-T7}=0.78-0.89$), relatedness (four items, "I feel a connection with the students," Cronbach's $\alpha_{T0-T7}=0.84-0.94$), and autonomy (four items, "I feel that my choices were based on my true interests and values," Cronbach's $\alpha_{T0-T7}=0.78-0.92$).

3.2.2 Mentoring quality

We assessed the perceived *school mentoring quality* (adapted from Ronfeldt and Reininger 2012) through the PSTs' ratings at the end of the teaching practicum using a 1 (*does not apply*) to 6 (*fully applies*) scale. Satisfactory reliability was achieved (12 items, "My mentor teacher provided me with useful feedback about my teaching," Cronbach's $\alpha_{T7}=0.94$). *University mentoring quality* was rated by PSTs at the end of the teaching practicum using a 1 (*totally disagree*) to 4 (*totally agree*) scale. The reliability of this established instrument (Kleinknecht and Gröschner 2016) was good (12 items, "Knowledge gained in campus courses was helpful for my practical schoolwork," Cronbach's $\alpha_{T7}=0.92$). School and university mentoring quality were handled as time-invariant predictor variables (traits).

3.3 Statistical analysis

3.3.1 Random intercept cross-lagged panel models

We computed random intercept cross-lagged panel models (RI-CLPMs) to investigate biweekly fluctuations in PSTs' basic needs satisfaction over the course of the teaching practicum (Hamaker et al. 2015). RI-CLPMs investigate stability and change in interrelated constructs over time. They allow us to learn more about the (intra-individual) mechanisms (e.g., carry-over effects) within state-like, intraindividual dynamics over time and to (interindividually) control for stable trait factors (Usami 2021). Therefore, RI-CLPMs are considered dynamic models that add a multilevel perspective to CLPMs. In RI-CLPMs, variance is accordingly partitioned into within- (state-like, intraindividual) and between- (trait-like, interindividual) person components. This can be expressed as

$$x_{it} = \mu_t + \kappa_i + p_{it} \quad (1a)$$

$$y_{it} = \pi_t + \omega_i + q_{it} \quad (1b)$$

where μ_t and π_t denote time-specific group means, and κ_i and ω_i are person-specific trait-like deviations ($M=0$) from the group means (Hamaker et al. 2015). In contrast, p_{it} and q_{it} are an individual's time-specific deviation from their expected scores ($\mu_t + \kappa_i$ and $\pi_t + \omega_i$), instead of the group means (i.e., μ_t and π_t) used in traditional CLPMs. In structural equation modeling software, these expressions are translated into a stable, trait-like, *between component* (random intercept factor) for κ_i and ω_i , similar to latent growth curve modeling, and a state-like *within component* for p_{it} and q_{it} (Mulder and Hamaker 2021). Structural relationships, in turn, are interpreted as state-like, intraindividual carry-over (i.e., autoregressive paths) or spillover (i.e., cross-lagged paths) effects. The results take on values between -1 and $+1$, with a value of 0 indicating no carry-over/spillover effect. A positive coefficient thus indicates that a measurement occasion in which a person scored above their expected score is likely to be followed by another measurement occasion in which they scored above their expected score (Hamaker et al. 2015). If no carry-over or spillover effects are found, this means that the current deviation from their expected score has no relation to the previous deviation, implying that a strong dynamic exists in which a PST returns to his/her expected score after a high/low score (Smit et al. 2021). We interpreted the effect sizes via correlational coefficients and β coefficients with indicators for small ($0.10 \leq \beta < 0.30$), medium ($0.30 \leq \beta < 0.50$), and large ($0.50 \leq \beta$) effects.

3.3.2 Model estimation

All models depicted in our results section were estimated with maximum likelihood using *Mplus* 8.4 (Muthén and Muthén 1998–2021), as indicator variables showed values for skew and kurtosis within the limits of -1.5 and $+1.5$ (Tabachnick and Fidell 2013). Missing data were addressed using full information maximum likelihood after ensuring that they were missing completely at random across time. To reduce

the number of parameters and ensure that the models were identified, we computed RI-CLPMs with two variable sets each (e.g., competence and relatedness), which is common practice in comparable studies (Moeller et al. 2022). This directly translated to three model fit indices each for RQ2 and RQ3 (2×3 models and respective fit indices). As deviations of the measuring intervals (due to school closure in winter) were expected, equality constraints were not imposed on the parameters over time. In line with Little (2013), we evaluated the χ^2 statistic, the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). Models were considered using the Hu and Bentler (1999) cutoff criteria for fit indices. Accordingly, CFI values ≥ 0.90 or ≥ 0.95 were considered an acceptable or excellent model fit, respectively. Furthermore, Hu and Bentler consider an RMSEA of less than 0.06 a good fit, whereas Little (2013) argued that also values of 0.05–0.08 reflect an acceptable fit in longitudinal structural equation modeling.

4 Results

4.1 Descriptive statistics and data screening

The descriptive statistics are depicted in Table 1. Prior to the analyses, we tested the data for outliers and patterns in PSTs' responses. Then, we computed three RI-CLPMs with manifest composite scores as indicator variables. Data analysis scripts and invariance tests (Appendix A) can be obtained via the Open Science Framework (<https://osf.io/bt8hm/>). Covariance coverage (i.e., the percentage of individuals contributing to maximum likelihood-based variance and covariance) was low for two measurement occasions with low attendance ($n_{t2} = 43$; $n_{t3} = 40$), resulting in *Mplus* issuing a warning that the standard errors for the H1 estimated sample statistics could not be computed. Therefore, these two measurements were excluded from further analyses. Therefore, we were unable to meaningfully impose invariance constraints for autoregressive paths, as there was also a slightly longer interval for t4 and t5, where the interval between the two seminars was two weeks in terms of school practice but four weeks in terms of the actual time period. Variation in participation for the remaining measurement points over time ($n_{min} = 53$, $n_{max} = 99$) also resulted in underpowered analyses (Power ~ 0.40 ; Mulder n.d.). We carefully considered these circumstances in our interpretation of the results.

4.2 Differences in basic needs satisfaction on a state-like, intraindividual and trait-like, interindividual level (RQ1)

Regarding RQ1, the ICC coefficients revealed equal proportions of variance on the state-like, intraindividual (within-person) level and the trait-like, interindividual (between-person) level for all three basic needs (ICCs = 0.45–0.55). These results indicate that PSTs differ on the state-like, intraindividual level in their basic needs satisfaction about as much as they differ on the trait-like, interindividual level. Therefore, it was important to consider the multilevel structure in all subsequent analyses

Table 1 Descriptive Statistics of Competence, Autonomy, Relatedness, and Mentoring Quality

	<i>n</i>	<i>M</i>	<i>SD</i>	Skewness	Kurtosis
<i>Competence</i>					
t0	99	3.65	0.54	-0.43	0.71
t1	75	3.73	0.49	-0.19	0.54
t4	53	3.86	0.60	-0.37	0.70
t5	70	3.88	0.55	-0.53	0.33
t6	97	3.95	0.60	-1.24	4.49
<i>Autonomy</i>					
t0	97	3.86	0.64	-0.33	0.14
t1	75	3.93	0.51	-0.11	-0.22
t4	53	4.00	0.76	-0.68	0.12
t5	70	3.85	0.75	-0.21	-0.47
t6	97	3.98	0.77	-0.91	1.22
<i>Relatedness</i>					
t0	97	3.98	0.65	0.00	-0.69
t1	75	4.09	0.54	0.22	-0.55
t4	53	4.07	0.77	-1.17	1.50
t5	70	4.20	0.61	-0.59	0.92
t6	97	4.15	0.77	-1.30	2.53
<i>Mentoring</i>					
University	92	2.29	0.63	-0.15	-0.82
School	93	4.26	1.07	-0.90	0.21

to consider both state-like, interindividual dynamics and trait-like, intraindividual differences in PSTs' learning during the six-month teaching practicum.

4.3 State-like intraindividual carry-over and spillover effects in basic needs (RQ2)

All three models (Fig. 2) computed with regard to RQ2 showed satisfactory model fit indices for competence and autonomy (Model A: $\chi^2[21]=11.58, p=0.95, CFI=1.00, RMSEA=0.00$), competence and relatedness (Model B: $\chi^2[21]=26.42, p=0.19, CFI=0.98, RMSEA=0.05$), and autonomy and relatedness (Model C: $\chi^2[21]=47.12, p<0.001, CFI=0.92, RMSEA=0.10$). Within all three models, residuals were correlated at T4, T5, and T6 ($p<0.001-0.05$). Additionally, competence and autonomy were correlated at T0 ($p<0.001$). Finally, we found high trait-like correlations between the random intercept factors ($r=0.68-0.82, p<0.001$).

The satisfaction of all three basic needs showed no carry-over effects—e.g., state-like dynamics from previous to subsequent basic needs satisfaction—during the teaching practicum, with a few exceptions (see Appendix B for all coefficients, <https://osf.io/yxpb2>). For competence, there was one carry-over effect from T5 to T6 ($\beta_{T5-T6}=0.36-0.40, p=0.04$). For autonomy, the paths from T4 to T5 and from T5 to T6 showed significant carry-over effects ($\beta_{T4-T5}=0.47-0.61, p<0.001-0.01$;

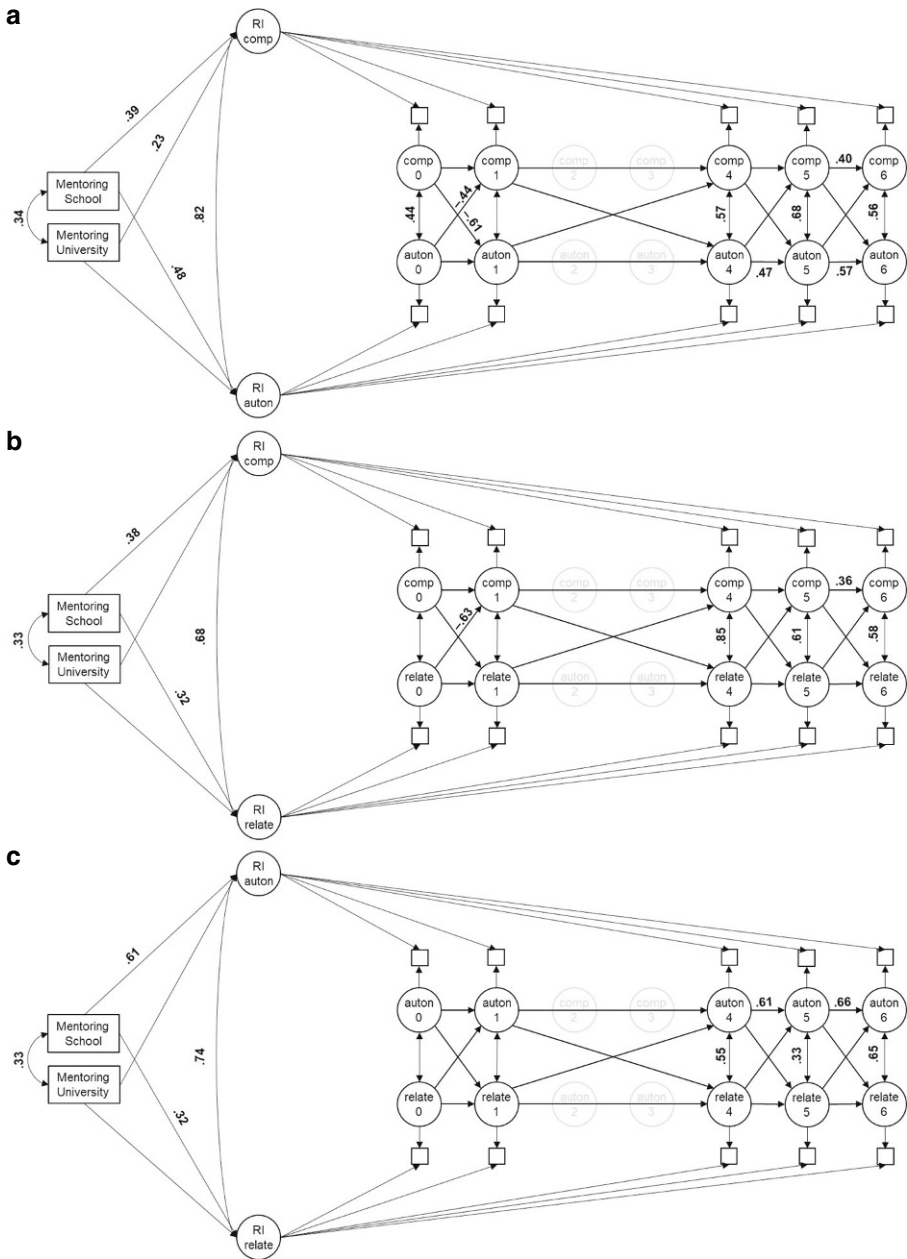


Fig. 2 Carry-Over Effects, Spillover Effects, and Residual Correlations for the RI-CLPMs. *Note.* Only significant paths are printed. Residual variables were intentionally left out. Estimates for RQ 3 (i.e., the prediction of interindividual differences) were obtained by separate models (see chapter 3.3.2). **a** Model A: competence and autonomy; **b** Model B: competence and relatedness; **c** Model C: autonomy and relatedness. *Comp* competence, *auton* autonomy, *relate* relatedness. *RI* refers to the respective random intercept factor

$\beta_{T5-T6}=0.57-0.66, p<0.001$). Relatedness showed no carry-over effects during the teaching practicum.

Furthermore, there were significant negative spillover effects (i.e., state-like, bidirectional influences between the satisfaction of different basic needs) between all three basic needs at the beginning of the teaching practicum. Competence at T0 negatively predicted autonomy at T1 ($\beta_{T0-T1}=-0.61, p=0.01$). Autonomy at T0 in turn negatively predicted competence at T1 ($\beta_{T0-T1}=-0.44, p=0.03$). Additionally, relatedness at T0 negatively predicted competence at T1 ($\beta_{T0-T1}=-0.63, p=0.02$). Fig. 2 presents an overview of all significant coefficients per Models A–C.

4.4 Trait-like, interindividual associations to mentoring quality in school and university (RQ3)

All three models (Fig. 2) with regard to RQ3 showed satisfactory model fit indices for competence and autonomy (Model A: $\chi^2[37]=29.36, p=0.81, CFI=1.00, RMSEA=0.00$), competence and relatedness (Model B: $\chi^2[37]=45.50, p=0.16, CFI=0.97, RMSEA=0.05$), and autonomy and relatedness (Model C: $\chi^2[37]=63.47, p=0.004, CFI=0.92, RMSEA=0.08$). To assess the relationship between mentoring and basic needs satisfaction on a trait-like, interindividual level, mentoring at school and in the university was examined as a predictor of the generally experienced satisfaction of each of the three basic needs. Predictors were entered jointly in the RI-CLPMs. The self-evaluated school mentoring quality predicted PSTs' basic needs satisfaction (competence: $\beta=0.38-0.39, p<0.01$; autonomy: $\beta=0.48-0.61, p<0.001$; relatedness: $\beta=0.32, p<0.01$). In contrast, the self-evaluated quality of university mentoring did not predict any of the basic needs (competence: $\beta=0.18-0.23, p=0.049-0.12$; autonomy: $\beta=0.06-0.08, p=0.55-0.64$; relatedness: $\beta=0.10-0.11, p=0.37-0.41$). Perceived school and university mentoring quality showed moderate intercorrelations ($r=0.33-0.34, p=0.001$). Fig. 2 provides an overview of the estimates for Models A–C.

5 Discussion

Research has increasingly investigated various aspects of PSTs' learning and motivation during a teaching practicum. A teaching practicum generally supports PSTs' motivation through individual hands-on experiences (Hascher and Hagenauer 2016). However, previous studies did not differentiate state-like, intraindividual dynamics and trait-like, interindividual differences in PSTs' learning and motivation. This study contributes new findings to address the lack of research by examining both state-like, intraindividual and trait-like, interindividual aspects of PSTs' self-determined motivation during a six-month teaching practicum. To do so, we used an RI-CLPM approach and a longitudinal panel design (Hamaker et al. 2015).

On a state-like, intraindividual level, we found few bidirectional effects between different basic needs over time (spillover effects) with medium to large effect sizes, which may underlie PSTs' state-like, intraindividual learning processes. Furthermore, we found medium to large effects of previous to subsequent basic needs

satisfaction over time (carry-over effects). Hence, our results support—on a trait-like, interindividual level—the claim that school mentors’ supportiveness and effectiveness are central to PSTs’ learning in this field (Burger et al. 2021).

5.1 Dynamics in basic needs satisfaction

We found a few effects from previous to subsequent basic needs satisfaction on a state-like, intraindividual level over time. With regard to the offer-and-use model of the teaching practicum (Hascher and Kittinger 2014), the longitudinal design of this study indicates that “offers” (by mentor teachers) and “uses” (by PSTs) change during a teaching practicum. As offers and uses influence the development of PSTs’ learning outcomes, associated learning processes are expected to change when new phases or situations occur in a teaching practicum. In our study, autonomy and competence were relatively stable at the end of the teaching practicum, whereas relatedness dynamically changed throughout the entire period.

The relative stability of competence at the end of the teaching practicum may be attributed to the increase in experience through hands-on activities throughout the practicum. Especially at the end, PSTs often experience their own teaching competence for the first time and develop some routines with their classes and with their mentor teachers—for instance, regarding lesson planning and dealing with feedback (Prilop et al. 2020). Similarly, PSTs’ ability to actively influence activities in the classroom (e.g., via autonomous lesson planning) over the course of a teaching practicum is associated with higher self-efficacy (Klassen and Durksen 2014). Consequently, PSTs are more often allowed to make their own—autonomous—choices at the end of their teaching practicum and to plan and teach lessons increasingly on their own (Gröschner et al. 2013). These carry-over effects at the end of the panel study could have been alternatively attributed to initial elevation bias, which is quite common in the responsiveness of participants across a series of measurement occasions and describes initially higher responses and late stabilization (Shrout et al. 2018). This phenomenon has also been described with regard to PSTs’ expectancies and values during a teaching practicum (Dehne et al. 2018). However, PSTs’ relatedness to their students during a teaching practicum remained variable across time. Relatedness has been described as an “underemphasized component of teachers’ basic needs” (Klassen et al. 2012, p. 150), so our research consequently contributes knowledge with regard to this dimension. Our findings may be attributed to both the frequent changing of class for which they are responsible over the course of the teaching practicum and the long process required to bond with students (Košir and Tement 2014). Additionally, PSTs are always at risk of being regarded by their students only as interim teachers, as they are at the very beginning of their career (Ronfeldt et al. 2020). As a result, PSTs may struggle to create and maintain a feeling of relatedness to their students. Nonetheless, research exposed beginning teachers’ relatedness to students as a mediator of stress exposure and well-being (Aldrup et al. 2017). As such, the role of carry-over effects on PSTs’ relatedness to their students should be further studied. Still, further research needs to pinpoint how the state-like, intraindividual dynamics in basic needs satisfaction align with specific phases and situations in a teaching practicum.

5.2 Bidirectional associations between basic needs satisfaction and their implications

The present study addresses the lack of longitudinal research using multiple measurement occasions for teacher motivation (Bardach and Klassen 2021). The examination of state-like, intraindividual dynamics of reciprocal and reversed relationships aims to understand the directionality and causality of the relationships between the variables (Kuppens and Myin-Germeys 2021). Negative bidirectional influences between basic needs require further explanation, as these occurred relatively unexpectedly. It can be assumed that PSTs feel more competent at the beginning of the teaching practicum, while they are still observing (e.g., the lessons of their mentor teachers) rather than teaching lessons. Furthermore, encountering their own teaching experiences can help teacher students to realize a discrepancy between the often-idealized assessment of their own teaching skills and the challenges they may encounter in a real classroom (Jähne and Gröschner 2021). Similarly, when mentor teachers, at the beginning of the practicum, expect PSTs to follow their instructional practices more strictly, the mentee will feel less autonomous but more competent in coping with the complex new school environment (Ulrich et al. 2020). In addition, intraindividual research has drawn attention to the complex interplay between the valence of events, past disruptive behaviors, and teacher emotions (de Ruiter et al. 2020). Such interplays might also take place with regard to PSTs' feelings of relatedness, which needs to be further examined. The negative relationship between relatedness and subsequent competence at the beginning of the teaching practicum may be attributed to the reception of PSTs at their respective schools and the engagement provided by their mentors to support them (Jähne and Gröschner 2021). PSTs also relate to peers during the teaching practicum, which may hinder or support the feeling of relatedness when they share (e.g., during a university course) their experiences of their placement schools (Lawson et al. 2015).

Further research is needed to examine the mechanism of these relationships in more detail. For example, how competent do PSTs usually feel at the beginning of the teaching practicum? Does a strongly led mentoring approach further strengthen this feeling, or does a feeling of competence arise from stricter guidance? What role does the relationship with their students play in improving PSTs' feelings of competence? To better understand the underlying mechanisms, in-depth empirical approaches could be used to explore varying contexts through more measurement points and shorter time intervals (Kuppens and Myin-Germeys 2021) while ensuring that this already busy aspect of teacher preparation is not overloaded. However, the new finding on bidirectional (spillover) influences can be interpreted as a particular strength of the RI-CLPM. Additionally, research needs to capture the influence of mentoring on a state-like, intraindividual level to consider in-the-moment associations—for instance, by adaptive mentoring (Rupp and Becker 2021; Van Ginkel et al. 2016).

5.3 The relevance of mentoring for PSTs' basic needs satisfaction

School mentoring—but not university mentoring—was related to PSTs' general basic needs satisfaction during the teaching practicum on a trait-like, interindividual level with medium to large effect sizes. The relationship between school mentoring and PSTs' learning outcomes aligns with previous research that found school mentors to be central to PSTs' motivation and emotions (e.g., Kuhn et al. 2022; Lin et al. 2019).

In previous research, mentoring quality—especially at school—has been assessed as heterogeneous (Clarke and Mena 2020). Thus, different learning opportunities in a mentor-mentee relationship (Hobson et al. 2009) and styles of mentoring (Gröschner and Häusler 2014; Mena et al. 2016; Van Ginkel et al. 2016) are needed to help properly prepare mentor teachers in school. Otherwise, unfavorable school mentoring may negatively affect PSTs' general satisfaction of their basic needs or convey unfavorable techniques to them (Hobson et al. 2009). However, the longevity and impact of such learning outcomes—whether positive or negative—has yet to be studied.

The finding that university mentoring is not significantly related to PSTs' basic needs satisfaction indicates that motivational aspects of learning processes during the teaching practicum have a rather strong situational component, which is linked to learning opportunities in the placement school instead of campus courses. Concerning the discussion of the role of theory and practice during a teaching practicum, university mentoring is often regarded as detached from teaching practice in school (Gröschner 2019). PSTs usually do not attribute experiences to the learning in university mentoring when there is no explicit relation—for instance, in video-based reflections of their own teaching experiences with peers or lecturers (Kleinknecht and Gröschner 2016). Two conditions need to be considered here: first, all items assessing PSTs' basic needs had a clear instructional or student-related focus, and second, PSTs were asked to rate their experiences during the last week. This instructional focus may explain the gap between campus-based courses and basic needs satisfaction at placement schools. Consequently, the finding that university mentoring did not affect relatedness is not surprising. To capture associated processes for relatedness, we need to shift our focus toward more dyadic designs (cf. de Ruiter et al. 2020).

5.4 Limitations

The use of a longitudinal design and multiple measurement occasions on both state-like, intraindividual and trait-like, interindividual levels are the strengths of this study. The number of measurement occasions and the length of the intervals as an approach to situational measurement are its limitations. To make precise predictions on a state-like level, a thorough experience-sampling design is needed and could be applied in future studies (Kuppens and Myin-Germeyns 2021). Another limitation is related to power. The analyses were underpowered, which has implications for some of the path coefficients with a high magnitude that did not reach a statistically significant level. However, it must be considered that the RI-CLPM is a complex

model, so standard errors are usually higher, which is no sign of biased estimates but relies on the fact that point estimates are less certain (Mulder *n.d.*). Additionally, two measurement occasions had to be excluded due to low participation. As a result, the interpretation of relatively unstable basic needs satisfaction between measurement occasions T1 and T4 should be done with caution. Low participation occurred during times of high workload at both institutions: the school and the university. PSTs prepare their first lessons at school. Therefore, the temporary dropout was traceable. In order to obtain a larger sample and, therefore, have sufficient power for all measurement occasions, multiple cohorts or multiple locations could be recruited and motivated to consistently participate through appropriate incentives. So-called many labs projects would support replicability of intraindividual findings from teaching practica (Klein et al. 2014).

To deal with the different time intervals, parameters were not constrained to be identical over time. A straighter interpretation could be achieved by collecting exact data on the measurement time for each participant and then using a continuous time dynamic modelling approach (Voelkle et al. 2018). Further, the RI-CLPM is advantageous in its separation of state-like, intraindividual and trait-like, interindividual variance. Still, no causal interpretation is possible. This is underlined by the fact that bidirectional effects between different basic needs only occurred between the basic needs at the beginning of the teaching practicum and simultaneously in both directions. The small number of effects could additionally be explained by the large standard errors. This may disguise the effects behind medium to high effect sizes without reaching statistical significance (see Appendix B, <https://osf.io/yxpb2>) and can be approached by increasing the sample size as outlined above. To measure the effect of different mentoring approaches (Mena et al. 2016) on PSTs' basic needs satisfaction, for example, experimental interventions are required. Consequently, controlling for non-systematic effects would require that mentor teachers receive training in close collaboration with university lecturers so that both the school and the university mentors benefit from this closer relationship.

6 Conclusion

The teaching practicum differentially impacts PSTs' motivation throughout its course. Taking a closer look at PSTs' basic needs satisfaction may help to elucidate the role of teaching practica and how PSTs can be best mentored. Although previous research has focused mainly on trait-like, interindividual differences in PSTs' learning, this study highlights the importance of gaining and integrating data on state-like, intraindividual dynamics within PSTs. This knowledge was connected with that of time-variant sources of tension in teaching practica as well as PSTs' time-invariant traits and perceptions. Teacher educators and mentor teachers should consider these time-variant sources of PSTs' basic needs, which largely depend on the school as a complex situational phenomenon.

Funding Funding for this research from the German Federal Ministry of Education and Research (Grant No. 16DHL1023) is gratefully acknowledged.

Funding Open Access funding enabled and organized by Projekt DEAL.

Conflict of interest M. F. Jähne, M. Dehne, S. Klauf and A. Gröschner declare that they have no competing interests.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Aldrup, K., Klusmann, U., & Lüdtke, O. (2017). Does basic need satisfaction mediate the link between stress exposure and well-being? A diary study among beginning teachers. *Learning & Instruction*, *50*, 21–30. <https://doi.org/10.1016/j.learninstruc.2016.11.005>.
- Bardach, L., & Klassen, R. M. (2021). Teacher motivation and student outcomes: searching for the signal. *Educational Psychologist*, *56*(4), 283–297. <https://doi.org/10.1080/00461520.2021.1991799>.
- Blömeke, S., Gustafsson, J.-E., & Shavelson, R. J. (2015). Beyond dichotomies: competence viewed as a continuum. *Zeitschrift für Psychologie*, *223*(1), 3–13. <https://doi.org/10.1027/2151-2604/a000194>.
- Boecker, S. K. (2017). Mentoring in Praxisphasen der Lehrer* innenbildung: Befunde und Forschungsperspektiven für das Praxissemester. In V. Stein, M.-O. Carl & J. Küchel (Eds.), *Mentoring – Wunsch und Wirklichkeit. Dekonstruktion und Rekontextualisierung eines Versprechens* (pp. 63–84). Budrich.
- Burger, J., Bellhäuser, H., & Imhof, M. (2021). Mentoring styles and novice teachers' well-being: the role of basic need satisfaction. *Teaching and Teacher Education*, *103*, 103345. <https://doi.org/10.1016/j.tate.2021.103345>.
- Clarke, A., & Collins, S. (2007). Complexity science and student teacher supervision. *Teaching and Teacher Education*, *23*, 160–172. <https://doi.org/10.1016/j.tate.2006.10.006>.
- Clarke, A., & Mena, J. (2020). An international comparative study of practicum mentors: learning about ourselves by learning about others. *Teaching and Teacher Education*, *90*, 103026. <https://doi.org/10.1016/j.tate.2020.103026>.
- Crasborn, F. J. A. J., & Hennissen, P. P. M. (2010). *The skilled mentor. Mentor teachers' use and acquisition of supervisory skills*. University of Technology.
- Dehne, M., Klauf, S., & Gröschner, A. (2018). Veränderung motivationalener Orientierungen im Praxissemester: Eine videobasierte Studie auf Basis der Erwartungs-Wert-Theorie. *Lehrerbildung auf dem Prüfstand*, *11*(1), 110–133.
- Eccles, J. S., & Wigfield, A. (2020). From expectancy-value theory to situated expectancy-value theory: a developmental, social cognitive, and sociocultural perspective on motivation. *Contemporary Educational Psychology*, *61*, 101859. <https://doi.org/10.1016/j.cedpsych.2020.101859>.
- Festner, D., Gröschner, A., Goller, M., & Hascher, T. (2020). Lernen zu Unterrichten – Veränderungen in den Einstellungsmustern von Lehramtsstudierenden während des Praxissemesters im Zusammenhang mit mentorischer Lernbegleitung und Kompetenzeinschätzung. In I. Ulrich & A. Gröschner (Eds.), *Praxissemester im Lehramtsstudium in Deutschland: Wirkungen auf Studierende*. Edition ZfE, (Vol. 9, pp. 209–241). Springer VS. <https://doi.org/10.1007/978-3-658-24209-1>.
- Gröschner, A. (2019). Zum Verhältnis von „Theorie“ zu „Praxis“: Anknüpfungen an John Dewey sowie Perspektiven für die Gegenwart und die Zukunft der praxisbezogenen Ausbildung von Lehrerinnen und Lehrern. In J. Košinár, A. Gröschner & U. Weyland (Eds.), *Langzeitpraktika als Lernräume – Historische Bezüge, Konzeptionen und Forschungsbefunde* (pp. 41–51). Waxmann.
- Gröschner, A., & Häusler, J. (2014). Inwiefern sagen berufsbezogene Erfahrungen und individuelle Einstellungen von Mentorinnen und Mentoren die Lernbegleitung von Lehramtsstudierenden im Praktikum voraus? In K.-H. Arnold, A. Gröschner & T. Hascher (Eds.), *Schulpraktika in der Lehrerbildung: Theoretische Grundlagen, Konzeptionen, Prozesse und Effekte* (pp. 315–333). Waxmann.

- Gröschner, A., Schmitt, C., & Seidel, T. (2013). Veränderung subjektiver Kompetenzeinschätzungen von Lehramtsstudierenden im Praxissemester. *Zeitschrift für Pädagogische Psychologie*, 27(1), 77–86. <https://doi.org/10.1024/1010-0652/a000090>.
- Gröschner, A., Müller, K., Bauer, J., Seidel, T., Prenzel, M., Kauper, T., & Möller, J. (2015). Praxisphasen in der Lehrerbildung – Eine Strukturanalyse am Beispiel des gymnasialen Lehramtsstudiums in Deutschland. *Zeitschrift für Erziehungswissenschaft*, 18(4), 639–665. <https://doi.org/10.1007/s11618-015-0636-4>.
- Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. P. P. (2015). A critique of the cross-lagged panel model. *Psychological Methods*, 20(1), 102–116. <https://doi.org/10.1037/a0038889>.
- Hascher, T., & Hagenauer, G. (2016). Openness to theory and its importance for pre-service teachers' self-efficacy, emotions, and classroom behaviour in the teaching practicum. *International Journal of Educational Research*, 77, 15–25. <https://doi.org/10.1016/j.ijer.2016.02.003>.
- Hascher, T., & Kittinger, C. (2014). Learning processes in student teaching: Analyses from a study using learning diaries. In K.-H. Arnold, A. Gröschner & T. Hascher (Eds.), *Schulpraktika in der Lehrerbildung* (pp. 221–235). Waxmann.
- Hobson, A. J., Ashby, P., Malderez, A., & Tomlinson, P. D. (2009). Mentoring beginning teachers: what we know and what we don't. *Teaching and Teacher Education*, 25(1), 207–216. <https://doi.org/10.1016/j.tate.2008.09.001>.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>.
- Jähne, M. F., & Gröschner, A. (2021). Kohärenz durch Reflexion? Eine qualitative Analyse zur Bewältigung wahrgenommener Inkohärenzen im Praxissemester. In C. Reintjes, T.-S. Idel, G. Bellenberg & K. V. Thönes (Eds.), *Schulpraktische Studien und Professionalisierung: Kohärenzambitionen und alternative Zugänge zum Lehrberuf* (pp. 19–36). Waxmann.
- Jang, H., Kim, E. J., & Reeve, J. (2012). Longitudinal test of self-determination theory's motivation mediation model in a naturally occurring classroom context. *Journal of Educational Psychology*, 104(4), 1175–1188. <https://doi.org/10.1037/a0028089>.
- Karaarslan, G., Sungur, S., & Ertepinar, H. (2014). Developing preservice science teachers' self-determined motivation toward environment through environmental activities. *International Journal of Environmental and Science Education*, 9(1), 1–19.
- Klassen, R., & Durksen, T. (2014). Weekly self-efficacy and work stress of pre-service teachers during the final teaching practicum: a mixed methods study. *Learning and Instruction*, 33, 158–169. <https://doi.org/10.1016/j.learninstruc.2014.05.003>.
- Klassen, R. M., Perry, N. E., & Frenzel, A. C. (2012). Teachers' relatedness with students: an underemphasized component of teachers' basic psychological needs. *Journal of Educational Psychology*, 104(1), 150–165. <https://doi.org/10.1037/a0026253>.
- Klein, R. A., Ratliff, K. A., Vianello, M., Adams Jr., R. B., Bahník, Š., Bernstein, M. J., . . . , & Nosek, B. A. (2014). Investigating variation in replicability: a “many labs” replication project. *Social Psychology*, 45(3), 142–152. <https://doi.org/10.1027/1864-9335/a000178>.
- Kleinknecht, M., & Gröschner, A. (2016). Fostering preservice teachers' noticing with structured video feedback: results of an online-and video-based intervention study. *Teaching and Teacher Education*, 59, 45–56. <https://doi.org/10.1016/j.tate.2016.05.02>.
- König, J., Rothland, M., & Schaper, N. (Eds.). (2018). *Learning to practice, learning to reflect?* Springer. <https://doi.org/10.1007/978-3-658-19536-6>.
- Korthagen, F. A. J., & Evelein, F. G. (2016). Relations between student teachers' basic needs fulfillment and their teaching behavior. *Teaching and Teacher Education*, 60, 234–244. <https://doi.org/10.1016/j.tate.2016.08.021>.
- Košir, K., & Tement, S. (2014). Teacher-student relationship and academic achievement: a cross-lagged longitudinal study on three different age groups. *European Journal of Psychology of Education*, 29(3), 409–428. <https://doi.org/10.1007/s10212-013-0205-2>.
- Kuhn, C., Hagenauer, G., & Gröschner, A. (2022). “Because you always learn something new yourself!” an expectancy-value-theory perspective on mentor teachers' initial motivations. *Teaching and Teacher Education*, 113, 103659. <https://doi.org/10.1016/j.tate.2022.103659>.
- Kuppens, P., & Myin-Germeys, I. (2021). Possible research questions that can be answered with ESM research. In I. Myin-Germeys & P. Kuppens (Eds.), *The open handbook of experience sampling methodology: a step-by-step guide to designing, conducting, and analyzing ESM studies* (pp. 21–32). Center for Research on Experience Sampling and Ambulatory Methods.

- Lawson, T., Çakmak, M., Gündüz, M., & Busher, H. (2015). Research on teaching practicum—a systematic review. *European Journal of Teacher Education*, 38(3), 392–407. <https://doi.org/10.1080/02619768.2014.994060>
- Lin, Z., Wu, B., Wang, F., & Yang, D. (2019). Enhancing student teacher motivation through mentor feedback on practicum reports: a case study. *Journal of Education for Teaching*, 45(5), 605–607. <https://doi.org/10.1080/02607476.2019.1675355>
- Little, T.D. (2013). *Longitudinal structural equation modeling*. Guilford.
- Mena, J., García, M., Clarke, A., & Barkatsas, A. (2016). An analysis of three different approaches to student teacher mentoring and their impact on knowledge generation in practicum settings. *European Journal of Teacher Education*, 39(1), 53–76. <https://doi.org/10.1080/02619768.2015.1011269>
- Moeller, J. (2021). Averting the next credibility crisis in psychological science: within-person methods for personalized diagnostics and intervention. *Journal for Person-Oriented Research*, 7(2), 53–77. <https://doi.org/10.17505/jpor.2021.23795>
- Moeller, J., Viljaranta, J., Tolvanen, A., Kracke, B., & Dietrich, J. (2022). Introducing the DYNAMICS Framework of moment-to-moment development in achievement motivation. *Learning and Instruction*, 101653. <https://doi.org/10.1016/j.learninstruc.2022.101653>
- Molenaar, P.C.M. (2004). A manifesto on psychology as idiographic science: bringing the person back into scientific psychology, this time forever. *Measurement: Interdisciplinary Research and Perspectives*, 2(4), 201–218. https://doi.org/10.1207/s15366359mea0204_1
- Mulder, J.D. Frequently asked questions. <https://jeroendmulder.github.io/RI-CLPM/faq.html>. Accessed 29 Aug 2022.
- Mulder, J.D., & Hamaker, E.L. (2021). Three extensions of the random intercept cross-lagged panel model. *Structural Equation Modeling*, 28(4), 638–648. <https://doi.org/10.1080/10705511.2020.1784738>
- Muthén, L. K., & Muthén, B. O. (1998–2021). *Mplus user's guide* (8th edn.). Muthén & Muthén.
- Niemiec, C. P., Ryan, R. M., & Deci, E. L. (2010). Self-determination theory and the relation of autonomy to self-regulatory processes and personality development. In R. H. Hoyle (Ed.), *Handbook of personality and self-regulation* (pp. 169–191). Wiley-Blackwell. <https://doi.org/10.1002/9781444318111.ch8>
- Perlman, D. (2011). The influence of an autonomy-supportive intervention on preservice teacher instruction: a self-determined perspective. *Australian Journal of Teacher Education*, 36(11), 73–79.
- Peters, J., & Pearce, J. (2012). Relationships and early career teacher resilience: a role for school principals. *Teachers and Teaching*, 18(2), 249–262. <https://doi.org/10.1080/13540602.2012.632266>
- Pianta, R. C., Hamre, B., & Stuhlman, M. (2003). Relationships between teachers and children. In W. M. Reynolds & G. E. Miller (Eds.), *Handbook of Psychology: Educational Psychology* (Vol. 7, pp. 199–234). Wiley.
- Prilop, C.N., Weber, K.E., & Kleinknecht, M. (2020). Effects of digital video-based feedback environments on preservice teachers' feedback competence. *Computers in Human Behavior*. <https://doi.org/10.1016/j.chb.2020.106390>
- Ranellucci, J., Rosenberg, J.M., & Poitras, E.G. (2020). Exploring pre-service teachers' use of technology: the technology acceptance model and expectancy-value theory. *Journal of Computer Assisted Learning*, 36(6), 810–824. <https://doi.org/10.1111/jcal.12459>
- Reeve, J., Jang, H., Carrell, D., Jeon, S., & Barch, J. (2004). Enhancing Students' Engagement by Increasing Teachers' Autonomy Support. *Motivation and Emotion*, 28(2), 147–169. <https://doi.org/10.1023/B:MOEM.0000032312.95499.6f>
- Ronfeldt, M., & Reininger, M. (2012). More or better student teaching? *Teaching and Teacher Education*, 28(8), 1090–1106. <https://doi.org/10.1016/j.tate.2012.06.003>
- Ronfeldt, M., Bardelli, E., Truwig, M., Mullman, H., Schaaf, K., & Baker, J.C. (2020). Improving pre-service teachers' feelings of preparedness to teach through recruitment of instructionally effective and experienced cooperating teachers: A randomized experiment. *Educational Evaluation and Policy Analysis*, 42(4), 551–575. <https://doi.org/10.3102/0162373720954183>
- de Ruiter, J.A., Poorthuis, A.M.G., Aldrup, K., & Koomen, H.M.Y. (2020). Teachers' emotional experiences in response to daily events with individual students varying in perceived past disruptive behavior. *Journal of School Psychology*, 82, 85–102. <https://doi.org/10.1016/j.jsp.2020.08.005>
- Rupp, D., & Becker, E.S. (2021). Situational fluctuations in student teachers' self-efficacy and its relation to perceived teaching experiences and cooperating teachers' discourse elements during the teaching practicum. *Teaching and Teacher Education*, 99, 103252. <https://doi.org/10.1016/j.tate.2020.103252>
- Ryan, R.M. (1995). Psychological needs and the facilitation of integrative processes. *Journal of Personality*, 63(3), 397–427. <https://doi.org/10.1111/j.1467-6494.1995.tb00501.x>

- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*, 68–78. <https://doi.org/10.1037/0003-066X.55.1.68>.
- Ryan, R. M., Deci, E. L., Vansteenkiste, M., & Soenens, B. (2021). Building a science of motivated persons: self-determination theory's empirical approach to human experience and the regulation of behavior. *Motivation Science*, *7*(2), 97–110. <https://doi.org/10.1037/mot0000194>.
- Shrout, P. E., Stadler, G., Lane, S. P., McClure, M. J., Jackson, G. L., Clavé, F. D., ..., & Bolger, N. (2018). Initial elevation bias in subjective reports. *Proceedings of the National Academy of Sciences*, *115*(1), E15–E23.
- Smit, R., Rietz, F., & Robin, N. (2021). Interactions of feelings of competence and motivation of pre-service science teachers in their laboratory course: a dynamic multilevel modeling approach. *Frontiers in Education*, *8*, 714495. <https://doi.org/10.3389/educ.2021.714495>.
- Spilt, J. L., Koomen, H. M. Y., & Thijs, J. T. (2011). Teacher wellbeing: the importance of teacher-student relationships. *Educational Psychology Review*, *23*, 457–477. <https://doi.org/10.1007/s10648-011-9170-y>.
- Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics*. Pearson.
- Tschannen-Moran, M., Hoy, A. W., & Hoy, W. K. (1998). Teacher efficacy: its meaning and measure. *Review of Educational Research*, *68*(2), 202–248. <https://doi.org/10.3102/00346543068002202>.
- Ulrich, I., Klingebiel, F., Bartels, A., Staab, R., Scherer, S., & Gröschner, A. (2020). Wie wirkt das Praxissemester im Lehramtsstudium auf Studierende? Ein systematischer Review. In I. Ulrich & A. Gröschner (Eds.), *Praxissemester im Lehramtsstudium in Deutschland: Wirkungen auf Studierende* (pp. 1–66). https://doi.org/10.1007/978-3-658-24209-1_1.
- Usami, S. (2021). On the differences between general cross-lagged panel model and random-intercept cross-lagged panel model: interpretation of cross-lagged parameters and model choice. *Structural Equation Modeling: A Multidisciplinary Journal*, *28*(3), 331–344. <https://doi.org/10.1080/10705511.2020.1821690>.
- Van den Broeck, A., Vansteenkiste, M., De Witte, H., Soenens, B., & Lens, W. (2010). Capturing autonomy, competence, and relatedness at work: construction and initial validation of the work-related basic need satisfaction scale. *Journal of Occupational and Organizational Psychology*, *83*, 981–1002. <https://doi.org/10.1348/096317909X481382>.
- Van Ginkel, G., Oolbekkink, H., Meijer, P. C., & Verloop, N. (2016). Adapting mentoring to individual differences in novice teacher learning; the mentor's viewpoint. *Teachers and Teaching: Theory and Practice*, *22*(2), 198–218. <https://doi.org/10.1080/13540602.2015.105543>.
- Vansteenkiste, M., Ryan, R. M., & Soenens, B. (2020). Basic psychological need theory: advancements, critical themes, and future directions. *Motivation and Emotion*, *44*, 1–31. <https://doi.org/10.1007/s11031-019-09818-1>.
- Voelkle, M. C., Gische, C., Driver, C. C., & Lindenberger, U. (2018). The role of time in the quest for understanding psychological mechanisms. *Multivariate Behavioral Research*, *53*(6), 782–805. <https://doi.org/10.1080/00273171.2018.1496813>.