



Assessing Competence Development and Emotional Responses During the Practical Semester of Vocational Student Teachers in Germany

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Abstract

In Germany, the integration of practical phases within teacher education programs aims to bridge the gap between theoretical knowledge and practical application. A key initiative is the practical semester, introduced in eleven federal states, which provides experiential learning opportunities supported by university seminars and regional authorities. Research has highlighted a significant correlation between practical training and teachers' competence development; however, limited studies have addressed the specific experiences of student teachers in relation to their professional competence. This study investigates how vocational education and training (VET) student teachers assess their competencies before and after engaging in school-based activities during this practical semester, with a focus on the emotional responses elicited during these experiences utilising event-contingent diaries and surveys from 23 VET student teachers in North Rhine-Westphalia during the 2023–2024 academic year. The results will provide valuable insights into the interplay between emotional responses and professional development among student teachers during the school practical semester.

Keywords Vocational student teachers · Event-contingent diaries · Practical semester · Competence development · Emotional valence · Control-value theory of achievement emotions

Introduction

The phenomenon of ‘practice shock’ has been widely recognized as a critical challenge for teacher education graduates transitioning into the teaching profession. Defined as the disparity between theoretical knowledge acquired during teacher training and the practical demands of classroom teaching, this issue has been reported

Extended author information available on the last page of the article

globally (Grossman, 2008). Research highlights that novice teachers often struggle to implement their pedagogical knowledge effectively, leading to difficulties in classroom management and instructional practices (Morton et al., 1997; Danner, 2014; Dicke et al., 2015).

In Germany, efforts to address this challenge have led to the integration of practical phases within teacher education programs. A notable initiative is the introduction of the practical semester, which has been implemented in eleven German states. This semester aims to bridge the gap between theory and practice by offering experiential learning opportunities supported by university seminars and regional authorities (LABG, 2009 § 12). For many student teachers, this period marks their first significant exposure to real-world teaching practices in vocational schools. The practical semester is particularly relevant in the context of practice shock, as it serves as an initial confrontation with the realities of teaching. It is designed to enhance students' development of competence while fostering a deeper understanding of their professional roles (Weyland & Wittmann, 2011).

Professional competence development of teachers has been a central topic of numerous research projects (Cramer, 2010; Kunter et al., 2011). The results highlight a significant correlation between practical training and the development of teachers' competence. However, comparatively few studies have examined the practical training of student teachers in relation to their experience of developing professional competence (Bodensohn & Schneider, 2008). Prior research also demonstrates a clear link between emotional experiences and the development of competence. Even the initial experience of teaching is accompanied by emotions and has an impact on future teaching practices (Burić et al., 2020; Frenzel et al., 2016; Hagenauer et al., 2015). Nevertheless, research findings on emotional experiences and competence development in the vocational training sector are still scarce. This study uses the framework of Control-Value Theory of Achievement Emotions (CVT) (Pekrun, 2006), in particular, the concept of emotional valence experienced by vocational student teachers in achievement situations. Emotional valence refers to the positive or negative quality of an emotion, that is, whether it is experienced as pleasant or unpleasant. This study explores how vocational education and training (VET) student teachers assess their competencies before and after engaging in school-based activities during the practical semester. It also examines the emotional responses elicited during these experiences.

The findings aim to determine whether the practical semester enhances competence development through the self-assessment of competence and contributes to reducing practice shock. To follow the research aim, this study applied event-contingent diaries and surveys collected from 23 German vocational student teachers during the school practical semester in the federal state of North Rhine Westphalia, Germany, in 2023 and 2024. Student teachers assessed their own competence before and after participating in school activities during the school practicum semester over the course of a week. In addition, students reported their perceived emotional experiences related to changes in their perceived competence. The study provides insight into novice teachers' experiences of entering the teaching profession, which can inform the development of teacher training to support teachers' competence development and enhance their positive emotional experiences.

Research Context: School Practical Semester of Vocational Student Teachers in North Rhine-Westphalia, Germany

Germany's teacher education system comprises two phases (Kultusministerkonferenz, 2004). Firstly, students study the theoretical academic foundations of their subject and its didactic principles at university, initially at bachelor's level and then at master's level. Secondly, the in-service training phase links the theoretical knowledge acquired during university with its practical implementation in schools (Alles et al., 2019). The practical semester, which is the focus of this study, takes place during the master's programme.

Due to its scope, the practical semester is a special format of the practical phase of teacher education. During this semester, students work in a school for a period of at least one semester as part of their Master's degree in teacher education (Schüssler, 2017). In Germany, at least eleven federal states have currently implemented such a semester in vocational teacher training (Frommberger & Lange, 2018). During the practical semester, which lasts several months, students spend a set period at a school as part of their learning environment. The practical semester aims to familiarise students with the professional field, determine their professional aptitude, and enable them to acquire practical teaching knowledge (Weyland & Wittmann, 2011). Thus, internships make a vital contribution to the development of reflective professionalism among future teachers.

The state of North Rhine-Westphalia has also introduced a five-month, 250-hour school-based practical semester as part of its Master of Education programme. During this semester, students actively participate in the daily teaching and non-teaching activities of the school (Arnold et al., 2011). Usually completed in the second semester of the Master's programme, the practical semester is the responsibility of the universities, but is designed, implemented and supervised in cooperation with schools and Centres for Practical Teacher Training (ZfsL), or study seminars in North Rhine-Westphalia (cf. LABG, 2009, § 12, para. 3).

Theoretical Framework

Student Teachers' Competence Development During Practice Periods

In recent decades, the concept of competence has gained increasing importance in various scientific disciplines, particularly in the field of education (Li et al., 2023; Antera, 2021). Competence is defined as a context-specific ability that can be acquired through learning processes, as described by Klieme et al. (2008). Grønberg (2013) emphasises the need always to interpret competence in the appropriate context. It is not only influenced by external references such as standards or expert knowledge, but also by the individual's internal factors. Competence is viewed as a subjective dimension that describes a person's ability to make responsible decisions in accordance with the obligations of their area of responsibility (Grønberg, 2013). The definition of competence, according to Andryukhina et al. (2016), encompasses an individual's ability to use their knowledge and skills in a targeted manner during

professional activities. Weinert's (2001) comprehensive description of competence encompasses the cognitive abilities and skills that individuals possess or can learn in order to solve specific problems. This competence also includes the associated motivational and social skills.

The concept of professional competence manifests itself as a multifaceted and complex entity (cf. Engeström et al., 2006). Professional competence is viewed as a dynamic concept that is continually constructed and reconstructed by various actors in diverse contexts, resulting in a range of definitions (Engeström et al., 2006). Looking more closely at it from an intuitive contextual perspective, according to Ellström (1997), it becomes clear that the learning and development of professional competence is embedded in specific situations and needs to be action-oriented. Without an appropriate context, competence remains an abstract skill that offers no practical opportunities for development. However, professional competence is ultimately a concept that is largely shaped by the individual. Accordingly, each individual makes a significant contribution to shaping and developing their understanding of professional skills and abilities (Antera, 2021).

The relevance of teachers' professional competence is increasingly recognised as a crucial aspect of the quality of education. In Germany's teacher education, the model of professional competence developed by Kunter et al. (2011) includes an analysis of learning opportunities and their effective use. The manifestation of motivational characteristics, such as enthusiasm and self-regulatory skills, has a direct impact on behaviour in everyday school life. Teachers' professional competence is a complex construct characterised by personal beliefs and subjective assessments of their own abilities in lesson design and subject knowledge, as noted by Cramer (2010). Mertens et al. (2018) also postulate that these beliefs act as guidelines for action and can be modified by both feedback and personal experience.

The promotion of competence development for student teachers during their practical phases of training is an essential aspect of professional preparation. During the practice phase, empirical studies have shown significant progress in various areas of competence development. The study by Bodensohn and Schneider (2008) shows an increase in subject-specific, methodological and social competences over the course of two compulsory block placements. Gröschner et al. (2013) used a pre-post design to investigate the increase in competences in the areas of teaching, education, innovation and assessment. The results show significant increases in the area of teaching and demonstrate a positive influence of university supervision during the placement on these developments. Furthermore, the study by Mertens et al. (2018) shows that student teachers' self-perception of their competences increases significantly during the placement semester. The development of student teachers' competencies during their student teaching is a dynamic process that is supported by a variety of learning opportunities. The significance of practice for professional behaviour underlines the importance of ongoing self-reflection on one's own competences and a committed engagement with the demands of the teaching profession. These findings support the assumption that a positive perception of one's own competence prior to a practice experience strengthens confidence in this competence and thus positively influences the experience of competence after the activity. A high self-perception of competence before an activity may lead to increased engagement, which in turn results in bet-

ter learning outcomes and a subsequent increase in perceived competence after the activity.

Student Teachers' Competence Development and Emotional Responses

Teachers face a multitude of impressions, uncertainties and contradictions on a daily basis and experience various emotions, which are sometimes contradictory (Burić et al., 2020; Frenzel, 2014). Consequently, emotions are the primary focus of numerous research studies (e.g. Burić et al., 2020; Frenzel et al., 2016; Hagenauer et al., 2015; Frenzel, 2014; Becker et al., 2014). The research group led by Frenzel investigated the emotions of teachers in several studies (e.g. Frenzel, 2014; Frenzel & Stephens, 2013), proposing that emotions in the teaching profession emerge with regard to the subjective evaluation of success or failure. For example, emotional valence influences the personal resources available to cope with situations, thereby affecting teachers' professional development (Lazarus & Folkman, 1987; Pekrun, 2006).

Emotions also play a significant role in the professional development of student teachers (Bach & Hagenauer, 2022; Daniels et al., 2011). With regard to the role of emotions during the various stages of a student teacher's professional development, it is reasonable to suggest that emotions related to achievement are particularly pertinent during the practical stages of school internships, given that student teachers frequently encounter high levels of performance pressure (Marais, 2013; Timoštšuk & Ugaste, 2012). In line with these suggestions, some studies have found that the emotions experienced by student teachers are highly significant in terms of social learning, identity development (Timoštšuk & Ugaste, 2012) and competence development (Marais, 2013). It has also been suggested that experiencing positive emotions is associated with a greater openness to new experiences and methods, improved relationships in the workplace, and an increased ability to deal with unforeseen events and obstacles. In contrast, experiencing negative emotions is associated with a higher likelihood of adhering to familiar routines and methods (Frenzel, 2014).

Similar research has indicated that student teachers' emotions play an important role in their cognitive performance, decision-making processes, problem-solving abilities, motivation levels, and overall achievement (Sutton & Wheatley, 2003). Most studies focus on specific emotions. The study by Becker et al. (2025), however, focuses on three specific emotions: joy, anxiety, and anger. While some studies have shown that positive emotions are predominantly experienced or anticipated during teaching practice (de Zordo et al., 2019; Timoštšuk et al., 2016; Marais, 2013), other findings suggest that negative emotions, particularly anxiety, are also present and can significantly influence student teachers' perceptions of their practice experiences (Hastings, 2004; Timoštšuk & Ugaste, 2012). Burić et al. (2020) found that negative emotions are associated with lower self-efficacy in teachers. Similarly, Frenzel et al. (2016) found negative correlations between negative emotions (such as anxiety) and teacher self-efficacy.

To date, few investigations have been conducted to understand the emotional development of student teachers during their school internship in Germany (Porsch & Gollub, 2017; Arnold et al., 2011). For example, Porsch and Gollub (2017) discovered that particular teaching-related anxieties decreased after the internship semester

had concluded. Furthermore, these studies allow us to identify factors that contribute to the success of internships. In the Learning to Practice project, ‘joy in school practice’ was assessed using a scale in Germany and North Rhine-Westphalia (Darge et al., 2018). The items do not target specific school situations but rather address the overall emotional state of prospective teachers in their everyday internship routine, with a particular focus on negative emotions. Overall, the current state of research clearly indicates that the emotions experienced during teaching practicums impact student teachers’ competency development. They influence their self-assessment regarding self-efficacy.

Achievement Emotions as Conceptual Framework

The Control-Value Theory of Achievement Emotions (CVT) provides a framework for analysing emotions experienced in achievement and academic settings (Pekrun, 2006). In the current study, emotions are conceptualised as momentary occurrences within a given situation at a specified point in time, *state achievement emotions*, versus habitual, recurring *trait achievement emotions* (Pekrun, 2006). According to the CVT, achievement emotions are categorized along three conceptually independent dimensions (Pekrun, 2006; Pekrun et al., 2023): *valence* differentiates whether an emotion is positive or pleasant, or negative or unpleasant; *arousal* distinguishes between physiologically activating emotions (high arousal) or deactivating emotions (low arousal); and *object focus* differentiates between activity emotions, which pertain to ongoing achievement-related activities, and outcome emotions, which refer to the outcomes of these activities (Pekrun, 2006).

This research focused on valence, a key dimension that psychological constructionist theories investigate to understand how affective stimuli and emotional experiences can be systematically structured (Shuman & Scherer, 2014). Earlier research has shown that positive activating emotions have a positive effect on learning and performance, although negative activating emotions can also sometimes enhance learning by inducing extrinsic motivation to invest effort to avoid failure (Shao et al., 2020). Based on the CVT (Pekrun, 2006), we measured the emotional valence experienced by vocational student teachers in achievement situations using the following positive and negative emotions: 0 = “Enjoyment”, 1 = “Hope”, 2 = “Joy”, 3 = “Relief”, 4 = “Relaxation”, 5 = “Anger”, 6 = “Anxiety”, 7 = “Boredom”, 8 = “Frustration”, 9 = “Hopelessness”, that were further categorized as positive or negative emotions.

The CVT (Pekrun, 2006) defines emotions as multicomponent, coordinated processes of psychological subsystems that include affective, cognitive, motivational, expressive, and peripheral physiological processes. In terms of the cognitive component of emotions, the CVT posits that perceived *subjective control* over achievement activities and their outcomes, as well as perceived *subjective values* of these activities and outcomes, are central to the arousal of achievement emotions (Pekrun, 2006). In this study, student teachers reported their anticipated coping expectancies and self-assessments of competence in relation to achievement situations. According to the CVT, prospective appraisals of control involve causal expectancies regarding one’s ability to successfully initiate and perform an action, as well as whether the action

will produce desired outcomes (Pekrun & Perry, 2014). Expectations of success or the avoidance of failure in achievement activities are influenced by self-evaluations of competence (Pekrun & Perry, 2014). In previous research (Pekrun et al., 2023), positive emotions were found to have significant positive correlations with control, while negative emotions exhibited significant negative correlations across various educational and work environments.

Research Question and Hypotheses

Following the theoretical framework, two research questions were formulated as follows:

RQ1) How is self-assessed task-related competence after learning activities related to the experienced level of competence before learning activities?

RQ2) How is self-assessed task-related competence after learning activities related to the experienced emotional valence (positive and negative emotions) before and after learning activities?

Based on the research gaps presented earlier, the following hypotheses were set:

H1: Experienced competence related to various activities during the practice period will develop positively over time.

H2: Experienced competence before the activity has a positive relationship with the experienced competence after the activity.

H3: Experienced emotional outcome-focused valence before the activity has a positive relationship with the experienced competence after the activity.

H4: Experienced emotional outcome-focused valence after the activity has a positive relationship with the experienced competence after the activity.

Figure 1 illustrates the conceptual research model used in this study. It posits that perceived competence after the activity is shaped by competence experienced before the activity (H2), as well as emotional valence before (H3) and after the activity (H4), and a general increase over time (H1). Additionally, the model includes several potential covariates—age, gender, study year, academic performance, and the type of teaching activity—that may influence post-activity competence either positively or negatively. Together, these factors represent a dynamic framework for investigating the interplay between emotional experiences and competence development during practice-based teacher education.

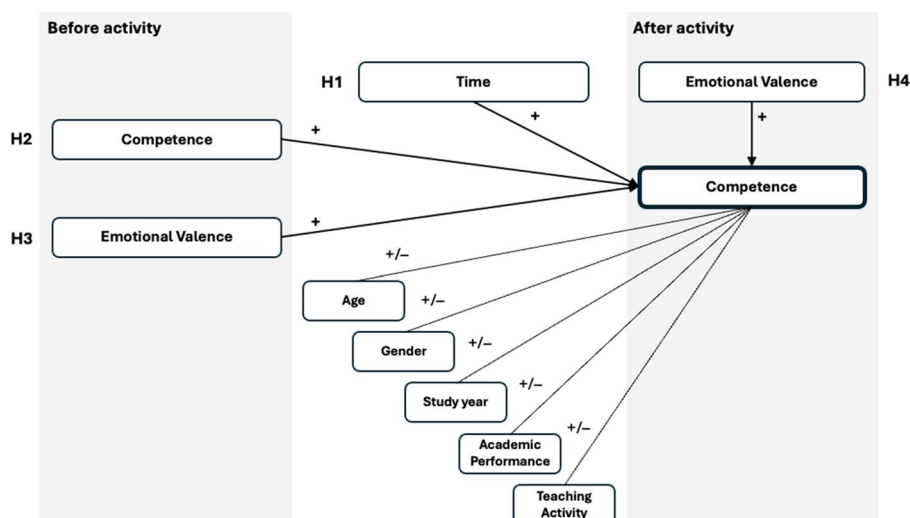


Fig. 1 Research design and hypotheses

Method

Participants and Procedure

The project was approved by the university's internal ethics committee, which considered the ethical implications based on the reviewed research plan. Students who were about to begin their practical semester were invited to participate in the study via email. Before data collection, participants were introduced to the study design, ethical considerations (e.g., data privacy and publication of results), and informed about their right to withdraw from the study at any phase. Participation was voluntary and based on a signed consent form.

The event-contingent diary (Ecological Momentary Assessments, EMA; see Stone et al., 1999) and survey data were collected from 23 German vocational student teachers ($M=27.3$, $SD=3.954$) in the vocational field of economic and business education. Of the participants, 11 (47.8%) were women, with gender information missing for two participants (8.7%). Most of them were first-semester students ($n=20$, 87.0%).

The focus of the diaries was on the self-assessment of competence development. The student teachers reported on the various activities undertaken during the school internship, as well as the assessment of their level of competence before and after participating in these activities. Both reports (2023 and 2024) were conducted in the fifth or sixth week of the practical semester.

This study reports the results of a cross-sectional survey study and longitudinal measurements conducted in spring 2023 (16 students, 8 women) and 2024 (7 students, 3 women). In addition to responding to a survey, participants responded to event-contingent (triggering factor: activity at school) questions (emotions pre/post and competence development post) on average 4.0 days ($SD=1.296$, $\min=1$, $\max=6$). The most frequent number of participation days was two.

During this period, participants reported 241 activities ($M=10.5$, $SD=5.116$) with the LearningTracker (LT) smartphone application (Nokelainen & Hartikainen, 2020). Students who participated in 2023 reported 187 activities, while those from 2024 reported 54 activities. On average, participants reported 2.6 ($SD=1.461$) activities per day. The average duration of these activities was 82.2 min ($SD=64.702$).

Measurements

Online survey measures included participants' age (years), gender (0 = "Woman", 1 = "Man"), and self-assessed prior academic performance: 0 = "Sufficient" ($n=0$, 0%), 1 = "Satisfactory" ($n=39$, 18.4%), 2 = "Good" ($n=153$, 72.2%), 3 = "Very good" ($n=20$, 9.4%).

EMA measures included participants' self-reports before and after each activity. Before the activity, the LT application was started, and the participants reported their experienced competence level ("I feel competent enough to carry out this activity") with response options from 0 "Totally disagree" to 4 "Totally agree" ("PreComp" variable). They also responded to a question related to their emotional state ("When I think about this activity, I feel") by choosing one emotion (Pekrun, 2006) from a list (0 = "Enjoyment", 1 = "Hope", 2 = "Joy", 3 = "Relief", 4 = "Relaxation", 5 = "Anger", 6 = "Anxiety", 7 = "Boredom", 8 = "Frustration", 9 = "Hopelessness").

After the activity, participants self-reported their ability to cope with the activity ("How did you cope with the activity?", response options from 0 "Very poor" to 4 "Very good") ("PostComp" variable). They also self-reported their emotional state ("After this activity, I feel") by choosing one emotion (Pekrun, 2006) from a list (0 = "Enjoyment", 1 = "Joy", 2 = "Pride", 3 = "Relief", 4 = "Relaxation", 5 = "Contentment", 6 = "Gratitude", 7 = "Anger", 8 = "Shame", 9 = "Boredom", 10 = "Frustration", 11 = "Sadness", 12 = "Disappointment"). Emotions before and after each activity were coded into dichotomous emotional valence (Pekrun, 2006) variables ("PreEmotVal", "PostEmotVal"): Negative emotional states were coded with a value of "0", and positive emotions with a value of "1".

Table 1 presents the distribution of emotional states, emotional valence, and competence before and after activities, listed in order of frequency.

Participants also gave a written description of each activity. The descriptions were categorised into the following seven categories by the researchers: (1) Passive teaching activities ($n=105$, 43.6%), (2) Lesson preparation activities ($n=33$, 15.2%), (3) Teaching activities ($n=31$, 15.7%), (4) Debriefing activities ($n=12$, 6.6%), (5) Individual supervision activities ($n=17$, 10.2%), (6) Seminar-related activities ($n=36$, 23.2%), (7) Other activities ($n=7$, 4.8%). Of these 241 activities, 73 were teaching-related (30.3%). This information was stored in the "TeachingActivity" variable (0 = "No teaching activity", 1 = "Teaching activity").

Statistical Analyses

A series of multilevel (e.g., Pinheiro & Bates, 2000), namely cumulative link mixed models (CLMMs) were employed with the *ordinal::clmm* program (Christensen, 2023) in the R statistical computing environment (R Core Team, 2020). These models

Table 1 Emotional states, emotional valence and competence before and after activities

Type	Pre-activity			Post-activity		
	Category	<i>n</i>	%	Category	<i>n</i>	%
<i>Emotion</i>	Relaxation	69	28.6	Relaxation	54	22.4
	Enjoyment	61	25.3	Enjoyment	36	14.9
	Hope	38	15.8	Contentment	35	14.5
	Joy	29	12	Relief	33	13.7
	Anxiety	15	6.2	Joy	33	13.7
	Boredom	9	3.7	Pride	18	7.5
	Relief	9	3.7	Boredom	9	3.7
	Frustration	8	3.3	Frustration	8	3.3
	Anger	2	0.8	Disappointment	6	2.5
	Hopelessness	1	0.4	Gratitude	5	2.1
<i>Valence</i>	1 Positive	206	85.5	1 Positive	214	88.8
	0 Negative	35	14.5	0 Negative	27	11.2
<i>Competence</i>	4 Totally agree	142	58.9	4 Very good	104	43.2
	3	81	33.6	3	103	42.7
	2	11	4.6	2	27	11.2
	1	5	2.1	1	5	2.1
	0 Totally disagree	2	0.8	0 Very poor	2	0.8

account for the nested structure of the data, with repeated measures for each student. The response variable was “PostComp” (values from 0 to 4), and the predictors were: “Time”, “PreComp”, “PreEmotVal” and “PostEmotVal”. Controlling for time-invariant variables in the analyses were participants’ age, gender, and self-assessed prior academic performance, as well as the dichotomous time-variant TeachingActivity variable.

An analysis of missing data patterns using the *mice* package (van Buuren & Groothuis-Oudshoorn, 2011) revealed two distinct patterns in the dataset across 241 observations. The majority of the data was complete ($n=212$, 88.0%). The remaining observations had missing values primarily in the “Age,” “Gender,” and “Performance” variables ($n=29$, 12.0%). Given the nature of the missing data, imputation was not performed.

Before proceeding with the analysis, adjusted intraclass correlation (*ICCI*) values were calculated with the *performance::icc* package (Lüdtke et al., 2021) to determine the possible need for multilevel modelling and the variance explained in the dependent variable due to clustering in the data. Results showed a medium size (see Murphy & Myers, 1998) *ICCI* value for the unconditional model ($Model0_{ICCI} = 0.184$), suggesting a need for the use of a multilevel modelling approach: 18.4% of the total variance related to the post-activity competence was accounted for by the between-student differences.

The assumptions underlying the CLMMs were assessed to ensure the validity of the analyses. Visual inspection of the relationships between the predictors and the ordinal outcome variable suggested generally monotonic trends. Similarly, Kendall’s τ_b correlations indicated moderate positive monotonic relationships between the response variable and the predictors (Table 2). The proportional odds assumption was

Table 2 Two-level Kendall's τ_b correlation matrix of the relationships between variables at both within and between-student levels before and after activities

	PreComp cwc	PostComp cwc	PreEmotVal cwc
PostComp cwc	0.30***		
PreEmotVal cwc	0.18***	0.16**	
PostEmotVal cwc	0.14**	0.29***	0.19***
	PreComp cbc	PostComp cbc	PreEmotVal cbc
PostComp cbc	0.60***		
PreEmotVal cbc	0.34***	0.33***	
PostEmotVal cbc	0.12*	0.26***	0.46***

τ_b =Kendall's tau-b correlation ($\tau_b > |0.06|$ weak association, $\tau_b > |0.19|$ moderate association, $\tau_b > |0.33|$ strong association); * $p < .05$; ** $p < .01$; *** $p < .001$; cwc=Centred-within-cluster (student); cbc=Centred-between-cluster

tested using a cumulative link model without random effects, and results indicated no violations.

Five CLMMs were analysed sequentially (Raudenbush & Bryk, 2002), starting with an unconditional random intercepts model (Model 0). The need for random slopes was tested, but the Likelihood Ratio Test (LRT) revealed no need to allow individual variation in experienced competence across time. Model 1 included a time-variant index variable for measurements across time for each student ("Time"). Model 2 tested the possible effect of controlling variables: "Age" (years), "Gender" (0 = "Woman", 1 = "Man"), "StudyYear" (0 = "2023", 1 = "2024"), "AcademicPerformance" (0 = "Sufficient", 1 = "Satisfactory", 2 = "Good", 3 = "Very good") and "TeachingActivity" (0 = "No teaching activity", 1 = "Teaching activity"). Model 3 added expected competence prior to the activity as a predictor ("PreComp"). Lastly, Model 4 added emotional valence (0 = "Negative", 1 = "Positive") before ("PreEmotVal") and after ("PostEmotVal") each activity as predictors.

Results

Table 3 summarises the results of the five cumulative link mixed models predicting post-activity competence and thereby addressing RQ1 ("How is self-assessed task-related competence after learning activities related to the experienced level of competence before learning activities?") and RQ2 ("How is self-assessed task-related competence after learning activities related to the experienced emotional valence (positive and negative emotions) before and after learning activities?").

The initial Model 0, which included only the random intercept for participants without any predictors, was estimated to examine the baseline level of post-activity competence. The fixed effect for the intercept was significant ($\text{Log} - \text{Odds} = -5.223$, 95% C.I. [-6.701, -3.745], $p < .001$). The negative value of the intercept indicates extremely low odds ratio ($OR = e^{-5.223} * 100 = 0.5\%$) of participants to report the lowest competence level (2 out of 241 observations). The random effect for the intercept (τ_{00}) was 1.073, suggesting considerable variability in baseline competence ratings across participants.

Table 3 Self-assessed competence development after activities

Predictors	Model 0		Model 1		Model 2		Model 3		Model 4	
	Log-Odds (C.I.)	S.E.	Log-Odds (C.I.)	S.E.	Log-Odds (C.I.)	S.E.	Log-Odds (C.I.)	S.E.	Log-Odds (C.I.)	S.E.
0 1	-5.223*** (-6.701 – -3.745)	0.754	-4.843*** (-6.358 – -3.329)	0.773	-4.785*** (-6.305 – -3.266)	0.775	-5.304*** (-6.852 – -3.755)	0.790	-6.351*** (-8.112 – -4.590)	0.899
1 2	-3.932*** (-4.831 – -3.032)	0.459	-3.561*** (-4.518 – -2.604)	0.488	-3.502*** (-4.466 – -2.539)	0.492	-3.988*** (-4.986 – -2.990)	0.509	-4.822*** (-6.027 – -3.618)	0.614
2 3	-2.146*** (-2.746 – -1.546)	0.306	-1.773*** (-2.460 – -1.086)	0.350	-1.837*** (-2.544 – -1.130)	0.361	-2.123*** (-2.833 – -1.412)	0.362	-2.419*** (-3.221 – -1.617)	0.409
3 4	0.324 (-0.196– 0.843)	0.265	0.749* (0.095– 1.402)	0.334	0.844* (0.171– 1.517)	0.343	1.028** (0.386– 1.669)	0.327	1.200*** (0.496– 1.904)	0.359
Time			0.070* (0.007– 0.133)	0.032	0.073 (-0.001– 0.146)	0.037	0.094* (0.020– 0.167)	0.038	0.091* (0.014– 0.169)	0.040
Performance cgm					1.347** (0.382– 2.313)	0.492	0.739 (-0.185– 1.663)	0.471	0.848 (-0.129– 1.826)	0.499
PreComp cwc							1.374*** (0.881– 1.867)	0.251	1.312*** (0.810– 1.813)	0.256
PreComp cbc							2.198*** (1.006– 3.390)	0.608	2.203*** (0.891– 3.515)	0.669
PostEmotVal cwc									3.259*** (2.106– 4.412)	0.588
PostEmotVal cbc									2.283 (-1.264– 5.830)	1.810
Random Effects										
σ^2	3.290		3.290		3.290		3.290		3.290	
τ_{00}	1.073 _{id}		1.128 _{id}		0.853 _{id}		0.510 _{id}		0.617 _{id}	
ICC	0.246		0.255		0.206		0.134		0.158	
N	23 _{id}		23 _{id}		21 _{id}		21 _{id}		21 _{id}	
Observations	241		241		212		212		212	
AIC	508.198		505.353		438.509		397.772		365.096	

Model 0 = PostComp ~ 1 + (1 | id); *Model 1* = PostComp ~ Time + (1 | id); *Model 2* = PostComp ~ Time + Performance + (1 | id); *Model 3* = PostComp ~ Time + Performance + PreComp + (1 | id); *Model 4* = PostComp ~ Time + Performance + PreComp + PostEmotVal + (1 | id); *Log-Odds* = Estimated log-odds values; *C.I.* = 95% Confidence Interval of the estimated values; *S.E.* = Standard error of estimated values; *p* = Statistical significance of the estimated values; *Threshold coefficients* (0|1, 1|2, 2|3, 3|4) = Estimated cut-off points for the ordinal outcomes; σ^2 = Variance of the level 1 residuals (within-students) is fixed to $\pi^2/3$; τ_{00} = Variance of the cluster means (between-students); *ICC* = Adjusted intraclass correlation, proportion of the variance in the response variable explained by the random effects (clustering of the data); *N* = Number of students; *Observations* = Number of observations from students; *AIC* = Akaike Information Criterion, predicting the power of predictors on the response variable

* $p < .05$; ** $p < .01$; *** $p < .001$

The other threshold coefficients for Model 0 were -3.932 (1|2), -2.146 (2|3), and 0.324 (3|4). The threshold for the 1|2 boundary, although slightly less extreme, still reflected a low likelihood of participants reporting a competence rating of 1 (5 out of 241 observations). The threshold for the 2|3 boundary indicated a moderate likelihood of reporting a rating of 2, as this rating was more common (27 out of 241 observations). Finally, the positive threshold for the 3|4 boundary indicated that participants were more likely to report higher competence levels, consistent with the majority of ratings being 3 or 4.

Model 1 added time as a predictor along with the random intercept for participants, thereby addressing H1 concerning change in post-activity competence over time. The fixed effect for time was significant ($\text{Log} - \text{Odds} = 0.070, p = .030$), indicating a slight positive change in post-activity competence ratings over time. The OR for time was $e^{0.070} = 1.07$ (95% C.I. [1.01, 1.14]), suggesting that the odds of reporting a higher competence rating increased by 0.07 times (7.0%) for each unit increase in time. The likelihood ratio test (LRT) comparing Model 0 and Model 1 showed that Model 1 significantly outperformed Model 0 ($\chi^2(1) = 4.846, p = .028$).

Figure 2 illustrates the predicted development of post-activity competence over time. Predictions and 95% confidence intervals were calculated and plotted using the *ggplot2* package (Wickham, 2016). The blue line represents the predicted competence scores, while the grey shaded area represents the 95% confidence intervals.

Model 2 added controls for age, gender, study year, self-assessed academic performance, and teaching activity. Self-assessed academic performance ($\text{Log} - \text{Odds} = 1.347, p = .006$) was a significant predictor of post-activity competence. The OR

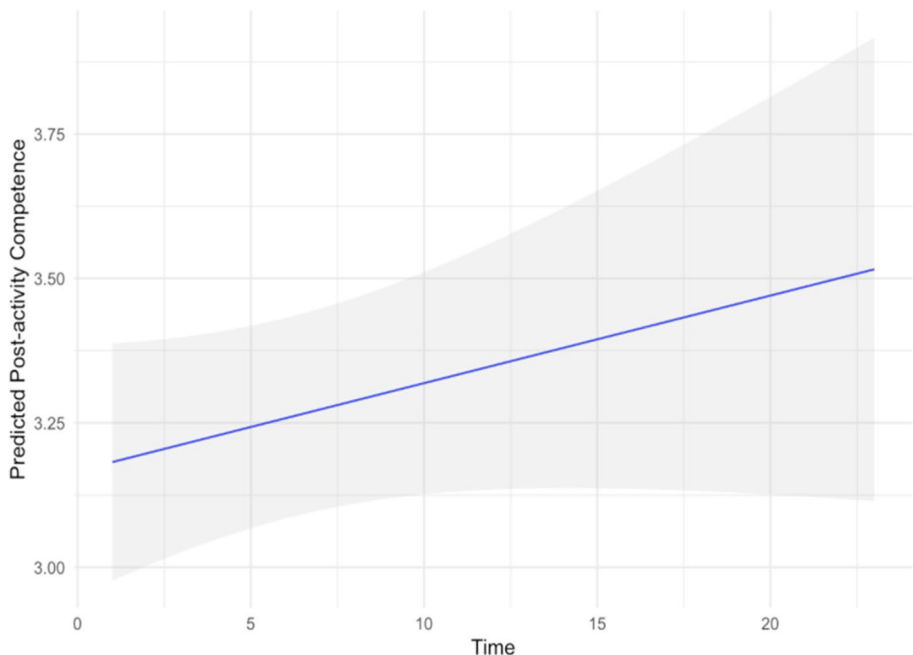


Fig. 2 Predicted development of post-activity competence over time

for self-assessed academic performance was 3.85 (95% C.I. [1.47, 10.10]). Time was not a significant predictor in this model. Further, no effects for the participants' age, gender, study year or teaching activity were found. LRT showed that Model 2 significantly outperformed Model 1 ($\chi^2(2) = 6.823, p = .009$).

Model 3 included pre-activity competence as a predictor, thereby addressing H2 concerning the relationship between competence before and after the activity. Both within-student ($\beta_{cwc} = 1.374, p < .001$) and between-student ($\beta_{cbc} = 2.198, p < .001$) self-rated expectations were positively significantly related to self-rated experienced competence after the activities. The OR for within-student expected competence was 3.95 (95% C.I. [2.41, 6.47]), indicating that participants who rated their pre-activity competence higher were almost four times more likely to report higher post-activity competence. The OR for between-student expected competence was even higher, 9.01 (95% C.I. [2.73, 29.67]). No interaction effects (indicating possible moderation) were found. This model fitted significantly better to the data than the previous model, $\chi^2(2) = 44.736, p < .001$.

Figure 3 shows the effects of cwc and cbc pre-activity competence on post-activity competence. In the figure, scatter plots with regression lines depict the relationships between pre- and post-activity competence. The blue lines represent the regression lines, while the shaded areas represent the 95% confidence intervals.

Model 4 added emotional valence before and after activities as predictors, thereby addressing H3 and H4 concerning the role of emotional valence in post-activity competence. Time ($\text{Log-Odds} = 0.091, p = .021$), both within-student ($\beta_{cwc} = 1.312, p < .001$) and between-student ($\beta_{cbc} = 2.203, p < .001$) pre-activity compe-

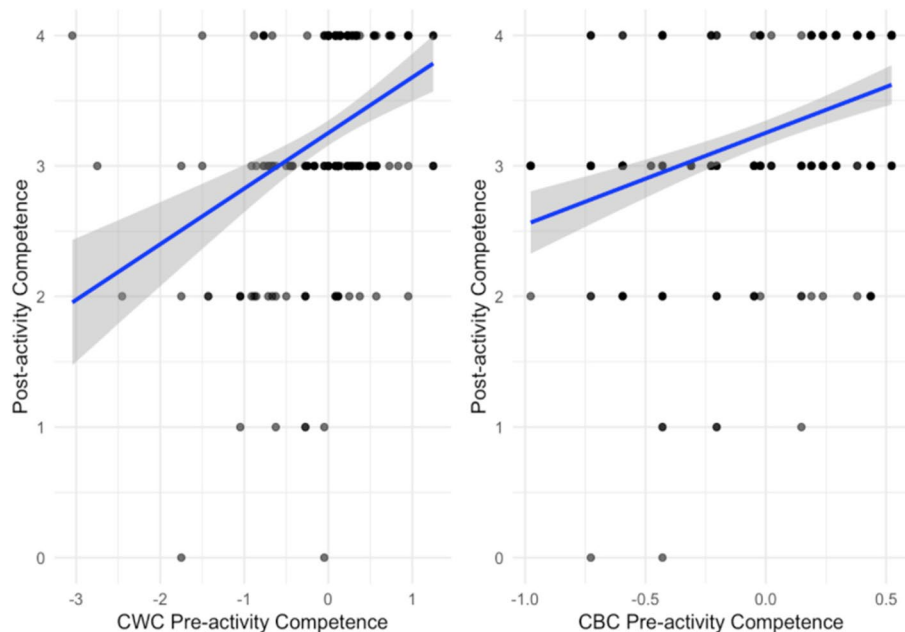


Fig. 3 Effects of within-student (cwc) and between-student (cbc) pre-activity competence on post-activity competence

tence remained a positive predictor of post-activity competence. The post-activity within-student emotional valence was a significant (and the strongest) positive predictor, with an OR value of 26.02 (95% CI [8.22, 82.42]). This means that when a participant felt positive emotions immediately after an activity, the odds of them rating their competence higher increased dramatically—by over 26 times—compared to when they did not feel positive emotions. This effect was only observed within participants, meaning that fluctuations in a participant's emotional state from one activity to another were highly predictive of their perceived competence. No interaction effects were found. The likelihood ratio test (LRT) showed that this new model outperformed the previous model, $\chi^2(2)=36.676, p < .001$.

Figure 4 illustrates the relationship between post-activity competence and within-student emotional valence post-activity, using a box plot to depict the distribution of competence ratings by emotional valence. The color-coded boxes represent the median and interquartile range, while the whiskers extend to the most extreme data points not considered outliers.

In summary (see Fig. 5), time had a significant positive effect, with post-activity competence ratings increasing slightly during the measurement period (supporting H1). Both within- and between-student pre-activity competence were significant predictors, underscoring the importance of participants' expectations before the activity

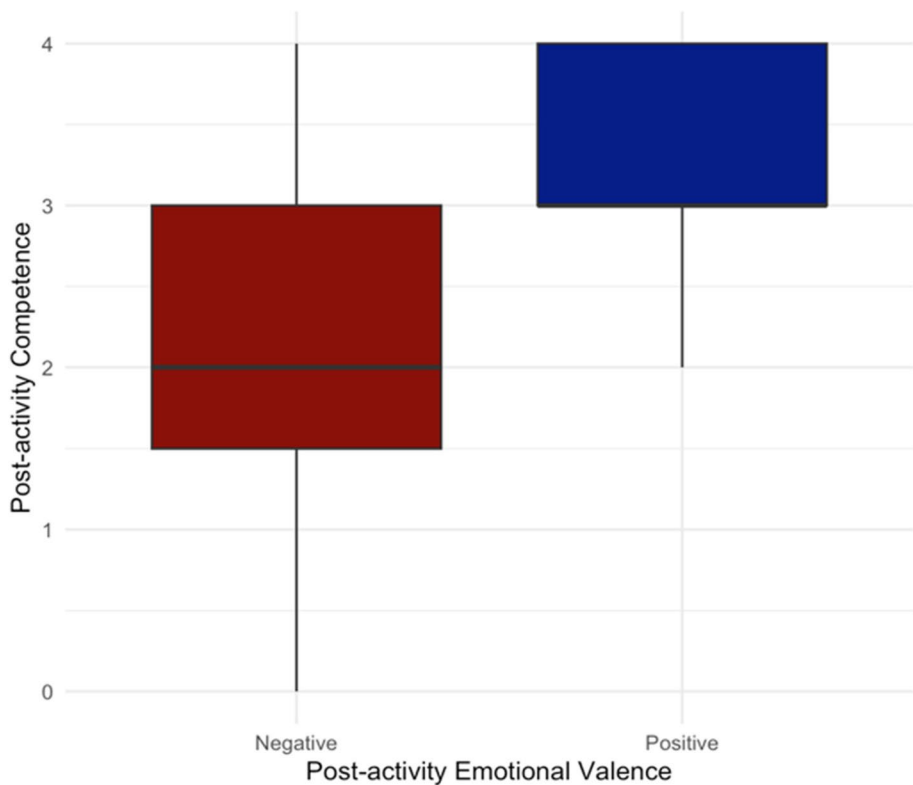


Fig. 4 Post-activity competence by within-student post-activity emotional valence

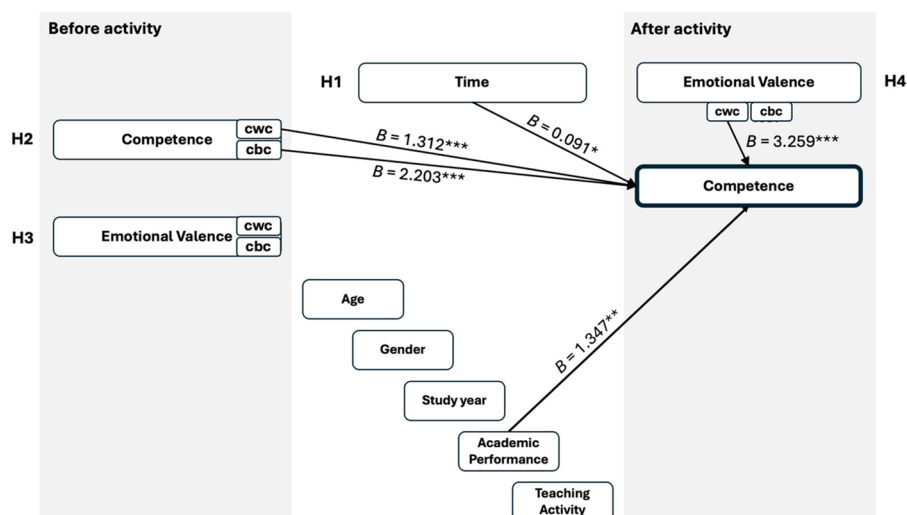


Fig. 5 Results of cumulative link mixed models. *Note.* $^*p < .05$; $^{**}p < .01$; $^{***}p < .001$; B = Estimated log-odds values; cwc = Centered-within-cluster (student); cbc = Centered-between-cluster

on their subsequent competence ratings (supporting H2). While pre-activity emotional valence was not a significant predictor (contrary to H3), post-activity within-subject emotional valence was significant (supporting H4), highlighting the role of immediate positive emotional experiences after the activity in shaping experiences of task-related competence. In addition, self-assessed academic performance was a significant positive predictor of post-activity competence.

Discussion and Conclusion

The study investigated the competence development of VET student teachers during their school practical semester in the German federal state of North Rhine-Westphalia. The study analysed how student teachers assess their competence before and after participating in school activities during the school practicum semester over a period of time by examining the relationship between self-assessed task-related competence after learning activities and the experienced levels of competence. The study also analysed how emotional experiences relate to changes in perceived competence by examining emotional valence before and after these activities, while controlling for various demographic and academic factors. The results from a series of CLMMs provided several key insights.

The initial analysis, Model 0, revealed significant variability in baseline competence ratings across participants, as indicated by the significant fixed effect for the intercept and the considerable random effect for the intercept. This suggests that participants had diverse starting points in their self-assessed competence levels, which could be attributed to individual differences not accounted for by the predictors in this model.

In Model 1, time was introduced as a predictor, showing a slight but significant positive effect on post-activity competence ratings. This finding, which supports H1, indicates that over time, participants were more likely to report higher competence, albeit with a small effect size. This result is also confirmed by other studies on the professional development of student teachers during the practical training phases in the literature. Bodensohn and Schneider (2008) demonstrate improvements in technical, methodological, and social competence during the practical phases of teacher training. Furthermore, Gröschner et al.'s (2013) study also indicates significant gains in teaching skills. The literature review on the practical semester by Ulrich et al. (2020) also showed that the student teachers' self-assessed competences usually change positively over the course of the internship semester.

Model 2 introduced controls for demographic and academic variables. Interestingly, only self-assessed academic performance in economic and business education and teaching emerged as a significant predictor, with higher self-rated academic performance strongly associated with higher post-activity competence. This highlights the importance of participants' confidence in their academic abilities as a key factor in how they perceive their competence after learning activities. This result supports the assumption that the practical semester is intended to facilitate the connection between university-based preparation in business education and teaching and the practical teaching experience gained in schools (Weyland & Wittmann, 2011). However, the predictor used in this study was self-assessed prior academic performance, not a direct measure of theoretical knowledge. Thus, the finding may indicate that participants who perceived themselves as better academically prepared also perceived stronger competence development during the practical semester. In vocational classroom settings, however, the relevant knowledge base likely extends beyond general academic performance. In the field of business education, it may include subject-specific knowledge, pedagogical knowledge, and knowledge of how business- and work-related content can be translated into meaningful classroom instruction. Because these more specific domains of professional knowledge were not measured directly in the present study, the results should be interpreted with caution.

Model 3 included pre-activity competence as a predictor, both within and between participants. The findings supporting H2 demonstrated that participants who perceived themselves as more competent before the activity were significantly more likely to report higher competence afterwards. This effect was particularly pronounced between participants, suggesting that those who generally viewed themselves as more competent were far more likely to continue feeling competent after the activities, thereby supporting the CVT (Pekrun, 2006; Pekrun et al., 2023) proposing that appraisals of competence influence achievement. This between-student effect also highlights the importance of students' broader self-perceptions, which may be shaped before the practical semester even begins. It suggests that interventions aimed at boosting general teaching self-efficacy—through mentoring, peer modelling, or reflective feedback—before or during the practicum may have lasting benefits on how students experience and evaluate their competence in real teaching situations (e.g. Schlosser & Paetsch, 2024).

Finally, Model 4 incorporated emotional valence before (H3) and after (H4) the activities. Results showed no support for H3. However, the within-student level post-

activity emotional valence was a strong predictor of post-activity competence (partially supporting H4). In other words, positive emotions immediately following an activity increased the likelihood that participants would rate their competence higher. This effect underscores the powerful influence of immediate emotional experiences on self-perceived competence, suggesting that fostering positive emotions after learning activities could significantly enhance students' competence perceptions. This result is also indirectly confirmed by other studies on emotions among teachers in the literature. For instance, Frenzel (2014) suggests that experiencing positive emotions is linked to more effective coping strategies in the workplace and greater adaptability in the face of unexpected challenges.

Interestingly, while post-activity emotional valence significantly predicted competence at the within-student level, no significant between-student effect was observed. In other words, although student teachers who felt more positive immediately after specific activities also reported higher competence in those same moments, students who were generally more positive across all activities did not consistently report higher competence overall. This may be due to the situational and state-like nature of achievement emotions, as proposed in the CVT framework. Emotional responses after activities likely reflect immediate contextual appraisals (e.g., how well a lesson went, how students responded), rather than stable traits. As such, momentary positive feelings had a more substantial motivational and self-evaluative impact than any general tendency to experience positive emotions.

In conclusion, the findings of this study emphasise the critical roles of student teachers' pre-activity competence perceptions and post-activity emotional experiences in shaping self-assessed competence during the practical semester. While time and self-assessed academic performance also played important roles, interestingly, the immediate emotional response following an activity emerged as a particularly influential factor. These results suggest that educational interventions or pedagogical support aimed at boosting student teachers' competence should consider strategies that enhance both their pre-activity confidence and post-activity positive emotions to maximise student teachers' competence development.

Practical semesters in North Rhine-Westphalia are preceded by seminars and accompanied by further seminars during the practical semester, which are provided by the universities and the Centres for Practical Teacher Training (ZfsL). The research results emphasise the importance of these preparatory and accompanying elements for the professional development of student teachers during the practical semester. In addition, the curriculum should emphasise the importance of supporting student teachers' self-reflection skills, as well as their understanding of emotions as part of teachers' work, from the beginning of the training. The studies by König et al. (2019) also found a positive relationship between the development of student teachers' skills and the quality of support provided by school counsellors, which also highlights the importance of available individual support.

Future research could build on these findings by examining more directly how student teachers' theoretical and pedagogical knowledge in business education (such as subject-specific knowledge in business education, pedagogical knowledge, and knowledge of how vocational content is translated into classroom instruction) relates to their perceptions of competence before and after specific activities during the

practical semester. This would help distinguish more clearly between perceived academic performance and directly assessed knowledge as predictors of competence development.

Limitations

This study had several limitations. *First*, the small sample size ($N=23$) limits the generalisability of the findings and may reduce statistical power, particularly for detecting between-student effects. Future investigations would benefit from a broader and more diverse sample. However, the intensive longitudinal design, capturing a total of 241 teaching-related activities across these pre-service teachers, provides a rich within-person dataset that strengthens the reliability of event-level inferences.

Second, the reliance on self-report measures for competence and emotional valence may introduce bias due to social desirability or inaccuracies in self-perception. Nevertheless, the momentary assessment strategy minimised retrospective distortions and allowed participants to report their emotions and perceived competence in close temporal proximity to the teaching activity, enhancing ecological validity. Furthermore, the dichotomisation of emotional valence into ‘positive’ and ‘negative’ categories represents a simplification of the complexity and multidimensionality of emotional experience. While comprehensive understanding of achievement emotions requires consideration of the numerous qualitative differences among discrete achievement emotions (Pekrun et al., 2023), future research would benefit from adopting a more differentiated conceptualisation of emotional states.

In this case, concentrating on discrete achievement emotions and professional development may be enhanced by qualitative data to provide a more thorough understanding of emotional processes.

Third, the study did not control for participants’ prior occupational experience in the vocational field or their previous teaching-related experience. These forms of prior experience may have influenced both pre-activity competence perceptions and post-activity evaluations of competence. Future research should include such background variables to better distinguish the effects of the practical semester from participants’ earlier professional and teaching experience. *Fourth*, while the event-contingent diary method captures real-time experiences, it may still be influenced by variability in how participants interpreted different activity types. To mitigate this, participants were asked to describe each activity, and researchers carefully categorised these into well-defined activity types to provide contextual consistency. *Finally*, the observational period was limited to a specific phase of the practical semester, which may not fully reflect longer-term developmental trajectories in competence or emotion regulation. Still, this period represents a critical transition into authentic classroom teaching and is highly relevant for capturing early indicators of professional growth and practice-related emotional responses.

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Data Availability No datasets were generated or analysed during the current study.

Declarations

Competing Interests The authors declare no competing interests.

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