

Research Article

Opportunities to Learn for Teachers' Self-Efficacy and Enthusiasm

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The aim of this study was to identify opportunities to learn for teachers' motivational orientations. Motivational orientations are relevant characteristics of psychological functioning, which are important for the behavior of a teacher and mandatory for effective teaching. We focus on three domains: self-efficacy, subject-specific enthusiasm, and enthusiasm for teaching the subject. Self-efficacy covers the belief of an individual that he or she is capable of performing required behaviors to produce a desired outcome. Teacher enthusiasm is an affective teacher orientation that is related to a specific subject and to teaching this specific subject. Different opportunities to learn are considered for teachers' motivational orientations. Since teacher education particularly focuses on the acquisition of professional knowledge, we added a further exploratory focus to the study and investigated the relationships between motivational orientations and professional knowledge (content knowledge and pedagogical content knowledge). 134 biology teachers participated in the study. The results reveal that teacher education at university, the attendance in professional development courses, and self-study provide opportunities to learn for self-efficacy and enthusiasm for teaching the subject. Moreover, we found self-efficacy and subject-specific enthusiasm to be positively related to pedagogical content knowledge.

1. Introduction

Teachers significantly impact students' performance and motivation (e.g., [1–3]). Different characteristics and abilities are described to be necessary for effective teaching [4]. Currently, the aspect of professional knowledge is an emphasized object of research (e.g., [5–16]). However, being an effective teacher takes more than just having professional knowledge. Teachers face numerous demands and challenges, for example, due to high student diversity in and among their classes, complex curricular requirements, and demanding communication situations with students, parents, or colleagues. Even a thorough lesson preparation does not guarantee effective teaching [4], because no planning can anticipate all the situations or conflicts which may possibly occur in the classroom. The gap between theoretical knowledge acquired in teacher education programs and the reality of teaching in schools is a challenge particularly for novice teachers [17, 18]. Due to these circumstances, teachers suffer from high levels of job stress, which can lead to disaffection or even burnout [19].

Moreover, being successful in the teaching profession requires a permanent “withinness” as well as the flexibility to deal with new situations and failure. Teachers are furthermore responsible for their own professional development. These demands are not only relevant in a specific teaching situation; teachers have to be able to face these demands also on the long run [20].

With respect to this big strain on teachers, several studies have highlighted the relevance of competence aspects, such as motivational orientations, which go beyond professional knowledge (e.g., [4, 21, 22]).

In the study at hand, we address both cognitive and affective domains of motivational orientations by taking teachers' self-efficacy and enthusiasm into consideration. Self-efficacy is a cognitive domain of teachers' motivational orientations [23] and has already been in the focus of several studies (e.g., [24, 25]). Here, we are enhancing this focus by adding the aspect of teacher enthusiasm as an affective domain of motivational orientations (e.g., [20, 23, 26]). In the following, two facets, namely, subject-related enthusiasm

and enthusiasm for teaching the subject [23], will receive special attention. The identification of opportunities to learn for teachers is one of the core aims in research on teachers' professional competence (e.g., [21]). This was investigated particularly for teachers' professional knowledge (e.g., [21, 27, 28]). Only few findings concerning teachers' motivational orientations exist (e.g., [29]).

The aim of this study is to understand due to which opportunities to learn motivational orientations develop. Accordingly, we aim to investigate whether different opportunities to learn are related to teachers' self-efficacy, subject-specific enthusiasm, and enthusiasm for teaching the subject. The findings will help to effectively foster teachers' motivational orientations.

Teacher education particularly focuses on the acquisition of professional knowledge (cf. for Germany: [30]). Accordingly, it is not useful to only consider teachers' motivational orientations in an isolated manner when examining their development. Thus, we decided to add a further more exploratory part to the study. This additional part concerns the examination of the interplay between teachers' professional knowledge and their motivational orientations. In this context, we will focus on teachers' content-related professional knowledge, that is, content knowledge (CK) and pedagogical content knowledge (PCK). The consideration of this interplay will help to gain a first understanding of possible synergy effects and to generate information about the character of beneficial situations (e.g., content-related courses during teacher education).

2. Background

2.1. Teachers' Motivational Orientations. Different abilities and skills enable the teacher to face the manifold demands in the teaching profession. These can be subsumed under the term *professional competence* [4]. We refer to the model of teachers' professional competence developed by Baumert and Kunter [4]. In the framework of this model, professional competence goes beyond the consideration of knowledge as sole characteristic of effective teaching. Four competence aspects are considered: (1) professional knowledge (e.g., content knowledge), (2) motivational orientations (e.g., teacher enthusiasm), (3) self-regulation skills (e.g., the responsible handling of the own resources), and (4) beliefs, values, and goals (e.g., epistemological beliefs).

Motivational orientations are relevant characteristics of psychological functioning. They are related to the "psychological dynamics of behavior, the maintenance of intentions, and the monitoring and regulation of occupational behavior" [4, p. 38]. Motivational orientations cover different domains, namely, (1) self-efficacy, (2) control beliefs, and (3) enthusiasm [4]. As mentioned above, we focus on both cognitive (i.e., self-efficacy) and affective (i.e., enthusiasm) domains of teachers' motivational orientations. These domains will be described in detail in the following.

As already mentioned also self-regulation skills are part of the model of teachers' professional competence. These have to be carefully distinguished from teachers' motivational orientations. Whereas motivational orientations are related

to a classroom context [20] (e.g., teaching a specific subject), self-regulation skills are of a more global nature and are related to a more general occupational context [20].

2.2. Teachers' Self-Efficacy and Enthusiasm

2.2.1. Self-Efficacy. Self-efficacy denotes an individual's belief that she or he is capable of producing a successful outcome [31]. Self-efficacy represents the cognitive domain of teachers' motivational orientations, as the underlying process is cognitive. An individual uses information to generate an expectancy of the own efficacy [31]. In contrast to more general constructs such as self-esteem, self-efficacy is linked to a specific context or task [32]. Self-efficacy of teachers can be described as a teacher's confidence to effectively organize and perform specific actions related to a particular teaching task [25].

Research has shown that self-efficacy of teachers is interrelated with different areas of their professional lives. In particular, three areas are described in the literature: (1) beliefs about the relationship between teachers and students (e.g., teachers' personal responsibility for students' learning [24, 33]), (2) teachers' professional practice (e.g., classroom management [25, 33, 34]), and (3) emotional aspects (e.g., emotional exhaustion or job satisfaction [24, 34–36]).

Different very closely related conceptualizations exist, which have to be carefully distinguished. The first approach concerns outcome expectancies. Outcome expectancies concern the belief of an individual that his or her behavior will lead to a certain outcome [31]. What distinguishes this approach from self-efficacy is that the individual does not refer to his or her own competence when building up outcome expectancies. Accordingly, outcome expectancies alone do not influence the behavior of an individual [31]. The second closely related approach concerns the expectancies of an individual for internal versus external control (locus of control) [37]. Here, an individual assumes that an outcome is caused by the own behavior (*internal* control) or by external factors or by chance (*external* control) [37]. Rotter's [37] considerations implicate that only one state at a time becomes apparent [38]. In contrast, one important assumption within the concept of self-efficacy is the belief of an individual that he or she is capable of performing a certain outcome, although external obstacles occur [31]. Moreover, Rotter's conceptualization is not task related as self-efficacy is; rather it is of a general nature (e.g., for internal locus of control: "becoming a success is matter of hard work, luck has little or nothing to do with it." [37, p. 11]).

2.2.2. Enthusiasm. Concerning teacher enthusiasm, two theoretical approaches are available.

The first approach considers teacher enthusiasm as instructional behavior (see [39] for a review). The underlying assumption within this conceptualization is, that you can see, if a person is enthusiastic. Accordingly, the behavior of a teacher (e.g., gestures and facial expressions; [40]) is in the focus when assessing teacher enthusiasm.

Within the framework of the second approach, teacher enthusiasm is conceptualized as personal characteristic. More

detailed, Kunter and colleagues [23] define teacher enthusiasm as an affective teacher orientation which includes enjoyment, excitement, and pleasure for teaching in general and for teaching a specific school subject. This definition uses internal indicators to describe enthusiasm; it treats enthusiasm as a personality trait, which is in line with other approaches applied in teacher enthusiasm research [41, 42]. This definition foresees that teacher enthusiasm contains at least two facets, namely, (1) subject-specific enthusiasm and (2) enthusiasm for teaching the subject [23]. *Subject-specific enthusiasm* describes a topic-related affective orientation [23]. It is close to the construct of individual interest, which is defined as a fairly stable positive person-object relation [43], here a teacher-subject relation. It is relatively resistant to the circumstances in the classroom because the source of enthusiasm, namely, the subject, is constantly present [23]. *Enthusiasm for teaching the subject* can be described as the enjoyment of the activity of teaching [23]. In this case, the object in the person-object relationship is the interaction with students. In contrast to subject-specific enthusiasm, enthusiasm for teaching the subject is not immune to influences such as organizational structures in schools or students' motivational characteristics [23]. To our knowledge, only the COACTIV project considered the two facets of teacher enthusiasm in such detail [20]. Accordingly, empirical findings concerning the relationship between the two facets of enthusiasm are only provided by this working group. They found that subject-related enthusiasm and enthusiasm for teaching the subject of mathematics teachers are not independent of each other but moderately correlated ($r = .36$) [20].

2.3. The Relevance of Teachers' Motivational Orientations for Teacher and Student Outcomes. Teachers' self-efficacy and enthusiasm are important both for teacher outcomes and for student outcomes.

Teacher Outcomes. Both theoretical considerations and empirical findings help to understand the importance of self-efficacy and enthusiasm for the professional lives of teachers. The expectancy value theory provides the theoretical underpinning. Within the expectancy value theory [44], two core aspects are described to be important for the selection of a certain activity as well as the performance and the persistence in this activity. The expectancy of an individual of how well he or she performs in a specific activity is concerned in the first aspect [44]. Self-efficacy [31] is very closely related to this first factor [44]. The valuing of this specific activity is integral part of the second aspect [44]. Beyond others, valuing has an intrinsic aspect. Intrinsic values are described as enjoyment of an individual engaging in a certain activity [44–46]. This concept is very closely related to the understanding of intrinsic motivation and to enthusiasm [20]. Transferring these considerations to the teaching profession, both self-efficacy and enthusiasm impact the choice to become a teacher as well as the performance and the persistence in the teaching profession. Accordingly, these two domains are of great importance for the whole professional life of a teacher. As mentioned above, the relevance of teachers' self-efficacy

and enthusiasm is also supported by empirical findings. Both domains are found to be related to the job satisfaction of teachers [36].

Student Outcomes. Teachers' self-efficacy is described to positively impact students' performance [34, 38, 47–50]. Different aspects, which are related to self-efficacy, help to understand the relevance of self-efficacy as characteristic of an effective teacher. Teachers' with positive efficacy expectations are described to be highly committed [51], to provide effective instructional strategies (e.g., [34]), and to be open towards their students [52, 53]. Also teachers' enthusiasm is considered an important predictor for student outcomes (e.g., [20, 54]). Beyond its direct relation to students' performance, Kunter and colleagues [21] found teacher enthusiasm to be the strongest predictor for instructional quality (compared to pedagogical content knowledge and self-regulation skills) which in turn positively affects students' performance. Different underlying mechanisms of the relevance of teacher enthusiasm for students are described. The enthusiastic behavior of the teacher is assumed to "infect" the students [55]. Other assumptions are that the enthusiastic behavior of the teacher catches the attention of the students [54] or that the enthusiastic teacher serves as a role model for the students [56]. Students' enthusiasm is in turn related to different student behaviors, which are positively related to their performance (e.g., concentration and on-task behavior) [57]. As mentioned above, teacher enthusiasm is related to instructional quality. Different aspects of instructional quality (more detailed, an effective classroom management and the individual learning support of students) serve as mediators for the relationship between teacher enthusiasm and students achievement.

2.4. Opportunities to Learn for Self-Efficacy and Enthusiasm. According to the relevance of teachers' motivational orientations for the whole professional lives of teachers, the question of how the development of self-efficacy and teacher enthusiasm can be supported during preservice teacher education at university and during the professional lives of teachers arises. In the focus of this article are different opportunities to learn for teachers' motivational orientations, that is, self-efficacy and enthusiasm.

2.4.1. Malleability of Teachers' Motivational Orientations. The important underlying assumption when thinking about opportunities to learn for teachers' motivational orientations concerns the malleability of teachers' motivational orientations. In other words, we assume that prospective teachers do not enter the teaching profession with an immutable status of motivation but that motivational orientations change over time. This malleability or learnability is also an important assumption within the framework of teacher expertise research (e.g., [58]), which is closely related to research on teachers' professional competence [4]. The ground assumption in the teacher expertise framework concerns the difference between novice teachers and expert teachers concerning the knowledge and the skills that are necessary to face the demands in the teaching profession [21, 58].

These characteristics are seen as learnable and are described to develop during preservice teacher education and during the time in the profession and finally transform to expertise [58]. Accordingly, teacher education is seen as crucial for the preparation of expert teachers. What is important to mention is that within the teacher expertise approach in particular knowledge and beliefs are in the focus of scholars (motivational orientations are not explicitly in the focus) (e.g., [59]). Nevertheless, as an expert teacher is characterized by aspects, which help to master the demands in the professional life of teachers [21, 58], also further aspects are important to consider (see Introduction). More detailed, also teachers' motivational orientations as well as self-regulation skills are related to instructional quality and students' performance [21], two crucial aspects of effective teaching. We consider teachers' motivational orientations as aspect of teachers' professional competence. One important characteristic of the concept of competence is its inherent malleability and learnability [60]. This theoretical assumption is supported by Kunter [20] who examined the stability of teacher enthusiasm (which is considered a domain of motivational orientations in the study at hand) and found that it indeed embodies a malleable construct.

2.4.2. The German Teacher Education System. The BioTeC project that provides the framework for the study at hand was conducted in Germany. We will provide a brief introduction into the German teacher education system in the following.

In Germany, three phases of teacher education can be distinguished. The *first phase of teacher education* takes place at university and takes four to five years. Three foci structure teacher education at university. Prospective teachers attend to (a) content-related courses (acquisition of CK), (b) courses related to PCK (acquisition of PCK), and (c) courses in general pedagogy (acquisition of pedagogical knowledge). This structure foreshadows that the core aim of this phase of teacher education is the acquisition of professional knowledge (i.e., CK, PCK, and pedagogical knowledge) [30]. Prospective teachers complete this phase with the first state examination that allows entering the second phase of teacher education.

This *second phase* aims at the acquisition of competencies which are more practice-oriented [30]. Differing between the different federal states, the second phase of teacher education takes between one year and a half and two years [61]. During this time, the prospective teachers receive only about half of the payment compared to a "full teacher." Supported by experienced colleagues, the prospective teachers plan and conduct their own lessons and attend further courses [61]. Prospective teachers complete this phase with the second state examination which allows them to work as "full" teachers.

Teacher education in Germany does not end with the second state examination; further development (e.g., during professional development courses) takes place in the *third phase of teacher education* [30] (here teachers are considered as full teachers receiving full payment). This phase is not strictly regulated; the regulations concerning the attendance

in professional development courses vary between the federal states (e.g., Hamburg: 30 h per year [62]; Bavaria: 60 h in four years [63]) or are not regulated at all [64, 65].

2.4.3. Formal and Informal Opportunities to Learn. All these three phases of teacher education provide opportunities to learn for (prospective) teachers. According to Tynjälä [66], formal and informal opportunities to learn can be distinguished. *Formal opportunities to learn* take place in institutions like universities and result in acquiring formal qualifications (e.g., master's degree). All three phases of teacher education provide formal opportunities to learn. Examples of formal learning opportunities are courses taken during university education (first phase of teacher education) and professional development courses (second and third phases of teacher education). *Informal opportunities to learn* arise in various situations; also all three phases of teacher education provide opportunities for informal learning. Informal learning is not intentional [66]. Examples for informal learning opportunities are "learning by teaching" and situations of self-study (e.g., reading journals).

Empirical evidence supports the relevance of formal opportunities to learn for teachers' motivational orientations. The findings of Andrew and Schwab [67] indicate that teacher education at university (first phase of teacher education) is important for the development of teachers' self-efficacy, because it creates confidence in teaching and influences the intention to stay in the profession. Opportunities during the second and third phases (here, professional development) are also described to have a positive impact on both the development of self-efficacy [29, 68–70] and teacher enthusiasm [40, 54]. It should be mentioned that the research related to teacher enthusiasm and its development refers to the behavioral conceptualization of enthusiasm (see Section 2.2.2). The aim of these studies was to train the teachers to artificially show certain levels of enthusiasm to investigate its impact on students' performance. Accordingly, these studies do not suffice to explain the meaning of opportunities to learn for teacher enthusiasm as it is conceptualized in this study.

Also the significance of informal learning for the development of teachers' motivational orientations is empirically supported. Findings from recent research indicate that the meaning of teaching experience is not entirely clarified. Carleton and colleagues [71] found that professional experiences help to increase the extent of teachers' self-efficacy. In contrast, Schmitz [72] found that teaching experience has no influence on teachers' self-efficacy. Findings are also available for the role of teaching experience relating to teacher enthusiasm. Kunter and colleagues [23] found a positive relationship between enthusiasm for teaching the subject and teaching experience.

The consideration of underlying mechanisms is necessary to understand the relevance of the identified formal and informal opportunities to learn. In this regard, the consideration of motivational theories is important. We refer to two theories in this regard: (1) the social cognitive theory of Bandura [31] and the considerations concerning intrinsic motivation made by Deci and Ryan [73].

In the framework of his *social cognitive theory*, Bandura [31] identified different sources that are important for an individual's *self-efficacy* beliefs. First of all, mastery experiences (i.e., the success an individual has in a certain situation) provide the basis for a positive manifestation of self-efficacy and are described as the most important source of self-efficacy [31]. One and maybe the most important indicator of successful teaching is the improvement of students' performance. Teachers' professional knowledge (here, in particular, teachers' PCK) is described to positively impact on students' performance (e.g., [21]). Accordingly, teacher education with its focus on knowledge acquisition [30] provides the basis for success in teaching and thus mastery experiences. Hence, a significance of teacher education at university and the attendance in professional development for self-efficacy seems plausible. A relationship between the teaching experience as informal opportunity to learn and self-efficacy can be assumed when teachers have positive experiences during teaching.

Vicarious experiences are the second important source for self-efficacy. Vicarious experiences embody experiences of others that are used to generate own efficacy expectations (i.e., if another person with comparable abilities is successful in a comparable situation, one assumes to be successful as well) [31]. Formal in-service teacher education, specifically the attendance in workshops (the attendance in professional development courses), provides the opportunity to benefit from the experience of the lecturer (or of colleagues). According to these theoretical considerations, we assume both preservice as well as in-service teacher education and the time spent in the profession (i.e., teaching experience) to be relevant for the development of teachers' self-efficacy.

The theoretical considerations of Deci and Ryan [73] help to understand the meaning of the considered opportunities to learn for *teacher enthusiasm*. Deci and Ryan [73] originally refer to intrinsic motivation. Nevertheless, intrinsic motivation and enthusiasm are very closely related constructs, as both concern positive emotional experiences related to a certain activity [42]. Different needs have to be fulfilled for the manifestation of intrinsic motivation or (transferred to the study at hand) teacher enthusiasm. One of these needs is the experience of competence [73]. Teacher education provides the basis for competence and teaching experience provides situations in which teachers can experience their own competence during teaching.

2.5. Teachers' Self-Efficacy and Enthusiasm and the Relation to Professional Knowledge. The aim of this study is to understand which opportunities to learn contribute to the development of teachers' motivational orientations. As teacher education particularly aims to acquire professional knowledge (cf. for Germany: [30]), an isolated consideration of motivational orientations in this context is not sufficient.

Professional knowledge covers the knowledge that is important for the professional life of a teacher [74]. In most cases, two categories are distinguished in the literature: (1) non content-related professional knowledge (e.g., pedagogical knowledge) and (2) content-related professional

knowledge [4, 75]. The study at hand focuses on content-related professional knowledge, which is composed of CK and PCK (e.g., [76]).

CK represents a deep understanding of a certain domain [75]. It includes the knowledge of the facts and concepts of this specific domain and its structure. Furthermore, CK covers the knowledge of how validity or invalidity is established within this specific domain.

PCK is described as the knowledge which is needed to make the subject matter comprehensible to students [75]. After the initial description of Shulman [75], several scholars were engaged in research on teachers' PCK and further expanded its definition [76–78]. In particular, two core facets of PCK are described in the literature: (1) the knowledge of the representation of subject matter and instructional strategies (hereinafter: *knowledge of instructional strategies for teaching*) and (2) the knowledge of students' (pre)conceptions or students' understanding (hereinafter: *knowledge of students' understanding*) [75–83]. The first facet, which comprises the *knowledge of instructional strategies for teaching*, covers both broadly applicable and topic-specific instructional strategies. Knowledge about representations (e.g., illustrations, models, examples, and analogies [75, 77]) plays an important role for this facet of PCK as representations are seen as an effective tool to support students' learning [75, 77]. Furthermore, the knowledge of adequate subject-related activities is also related to this first facet (e.g., experiments [77]). The *knowledge of students' understanding* embodies the further facet of PCK and covers knowledge of the requirements of learning (e.g., prior knowledge [77] as well as knowledge of specific learning difficulties (e.g., knowledge about misconceptions, [77])).

Empirical evidence concerning the interplay between knowledge and further (also noncognitive) competence aspects is limited (c.f. [84]), although teachers' professional knowledge and their motivational orientations are well-established aspects of teachers' professional competence (e.g., [4]).

Raudenbush and colleagues [85] stressed the important interaction between knowledge and self-efficacy. Egel [86] looked into different aspects with regard to the self-efficacy of prospective English teachers. One of her findings was that high-achieving prospective English teachers (i.e., teachers with a high amount of professional knowledge) scored higher concerning self-efficacy. Riese and Reinhold [87] focused on the relationship between physics teachers' CK and PCK and their general as well as teaching-related self-efficacy. They found a significant positive correlation between teaching-related self-efficacy and CK. Also other studies that focus on related constructs are important in this context. Studies that deal with professional knowledge related to the implementation of technology in school and teachers' self-efficacy also reveal a positive relationship between these two constructs [88, 89]. Some authors [90] found a relationship between teachers' academic self-concept and their professional knowledge. The above-mentioned considerations of Bandura [31] support these findings. He identified mastery experiences as a source of self-efficacy. Professional knowledge allows for these mastery experiences during teaching. One example

is the significance of teachers' professional knowledge for students' learning success (e.g., [7, 16, 74]).

To our knowledge, the relationship between teacher enthusiasm and teachers' professional knowledge has only been investigated in the framework of the COACTIV project [21]. More detailed, the relationship between PCK and teaching enthusiasm was in the focus. The results revealed no relationship between the respective variables. Nevertheless, as the empirical basis is small, the theoretical assumptions of Deci and Ryan [73] can help to understand possible interrelationships. Teachers' professional knowledge enables teachers to experience success in teaching. Success in teaching is important for the experience of the own competence, which in turn provides an important source for the manifestation of enthusiasm. Accordingly, we also assume a relationship between teacher enthusiasm and teachers' professional knowledge.

These interrelationships have to be considered if one aims to infer implications for the improvement of teacher education in terms of the support of teachers' motivational orientations.

3. Research Questions and Hypotheses

The core aim of the study at hand is the identification of opportunities to learn for teachers' motivational orientations (self-efficacy, subject-specific enthusiasm, and enthusiasm for teaching the subject). We aimed to cover different phases of teacher education as well as both formal and informal learning opportunities. More specifically, we consider the following opportunities to learn: (1) teacher education at university (first phase of teacher education; here, the perceived quality of university-level teacher education), (2) professional development (second and third phases of teacher education; here, participation in workshops and lectures), (3) teaching experience, and (4) self-study (here, reading journals). Accordingly, our first research question is the following:

(1) How are (a) self-efficacy, (b) subject-specific enthusiasm, and (c) enthusiasm for teaching the subject related to the respective opportunities to learn [(1) to (4)]?

With regard to the currently available findings [5, 23, 29, 40, 67, 68] as well as theoretical assumptions [31, 73], we assume a positive relationship between the considered opportunities to learn and teachers' self-efficacy and both facets of enthusiasm. Figure 1 gives an overview of the considered relationships.

It is beyond dispute that the acquisition of professional knowledge is the first aim of teacher education. Accordingly, an isolated consideration of motivational orientations is not sufficient to generate an in-depth understanding of its development. To gain a first insight into these hypothesized interrelations, we added a further more exploratory research question:

(2) How are (a) self-efficacy, (b) subject-specific enthusiasm, and (c) enthusiasm for teaching the subject related to CK and PCK?

With reference to current findings [85, 87], we assume a relationship between teachers' self-efficacy and their content-related professional knowledge. Furthermore, as CK and PCK

are very closely related to a specific subject, we assume a positive relationship between subject-specific enthusiasm and both CK and PCK.

4. Method

The study at hand is part of the BioTeC (acronym for Biology Teachers' professional Competence) project. The project has three research foci: (1) the examination of the empirical structure of teachers' professional competence, (2) the identification of opportunities to learn for teachers' professional competence, and (3) the examination of the predictive validity of teachers' professional competence for students' performance. The BioTeC project focuses on two aspects of teachers' professional competence: (1) motivational orientations and (2) professional knowledge. The study at hand concerns the second research focus and focuses on teachers' motivational orientations.

4.1. Measures

4.1.1. Teachers' Self-Efficacy and Enthusiasm. The measure of teachers' self-efficacy is a widely used instrument developed by Schmitz and Schwarzer [91], which consists of ten Likert-type items (4 = fully applies; 3 = largely applies; 2 = does rather not apply; 1 = does not apply at all). The instrument assesses different skills that are relevant for the teaching profession. It addresses (1) the relationship with students and parents (e.g., dealing with difficult students), (2) emotional aspects (e.g., resignation), and (3) aspects related to professional practice (e.g., creative ideas for the improvement of lessons; *"I know that I will be able to clarify individual problems of students even better in the future."*).

Both subject-specific enthusiasm (three items; *"I am enthusiastic about the subject biology."*; *"I think biology is an exciting subject."*; *"I always try to get students enthusiastic about the subject biology."*) and enthusiasm for teaching the subject (two items; *"I teach biology with great enthusiasm."*; *"Teaching biology is fun."*) were measured using instruments developed by Baumert and colleagues [92]. As our sample consists of biology teachers while the original instruments address mathematics teachers, we replaced "mathematics" with "biology" in the items. The same Likert scale that was used for self-efficacy was applied to the items. The reliability of the scales is described by the factor ρ coefficient, which overcomes the shortcomings of Cronbach's alpha coefficient outlined by Raykov [93]. The factor ρ coefficients for teachers' self-efficacy, subject-specific enthusiasm, and enthusiasm for teaching the subject were .71, .73, and .79, respectively, which indicates that the scales had good reliability and confirm convergent validity among indicators of these factors [94].

4.1.2. Opportunities to Learn. We assume different opportunities to learn for self-efficacy and the two facets of enthusiasm: (1) teacher education at university (here, the perceived quality of university-level teacher education), (2) professional development (participation in workshops and

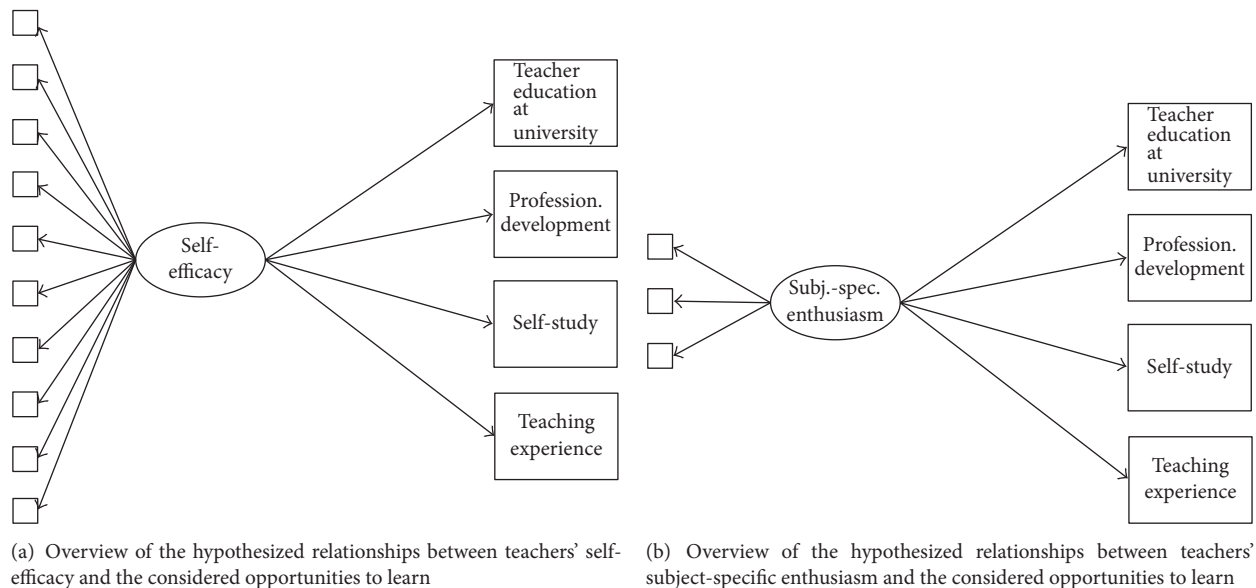


FIGURE 1

lectures), (3) teaching experience, and (4) self-study (reading journals):

- (1) To gain information about teacher education at university as formal learning opportunity, we used the quality of teacher education at university as proxy. Three Likert-type items were applied to measure the perceived quality of university-level teacher education ($\alpha = .72$). As we have a sample of in-service teachers, the quality of university-level teacher education was graded retrospectively. Each item focused on one of the core areas of teacher education at German universities, which is composed of (a) biology courses (acquisition of CK), (b) biology education courses (acquisition of PCK), and (c) courses in general pedagogy (acquisition of pedagogical knowledge) [30]. Each item started with a request ("Please grade the quality of the teacher education program you attended with regard to your job as a biology teacher."). The

following answer alternatives were provided for each item: 1 = *very good*; 2 = *good*; 3 = *satisfying*; 4 = *sufficient*; 5 = *inadequate*; 6 = *unsatisfactory or not part of teacher education program*. The areas of teacher education (a) to (c) were summarized to provide a score that describes the general quality of teacher education. We decided to assess the *perceived* quality of teacher education, as we assume that the individual rating of quality is more predictive for motivational orientations.

- (2) To measure the amount of professional development, we asked the teachers about their participation in workshops and lectures related to their subject biology in the past two years. We used a single item ("How often did you participate in workshops and lectures for the purpose of professional development in your subject biology during the past two years?") with four answer alternatives (0 = *never*; 1 = *once*; 2 = *once a year*; 3 = *more than once a year*) (cf. [5]).

- (3) To measure their teaching experience, teachers were asked about the number of years they had been teaching (*"I have been teaching in schools for — years."*) (cf. [5]).
- (4) To gain information about the conduction of self-study, teachers were asked how often they perform further individual training beyond organized workshops or lectures (*"How often do you engage in self-study [e.g., reading journals]?"*) by a single item providing four answer alternatives: 0 = never; 1 = once; 2 = once a year; 3 = more than once a year (cf. [5]).

4.1.3. Teachers' Content-Related Professional Knowledge. Two instruments [5] were used to assess biology teachers' content-related professional knowledge, that is, their CK and PCK. We decided to apply a paper-and-pencil test, as we have a relatively large sample. The items of the paper-and-pencil test were developed in the framework of the BioTeC project (see [5] for more information about the item development). Depending on the knowledge domain, we decided to consider both closed-ended and open-ended items. As we wanted to gain a more in-depth insight into teachers' PCK (e.g., about the reasons for a respective planning decision), we used open-ended items to measure PCK. CK was measured with closed-ended items. The instruments addressed teachers' knowledge of the Wadden Sea ecosystem, which is a very common topic in secondary schools in the north of Germany (where the study had been conducted), as this ecosystem is located in the north of Germany. We followed the conceptualization of CK as described in the background and measured it using 19 multiple choice items (*"Mussel beds are important for blue mussels. Do they have another function in the Wadden sea ecosystem?"*; cf. [5]). PCK was assessed by nine open-ended items that addressed, according to the conceptualization described in the background, both knowledge of instructional strategies for teaching (five items) and knowledge of students' understanding (four items). An item example for PCK is (cf. [5]) *"In the lesson before, 8th grade students have learned that blue mussels need water to be able to breathe. Please create a short outline for a problem-oriented beginning of a lesson with the topic 'survival of the blue mussels during low tide'."* 10% of the open-ended items were coded by two raters. The intraclass correlation coefficient (.97) revealed good intercoder reliability. We used the software ACER ConQuest [95] to analyze the data. As we have both dichotomously scored items and partial credit items, we applied a partial credit model. We used the Maximum Weighted Likelihood Estimation (WLE) to estimate the person ability scores. This method is less biased when compared to maximum likelihood estimation [96]. The estimated person ability scores were used for the following analyses.

WLE person separation reliability for content knowledge and pedagogical content knowledge was .69 and .78, respectively, indicating that both scales had acceptable internal consistency.

The instruments, instrument development, scoring of the items, and reasons for topic selection are described in detail in the article written by Großschedl and colleagues [5].

4.2. Sample and Data Collection Procedure. This study refers to the sample that was used to analyze the development of biology teachers' content-related professional knowledge in the framework of the BioTeC project (cf. [5]). Secondary school biology teachers ($N = 134$, 75.4% female, age: $M = 43.7$, $SD = 10.2$) from northern Germany (e.g., Mecklenburg-West Pomerania and Schleswig-Holstein) participated in the study at hand. The participating teachers' experience ranged from seven months to 42 years ($M = 16.4$, $SD = 11.7$). In our sample, 54.5% of the participants were certified to teach in academic track schools, 17.1% were certified to teach in nonacademic track schools, and 26.9% attended a teacher education program in the former German Democratic Republic. In Germany, there is a general distinction between schools that qualify their students for an academic career (academic track schools) and schools that certify their students for a vocational career (nonacademic track schools). Accordingly, there are different teacher education programs certifying the prospective teachers for a career at academic track schools or nonacademic track schools. In addition, there was an additional teacher education program in the former German democratic republic. In this program, there was no distinction between different tracks [97]. Moreover, this program differs in the consideration of practical phases. Whereas the completion of recent teacher education programs at university leads to a second more practical phase (see Section 2.4.2), this program from the former GDR had an integrated practical phase [97, 98]. The remaining teachers acquired a certificate that is not related to teaching (e.g., a Master's degree for biology). Participants were recruited by telephone or mail. The teachers were rewarded for their participation in the study. They got no money but material and equipment for a teaching unit related to the topic ecosystem Wadden Sea (e.g., blue mussels and aquarium). Teachers received the questionnaires by mail and were instructed not to use external sources of information (e.g., textbooks). No time limit was set for answering the questionnaires [5].

5. Results

5.1. Descriptive Statistics. Table 1 provides information about the descriptive statistics of the measures.

5.2. Validity Check I: Are Teachers' Self-Efficacy, Subject-Specific Enthusiasm, and Enthusiasm for Teaching the Subject Empirically Separable? We analyzed the discriminant validity of our measures with confirmatory factor analysis (CFA) using the structural equation software MPlus 5.21 [99]. The three-factor model assumes different latent factors for (1) self-efficacy, (2) subject-specific enthusiasm, and (3) enthusiasm for teaching the subject. This model was compared to a one-factor model and a two-factor model. The one-factor model assumes a single latent factor behind teachers' responses. The two-factor model distinguishes between self-efficacy and enthusiasm (both subject-specific enthusiasm and enthusiasm for teaching the subject) as separate factors. Maximum likelihood estimation with robust standard errors

TABLE 1: Descriptive statistics.

Measure	n_{items}	M	SD	Min	Max
<i>Motivational orientations</i>					
Self-efficacy	10	20.51	3.30	1	4
Subject-specific enthusiasm	3	8.35	1.01	1	4
Enthusiasm for teaching the subject	2	5.27	0.93	1	4
<i>Content-related professional knowledge</i>					
CK	19	17.95	3.95	0	2
PCK	9	8.69	3.56	0	2
<i>Opportunities to learn</i>					
Perceived quality of teacher education at university	3	3.06	1.04	1	6
Professional development	1	2.10	1.11	0	3
Teaching experience	1	16.38	11.71	0	3
Self-study	1	2.51	0.82	0	3

Note. CK: content knowledge; PCK: pedagogical content knowledge.

was applied to the data. The results show that the three-factor model outperforms both the one-factor model and the two-factor model. See Table 2 for detailed results. To test whether the three-factor model fits the data significantly better than the one-factor model and the two-factor model, we computed the scaled χ^2 -statistic according to Satorra and Bentler [100]. This test indeed showed that the three-factor model fits significantly better than both the one-factor model ($\text{TRd} = 63.89$, $\Delta\text{df} = 3$; $p < .001$) and the two-factor model ($\text{TRd} = 15.10$, $\Delta\text{df} = 2$; $p < .001$). No post hoc modifications were indicated by the analysis; the goodness-of-fit indices for the three-factor model and the residual analysis did not indicate any problems. The latent correlations between the respective constructs are not excessively high (i.e., $<.60$), which confirms the discriminant validity of the measures (cf. [94]). Analyses show that there is a large latent correlation between subject-specific enthusiasm and enthusiasm for teaching the subject ($r = .57$, $p < .001$), a medium correlation between self-efficacy and subject-specific enthusiasm ($r = .43$, $p < .001$), and also a medium correlation between self-efficacy and enthusiasm for teaching the subject ($r = .49$, $p < .001$). The three-factor structure which we found in this analysis was considered in the following regression analysis.

5.3. Validity Check II: Are CK and PCK Empirically Separable?

We analyzed the discriminant validity of the measures for content-related professional knowledge in the framework of a Rasch analysis using ACER ConQuest [95] (see [5] for a more detailed description of the analysis). We decided for a Rasch analysis as the measures are part of a performance test that was developed in the framework of the project and as the measures are composed of both dichotomous and polytomous items. Two models were specified. Model 1

assumes content-related professional knowledge to be one-dimensional. Model 2 is a two-dimensional model and assumes CK and PCK as unique dimensions of teachers' content-related professional knowledge. The results reveal that the information-based criteria are lower for the two-dimensional model (see Table 3). A χ^2 -difference test gives information, if the two-dimensional model significantly outperforms the one-dimensional model. The results show that the two-dimensional model significantly outperforms the one-dimensional model ($\chi^2 [2] = 104.75$, $p < .001$). According to these results, CK and PCK are considered as unique dimensions of teachers' content-related professional knowledge in the following analysis. We found a medium correlation between CK and PCK ($r = .48$, $p < .001$).

5.4. How Are the Considered Opportunities to Learn Related to Teachers' Self-Efficacy, Subject-Specific Enthusiasm, and Enthusiasm for Teaching the Subject? We analyzed the relationship between the opportunities to learn and teachers' self-efficacy, subject-specific enthusiasm, and enthusiasm for teaching the subject with the structural equation software MPlus [99]. As we found that these three domains of motivational orientations are empirically separable (see Section 5.2), they are represented as separate latent factors in a regression analysis. In contrast, the perceived quality of university-level teacher education, professional development, teaching experience, and self-study represent manifest variables. The latent factors were regressed on the manifest covariates (MIMIC model, [99]). We conducted separate analyses for the three dependent variables. Detailed results are provided in Table 4.

5.4.1. Self-Efficacy. Our analysis shows that there is a significant relationship between the perceived quality of university-level teacher education and self-efficacy, which indicates that self-efficacy improves with increasing perceived quality. Moreover, the results show a significant positive relationship between the frequency of participation in professional development courses and self-efficacy as well as between the frequency of self-study and self-efficacy. In contrast, no significant relationship was found for teaching experience and self-efficacy.

Bandura's [31] studies help to understand the importance of a high-quality teacher education. He identified mastery experiences as an important source of self-efficacy. Mastery experiences strongly depend on the capabilities of teachers [101, 102]. Teacher education at university represents the most important phase of the professionalization of teachers and mainly aims at the acquisition of professional knowledge [30]. Professional knowledge in turn is one of the important prerequisites to master the demands in the teaching profession [4]. High-quality teacher education enables the prospective teachers to successfully acquire professional knowledge and thus enables them to have mastery experiences during teaching. Accordingly, it seems plausible that high-quality teacher education supports teachers' self-efficacy. In addition, teacher education enables confidence in teaching and supports the intention to stay in the profession, two further aspects which are related to self-efficacy [67].

TABLE 2: Goodness-of-fit indices for three models ($N = 134$).

	df	χ^2	χ^2/df	CFI	TLI	RMSEA	AIC	BIC
Single-factor	77	144.98	1.88	.73	.68	.08	2797.54	2918.94
Two-factor	76	114.70	1.51	.85	.82	.06	2753.90	2878.19
Three-factor	74	79.57	1.08	.98	.97	.02	2722.49	2852.56

Notes. χ^2/df : relative chi-square; CFI: comparative fit index; TLI: Tucker-Lewis fit index; RMSEA: root-mean-square error of approximation; AIC: Akaike Information Criterion; BIC: Bayes' Information Criterion.

TABLE 3: Final deviance and information-based criteria for different partial credit models of content-related knowledge.

	Domain of content-related knowledge	One-dimensional model	Two-dimensional model
Allocation to dimension	CK	A	A
	PCK	A	B
Deviance (number of free parameters)		5819.97	5715.22
AIC		5913.97	5813.22
BIC		6050.17	5955.22

Notes. CK: content knowledge; PCK: pedagogical content knowledge; AIC: Akaike Information Criterion; BIC: Bayes' Information Criterion.

TABLE 4: Unstandardized regression coefficients (standard errors in parentheses) for teachers' self-efficacy as well as enthusiasm and the considered opportunities to learn.

	Self-efficacy	Subject-specific enthusiasm	Enthusiasm for teaching the subject
Quality	-.22 (.11)*	.08 (.19)	-.23 (.11)*
Frequency of professional development	.14 (.06)*	-.01 (.04)	.08 (.05) [†]
Teaching experience	.05 (.11)	-.10 (.13)	<.001 (.003)
Frequency of self-study	.23 (.08)**	.02 (.04)	.12 (.05)*

Notes. Quality: perceived quality of university-level teacher education (1 = very good; 6 = unsatisfactory or not part of teacher education program); a negative regression coefficient indicates that the respective motivational orientation increases with increasing quality. The continuous variables (quality and teaching experience) were standardized before the analysis. [†] $p < .10$, * $p < .05$, and ** $p \leq .01$.

Additionally, we found professional development and self-study to be related to self-efficacy. Again, the sources of self-efficacy identified by Bandura [31] are helpful to interpret our findings. Both professional development and self-study can support teachers with having success in their teaching routine, that is, having mastery experiences. Besides mastery experiences, vicarious experience is described as a further source of self-efficacy [31]. Specifically, professional development training provides the opportunity to profit from vicarious experience (i.e., the experience of the lecturer). Contrary to our expectation, we found no relation between teaching experience and self-efficacy. In the literature, the findings concerning the relevance of teaching experience are mixed [71, 72]. An explanation for our result could be that teaching experience (as it is measured in our study) does not provide any information about the personal success in teaching. More information about the time spent in the profession is necessary to explore how self-efficacy is related to teaching experience.

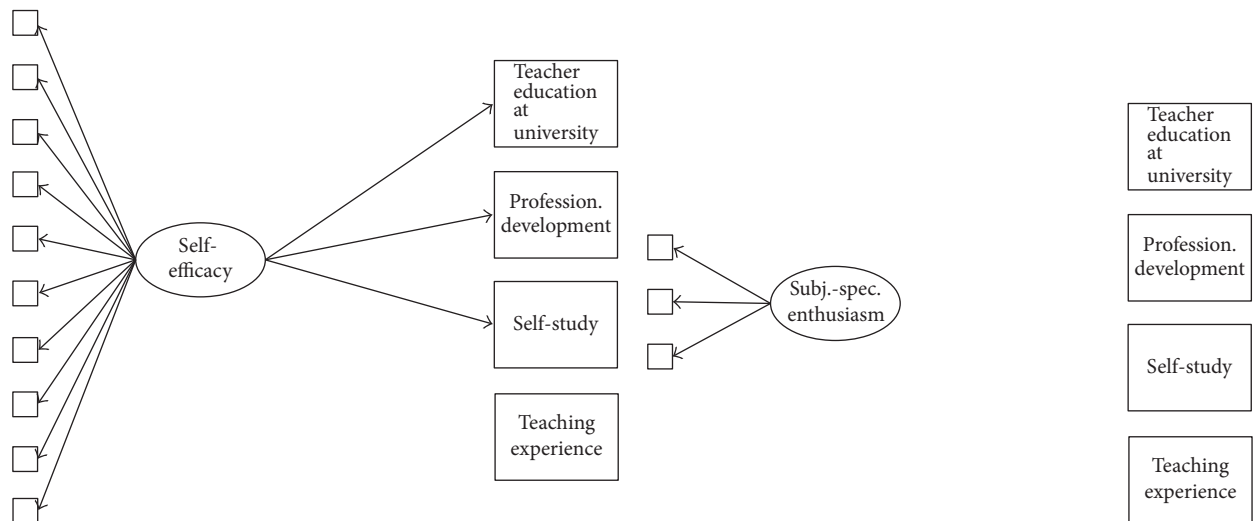
5.4.2. Subject-Specific Enthusiasm. Our study shows that subject-specific enthusiasm is not significantly related to either the perceived quality of university-level teacher education, professional development, teaching experience, or self-study.

One possible explanation could be that subject-specific enthusiasm is closely related to the construct of subject interest [43], which is a rather stable trait and is less influenced by contextual factors [23].

5.4.3. Enthusiasm for Teaching the Subject. Enthusiasm for teaching the subject and the perceived quality of university-level teacher education are significantly related, which indicates that the enthusiasm for teaching the subject improves with an increasing perceived quality of teacher education. We found a marginally significant positive relationship between the frequency of participation in professional development courses and enthusiasm for teaching the subject. Moreover, the frequency of self-study is significantly positively related to enthusiasm for teaching the subject. No significant relations occur between enthusiasm for teaching the subject and teaching experience.

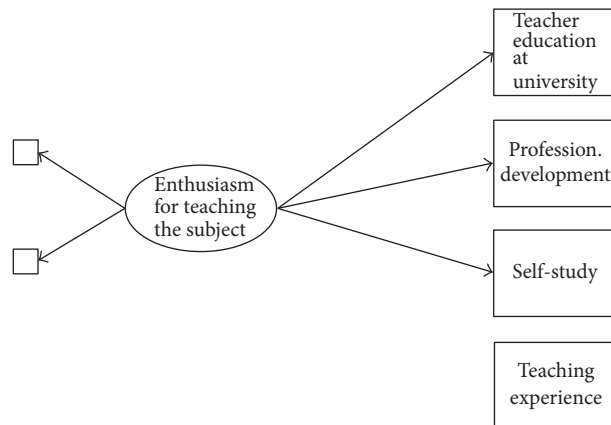
Enthusiasm for teaching the subject is more strongly influenced by the daily teaching routine [23] than by subject-specific enthusiasm. A high-quality teacher education as well as professional development and self-study support teachers to master demands and conflicts in their teaching routines.

Contrary to our expectation and the findings of Kunter and colleagues [23], our findings show that neither of the two dimensions of enthusiasm is related to teaching experience.



(a) Significant relationships between teachers' self-efficacy and the considered opportunities to learn

(b) Significant relationships between teachers' subject-specific enthusiasm and the considered opportunities to learn



(c) Significant relationships between teachers' enthusiasm for teaching the subject and the considered opportunities to learn

FIGURE 2

As stated above, capturing the time span of teaching experience only cannot give any further information about this time span.

Table 4 and Figure 2 give an overview about the results.

To sum up, in particular, teacher education at university, professional development courses, and self-study represent opportunities to learn for teachers' motivational orientations. This is in line with the findings we made in the framework of the BioTeC project concerning opportunities to learn for teachers' content-related professional knowledge (cf. [5]).

5.5. How Are CK and PCK Related to Biology Teachers' Self-Efficacy, Subject-Specific Enthusiasm, and Enthusiasm for Teaching the Subject? With reference to our additional focus, we analyzed how CK and PCK are related to self-efficacy and the two enthusiasm facets. In order to investigate this relationship, we computed bivariate correlations using MPlus [99]. We decided to apply a correlation analysis, as we assume no causal relationship between professional knowledge and

motivational orientations but an interaction between the two competence aspects. Motivational orientations (self-efficacy, subject-specific enthusiasm, and enthusiasm for teaching the subject) and content-related professional knowledge (CK and PCK) are represented by latent factors. The results show that CK is not correlated to either self-efficacy ($r = -.01, p = .95$), subject-specific enthusiasm ($r = .12, p = .30$), or enthusiasm for teaching the subject ($r = .08, p = .55$).

For PCK, we found a marginally significant positive correlation with self-efficacy ($r = .17, p = .07$) and a significant positive correlation with subject-specific enthusiasm ($r = .22, p = .04$). In contrast, no relationship occurs between PCK and enthusiasm for teaching the subject ($r = .06, p = .74$). An overview of the bivariate correlations is provided in Table 5.

Contrary to our expectation, we did not find any correlation between biology teachers' CK and their self-efficacy as well as their subject-specific enthusiasm. In contrast to our result concerning the relationship between CK and self-efficacy, Riese and Reinhold [87] did find a significant positive

TABLE 5: Latent correlation matrix for self-efficacy as well as enthusiasm and content-related professional knowledge.

	Content knowledge	Pedagogical content knowledge	Self-efficacy	Subject-specific enthusiasm	Enthusiasm for teaching the subject
CK	—	.48***	-.01	.12	.08
PCK		—	.17 [†]	.22*	.06
Self-efficacy			—	.43***	.49***
Subject-specific enthusiasm				—	.57***
Enthusiasm for teaching the subject					—

Notes. [†] $p < .10$, * $p < .05$, and *** $p < .001$.

correlation between physics teachers' CK and their self-efficacy. Different remarks should be made to explain this unexpected result. First, we assume that it is necessary to consider self-efficacy in a subject-related manner to gain information about its relation to content-related professional knowledge. Riese and Reinhold [87] captured self-efficacy related to teaching physics. The more general instrument we applied in the study at hand is obviously too broad to contribute to the explanation of the relationships between self-efficacy, respectively, and CK. A more subject-related instrument, like the STEBI (Science Teaching Efficacy Belief Instrument [103]), would have given better insight into this relationship. A further explanation could be that CK alone does not suffice to be successful during teaching. This is supported by studies that found no direct relationship between CK and students' achievement [104–106] or found that PCK is the less relevant predictor for students' achievement [74]. Having success in teaching leads to mastery experiences or the experience of one's own competence. Both are important sources for self-efficacy and enthusiasm, respectively.

We found teachers' PCK to be related to self-efficacy and subject-specific enthusiasm. In contrast, no relations appear with enthusiasm for teaching the subject. Self-efficacy is defined as a cognitive domain of teachers' motivational orientations [23]. Moreover, PCK is inseparably related to the content and, thus, a specific subject. Accordingly, the findings concerning self-efficacy and subject-specific enthusiasm match our expectations. The lacking relationship between enthusiasm for teaching the subject and the domains of content-related professional knowledge, especially PCK, represents an unexpected result. The research base related to enthusiasm as it is conceptualized in the study at hand is very small, especially for the two facets subject-specific enthusiasm and enthusiasm for teaching the subject. Further research is needed to clarify this issue.

6. Limitations and Implications

6.1. Limitations of the Study. Different concerns arise related to (1) the design and sample, (2) the applied instruments, and (3) the conduction of the study.

Design and Sample. Our main concern is related to the cross-sectional design of our study. We were interested in the meaning of different opportunities to learn for teachers' motivational orientations. Due to the limitations of a cross-sectional design, it is not possible to infer about causality.

A longitudinal design considering also the motivational orientations prior to the involvement in the different opportunities to learn would help gain causal information about the effect of the selected opportunities on the development of teachers' self-efficacy and enthusiasm. A further aspect that is important to mention is that we were not able to control if other background variables (like general optimism) are related to variables like the perceived quality of teacher education or teachers' self-efficacy. Our sample consisted of biology teachers only. This may potentially cause concerns about generalizability. Here, further research that considers a more diversified teacher sample is needed.

Instruments. We measured the quality of teacher education using retrospective self-reports. There are very experienced teachers in our sample, which causes concerns of validity. Moreover, it is important to mention that the perceived quality only represents one indicator of the actual quality of teacher education. It would have been useful to use an additional measure of quality that is more objective (e.g., a ranking of different universities). Nevertheless, as we are interested in the meaning of teacher education quality on motivational orientations (not on professional knowledge), the individually perceived quality is an aspect of great importance. We did not ask the teachers about the specific settings of the professional development courses. Accordingly, we are not able to infer about the intensity of the respective courses. We know from the literature that particularly intensive courses that cover a longer time period (like a summer school; [28]) impact on teachers and that the impact of courses that last only a few hours or one day is very limited (e.g., [107]). As our results support the assumption that the attendance in professional development represents an important learning opportunity, it would have been useful to know more about the setting of the courses.

Conduction of the Study. Teachers received the questionnaires by mail. Although they were instructed to complete the questionnaires on their own, we were not able to control this. This is particularly relevant for the instruments used to capture content-related professional knowledge. However, at least the items related to PCK were not appropriately solvable using the internet or other external devices.

6.2. Implications for Further Research. According to our results and occurring concerns, further research should in

particular focus on the investigation of possible reverse effects in a longitudinal research design.

First, it is interesting to further investigate whether, for instance, motivated teachers are more likely to participate in professional development courses or more likely to conduct self-study. A longitudinal research design could help to clarify this issue.

Second, the results of our second exploratory focus reveal that teachers' motivational orientations are related to their content-related professional knowledge. With regard to the strong focus on knowledge acquisition in teacher education, it is of additional interest to further investigate the relationship between motivational orientations and content-related professional knowledge. Here, a longitudinal design would also help to shed light on this aspect and to make causal statements. One assumption is that content-related professional knowledge enables teachers to face the demands in the teaching profession and thus has a positive influence on teachers' motivational orientations. Reversely, motivated teachers are more willing to actively participate in teacher education courses, which in turn result in greater knowledge. Moreover, the results of this study are an interesting prerequisite for the examination of the impact of teacher education courses that are related to professional knowledge (i.e., most of the provided courses) for the development of teachers' motivational orientations.

6.3. Implications for Teacher Education. Our results suggest that opportunities to learn are indeed meaningful for motivational orientations. More detailed, teacher education particularly provides opportunities for the development of self-efficacy and enthusiasm for teaching the subject. Self-efficacy is a very powerful domain of teachers' motivational orientations because it is important not only for satisfaction in the profession but also for students' performance [34, 38, 47–50]. Teacher enthusiasm is an important factor for job satisfaction [36] and students' performance [21]. Thus, beyond fostering professional knowledge, fostering these domains of teachers' motivational orientations should be one of the main goals of teacher education.

To improve these to domains of teachers' motivational orientations in the best possible way, it is important to think about three points: (1) institutional/external factors, (2) "tailored" teacher education, and (3) the interplay between knowledge and motivation.

Institutional/External Factors. Both the participation in professional development courses and the frequency of self-study are related to self-efficacy and enthusiasm for teaching the subject. In Germany, the guidelines for participation in professional development courses are not very strict. As already mentioned (see Section 2.4.2), the number of courses varies between the federal states or is not strictly regulated. Furthermore, there is no additional incentive (e.g., reduction of lessons) to attend. Self-study is often neglected because of the high workload in the teaching profession. Thus, it is of great importance to make the teachers aware of the usefulness of professional development courses and self-study. It is important to communicate the relevance of these factors for

the own motivational development, for example, by referring to the underlying mechanisms or by presenting the results of empirical studies that support the relevance of in-service teacher education for the manifestation of teachers' motivational orientations. In addition, it is necessary to enable teachers to effectively self-study, for example, by conveying strategies of self-study or by facilitating the teachers getting access to journals (e.g., the schools could provide access to journals).

"Tailored" Teacher Education. The results of our second research question help to understand on what professional development courses as well as self-study should focus on. We found a positive relationship between self-efficacy as well as subject-specific enthusiasm, respectively, and PCK. This indicates that PCK-related topics (e.g., selection of adequate representations or consideration of learning difficulties) in professional development courses or in journal articles that teachers' use in terms of self-study provide opportunities for the development of self-efficacy and enthusiasm. Beyond that, the task-specificity of self-efficacy leads to further research questions. Lee and colleagues [22] found that teachers' self-efficacy differs based on different tasks (e.g., classroom management), which indicates that teachers' self-efficacy is not a general construct. This supports the assumption that different trainings related to different tasks would have different effects.

Interplay between Knowledge and Motivation. It is important to understand that there is a complex interplay between teachers' professional knowledge and their motivational orientations. Our results indicate that a teacher with a high amount of CK is not necessarily motivated. As discussed above, this possibly indicates that CK, as it is acquired during teacher education, does not suffice to be successful in teaching, which is of great importance for the motivation of a teacher. Teacher education could contribute to this issue by providing content-related courses that are more school-related (e.g., by focusing more on school-relevant topics or by including experiments that are also possible to conduct in schools).

7. Conclusions

Self-efficacy and enthusiasm of teachers increasingly gained attention in recent research on teachers' professional competence. The results of our study reveal that teachers' motivational orientations benefit from formal and informal opportunities to learn. Moreover, the results reveal that not only the first phase of teacher education (teacher education at university) provides opportunities to learn and that also in-service teachers have the opportunity to further develop their motivational orientations (e.g., by attending professional development courses). This is a pleasing result because self-efficacy and teacher enthusiasm are important factors throughout a teacher's professional life. Furthermore, the study took the strong focus of teacher education programs on the acquisition of professional knowledge into account by considering the relationship between self-efficacy as well as

enthusiasm and professional knowledge. Our findings reveal the relevance of considering motivational orientations and professional knowledge as two complex, concurrent aspects of professional competence to gain more insight into their interplay for the sake of teacher education improvement. This finding is an important prerequisite for the further examination of the development of teachers' professional competence.

Disclosure

Parts of this article (in a manuscript version) are part of the publication-based dissertation of the corresponding author [108].

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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