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International journal for research in vocational education and training 13 (2026) 3, S. 392-423

International Journal for Research in Vocational Education and Training (IJRVET)
2026, Vol. 13, Issue 3, 392–423
https://doi.org/10.13152/IJRVET.13.3.4

Professionalisation of Future VET Teachers Through Assignment-Related Action Competence

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Received: 16 June 2025, Accepted: 03 December 2025

Abstract

Purpose: This study investigates the effectiveness of Cooperation Laboratories (Co-Labs) in strengthening competences in the analyse, modification, and development of teaching assignments (assignment-related action competences) among Vocational Education and Training (VET) teacher students. Furthermore, it examines how this learning arrangement contributes to their professionalisation by addressing the so-called double theory–practice gap in VET teacher education, which requires future teachers to connect theoretical knowledge with both school-based and company-based practice.

Method: The study follows a mixed-methods design, combining a quantitative pre-post survey (N = 156 observations) with a qualitative analysis of reflection-based student portfolios (N = 13). The dimensions of knowledge, ability, and willingness were assessed based on the competence model of the German Standing Conference of the Ministers of Education and Cultural Affairs (KMK). The quantitative part provides standardised insights into competence development across two course cycles, while the qualitative part offers context-specific perspectives on how VET teacher students perceive their learning processes within the Co-Lab.

Findings: According to the KMK competence model, the results show (i) a slight improvement in assignment-related knowledge, (ii) a significant increase in ability to handle teaching assignments, and (iii) consistently high motivation levels to work with teaching assignments with no significant changes over time. The qualitative data provide context-specific insights into the VET teacher students' perspectives: They highlight that students perceive assignment development, the multi-perspective collaboration with practitioners, and feedback loops as central to their learning progress.

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ISSN: 2197-8646
https://www.ijrvet.net

Conclusion: The findings highlight the potential of the Co-Lab format to foster the professionalisation of VET teacher students. By focusing on teaching assignments in a cooperative and multiperspective way, the format strengthens assignment-related action competences. The combination of theory with school and company practice in Co-Labs helps to address the double theory–practice gap in VET teacher education. The study thus contributes to the discussion on innovative university formats that enhance professionalisation processes and promote action-oriented competence development among future VET teachers.

Keywords: Vocational Education and Training, VET, VET Teacher Education, Professionalisation, Teaching Assignment

1 Introduction

The development of professional action competence is a key objective of n vocational education and training (VET). The dual system combines learning at vocational schools with learning and working in companies. As a result, VET students must be prepared to connect educational and occupational requirements (Cedefop, 2023a). Therefore, VET teacher education needs to address these dual conditions explicitly and prepare future teachers for the complexity of both learning environments (Kiikeri et al., 2024).

However, many VET teacher students struggle to meet these specific requirements. They often find it difficult to link theoretical knowledge from university studies with the practical demands of school teaching and work processes in company-based practice (Hantsch & Hantke, 2024; Manal et al., 2024). This leads to the so-called double theory–practice gap: VET teacher students need to connect theoretical knowledge with both school and in company-based practice. To address this gap, university formats are required that systematically integrate theory with both practical contexts.

A promising approach lies in the development of assignment-related action competences of VET teacher students (Gießler et al., 2020). We define assignment-related action competences as the individual's ability and willingness, based on professional knowledge, to act responsibly by handling assignments. This includes analysing, modifying, and developing practice-, action-, and competence-oriented assignments. These competences enable VET teacher students to translate theoretical insights into classroom practice through handling these teaching assignments. Such assignments help strengthen the connection between theoretical knowledge and professional realities (Gerlach et al., 2012) and can promote action- and competence-oriented teaching (Kleinknecht, 2011).

Yet, in many university courses, assignments receive little attention (and are often treated only at an abstract level (Gießler et al., 2020). As a result, VET teacher students often lack the practical experience needed to develop appropriate teaching assignments (Grundmann et al., 2018).

To foster these competences, so-called Cooperation Laboratories (Co-Labs) were developed in vocational teacher education modules at Technische Universität Berlin (TU Berlin). The Co-Lab is an innovative university format that links theory and practice through collaborative, multiperspective learning processes involving university lecturers, vocational school teachers, and company-based practitioners. Within the Co-Lab, VET teacher students are guided through the process of analysing, modifying, and developing assignments for their future teaching (Conty et al., 2023a).

For evaluating the Co-Lab's effectiveness, the German Standing Conference of the Ministers of Education and Cultural Affairs (KMK) competence model (2021) provides the conceptual framework. It differentiates professional action competence into knowledge, ability, and willingness. Building on this model, the aim of this study is to examine whether and how the Co-Lab format supports the professionalisation of future VET teachers by strengthening their assignment-related action competences.

2 The Co-Lab Format to Promote Assignment-Related Action Competences

In Germany, VET teacher training follows a two-phase system comprising university studies and a preparatory teaching service. The overall framework is regulated by the state (KMK), while the concrete implementation lies within the responsibility of the German federal states. Future vocational school teachers first undertake university studies (Master level), including internships in companies and vocational schools, before entering a preparatory teaching service emphasising practical school-based work (Cedefop, 2020). This structure is intended to ensure the integration of scientific knowledge with professional practice and to enable future teachers to develop both pedagogical competence and practical readiness (Cedefop & Federal Institute for Vocational Education and Training (BIBB), 2023). University education is thus expected to link scientific knowledge with professional practice and to enable future teachers to apply and further develop their professional action competence (see Section 3.2). Within this context, innovative higher education formats such as the Co-Lab aim to strengthen the connection between academic training and professional practice.

The Co-Lab is conceptualised both as a stand-alone course and as a transferable didactical model that can be integrated into different teacher education modules. In its stand-alone form, it is anchored as a compulsory master's module, ideally situated in the semester prior to the school placement semester in vocational schools. Its duration is one semester with weekly sessions of four hours (4 × 45 minutes). Student performance is typically assessed as a portfolio, consisting of a presentation (30%) and a reflective term paper (70%). However, the assessment format may vary depending on institutional requirements and course frameworks. When transferring the Co-Lab to other courses, contextual adaptations are possible,

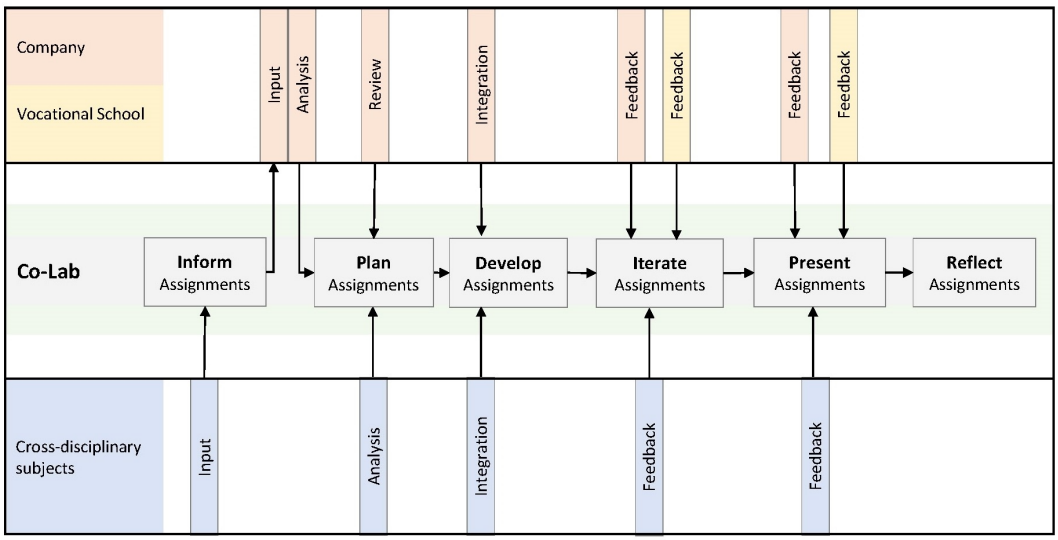
but two conditions are essential: (1) Close collaboration among VET teacher students, university lecturers, vocational school teachers, and practitioners; and (2) guiding VET teacher students through the learning process of analysing, modifying, and developing teaching assignments. Together, these conditions form the basis for strengthening assignment-related action competences. The Co-Lab developed at TU Berlin represents a cooperative, practice-oriented learning setting aimed at strengthening assignment-related action competences. Since its initial implementation in 2020, the format has been iteratively refined over multiple cycles in collaboration with university lecturers, vocational school teachers, and practitioners. Since 2022, a consolidated didactic concept has been established that integrates both subject-specific and interdisciplinary perspectives.

The central element of the Co-Labs is multi-perspective collaboration:

- Collaboration with schools to co-design and reflect assignments under real curricular and organizational conditions.
- Collaboration with companies to embed authentic work processes from the respective occupational fields.
- Collaboration with university lecturers across disciplines to translate societally relevant issues into VET content.

This multi-perspective approach creates an integrative learning setting in which school and company perspectives are systematically combined (Marmet, 2023). In doing so, Co-Labs seek to bridge the gap between theoretical knowledge and practical experience from school-, workplace-, and society-oriented perspectives (Conty et al., 2023a).

The aim of the Co-Lab is for VET teacher students to recognise the complexity of academic training and professional practice and to generate independent solutions through sustained work with teaching assignments. To achieve this, the seminar follows a clear structure as shown in Figure 1. At its centre, the Co-Lab course comprises six consecutive phases: Inform, plan, develop, iterate, present, and reflect on teaching assignments. These phases take place within the seminar and are coached by university lecturers.



Note. Colour coding: Grey: Co-Lab course including the assignments development process, green: Theoretical inputs, red: Company contexts, orange: School contexts, blue: Cross-disciplinary subjects.

Figure 1: Spatio-Temporal Organisation of the Co-Lab

The six phases include the following steps:

- Inform: VET teacher students receive inputs, analyse existing assignments, and modify them. This forms the basis for their own development process.
- Plan: VET teacher students define aims, criteria, and constraints, and coordinate with partners from schools and companies.
- Develop: VET teacher students design a first version of their assignments.
- Iterate: VET teacher students test elements, integrate feedback, and refine the design.
- Present: VET teacher students present their assignments to peers and partners.
- Reflect: VET teacher students evaluate outcomes and derive lessons learned.

Surrounding this process, theoretical inputs (green) provide concepts and tools. Company partners (red) contribute workplace practices and sustainability challenges. Vocational schools (orange) add curricular requirements and classroom implementation perspectives. Cross-disciplinary subjects (blue) introduce broader societal and theoretical lenses. Regular feedback and reflection loops are supported by a structured checklist (Conty & Grundmann, 2023).

In terms of university didactics, the Co-Lab format opens up a range of innovative implications. It integrates real-life professional problems, interdisciplinary changes of perspective and socially relevant cross-disciplinary subjects such as sustainability, digitalisation and inclusion into university education. It also promotes collaborative forms of learning through structured peer feedback phases and dialogue-based reflection. This leads to a change in the role of the teacher: University lecturers increasingly act as coaches (Conty et al., 2023b).

3 Theoretical Framework

This chapter outlines the theoretical framework that guide the study. It addresses central concepts relevant to understanding competence development in teacher education, beginning with the theory–practice gap (3.1) and the framework of professional action competence (3.2). Building on this, the three competence dimensions examined in the study (professional knowledge (3.3), ability (3.4), and willingness (3.5) are discussed in detail. Together, these perspectives provide the conceptual basis for deriving the research question (3.6).

3.1 The Theory–Practice Gap in Teacher Education

The gap between theory and practice remains a major challenge in teacher education: Theoretical knowledge acquired at university is often difficult to apply in school practice. The problem is not new. Two decades ago, Tenorth (2003) described a fundamental tension between theoretical reflection and practical training. Smagorinsky et al. (2004) likewise documented the persistent difficulty of translating theoretical knowledge into classroom teaching.

In VET teacher education the challenge is particularly acute. Its dual orientation to teaching skills and hands-on knowledge of work processes places additional demands on teacher preparation (Schmidt, 1979). With school and workplace, VET teachers have to connect multiple institutional settings (Kremer & Sloane, 2014). But structural tensions arise because universities are primarily academically oriented, whereas schools and companies emphasise practical action and problem solving (Thiel & Rothgang, 2016). This discrepancy creates barriers for future VET teachers who try to combine theoretical and practical learning. Three key challenges are being faced in German VET teacher education:

– The three phases of teacher education (university studies, preparatory service, and professional entry) are only loosely connected. This leads to structural fragmentation and weak collaboration among actors (Blömeke, 2006). As a result, professionalisation processes lack continuity and coherence (Pilypaitytė & Siller, 2018).

- In the first phase, subject studies, subject didactics, and educational sciences are often poorly integrated. This reduces coherence and makes it difficult for students to connect theory and practice. Therefore, many students perceive university knowledge as abstract and hard to apply in real teaching situations (Grundmann et al., 2018).

- The balance between subject-based and action-based approaches remains unresolved. Focusing too strongly on either perspective can cause didactic imbalances and hinder coherent competence development (Kremer & Sloane, 2007). In addition, implementing the learning-field concept (KMK, 2021) often requires novices to take on new roles with limited support, which leads to uncertainty (Riedl, 2015).

These conditions have far-reaching consequences for future VET teachers, especially during the transition from university to the preparatory service and their first independent teaching. Many experience a "practice shock" at this stage (Hascher, 2011). In sum, the theory–practice gap persists across all phases of professionalisation. The concept of professional action competence offers a useful lens for analysing how this gap.

3.2 Professional Action Competence in Teacher Training

In this manuscript, the concept of competence is examined in the context of teacher education. We refer to Weinert's (2001) definition, which describes competence as the interaction of cognitive abilities and skills with motivational, volitional, and social dispositions. This understanding highlights both the cognitive and non-cognitive dimensions of professional competence. This foundational perspective has been taken up and further developed in subsequent research (Erpenbeck et al., 2017). It has become the central reference point in German vocational teacher education, formally embedded in the standards of the KMK Within this framework, professional action competence is defined as the individual's willingness and ability to act appropriately and responsibly in professional, social, and private situations (KMK, 2004, 2022). This KMK competence model (2004, 2022) specifies three central dimensions of competence: Knowledge, ability, and willingness. In line with this, Baumert and Kunter (2006) proposed a model of professional teaching competence that extends Weinert's definition by incorporating motivational, volitional, and affective components to reflect the complexity of professional action. Complementarily, Erpenbeck and Rosenstiel (2007) conceptualize competences as self-organization dispositions of mental and objective action, thereby emphasizing their role in enabling individuals to act effectively in complex and dynamic contexts. Such a comprehensive understanding of competence has gained importance particularly in light of changing work environments (Bretschneider et al., 2011).

Following Baumert and Kunter (2006), we regard professional knowledge, self-efficacy, and motivational orientations as key components of professional action competence. Research suggests that these competences can be developed through appropriate learning opportunities. Their development depends on institutional quality factors that shape the structural and content-related learning conditions.

3.3 Knowledge: Professional Knowledge

The professional knowledge of teachers represents a central dimension of professional action competence. It enables a differentiated perception, interpretation and organisation of teaching situations (Baumert & Kunter, 2006, 2011). Establishing this knowledge base is a necessary prerequisite for professional teacher behaviour and successful teaching (Lohmann et al., 2021).

On the basis of Shulman (1986, 1987), professional knowledge is differentiated into three categories: Subject knowledge (in-depth understanding of subject content), subject-didactic knowledge (knowledge about teaching and explaining subject content) and pedagogical knowledge (general knowledge about learning processes and lesson design, independent of subject reference). Voss et al. (2015) further specify these categories by differentiating between declarative, procedural and conceptual knowledge. Professional knowledge always comprises content-related schemata and links that structure the fundamental principles of a domain and enable in-depth understanding (Rittle-Johnson et al., 2001). Studies show that this professional knowledge should be imparted in the first phase of teacher training and progressively differentiated over the course of professionalisation (Schneider & Plasman, 2011).

Curricula are investigated with regard to their promotion of professional knowledge in empirical teacher education research (König & Seifert, 2012), as well as how this knowledge influences lesson structure and responses to unexpected challenges (Blömeke et al., 2015; Klusmann et al., 2012). Hereby, the cumulative increase in knowledge is measured in cross-sectional studies using group comparisons in different study phases, whereby significant differences are interpreted as an indicator of learning gains (König & Blömeke, 2009).

3.4 Ability: Self-Efficacy Expectations and Teaching Expectations

The self-efficacy expectation (SEE) is another central dimension of professional action competence in teacher training. According to Bandura (1997), self-efficacy refers to a person's subjective conviction that they can successfully perform specific actions to achieve desired outcomes. This conviction significantly influences goal-setting, the amount of effort invested, and the way failures and setbacks are managed.

In the context of the professionalisation of future teachers, it has been shown that SEE and teaching expectations shape the professional self-image (Baumert & Kunter, 2006; Voss et al., 2015). Numerous empirical studies highlight the importance of concrete experiences for the development of self-efficacy (Warner & Schwarzer, 2009). Structured and guided learning opportunities promote a positive professional self-perception, especially if future teachers experience their learning space as designable and supportive (Fuchs & Wyss, 2018; Imhof & Schlag, 2018; Porsch & Gollub, 2018). Social feedback, real-life experiences and affective and physiological behaviour act as additional influencing factors (Bandura, 1997). SEE plays therefore a key role of professional behaviour (Caprara et al., 2008). Professional ability, a key part of professional competence, is strongly supported by self-efficacy and teaching expectations, making their promotion essential in teacher training.

3.5 Willingness: Motivation

The willingness of future teachers represents the third central aspect of professional action competence in teacher training. Willingness is operationalized through different motivational dimensions to capture this complex interplay. It is not conceived as a standalone construct, but rather as a dynamic interaction of various modes of expression. The distinct motivational facets enable a nuanced understanding of the complex interplay of personal interests, social framework conditions, professional goals and expected outcomes of action (Ryan & Deci, 2000).

In this study, motivation is differentiated into five theoretically based subconstructs: Intrinsic motivation, achievement motivation, extrinsic motivation, professional motivation and outcome expectation. Each motivational dimension contributes to explain professional willingness and enables a nuanced view of motivational influences in the professionalisation process (Rheinberg & Vollmeyer, 2019):

- Intrinsic motivation describes acting out of personal interest and inner pleasure in the activity itself. This form of motivation is considered to be particularly stable and effective for learning, as it is associated with increased commitment, in-depth processing of content and long-term willingness to act (Deci & Ryan, 1985). For future teachers, intrinsic motivation can manifest itself, for example, in their enjoyment of developing innovative teaching materials or experimenting with new approaches to lesson planning, motivated by authentic professional interest and curiosity (Han & Yin, 2016).

- Achievement motivation as defined by Atkinson (1957) describes the striving for success and the willingness to deal with challenges. It represents a central drive for goal-orientated action and is linked to the ability to show perseverance and initiative even in difficult

situations. For prospective teachers, it forms an important basis for preparing themselves for the demands of teaching.

– Extrinsic motivation refers to external incentives such as recognition, rewards or social expectations. In phases of low self-motivation, it can take on an important compensatory function (Ryan & Deci, 2000). In the context of teacher training, for example, this relates to the fulfilment of formal performance requirements or feedback from teachers.

– Professional motivation is particularly relevant for the career choice and identification of future teachers. This includes the conscious decision in favour of the teaching profession, identification with its values and the desire for continuous further development (Day & Gu, 2007). It is closely linked to professional biographical orientations and forms the basis for long-term professional stability and resilience.

– Outcome expectations, as defined by Bandura (1977), should be given particular emphasis. They refer to the anticipated consequences of specific actions. Students who are confident that their actions will lead to positive outcomes demonstrate a higher willingness to engage with complex tasks in practical settings. Positive outcome expectations can thus function as a motivational amplifier.

3.6 The Research Question

For evaluating the Co-Lab's effectiveness, the KMK competence model (2021), which differentiates professional action competence into knowledge, ability, and willingness, provides the conceptual framework. This study examines whether and how the Co-Lab strengthens future VET teachers' assignment-related action competences. The central research question is: How effective is the Co-Lab format in strengthening assignment-related action competences among future VET teachers?

4 Methodology

To investigate the effectiveness of the Co-Lab in fostering assignment-related competences, a mixed methods design was applied. This chapter outlines the methodological framework of the study, including the study design (4.1), the quantitative component (4.2), and the qualitative component (4.3). The combination of both strands allows for a comprehensive understanding of competence development by integrating measurable developmental trends with context-sensitive insights into students' reflective processes.

4.1 Study Design

A mixed methods approach combining a quantitative and a qualitative part was chosen to analyse the effectiveness of the Co-Lab. This design allows an empirical analysis of the intervention from different perspectives (Ivankova & Wingo, 2018). In this context, it follows a convergent parallel model in which quantitative and qualitative data are collected simultaneously, analysed separately and then integrated (Almeida, 2018). In this way, the strengths of both approaches are utilised: quantitative data provide generalisable findings through standardised procedures, whereas qualitative data offer context-specific insights into subjective perceptions (Creswell, 2012). By combining these perspectives, the study generates a multidimensional picture of the research object and achieves higher explanatory power, context sensitivity and transferability of its results (Ivankova & Wingo, 2018). Table 1 provides an overview of the methodological approaches used in the quantitative and qualitative parts of the study.

Additional data collected in the study are reported in two further papers focusing on specific aspects: The role of didactic focal points (Conty & Langen, submitted) and integrating sustainability into teacher education (Conty & Langen, under review).

Table 1: Methodological Approaches – Overview of the Quantitative and Qualitative Studies to Investigate the Effectiveness of the Co-Lab With Regard to the Development of Assignment-Related Competences

Aspect	*Quantitative Part*	*Qualitative Part*
Research Focus	Measuring the development of teaching assignment-related competence (knowledge, ability, willingness)	Understanding how students perceive and reflect on their teaching assignment-related competence
Measurement Time Points	Start and end of courses surveyed in 2022 and 2023	End of Co-Lab courses in 2022 and 2023
Participants/ Observations	N = 156 observations (Co-Lab and control group)	N = 13 Co-Lab students
Data Source / Material	Online surveys (tool: SoSci survey) with closed-ended items	Written term papers (approx. 10 pages each)
Instruments / Categories	Knowledge test, Likert-scale items for SEE, teaching persuasion, and motivation	Deductive categories based on KMK competence model; open coding
Analytical Approach	Descriptive statistics and two-way ANOVA	Qualitative analysis following Mayring (2014), using a mixed deductive-inductive coding approach
Outcome Type	Statistical results showing development trends across constructs	Contextualised insights into students' subjective development and learning processes

4.2 Quantitative Part

The quantitative part of the study aims to record the effectiveness of the Co-Lab in developing assignment-related competences. The underlying key methodological data are shown in

Table 1. The survey was conducted at two measurement points (start and end of the Co-Lab and control courses) in 2022 and 2023. A total of 156 observations were collected (Co-Lab: 121 observations; control group: 35 observations). An online-based questionnaire (SoSci Survey) was used to collect data, which is based on the KMK competence model (2021). This differentiates between knowledge, ability and willingness. The questionnaire was developed as part of an iterative validation process and revised with the help of expert feedback (Conty & Langen, submitted). The detailed structure of the questionnaire is shown in Table 2.

The survey comprised closed items on three areas: Assignment-related knowledge, self-efficacy expectations (being a teacher, handling with assignments and teaching persuasion) and motivational dimensions (intrinsic motivation, achievement motivation, extrinsic motivation, professional motivation and outcome expectation). All scales showed acceptable to excellent reliability values (Cronbach's α = 0.75-0.88).

Table 2: Structure of the Questionnaire by the Dimensions of the KMK Competence Model

Dimension	*Subdimension/Construct*	*Items*	*Scale*	*Cronbach's α*	*Example Item*
Knowledge	General aspects of assignments	2	9 points	-	Which statements apply to operators?
	Action and competence orientation	3	16 points	-	Arrange the steps of a complete action in chronological order by dragging the terms to the appropriate fields.
	Cross-sectional subjects	4	14 points	-	Name three possibilities for differentiation.
Ability	SEE in being a teacher	4	4-point Likert	0.84	Even when my classes are interrupted, I remain calm.
	SEE in handling assignments	7	4-point Likert	0.81	I can design teaching assignments that reflect real-life situations.
	Teaching persuasion	5	4-point Likert	0.75	I will modify assignments to reflect current workplace realities.
Willingness	Intrinsic motivation	4	4-point Likert	0.83	I enjoy working with teaching assignments.
	Achievement motivation	4	4-point Likert	0.85	It is important to me to perform well in this area.
	Extrinsic motivation	3	4-point Likert	0.81	I want to meet others' expectations regarding my performance.
	Professional motivation	3	4-point Likert	0.83	Knowing how to design assignments will help me in my future profession.
	Outcome expectation	3	4-point Likert	0.88	I expect a good final grade in this course.

Note. The sample consists of 156 participants. A 4-point Likert scale was used (1 = disagree to 4 = agree completely). Cronbach's α coefficients were calculated according to George and Mallery (2003), with values greater than .60 considered acceptable. The study followed the ethical guidelines of TU Berlin; participation was voluntary and anonymous and had no influence on students' course grades. The order of questions was randomised to reduce copying during the closed-book format.

A two-way analysis of variance (ANOVA) with repeated measures was used for the evaluation. This made it possible to analyse both intra-individual competence developments over

time and intergroup effects between Co-Lab students and the control group. Participation was voluntary and anonymous; the results had no influence on the course grade.

Table 3 provides an overview of the topics, point values, and item formats included in the newly developed knowledge test, which was specifically designed to assess assignment-related knowledge.

Table 3: Overview of Topics, Points, and Question Types of the Knowledge Test

Block	*Topic*	*Points*	*Question Type*	*Assignment Description*	*Example Question*
1	Lesson Assignment	5	Matching	Sort the terms into the empty boxes of the diagram by dragging the labels to the corresponding box.	/
	Operators	4	Dichotomous Questions (True/False)	Which statements apply to operators?	Operators in teaching assignment instructions facilitate communication between learners and teachers.
2	Action *Competence	4	Dichotomous Questions (True/False)	In which three dimensions does action competence unfold?	Professional action competence, methodological competence, and learning competence
	Complete Action	6	Ranking	Arrange the steps of a complete action in chronological order by dragging the terms to the appropriate fields.	/
	Real-World Relevance	6	Dichotomous Questions (True/False)	What is meant by real-world relevance?	Teaching assignments have real-world relevance when they address private, societal, or professional problems of students.
3	Sustainability	3	Dichotomous Questions (True/False)	What is meant by conflicts of sustainability goals?	Conflicts arise when fulfilling one sustainability dimension prevents or excludes fulfilling another.
	Diagnostics	4	Dichotomous Questions (True/False)	Which statements apply to assignment representations?	Assignment representations exist in visual, textual, numerical, or conceptual forms, but not in their combination.
	Digitalisation	4	Dichotomous Questions (True/False)	From which three perspectives can digitalisation be considered according to the Dagstuhl Declaration?	Technological, application-oriented, and socio-cultural perspectives
	Differentiation	3	Semi-Open Questions (Text Input)	Name three possibilities for differentiation.	Differentiation by [free text field]
	Total	39	Mixed Questions		

4.3 Qualitative Part

A qualitative approach was chosen to obtain contextualized insights into the students' subjective experiences in analysing, modifying and developing teaching assignments. The key methodological data are presented in Table 1. Several Co-Lab seminars with identical structures were offered in parallel, and for one of them we received permission to analyse the portfolios anonymously. The data set comprises all 13 portfolios from this seminar (n = 4 in 2022 and n = 9 in 2023), ensuring comprehensive coverage rather than selective sampling. These portfolios were written by Master's students who participated in the Co-Lab seminars as part of their professional training. The use of the portfolios was approved for research purposes, and all data were anonymised prior to analysis. As reflective instruments, the portfolios provided material for reconstructing how student teachers perceived and articulated their processes of assignment development. The evaluation followed the principles of qualitative content analysis according to Mayring (2014). The coding framework was initially developed deductively based on the three dimensions (knowledge, ability, and willingness) of the KMK competence model (2021) and subsequently extended through inductive, open coding.

5 Results

To answer the research question of the Co-Lab's effectiveness, the KMK competence model (2021) provides the conceptual framework.

5.1 Dimension: Knowledge

Students' knowledge regarding teaching assignments is assessed through a knowledge test. At the beginning of the courses (T1), the means (M) of correctly answered questions is 60.3% (control group) and 64.9% (Co-Lab), as shown in Table 4. The overall response range across all measurements spans from 28% to 92%. At the end of the courses (T2), average scores increase slightly to 61.5% (control group) and 68.1% (Co-Lab). The two-way ANOVA reveals no statistically significant effect for time $F(1,152) = 0.70$, $p = 0.403$, $\eta^2 = 0.005$) or for the interaction between time and group $F(1,147) = 0.14$, $p = 0.714$, $\eta^2 = 0.001$). A more nuanced picture emerges when the two course runs are analysed separately: a statistically significant medium effect is found in Run 1 (2022) for time ($F(1,90) = 6.66$, $p = 0.011$, $\eta^2 = 0.069$), whereas Run 2 (2023) shows a slight decrease. Interestingly, the Co-Lab group shows a substantial increase of more than 10 percentage points in Run 2 (from 57.0% to 68.6%).

Overall, the descriptive results reveal relatively high initial knowledge levels across groups, with averages around 60–65%. Changes over time are generally small and, in some cases, even negative. However, the substantial improvement of the Co-Lab group in Run 2

(from 57% to 68.6%) demonstrates that measurable knowledge gains are achievable. These findings suggest that the Co-Lab did not primarily expand assignment-related knowledge. Nevertheless, the results point to its potential to foster cognitive growth in specific contexts.

Table 4: Descriptive Results (Mean, SD and Range) of the Correct Score (%) of the Knowledge Test for Co-Lab Students and Control Group at T1 (Initial Measurement) and T2 (Follow-Up) Divided Into the Runs 2022 and 2023

Measuring time	*Run*	*Group*	*Correct score*		
			Mean %	*SD*	*Range%*
T1	1+2	Co-Lab	64.9	13.40	28-92
		Control	60.3	13.53	28-85
	1	Co-Lab	57.0	16.56	28-85
		Control	57.1	14.70	28-79
	2	Co-Lab	68.6	9.92	46-92
		Control	62.5	12.35	44-85
T2	1+2	Co-Lab	68.1	10.44	43-92
		Control	61.5	13.93	33-85
	1	Co-Lab	74.0	12.91	44-92
		Control	71.8	9.59	62-85
	2	Co-Lab	64.5	7.30	43-85
			53.3	11.38	33-61

The analysis of the portfolios indicates that the explicit acquisition of assignment-related knowledge is rarely addressed. One student summarises this perspective in a term paper:

> *"The development process was exciting, but in many cases, it was already clear how and why such teaching assignments were created due to previously acquired knowledge about that" (7th portfolio).*

This observation may indicate that students perceived assignment-related knowledge as already available from previous courses and therefore did not emphasise its acquisition within the Co-Lab (Baumert & Kunter, 2006). Another explanation is that they considered knowledge primarily as a prerequisite rather than a learning outcome, which made them focus more strongly on application and reflection (Blömeke et al., 2015).

5.2 Dimension: Perceived Ability

The quantitative results in the ability dimension show an increase over time in all three constructs: SEE in being a teacher, SEE in handling assignments, and teaching persuasion (see Table 5). At the beginning of the course (T1), the means for teaching persuasion are in the

upper range for both groups (M = 3.0/3.1). The means for the SEE in being a teacher and in handling assignments are slightly lower (M = 2.5-2.9). At the end of the courses (T2), all three constructs showed an increase to means between 3.1-3.3. The strongest increase is recorded for SEE in being a teacher with an increase of ΔM = +0.6.

Table 5: Descriptive Results (Mean, SD and Range) of the SEE in Being a Teacher, SEE in Handling Assignments, and Teaching Persuasion for Co-Lab Students and Control Group at T1 (Initial Measurement) and T2 (Follow-Up)

Measuring Time	*Group*	*SEE in Being a Teacher*	*SEE in Handling Assignments*	*Teaching Persuasion*
			Mean (SD) [Range]	Mean (SD) [Range]
T1	Co-Lab	2.7 (0.65) [1-4]	2.7 (0.47) [1-4]	3.0 (0,42) [2-4]
	Control	2.9 (0.56) [2-4]	2.5 (0,54) [2-4]	3.1 (0,45) [2-4]
T2	Co-Lab	3.3 (0,52) [2-4]	3.1 (0.41) [2-4]	3.3 (0,45) [2-4]
	Control	3.3 (0.45) [2-4]	3.1 (0,56) [2-4]	3.3 (0,52) [2-4]

The results of the two-way ANOVA confirm the trends (see Table). They show significant effects over time for the three constructs. A medium effect is found for SEE in being a teacher $F(1,156) = 15.08$, $p = 0.0002$, $\eta^2 = 0.092$), for SEE in handling assignments $F(1,156) = 23.50$, $p < 0.001$, $\eta^2 = 0.136$) and a large effect for Teaching persuasion $F(1,156) = 10.23$, $p < 0.001$, $\eta^2 = 0.171$). There are no group or interaction effects.

Table 6: Results of Two-Way ANOVA (F-Value, p-value, Partial η^2 and Effect Size Interpretation) on SEE in Being a Teacher and SEE in Handling Assignments and Teaching Persuasion: Effects of Measurement Time, Group, and Interaction

Construct	*Variable*	*F-Value*	*p-Value*	*Partial η^2*	*Effect Size Interpretation*
SEE: Being a Teacher	Measurement time	F(1,156)=15.08	0.0002**	.092	Medium
	Group	F(1,156)=1.77	0.1859	.012	Minor
	Interaction	F(1,156)=0.76	0.3861	.005	Minor
SEE: Handling Assignments	Measurement time	F(1,156)=23.50	0.0000***	.136	Medium
	Group	F(1,156)=1.69	0.1955	.011	Minor
	Interaction	F(1,156)=1.14	0.2879	.008	Minor
Teaching Persuasion	Measurement time	F(1,156)=10.23	0.0000***	.171	Large
	Group	F(1,156)=1.77	0.1859	.012	Minor
	Interaction	F(1,156)=0.76	0.3861	.005	Minor

Note. *p < .05, **p < .01, ***p < .001. Effect size estimates are based on partial η^2 according to Cohen's (1988) guidelines.

This indicates that students increasingly perceive themselves as capable of taking on the professional role of a teacher and of developing teaching assignments. The increase is visible across all three facets of self-efficacy and occurs consistently in both seminar types (Co-Lab and control group). This broad and consistent pattern suggests that the course participation in general fosters students' confidence in their professional abilities, regardless of format. At the same time, the lack of group effects indicates that the Co-Lab does not outperform the control condition at a purely quantitative level. However, the mixed-methods approach allows the qualitative data of Co-Lab participants to provide a more differentiated picture of how ability development is experienced and described.

The students describe in their portfolios how they were able to expand their teaching ability through handling assignments in combination with continuous feedback and reflection loops:

> *"Developing your own teaching assignment with feedback, supervision from the lecturer and support from experts provides a good basis for your future work as a teacher." (4th portfolio)*

> *"These assignments represent an initial exercise and can serve as a basis for future application, at the latest when the students are allowed to plan their own lessons in the practical semester." (7th portfolio)*

These statements suggest that students perceive assignment design not only as a course-related exercise but also as an initial step in preparing for professional practice. The reflections point to the idea that working on authentic assignments, combined with structured support from lecturers and experts, creates a sense of continuity between university learning and later teaching practice. Students seem to interpret the course tasks as rehearsal spaces where they can safely test and consolidate their abilities, while already anticipating their application in real classroom contexts.

The students highlighted the ability to design learning assignments in a target group-oriented and action-oriented manner as a key outcome of the course. In particular, complete action, subject relevance, and cross-disciplinary subjects were mentioned as key didactic orientation parameters:

> *"Creating learning assignments in the sense of a complete action is part of a teacher's everyday work. The course is therefore a good preparation and exercise for this, which can be used again later in professional life." (2nd portfolio)*

> *"As a result, [...] it was possible to develop an assignment that not only combines specialised theory and cross-disciplinary subjects, but is also action-oriented." (4th portfolio)*

These reflections indicate that students' ability development may extend beyond technical aspects such as task completion and classroom routines. Instead, the statements suggest that

students begin to recognise and apply broader pedagogical quality standards, including the importance of complete action, subject relevance, and the integration of cross-disciplinary perspectives. This points to an emerging awareness that professional ability is not only about producing assignments but also about aligning them with didactic principles that shape effective teaching practice.

In addition, the qualitative data indicate the development of interdisciplinary abilities relates to professional self-organisation and collaboration. Several students highlight that their organisational skills are enhanced through group work, time management, and task allocation:

> *"I learned what good organisation and a good understanding of teamwork are all about. [...] Thanks to a precise schedule and the free work phases in between, we managed everything together." (10th portfolio)*

At the same time, students highlight peer feedback as a central element in the design process of teaching assignments:

> *"The peer feedback in the form of ideas, suggestions and reflection on the assignments helped us advance in our own design process." (13th portfolio)*

Taken together, these remarks suggest that ability development is not only an individual achievement but also emerges from collective processes. Collaboration, structured organisation, and reciprocal feedback appear to provide essential resources for refining didactic ideas and strengthening professional competence. This suggests that peer collaboration is understood as more than social support; it may function as a structured mechanism for exchanging perspectives, testing ideas, and jointly refining didactic decisions. The students' remarks indicate that feedback from peers is perceived as a resource that stimulates critical reflection and improvement. In this sense, collaborative exchange appears to contribute directly to the development of professional ability by linking individual design processes with collective learning dynamics.

The students emphasise that the knowledge and experiences gained can be effectively applied in school practice. The following quotations illustrate:

> *"What we learnt about teaching assignments can also be applied in the following semester." (12th portfolio)*

> *"The course prepares future teachers well for their work at vocational schools." (8th portfolio)*

The reflections show that students perceive their growing abilities as useful and transferable to future classroom practice. Their emphasis on readiness for the school placement semester suggests that competence development is experienced as sustainable and professionally rele-

vant. Overall, the quantitative and qualitative results indicate that Co-Lab students are able to enhance their ability to handle assignments in a professional manner. They appear to be supported by structured work phases, feedback loops, and authentic application contexts. Taken together, these elements point to the development of professional competences in terms of self-efficacy, reflective capacity, and action-oriented teaching practices, which will be further elaborated in the discussion section.

5.3 Dimension: Willingness

The motivational facets operationalised for the dimension willingness are assessed using five subconstructs: intrinsic motivation, achievement motivation, extrinsic motivation, professional motivation, and expectations of results. These subscales together represent motivation $_{Overall}$.

The results show a consistently high level of motivation, with no significant differences over time (T1–T2) or between the groups, as demonstrated by the two-way ANOVA (see Table).

Table 7: Results of Two-Way ANOVA (F-Value, p-Value, Partial η^2 and Effect Size Interpretation) on Motivation $_{Overall}$, Intrinsic Motivation, Achievement Motivation, Extrinsic Motivation, Professional Motivation and Outcome Expectation: Effects of Measurement Time, Group, and Interaction

Construct	*Variable*	*F-Value*	*p-Value*	*Partial η^2*	*Effect Size Interpretation*
Motivation $_{Overall}$	Measurement time	F(1,156)=1.30	.2561	.009	Minor
	Group	F(1,156)=0.05	.8226	.000	Minor
	Interaction	F(1,156)=0.39	.5358	.003	Minor
Intrinsic Motivation	Measurement time	F(1,156)=0.05	.8223	.000	Minor
	Group	F(1,156)=0.00	.9597	.000	Minor
	Interaction	F(1,156)=0.02	.8825	.000	Minor
Achievement Motivation	Measurement time	F(1,156)=0.21	.6457	.001	Minor
	Group	F(1,156)=0.24	.6226	.002	Minor
	Interaction	F(1,156)=0.21	.6470	.001	Minor
Extrinsic Motivation	Measurement time	F(1,156)=0.61	.4373	.004	Minor
	Group	F(1,156)=0.59	.4439	.004	Minor
	Interaction	F(1,156)=0.41	.5234	.003	Minor
Professional Motivation	Measurement time	F(1,156)=1.37	.2437	.009	Minor
	Group	F(1,156)=0.14	.7063	.001	Minor
	Interaction	F(1,156)=0.26	.6106	.002	Minor

Outcome Expectation	Measurement time	F(1,156)=3.57	.0609	.023	Small
	Group	F(1,156)=0.04	.8498	.000	Minor
	Interaction	F(1,156)=0.12	.7345	.001	Minor

Note. *p < .05, **p < .01, ***p < .001. Effect size estimates are based on partial η^2 according to Cohen's (1988) guidelines.

The motivation $_{Overall}$ of the Co-Lab participants is M = 3.2. Among the subconstructs, professional motivation (M = 3.6–3.7) and extrinsic motivation (M = 3.4–3.6) show particularly high mean values, whereas intrinsic motivation (M = 3.1–3.2), achievement motivation (M = 2.9–3.0), and expectations of results (M = 2.9–3.2) are somewhat lower (see Table 8).

These findings suggest that students begin the course with a generally high motivational baseline, especially with regard to professional orientation and externally anchored incentives. This pattern appears consistent with the study context, as Master's students are already oriented toward a teaching career and therefore place greater emphasis on career-related and social responsibilities than on purely intrinsic or achievement-oriented motives.

Table 8: Descriptive Results (Mean and SD) of Motivation Constructs (Motivation $_{Overall}$, Intrinsic Motivation, Achievement Motivation, Extrinsic Motivation, Professional Motivation and Outcome Expectation) for Co-Lab Students and Control Group at T1 (Initial Measurement) and T2 (Follow-Up)

Time	*Group*	*Motivation* $_{Overall}$	*Intrinsic Motivation*	*Achievement Motivation*	*Extrinsic Motivation*	*Professional Motivation*	*Outcome Expectation*
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
T1	Co-Lab	3.2 (0.44)	3.1 (0.65)	2.9 (0.61)	3.4 (0.57)	3.6 (0.61)	3.0 (0.46)
	Control	3.1 (0.39)	3.1 (0.63)	2.9 (0.59)	3.4 (0.46)	3.5 (0.50)	2.9 (0.63)
T2	Co-Lab	3.2 (0.42)	3.1 (0.66)	2.9 (0.56)	3.4 (0.54)	3.6 (0.67)	3.1 (0.66)
	Control	3.3 (0.46)	3.2 (0.64)	3.0 (0.76)	3.6 (0.55)	3.7 (0.47)	3.2 (0.85)

Numerous statements from the students' reflection papers indicate a strong identification with the professional goal and the practical relevance of the course. Additionally, motivation is fostered by teamwork, feedback processes, and the perceived connection to the upcoming practical semester: "I am now positive and motivated about the upcoming school placement semester and am looking forward to applying the knowledge I have learnt and sharing it with the trainees." (11th portfolio)

This statement suggests that motivation is closely linked to anticipation of real teaching practice. The reference to the upcoming school placement semester shows that students interpret their current engagement as direct preparation for authentic teaching contexts. In this sense, willingness seems to be spurred by the prospect of applying newly acquired skills, which reinforces the perceived relevance of the course.

Other statements emphasize professional motivation arising from the direct relevance to practical action:

> *"This detailed planning of lessons was very informative and awakens the motivation to try it out in vocational school lessons." (1st portfolio)*

> *"The positive feedback at the end of the semester motivates me to carry out exactly this teaching assignment we designed in a class." (3rd portfolio)*

These considerations suggest that professional motivation is strongly linked to the authenticity and applicability of the assignments. The fact that students explicitly refer to lesson planning and classroom implementation suggests that they value assignments that reflect real professional requirements. Feedback appears to play a reinforcing role by validating students' efforts and encouraging further action, as it provides recognition for work done while also providing new impetus for improvement. In this way, motivation appears to be sustained by a cycle of authentic practice and responsive feedback, a mechanism that has also been highlighted in the context of ability development.

Extrinsic motivational factors, particularly those related to social responsibility and group work, become clearly evident:

> *"Being responsible for my team partner meant I was more motivated to complete the assignments promptly." (13th portfolio)*

> *"The presentation of the results and the dialogue about them were very motivating for our group." (10th portfolio)*

Such statements imply that external structures and collective responsibility can act as motivational factors that ensure commitment and the timely completion of tasks. Responsibility towards peers and the obligation to produce results seem to create a form of social pressure that transforms external expectations into personal commitment. This dynamic seems to encourage students to stay focused and actively participate, underscoring the importance of structured collaboration and shared responsibility as extrinsic motivational resources. Similar to the findings on the ability dimension, collaboration thus proves to be an interdisciplinary mechanism that supports both ability development and motivation.

Despite the comparatively lower values in the quantitative part, the qualitative data shows a clearly recognisable intrinsic motivation:

> *"I really enjoyed working on the learning situation and the learning assignments." (5th portfolio)*

> *"I am full of enthusiasm and am starting the practical semester with positive conviction." (6th portfolio)*

These statements suggest that, beyond structured and externally driven orientations, students also experience joy, enthusiasm, and personal satisfaction in engaging with the tasks. The fact that such aspects emerge more prominently in reflective writing than in the survey data indicates that intrinsic motivation may be situational and context-dependent, becoming especially visible when students describe their own experiences in detail. In this sense, intrinsic motivation appears to complement professional and extrinsic drivers by adding an element of emotional involvement, which may play a crucial role in sustaining long-term willingness to teach.

Overall, the results indicate a stable initial level of motivation, primarily driven by professional and extrinsic factors, which is plausible given that Master's students are already committed to a teaching career. At the same time, the qualitative feedback highlights intrinsic motivation. This divergence can be explained by methodological factors: questionnaires capture structured and predefined orientations, while reflective writing allows for subjective experiences and situational enjoyment (Ivankova & Wingo, 2018). As Bryman (2016) notes, qualitative approaches reveal nuances often lost in standardised surveys, which helps explain why intrinsic aspects such as the joy of designing teaching materials emerge more clearly in the portfolios.

6 Discussion

This chapter discusses the findings of the study in relation to the theoretical framework and the three dimensions of assignment-related action competence. It examines how the Co-Lab contributed to the development of knowledge, ability, and willingness among student teachers (6.1), analyses the specific features of the Co-Lab that foster these competences (6.2), and outlines the study's limitations together with implications for future research (6.3).

6.1 Dimensions of Assignment-Related Action Competence

This study investigates the effectiveness of the Co-Lab in developing assignment-related competences in student teachers. This is based on the understanding of KMK competence model, which is structured along the dimensions of knowledge, ability and willingness (KMK, 2021). In the following section, the process of competence development is discussed along these three dimensions.

(1) Knowledge: Fundamental of Assignment Knowledge

The quantitative analysis reveals only slight increases in assignment-related knowledge, with some cases even showing minor decreases. However, these findings should not be interpreted as indicative of failure in the learning process, but rather as a reflection of structural con-

ditions and didactic priorities during the process. Assignment-related knowledge does not develop in isolation but is functionally embedded within complex developmental processes (Blömeke et al., 2015).

The high mean values in the beginning of the course, averaging around 65%, and the wide range of values (28% to 92%) suggest that many students already possess a solid foundational knowledge of assignment development—an expected finding for a Master's programme. In this context, the limited increase can be explained by a ceiling effect (Staus et al., 2021).

The slight decline observed in one course iteration may be attributed to motivational fluctuations or random response behaviour. Research indicates that, particularly in online assessments, random guessing or low effort can distort results (Osborne & Blanchard, 2011; Vriesema & Gehlbach, 2021). This is especially relevant when participation is voluntary and the assessment has no impact on performance evaluation, as was the case in this study. Additionally, the low response rate in the control group (ten students at the conclusion of one course) limits the validity of the quantitative findings (Columb & Atkinson, 2016).

In contrast, the Co-Lab group shows a significant increase in knowledge in the second course iteration, rising from 57% to 68.6%. This indicates that cognitive learning improvements are achievable. However, such improvements appear to depend on specific conditions.

Nevertheless, both the didactic design of the Co-Lab and the qualitative data suggest that assignment-related knowledge was not the primary focus. Rather, the Co-Lab aims to apply and deepen existing knowledge in working with teaching assignments and to facilitate its transfer to new contexts. Students themselves rarely emphasize knowledge acquisition, instead referring to application, reflection, and transfer. This pattern aligns with the theoretical conceptualization of professional knowledge as a necessary prerequisite—but not the endpoint—of professional practice (Baumert & Kunter, 2006; Voss et al., 2015).

(2) Ability: Self-Efficacy and Confidence in Handling Teaching Assignments

In the domain of ability, the quantitative findings reveal significant increases across all constructs surveyed: On general SEE as a teacher, SEE in handling teaching assignments and teaching persuasion. The demonstrated growth in self-efficacy can thus be interpreted as a meaningful step toward professional behaviour, as it influences the quality of lesson planning, implementation, and reflection (Bandura, 1997; Caprara et al., 2008).

These findings are supported by qualitative data, which illustrate how students in the Co-Lab expand their professional competence in handling assignments through practical experience, peer collaboration, and continuous feedback. Students describe how independently designing complex teaching assignments, supported by structured feedback and reflective cycles, enhanced their didactic understanding in this area. Many students report an increased awareness of the importance of complete actions, operational realism, and the integration of current cross-sectional topics. These findings suggest the development of instrumental and reflective-adaptive abilities (Anselmann et al., 2022).

In addition, students emphasize the substantial learning benefits gained from cooperative elements such as peer feedback, team organization, and multi-perspective analysis of assignment standards. These aspects foster interdisciplinary abilities essential for managing complex situations in everyday school life. The results clearly demonstrate that the Co-Lab format effectively supports the development of professional ability. The interplay between subject-specific didactic skills, professional conviction, and reflective application practice emerges as a key factor in fostering assignment-related action competences.

(3) Willingness: Motivation as a Multifaceted Driver in Teaching Assignments
The motivational dimension, understood as an expression of willingness within the framework of professional action competence, is examined through five sub-constructs: Intrinsic motivation, achievement motivation, extrinsic motivation, professional motivation and outcome expectancy. The quantitative findings show a consistently high and stable level of all sub-constructs, with no significant changes over time or between groups. This indicates that students already begin the course with a strong sense of professional commitment, which remains steady but becomes further reinforced and contextualized. Such a pattern is typical for students in advanced stages of their studies (Day & Gu, 2007).

The qualitative analysis of the portfolios provides a more differentiated view of motivational development. Many students report an increased awareness of the relevance and meaningfulness of engaging with teaching assignments. They describe the course as a concrete preparation setting in which theoretical knowledge is effectively transferred into practice. This experience strengthens their professional self-image and activates motivation on a deeper level.

External sources of motivation such as responsibility within group work, the goal of delivering a successful presentation or the expectations of instructors are also mentioned as important driving factors. However, these external influences do not replace internal motivation. Instead, they complement an already strong intrinsic interest in creative teaching tasks. In several cases, students explicitly express feelings of joy and curiosity when working on assignments. These are clear indicators of intrinsic motivation, even if this is less prominently reflected in the quantitative data.

6.2 Fostering Assignment-Related Action Competence Through the Co-Lab

The development of assignment-related action competence emerges from the dynamic interaction of knowledge, ability, and willingness, as conceptualized in the KMK competence model (2021). These three dimensions are not isolated entities but mutually reinforcing components that form together the foundation of professional teaching practice. The relevance of the competence facets addressed was also recognised in the control groups, which points to the fundamental importance of assignment work in teacher training.

While knowledge provides the essential basis for understanding and designing teaching assignments, it gains functional relevance when integrated into practical application contexts. The findings suggest that knowledge, though necessary, is insufficient on its own to foster professional competence. Rather, its significance lies in its embeddedness within action-oriented and reflective processes.

Ability, particularly in the form of self-efficacy and adaptive-reflective skills, enables the translation of knowledge into effective teaching behaviour. The increase in self-efficacy among participants underscores its role as a mediator between theoretical understanding and practice.

Willingness, as expressed through motivational constructs, serves as the driving force behind sustained engagement and professional growth. The quantitative data show stable high motivation levels, while the qualitative insights reveal a deepening of professional commitment and a growing appreciation for the pedagogical relevance of teaching assignments.

The interplay of these dimensions highlights that assignment-related action competence is not a linear accumulation of skills and knowledge but a complex, context-sensitive process. It is shaped through iterative cycles of application, reflection, and feedback. The multiperspective collaboration with schools, companies and university lecturers across disciplines, as the central element of the Co-Lab, helps to link theoretical knowledge and practical experience from school-, workplace-, and society-oriented perspectives.

Consequently, professional teaching competence should be understood as an integrated construct in which knowledge, ability, and willingness coalesce to support the professionalisation of VET teacher students through assignment-related action competence.

6.3 Limitations and Implications for Further Research

Several limitations should be considered when interpreting the findings, as they could affect the generalisability of the results.

First, the response rate in the control group is relatively low at the end of the course, which introduces the risk of sample bias. One possible explanation for the low participation is limited awareness among university lecturers and students regarding the importance of evaluating formats. Limited recognition of the relevance of such evaluations often results in lower participation rates, thereby reducing the representativeness of the data. Nevertheless, the consistent patterns across the available control group data suggest that the main findings are not random, but reflect broader trends.

Second, many students enter the courses with high initial scores across various dimensions of assignment-related competence. This ceiling effect limits the ability of the measurement instruments to detect further improvements, meaning that actual developments might be underrepresented in the quantitative analysis. Future research should therefore apply more

sensitive measurement instruments or longitudinal designs that allow for a finer-grained capture of incremental competence growth.

Third, challenges in collaboration with some practice partners occur over the course of the project. Difficulties in communication or in aligning expectations may hinder the consistent implementation of the format in certain cases. This highlights the need for clearer coordination structures and for research that explores the role of institutional partnerships in sustaining innovative training formats.

At the same time, we highlight the need for context- and target group-specific adaptations when implementing the format. University-specific framework conditions, disciplinary requirements and the heterogeneity of the student body must be taken into account during transfer in order to prevent unreflective standardisation. Only by taking these factors into account can the potential of the Co-Lab format be fully utilised and sustainably anchored in teacher training.

Despite these limitations, the combination of quantitative and qualitative data, the replication of findings across several pilot cohorts, and the consistency with theoretical frameworks on teacher professionalisation support the cautious generalisation of the results. Moreover, the data were collected over a two-year period in several parallel Co-Lab seminars, which reduces the likelihood that the effects observed are due to isolated cohort dynamics. This temporal extension and structural replication strengthen the robustness of the findings and suggest that the identified mechanisms are transferable beyond a single course context.

The Co-Lab format also demonstrates a high level of connectivity in an international context. Positive effects have been documented in several vocational disciplines, which indicates that it can be transferred across disciplines. The model appears to be particularly relevant for countries with established or developing dual training system. In Europe, countries such as Germany, Austria, the Netherlands, and Denmark have long-standing dual vocational training structures with substantial work-based learning components (Cedefop, 2024). Similar developments are evident in other EU Member States, for example in Hungary, where policy frameworks increasingly emphasise practical relevance (Cedefop, 2023b). Beyond Europe, countries including India, China, Russia, and Vietnam cooperate with the German government to adapt elements of the dual system (Euler, 2013), while Mexico has developed a dual VET model based directly on German training regulations (Cáceres-Reebs & Schneider, 2013). This demonstrates how the approach enables the systematic integration of practical relevance into university teacher training. The integration of internationally relevant subject areas and the promotion of interprofessional cooperation makes the format highly relevant for global education policy discourse.

Future studies should investigate the Co-Lab with larger and more diverse samples, across different institutional and cultural contexts, and over extended time frames. Hypotheses to be explored include whether assignment-based collaboration enhances not only self-efficacy and willingness, but also long-term retention of professional competences, and whether

interprofessional formats foster sustainable changes in teaching practice. A further central question is whether the competences developed in the Co-Lab are not only perceived during the university phase, but are also applied and consolidated during the school placement semester and later in professional teaching practice. Additional aspects worth considering are the role of institutional partnerships, the influence of digital tools in supporting collaborative design processes, and the potential of the Co-Lab model to adapt to different cultural traditions in vocational teacher education.

7 Conclusion

The Co-Lab represents an innovative didactic format that addresses the frequently discussed double theory–practice gap in vocational teacher education. The mixed-methods study confirms the positive effects of the Co-Lab, as previously indicated in the 2020 and 2021 pilot studies (Conty et al., 2022; Conty et al., 2023a). A key strength of the Co-Lab lies in its systematic approach to analysing, modifying, and developing authentic teaching assignments in close collaboration with schools, training companies, and university lecturers from various disciplinary backgrounds. This approach fosters assignment-related action competence by deepening professional knowledge, enhancing self-efficacy, and promoting strong motivation among future VET teachers.

The findings provide a theoretically grounded and empirically supported contribution to advancing innovative didactic approaches in VET teacher education. The Co-Lab demonstrates how research-based, practice-integrated, and transferable professionalisation processes can be systematically strengthened among VET teacher students. Despite certain limitations, the results cautiously suggest transferability beyond the investigated courses. Future research should, among other aspects, examine the long-term application of these competences in school placements and later professional practice. In this sense, the Co-Lab offers a promising contribution to both national and international debates on how to foster the professionalisation of VET teacher students.

Acknowledgement

This research was carried out as part of the project 'TUB Teaching 2.0-Innovative entry, professional and research orientation in vocational teacher training programmes' and was funded by the 'Quality Offensive Teacher Training' of the federal and state governments with funds from the Federal Ministry of Education and Research. Funding reference number: 01JA1628.

Ethics Statement

The authors report there are no competing interests to declare. The ethical requirements were respected by the authors. The procedures fulfil the requirements of the IJRVET's ethical statement.

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