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Roles of science and research in vocational teacher preparation: A case study from a Norwegian VET teacher programme

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Abstract

Bridging vocational skills and scientific principles can pose challenges in vocational education and training (VET) teacher programmes. This study aims to enhance such programmes by exploring the potential of reflective practices among students and educators on the nature of science and research in VET contexts. Engaging VET teacher students with multidisciplinary backgrounds in a learning community, the study explores how to further develop research-based teacher training by 'nudging' student cooperation. A pedagogical course designed to appreciate students' prior experiences aimed at preparing them to reflect upon their own professional development from a scientific perspective. Using five focus group interviews with 19 first-year students, the study identifies and explains four key factors for quality in VET teacher training: relevance of pedagogical theory, the value of a multidisciplinary approach, recognition of students' VET backgrounds, and the importance of community in learning. The findings emphasise the significance of creating coherence between research, vocational skills, educational theory, and real-world applications to develop quality in VET teacher training. This study has implications for educators and policymakers, underlining the need for a comprehensive approach to research-based VET teacher competence that integrates personal, academic, and professional elements.

Keywords: vocational teacher training, research-based education, vocational education and training, science

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Introduction

Vocational education and training (VET) teachers are crucial in linking professional knowledge and skills with VET as practiced in work life and educational contexts (Antera, 2021; Oviawe et al., 2017; Rapp et al., 2023). This study is guided by the following research questions: *How can VET teacher training empower enrolled students to engage with science and research, and what can be learned from students' experiences to develop high-quality, research-based VET teacher training?*

Creating quality VET teacher training can be complex, especially when student teachers come from diverse backgrounds and work experiences, requiring individual support to navigate the conflicting logics of the labour market and educational systems (Hylander & Smeplass, 2022). In the changing landscape of VET demands, there is a need for updated approaches in VET teacher training, particularly in bridging the gap between vocational skills and pedagogical expertise. VET teacher education is pivotal for ensuring that VET students are provided with appropriate and relevant training for their future careers (Levin et al., 2023). In this respect, the quality of VET teacher courses is an important aspect of providing VET teachers with the relevant tools and approaches to succeed in schools (OECD, 2021). As part of this special issue on the cooperation between research, teaching and learning in VET, this research contributes with a perspective from inside a Norwegian VET teacher training programme where students were invited to participate in research regarding their own professional development as part of a learning community.

The article reports on a four-year development project at a Norwegian university focused on improving the coherence and relevance of a bachelor's programme for student teachers with a background in VET. In international research, it is evident that VET teacher training is a complex field of study, where finding the balance between the practical aspects of vocations and teacher professionalism is a recurring theme (Atkins & Tummons, 2018; Bünning et al., 2022; Kosloski et al., 2022). Nordic scholars have previously argued that there is a lack of literature on 'vet teacher education' (Loeb & Gustavsson, 2017), and that there is a need for more research both in Nordic and English languages. Yet, this field is swiftly advancing and must be recognised as an international domain, transcending regional and linguistic boundaries.

In Europe, VET teachers are trained very differently to cater to the specific national systems they serve, based on learning context and content they are termed trainers or teachers (Misra, 2011). Internationally, the terminology and scope of vocational education and teacher preparation also vary significantly. VET teacher education is also referred to as 'teacher training' or 'teacher preparation'. Similarly, Vocational Education and Training (VET) itself may also be known as Career and Technical Education (CTE) in some contexts and Technical and Vocational Education and Training (TVET) in others, reflecting a

diverse international research landscape that encompasses various educational levels and specialisations. While there are great differences between how VET is organised and taught in different places, teacher training is also diversified across national contexts (Cedefop, 2022). However, certain aspects of teacher training can be regarded as common issues worth discussing across national and contextual borders. VET teachers are for the most part required to have a degree in a specific field of studies, plus an appropriate pedagogical qualification (Cedefop, 2022). In most VET systems, a vocational teacher should be competent both in a vocation and in the teacher profession (Köpsén & Andersson, 2017). While VET teacher training typically involves pedagogical training, a unique challenge for this group of teachers is the bridging of vocational professions with specific learning contexts in schools or companies. Therefore, researchers have investigated the development of VET teacher's double identities as a specific aspect of VET teacher training (Antera & Teräs, 2024). International discussions about VET teachers training reveal tensions that arrive when constructing 'teacher professionalism' (Schmidt, 2017; Smith & Yasukawa, 2017). In Norway, the VET teacher curriculum mandates broad and in-depth VET knowledge and skills (Ministry of Education and Research, 2013). This illustrates how *the Norwegian VET teacher role* is designed to train students in all VET settings, including schools, companies and other workplaces (Cedefop, 2022), a relevant context for this study. Possessing practical skills does not in itself equate to being a well-prepared VET teacher or developing a professionalism that includes abilities to deal with modern life diversity and moral complexity (Hargreaves, 2000). Quality in VET training necessitates strong connections between the school system and the companies that provide training and future employment. Critiques, such as those by Hiim (2017), highlight the Norwegian curriculum's failure in schools to ensure relevance for young trainees, illustrating the necessity for educating teachers who are able to orient themselves in educational landscapes to ensure both experienced relevance and scientific incorporation. Prior research in Norway, including Hylander and Smeplass (2022), and Smeplass (2022), underscored the risk for disengagement of VET student teachers when their prior certifications and work experiences are not meaningfully integrated into their teacher training.

To be a professional teacher entails having in-depth knowledge and skills in the field, in addition to knowledge about teaching (Helleve et al., 2018). Further, a professional teacher has a reflective approach to their own teaching and seeks knowledge and experience to develop it (Hammerness et al., 2005). This study contributes to a deeper understanding of integrating practical skills with educational theory, offering valuable insights for educators and policymakers in the field of VET on how teacher professionalism can be built upon both VET

experience and science, when students are engaged through communities of practice.

In the next section a theoretical description for VET teacher training is outlined, using the concepts of communities of practice and teacher collegiality. This is followed by details of the context of our Norwegian case study. Subsequently, the methodological approach is described, and the analysis follows, illustrating our four themes for critical engagement of students in the course. Through analysing five focus group interviews with 19 first-year students, we identified four key themes: (1) the importance of relevance and practical application of theory; (2) the value of a multidisciplinary approach to teacher training; (3) the need for recognition and acknowledgment of students' VET certificates and work experience; and (4) the importance of developing a sense of community and belonging through learning networks and collaboration. Lastly, we present a discussion and conclude on how educators must navigate science as part of quality development in VET teacher training.

Theories for VET teacher training

The study is informed by theories of communities of practice, emphasising the social constructions of learning in community as presented by Lave and Wenger (1991). This theory highlights the relationship between learning and the context in which it occurs, arguing that learning is not merely an individual cognitive activity, but a social and cultural event influenced by communities of practice (Smeplass, 2023a, 2023b). We employ this perspective to the organisation of the course for VET teachers and have integrated the acknowledgement of learning as a social process in the analysis. Furthermore, the perspective on teacher collegiality, developed by Hargreaves (2013), highlights how teachers should be *nudged* into collaboration for enhanced learning. In teacher education, this entails using the learning situations to develop a sense of professionalism and community, that fosters critical reflection through open dialogue between students and educators (Smeplass & Hylander, 2021). This perspective is used to understand how science as an integral part of VET teacher education can foster professional development. We argue that these theories are particularly suitable for studying and developing quality in VET, as they acknowledge the social processes of learning and developing professional integrity and identity.

In Norway, the integration of vocational theory and pedagogical training into a bachelor's programme for VET teacher training has been operational since 2007 (Rokkones et al., 2019). This development reflects a broader trend in education that responds to evolving labour market needs. Teachers are increasingly expected to adapt to changes within their vocations and to provide training that aligns with labour market demands (Ministry of Education and Research, 2015).

The evolution in VET teacher training is part of a larger interest in enhancing overall teacher education quality (Smeplass & Leiulfsrud, 2022; Smeplass et al., 2023). As educational systems globally have become more intertwined with political and economic considerations, the reliance on scientific evidence to inform educational policymaking has grown (Wiseman, 2010). This shift is evident in the evolving professional standards for teacher education, where empirical evidence from educational research is increasingly valued for shaping teacher professionalism (Diery et al., 2020). The concept of 'professional competence' in this context has evolved to encompass both professional practice and practice-based learning (Antera, 2021; Mulder, 2014). This is particularly pertinent for vocational teachers who must balance expertise in their professional field with their emerging skills in teaching. This dual role presents challenges in developing a cohesive teacher identity, as they navigate the dynamics of professional practice, which often require a degree of standardisation, especially in safety-critical fields (Antera, 2022; Eick, 2009; Mulder, 2014). Research-based teacher education has become a key norm in striving for educational quality. However, the integration of research into teaching varies considerably across institutions and programmes (Munthe & Rogne, 2015). In vocational teaching, this translates into a complex transition between various occupational domains, involving the negotiation and mediation of competencies as individuals integrate their prior experiences into their new educational roles (Antera, 2022; Smeplass, 2023b). VET teacher students must therefore find ways to integrate their skills and experiences in a meaningful way. Research has shown how VET teachers experience various inter-related professional, educational, and personal dilemmas due to rapid changes in society (Nakar, 2016; Zirkle, et al., 2019), illustrating how VET teacher training is a highly contested and political topic worldwide (Smith et al., 2015). A pedagogical question is how universities can develop programmes and courses that includes the professional development of the individual with the societal need for strong and reflected teachers. Our study sheds light on the intricacies of developing high-quality, research-based VET teacher training in an environment where multiple branches of science converge. Aligning with international discourse, our findings stress the importance of integrating personal experience, academic learning, practical training, and labour market realities in teacher education (Adoniou, 2013; Darling-Hammond et al., 2012). In study programmes similar to the one studied, where VET teachers come from different VET tracks prior to their entrance, educators should reflect upon what the differences between natural and social sciences is, as VET pedagogy and VET didactics need to incorporate these logics for students to understand the role of science in the teaching profession and in the development of their vocational fields. Figure 1 illustrates how such VET teacher training incorporates different aspects in a compound scientific field.

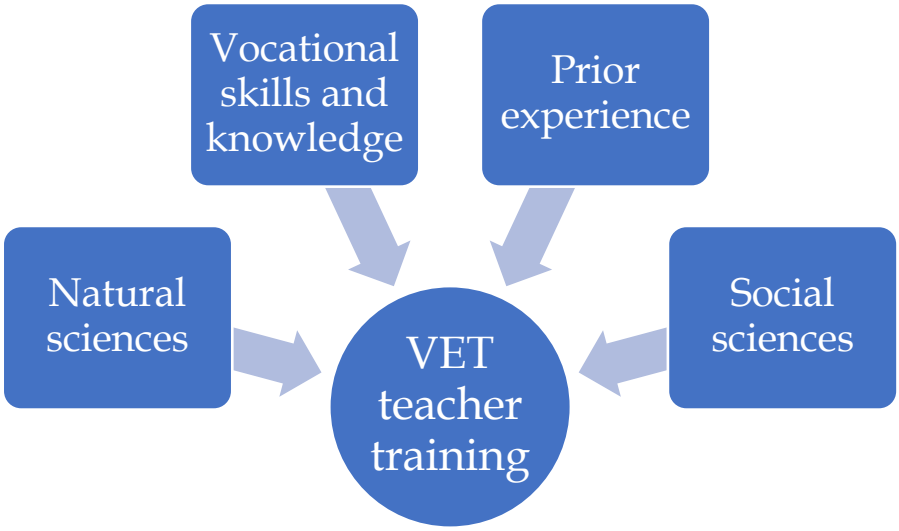

Figure 1. Integration of sciences, vocational skills and experience in Norwegian VET teacher training.

In this model, pedagogy and didactics are represented through the social sciences, while natural sciences encompass the knowledge that comes from fields such as physics, engineering, medicine and more. At the same time, prior experiences both professional and others are essential for the programme in this study. In the following section, we will continue by explaining the context and approach of our study before we continue to the analysis.

A Norwegian case study

In Norway, VET is taught in upper-secondary school through ten different clusters – each leading to one of about 200 certificates (Smeplass & Schmees, 2023). The teacher training programmes are designed to prepare VET teachers to teach in one of these clusters and build upon prior VET experience. After completing a bachelor's programme, the VET teachers are qualified to teach in schools or companies. Since 2020, educators at the Norwegian University of Science and Technology have been developing a vocational teacher course, tailored to a standardised requirement for all student teachers. The three-year bachelor's degree in VET teacher training is designed to align with the Norwegian national curriculum, emphasising strong ties between vocational, pedagogical, and practical training in both educational and corporate environments. The specific course for this study, comprising 7.5 ECTS, is mandatory for these VET teachers in their second semester. The curriculum requires students to

spend three weeks per semester on campus, dedicating one day each week to this specific course. Given the Department of teacher education's status as Norway's largest, these standardised requirements are generally focused on providing a foundational theoretical understanding of the teaching profession within a Norwegian context. However, over the past four years, the course has been continually refined to better suit the specific needs of VET teachers, employing active learning methods to successfully integrate pedagogical theory into vocational education (Hylander & Smeplass, 2022, 2024; Smeplass & Hylander, 2021). In this context pedagogical theory is a concept that encompasses learning theories and the philosophy of education as an integral part of educational sciences. Norwegian VET teachers often find roles in upper secondary schools as teachers in one of the ten VET clusters. Others end up working in secondary education or as trainers and mentors in the corporate sector. A breadth of potential roles underscores the importance of developing a professional approach to teaching practical subjects and addressing the needs of both students and businesses (Sylte, 2021). The course development was guided by these inherent dualities in VET teacher training, integrating various organisational logics from inclusive educational systems to market-driven selectivity. After three years of leveraging student evaluations to refine the course, it was restructured in spring 2023 to serve exclusively as a specialised course for VET student teachers (Hylander & Smeplass, 2024). Table 1 illustrates the content of the specialised course.

Methodological approach

The study is a development project that includes several sources of information, from course curriculum, informal information gathered during teaching sessions and qualitative systematic approaches to ensure validity, reliability and a systematic approach (Merriam, 2015). Focus groups are well suited to foster an open dialogue between participants and give them the opportunity to share their ideas and have them acknowledged or challenged by other group members (Kamberelis & Dimitriadis, 2011). Out of 10 collaborative groups in the cohort, five groups self-selected to be part of groups interviews during the semester's final session. These students volunteered to share their experiences and to use the session to reflect upon their own learning and give the educators feedback. A survey was conducted with the entire cohort, enabling a joint discussion on the course organisation and usefulness with the students, while also providing an important anonymous option for feedback. Nineteen students participated in the group interviews, each lasting between 60 and 80 minutes. Students provided written consent and were assured of their right to withdraw at any time.

Table 1. Themes and tasks in the course.

Task	Theme	Pedagogical intention	Expected product	Relevant scientific sources
1	Group collaboration	Facilitate understanding of diverse vocational backgrounds; Promote collaborative skills.	PowerPoint presentation on vocational backgrounds.	Øiestad (2021).
2	Science in vocational education	Explore the use of scientific knowledge in vocational teaching and development.	Documentation of research and discussion findings.	Kjelsberg (2022), Smeplass (2022).
3	Master apprenticeship	Understand the historical and contemporary relevance of master apprenticeship in vocational training.	Reflective notes and analysis of texts.	Nielsen & Kvale (2021), Rasmussen (2021).
4	Learning methods	Develop critical reading and assessment skills through annotated bibliographies.	Annotated bibliography of selected texts.	Illeris, K. (2012).
5	Learning theories in vocational education	Apply learning theories to understand and enhance vocational training.	Summary of learning theories relevant to vocational education.	Sylte (2021), Chapter 6.
6	Curriculum and teaching planning	Reflect on curriculum and its translation into practical teaching.	Sketch of a teaching plan based on selected curriculum goals.	Sylte (2021), Chapters 3 and 10.
7	Ethical awareness in teaching	Develop ethical consciousness and decision-making in educational settings.	Teaching plan on ethical awareness for educators.	Sylte (2021), Chapters 4, 8, 11.
8	Vocational teacher's role	Reflect on the evolving role of a vocational teacher in contemporary education.	Individual teacher profiles.	Sylte Chapter 8, Smeplass (2022).
9	The concept of Bildung in education	Explore the role of danning in vocational education and its societal impact.	Teaching plan highlighting the concept of danning.	Straume (2016).
10	Innovative teaching methods	Develop and propose innovative teaching methods for future vocational education.	A detailed plan for a R&D project.	Sylte (2021). Various educational resources.
11	Podcast creation	Enhance communication and technical skills through creating educational podcasts.	A 20-minute educational podcast on a chosen topic from the course.	Various resources on podcasting. Podcast studio provided by the university.

Emphasising the non-evaluative nature of their feedback, the main investigator assured participants of their freedom to speak candidly without impacting their course assessment. Through the semester, teachers and students developed a professional relationship that enabled a respectful, and curiosity driven approach to discuss professional development and learning processes (Webster & Mertova, 2007). The interviews were conducted on the university campus in a group room during the last training sessions of the course, prior to the exams. The groups' assignments were assessed collaboratively by the teachers at the end of the semester, after the data had been gathered. Given the inherent power dynamics in researching a student group one is teaching, special attention was paid to ethical considerations (Kincheloe et al., 2011), such as being an open listener and acknowledging the students' needs for recognition during the interviews. Furthermore, careful considerations regarding the researcher role and responsibilities towards the students were carefully considered (Fleming, 2018). The interviewers led the discussion but took role of being an active listener and curious conversation partner, engaging with positive body language and asking follow-up questions when needed. Students were informed that the researchers were responsible for respecting their opinions and upholding the integrity of the study. If they experienced something they did not want to have included in the transcriptions they could let the researcher know, and anything they said would be removed from the analysis. Given that no participants gave indications of any issues, we assumed that the students' experience was well informed and that the interviews were conducted in a confidence enhancing manner. Furthermore, the anonymous questionnaire which contained both predefined and open questions did not show any discrepancies to the narratives shared during the interviews. Hence, the study was registered with and approved by the Norwegian Agency for Shared Services in Education and Research (Sikt), and adhered to strict ethical standards, particularly focused on mitigating any adverse effects of participation.

The focus groups, led by one or two researchers, were recorded and transcribed. An interview guide prompted students to discuss their professional development, the relevance of their vocational background to their future teaching careers, and their engagement with the course content. The interview guide was based on experience from prior studies, the theory of communities of practice, and was designed to foster a group-based dialogue where the students were more active than the interviewer. Using Nvivo, the analysis involved a meticulous review of the data, identifying key themes in student feedback and coding extended dialogue segments for systematic evaluation. The analysis was a mix of thematic analysis and inductive interpretation from the researchers (Braun & Clarke, 2006), who coded and recoded the data in two cycles with discussions of the findings throughout. This approach facilitated comparisons across group narratives and individual feedback and contributed to the quality

of the interpretations. Including inductive interpretation was useful to ensure that the students' experiences were at the center of our investigation. To ensure confidentiality, student identities were anonymised, and minor adjustments were made to the transcript excerpts for readability in English (Wa-Mbaleka, 2019). The excerpts in the analysis have been specifically chosen to give readers insight into the interview setting to assess the context and understand the dynamics of the interviews. Some words are also indicated in their original language.

Analysis

This analysis is based on the four themes developed through our analysis strategy, and illustrates the central aspects of the students' descriptions of how they engaged with science and each other through the course: (1) the importance of relevance and practical application of theory; (2) the value of a multi-disciplinary approach to teacher training; (3) the need for recognition and acknowledgment of students' VET certificates and work experience; and (4) the importance of developing a sense of community and belonging through learning networks and collaboration. These themes are presented by providing information about the course and other contextual factors in combination with examples from the interviews alongside explanations of how we interpret the data.

The importance of relevance and practical application of theory

In our study focusing on a general pedagogy course within a VET teacher programme, we explored how pedagogical theory, covering knowledge, learning, and the concept of 'Bildung' in the Nordic context, impacts students preparing for professional teaching roles (Hylander & Smeplass, 2024; see also Table 1). This context is relevant to understanding how the students experienced and reacted to the course content. Our previous studies have indicated that students can find academic requirements overwhelming (Hylander & Smeplass, 2022; Smeplass, 2022, 2023a, 2023b), and this has become an integral part of the course design to empower students through communities of practice (Lave & Wenger, 1991). According to the Norwegian national curriculum for vocational teacher training, students are required to have pedagogy, didactics, as well as pedagogical practice (Ministry of and Education Research, 2013). The curriculum is designed to support their professional development and bridge between vocational knowledge and skills, scientific knowledge, and practice. As a requirement at their bachelor's programme, during their first year, students have 20 days of practice in upper secondary school, 10 days in secondary school and 15 days of practice in a company to develop their vocational knowledge and

skills. In addition to these practice requirements, 80% of the student population in this programme are full-time employees already teaching students before they have obtained the formal qualifications. This entails that students need to find the theory they are taught to be relevant for their professional development. The analysis of the focus group interviews indicated that students in general were able to bridge the rather abstract theoretical framework into their practical experiences and responsibilities, illustrating how the students were able to use pedagogical theory for professional development when they found the course content relevant. One student mentioned that:

> [Pedagogical theory] is a proper toolbox that you can use as a teacher yourself. It enables you to understand how you learn to be a teacher ourselves. The more strategies we have, the better, I believe.

Another student pointed out that even though they had already worked as unskilled teachers for two years prior to starting at the bachelor's programme:

> When you start the training, you become more confident. You feel more secure in what you already have to face [as a teacher]. You become more assured in the relational aspects of the profession, but also more confident in that what you are doing already is actually quite good. The things you have learned being in the profession into the school, it's the right way of doing it. And you understand the theories more when you work with them in practice. You become like ah… That's why everybody is talking about Dewey. […] I wanted to send a message to my school principal and say, I know who Hiim and Hippe is.

Both of these examples illustrate how students can feel empowered by pedagogical theory, when it makes sense to them in relation to the work they envision themselves doing, or even complements their established practices in schools. Several of the informants describe theory as something that gives them a 'proper vocabulary' for central aspects of the learning process, and that it becomes easier to speak with colleagues at the schools when they can use certain terms and phrases commonly used by teachers in their field. This way, pedagogical theory is not simply external knowledge they are required to learn but becomes part of their professional understanding of being a teacher. In one group, the students discussed how theory assisted in facilitating communication with colleagues and enhancing understanding of educational reforms, such as the 'knowledge promotion reform' since 2020:

> Student A: Now after this course I understand what the overarching elements of the reform is. […] Now I understand that I will educate the vocational workers for the future. I have colleagues who wanted to retire, because there were new demands. People want to be in their comfort zone.
>
> Researcher A: But do you feel we support you in handling this?
>
> Student A: Yes, because we learn many new tools we can use, and we understand the reform more. We understand the terms they use. Use of terms, assessments, decoding. If someone asks me about the term bildung, I can answer 'yes, yes, it is

> like this'. If you asked me 6 months ago, I would for example think 'What do they mean by the term upbringing'. What do you other guys think?
>
> Student B: I agree with you, because now you know the theory. Because like the term Bildung, it has just been there. I have never bothered to investigate more, even though I probably should. But it helps that you can reflect much more.

Other students describe the theoretical frameworks from the course as intuitive, for example the aspect of 'learning by doing', inspired by John Dewey, or reflecting upon the use of methods in light of the pedagogical thinkers Illeris (2016) or Straume (2013). Overall, students indicated a very steep learning curve being first-year students at the programme. However, the analysis of the focus group interview showed that students in general found good use of the theories and concepts they were presented with because they were encouraged to reflect upon their practical meaning, as well as develop materials together that exemplified their meaning in concrete ways.

The value of multidisciplinary approaches in teacher training

The second theme in the analysis is connected to the teaching activities in the course on one hand, and the diversity of skills and knowledge in the group on the other. The study programme in focus for this research, accepts students with certificates from electrical subjects, health, building and construction, industry subjects as well as restaurant and food services. In the profession courses these students all come together into one larger group of approximately 40–50 students per cohort. The course design for this specific cohort required the students to perform and document 11 different 'tasks' connected to the curriculum. These were initiated on campus during the three week-long gatherings during the semester, and the students would continue to collaborate digitally between them as they were situated at different parts of the country. The tasks were designed to utilise the multiple disciplinary backgrounds of the students in a way that would foster dialogue and collaboration through developing various outputs such as teaching materials, presentations, reports and podcasts collaboratively (an overview of the tasks can be found in Table 1). Each task was strategically designed to integrate the diverse skills and experiences of the students, highlighting the applicable value of a multidisciplinary approach to VET teacher training. These tasks, while they varied in nature, shared a common thread – the application of theoretical knowledge in concrete, real-world contexts. The course began with establishing collaborative groups of four to five students, where they explored their diverse vocational backgrounds. This exercise was intended to foster a deeper understanding of each other's experiences but also highlighted the multifaceted nature of vocational expertise. The students were also trained in critical examination of feedback mechanisms within group dynamics and practical teaching scenarios, to support their collaborative efforts. The course ventured into the concept of master apprenticeship [in Norwegian, *mesterlære*],

where students discussed its evolution and contemporary relevance, particularly focusing on how this time-honoured tradition continues to shape vocational competence today. To deepen their critical thinking and evaluation skills, the students engaged in creating an annotated bibliography, assessing the strengths and weaknesses of various educational theories and practices. Throughout the tasks, the underlying emphasis was always on applying pedagogical theories in practical settings, either to foster the students' own learning, or to envision how the concepts could be used as guiding principles in future teaching situations. As shown in Table 1, the students were challenged through the course to think critically about the role of science in the vocational teacher profession, making the learning process both dynamic and rooted in each individuals' real-world experience to ensure the relevance of the course. This blend of practical application and fostering their theoretical understanding aimed to equip them with the tools necessary to navigate the mentioned complexities of vocational education effectively. The teaching design was based on prior experiences from the development project (see for example Hylander & Smeplass, 2022, 2024; Smeplass & Hylander, 2021). Being a VET teacher is about demonstrating knowledge of specific vocational subjects, while students also need to develop skills that are of a more generic type. One example would be developing their teaching in a way that enables learning. Many of these aspects are shared across the different vocational fields, such as teaching design, evaluation, democratic awareness, observation and documentation of learning processes and more. In this programme, the multidisciplinary student group requires their educators to teach in an inherently diverse setting, and identifying commonalities and general aspects of what good teaching is, becomes pivotal in ensuring professional training for all students in this context.

As a case of a multidisciplinary VET teacher preparation, the analysis of the students' experiences of this teaching design illustrates how students can use their own experiences to build a professional identity to relate to the teacher role. One of the students described how he mirrors himself in the university lecturers:

> You have become my role models, because when I have my practice in schools… on one side I am a student here, but I am also a teacher. So, I observe my own teachers: How do you treat us in the lecture room. And sometimes, you actually do things I know I do not want to do myself… [joint laughter]. I have become relying on the iceberg model you made for me for example.

The student explains how he finds value in having these different roles and observes the own surroundings in the development of his teaching strategies. This process is often referred to as teacher identity formation (Andersson & Köpsén, 2019; Timoštšuk & Ugaste, 2010). As part of their boundary crossing between the vocation and the role and status of being a professional teacher, the

students use the multidisciplinary space they are engaged in as a community of practice (Hargreaves, 2000, 2013; Lave & Wenger, 1991; Smeplass, 2023a).

This group discussion showcases how the students explain how the methods in the course wee useful to develop their own teaching:

> Researcher: And can you say something about how you have experienced the work method in the course?
>
> Student C: I find it terribly exciting. I have used it in my own teaching. Both with podcasts and making posters. How you can achieve the best possible learning with the right approach. So far, after I cracked the codes in [the subject], I have used it unconsciously. I understand why you have this subject. I didn't get it at the first meeting, but gradually I have understood.
>
> Student D: I was a bit overwhelmed that there were so many tasks to do in total. I thought, oh God, how is this going to be. But I have actually liked it, because it has been concrete throughout the semester. So, it's a bit different than other courses.
>
> Student E: It's very good that the tasks have free reins. And optional submission methods. It makes it very flexible to discuss and reflect together.
>
> Student D: It was really nice in task 7, then we filmed a video. And it was fun to do such things too. Not just produce text.

All of the five groups interviewed mentioned that they found the multi-disciplinary space they participated in together as useful and inspiring, although some pointed out that they experienced a mismatch between the workload and the credit points in the subject. This illustrates how one risk of letting students decide how to solve tasks themselves can sometimes lead to excessive efforts. Several students explained how the concrete tasks in the course contributed to developing new skills they want to employ in the profession. One student said: 'It is very important to be given the freedom to decide methods ourselves.' At the same time, they explained how one of the tasks, where they were asked to make a teaching plan for other teachers, made them insecure because it was complicated to envision how others would interpret their suggestions.

In one of the discussions, a group described how they can use each other's strengths when they produce joint products in the course. One student explained:

> In this group we have divided the tasks […] someone is very good at creating structure, others are good at taking notes from discussions. I just wrote down what everybody said, and all of a sudden, we had two whole pages. […] I believe that in this group we are all quite structured people, and we like to make good products.

The comment shows how these students, even though they had quite different backgrounds (chef, social worker, welder, and children- and youth worker), they could all use their various skills in solving the concrete tasks, although it required some negotiations between them to agree on their division of labour. Another student explained how he had to alter the way he reflected upon some of the production standards he was used to strive from as a professional chef:

> When I worked in the kitchen, I always looked for perfection. But after I started this education, I have realised that I cannot look for the perfect result. I need to look for the imperfect, because that's how you can identify rooms for improvement.

After this comment his fellow students could agree with the principles of focusing on the aspects of learning, more than the end product, which is often the focus in several productive professions. Overall, this theme illustrates how students in the course found ways to develop their professional identities and roles through multidisciplinary group work. The diversity within groups fostered dialogues bridging practical and scientific aspects of becoming a vocational teacher, enriching the learning experience.

The need for recognition and acknowledgment of students' VET certificates and work experience

This theme underscores the importance of acknowledging and valuing the professional expertise and experience VET student teachers bring to their educational journey. Prior investigations have shown how teachers who manage to balance their teacher identities with their occupational identities by maintaining their participation in the different communities seem to be the best prepared to teach their vocational subjects (Antera, 2023; Fejes & Köpsén, 2012; Köpsén & Andersson, 2017; Smeplass, 2023b). In Norway, the prerequisite for enrolling in the VET teacher bachelor's programme includes a craftsman's or journeyman certificate, along with a minimum of two years of relevant vocational experience (Ministry of Education and Research, 2013). This requirement ensures that VET student teachers possess specialised competence in at least one profession, yet they will be required to teach students in upper secondary school preparing them for all certificates in their subject cluster.

During the interviews many students expressed a deep sense of 'professional pride' (in Norwegian, *yrkesstolthet*) and viewed this as essential to their development as educators. One student described:

> I have gained more professional pride, after I started studying, than before. And I see much more the importance of skilled workers. But that's because I don't come from an environment where there is a lot of professional pride as skilled workers, than when you are actually working in that job. [It has become] one of my banner issues, that one should get much more responsibility as a skilled worker and then. And be seen, receive professional development. The thing with professional pride as a skilled worker, there is very little of it in the healthcare sector. But that's not new. I wasn't proud before to say that I had received a vocational certificate in skilled labour. But today I am.

In another group, the researcher asked a follow-up question to see how the students saw themselves as part of the VET system:

> Researcher: You all seem to be very oriented to your professions, still it is almost like you know you will contribute to change issues in your sectors when you are teachers, that you will help make the vocational workers for the future.
>
> Student F: Yes, I hope we can be able to do that.

Another student explained:

> We have a lot of knowledge, but now we must learn to transfer that. There are many things I have never thought about as a paramedic, like relations with the students, and their individual learning requirements.

Then a student followed up with:

> There are things that are intuitive, for example that blackboard teaching is not very effective in vocational education and training. But now we have concretised why, and have a concept to explain why.

This analytical theme shows how in a professional context where everyone has the certificate in their background, students can develop a stronger sense of pride and acceptance for how the task of becoming a teacher is also about making tacit and implicit knowledge and skills available to pupils and apprentices to support their professional development. The Norwegian case study demonstrates that when VET student teachers feel their backgrounds are recognised and supported by the system and in their learning surroundings, they actively seek ways to integrate new scientific and pedagogical knowledge with their professional expertise.

Community and belonging through learning networks and collaboration

As mentioned, the students only meet face to face three weeks during each semester and must collaborate digitally the rest of the time. This practice was developed through the Covid-19-pandemic, and continued in its aftermath, as both educators and students found this way of engaging at times in ways that suit the groups better for the overall learning (see, e.g., Smeplass & Hylander, 2021), but also because it is a practical way of collaboration that saves time. Through the focus group interviews, all groups were encouraged to discuss their collaboration and whether this had contributed to their professional development. Although two groups reported conflicts related to uneven work distribution, they generally expressed satisfaction with their ability to complete tasks and receive positive feedback from teachers. In the other groups, students first of all highlighted how they relied on each other through the course and that the community they shared was pivotal for their learning. One student explained that they felt they were being trained for collaborative work in schools as

teachers: 'I feel that working like this is very good. Because this is how we are going to work in the future'. Another explained how they could also learn from each other: 'For me the greatest input has been through our sharing of experiences.' Given that all students were both part of one particular learning group, as well as part of a class cohort, it was not always clear whether they were referencing the broader community or the smaller collaborative groups. Still, the overall picture is that the interviewed students found the group to ease their work and strengthen their own efforts. One student remarked:

> I think that if we did not have the collaborative groups, I would have struggled much more. Because the topics we have been through, are things you need to discuss with someone to gain some understanding.

Another student's statement shows how vulnerable adult learners can feel when they are challenged by the academic requirements:

> When you asked us to read [one of the more difficult texts in the curriculum], we discussed whether it was a joke or not, because it made no sense. It became almost surrealistic, is this a test? We had a group chat and discussed it. But if I had received that text alone, without my group… I would have dropped out I believe.

Besides illustrating how students were able to speak freely and directly to their educators in the interview setting, this honest description shows how educators can sometimes unintentionally create uncertainty with their teaching design and even demotivation for some vocational student teachers if tasks become unreachable or confusing. In our experience as educators, the thresholds for students' tolerance can vary significantly within the same cohort. At the same time, as some students were struggling with the tasks and demands, the analysis reveals how the community of students were able to assist each other in these ordeals, and eventually ended up delivering well-defined tasks that received praise from the teachers. The focus group interviews underscored the ability of the student community to navigate complex discussions encompassing science, pedagogy, and the application of theoretical concepts to vocational practices. This collaboration not only facilitated the development of their teaching skills, but also fostered a sense of belonging and mutual support, which proved to be instrumental in their professional growth.

In summary, the findings from the focus group interviews indicate that the collaborative and community-oriented approach adopted in this VET teacher training programme played a fundamental role in students' ability to manage complex tasks and develop professionally as part of a learning community (Lave & Wenger, 1991). This approach illustrates the power of collective effort and peer support in adult learning, especially in vocational education teacher contexts.

Discussion and conclusion: Navigating science in vocational teacher preparation

In this study we asked: How can VET teacher training empower enrolled students to engage with science and research, and what can be learned from students' experiences to develop high-quality, research-based VET teacher training? We find that in a multidisciplinary learning environment, where students engaged with concrete, outcome-oriented tasks, there was a significant emphasis on the relevance of these tasks to the teaching profession. The approach fostered engagement among students, facilitating the development of their professional identity in line with Antera (2021) and Andersson and Köpsén (2019). This new professional identity is a blend of professional pride, lived experiences, and insights from both natural and social sciences. These findings respond to the first part of our research question by demonstrating how the engagement with practical and relevant tasks in a multidisciplinary setting empowers students to actively participate in and contribute to their learning, thereby enhancing their engagement with scientific and pedagogical research.

The study contributes to the understanding of research-based VET teacher training as a constructed scientific field that needs critical evaluation and professional reflection. It underscores that while VET and VET teacher training as combined academic disciplines need to integrate scientific knowledge and theories from various fields, it can also be viewed as a distinct discipline. In this context, educators and scientists within the multidisciplinary field of VET teaching must first recognise and understand the inherent divisions within these disciplines. Only then can they effectively bridge these gaps, aiding in the comprehensive development of VET teacher trainees, highlighting what can be learned from integrating diverse scientific knowledge into VET teacher training to develop quality and research-oriented programmes.

The diversity of students' backgrounds in the Norwegian case study necessitates a programme that meets varied professional development needs. Our analysis shows that when students are regarded as participants in a learning community that is characterised by open dialogue, both students and educators can learn from the diversity present in multidisciplinary VET teacher training. When students were invited to participate in our research regarding their professional development being part of a community, they assisted their educators in understanding how their course was experienced as useful. Furthermore, it gave valuable insights to how the educators could better design the various tasks and foster a positive learning environment in the future, contributing to the further development of the programme.

Students reported that pedagogical theory was useful to develop a professional vocabulary for their workplace, in their teacher practice as well as

in collaborative groups. We found that developing a common language for learning processes was experienced as inspiring and empowering. We also found that when both educators and students reflect upon what science means in education together, this creates a learning space where personal, academic, and professional development becomes embedded. These reflections and participations enhance the VET training environment, directly addressing how VET teacher training can empower these students.

The findings of our study lead us to conclude that the field of multidisciplinary VET teacher training, evolving in nature, requires a combination of natural sciences' desire for objective knowledge with the constructivist, humanist, and value-oriented perspectives of social sciences. Each discipline carries distinct traditions and principles, an example being the contrast between the 'context of discovery' and the 'context of justification' (see, e.g., Swedberg, 2012). For instance, an industrial teacher must grasp both the properties of materials and the social dynamics of learning, while a healthcare teacher needs to balance medical knowledge with pedagogical strategies. Merging these diverse scientific branches in VET teacher training is a complex task, necessitating a nuanced development of both knowledge and skills for educators and students alike. This complexity extends to understanding the research front in various disciplines, which is not a singular concept but rather a constellation of different 'research fronts' that should be integrated into a consistent educational experience.

As our figure initially illustrated, VET teacher training incorporates different branches of science with experience and VET competences to build an environment for professional learning and development (Hargreaves, 2000, 2013). Our study shows that in developing a critical science perspective, pedagogical theory as provided in the specific course has proven useful, particularly when students were encouraged to build upon their professional pride within a learning environment tailored to their specific progression from practitioners to teachers. Developing a critical perspective on the role of science in their fields is as crucial as understanding learning and teaching methods. Students' reflections reveal that dealing with these intricate questions from a philosophy of science standpoint also can be empowering, particularly when vocational training and experiences are acknowledged as valuable resources. We conclude in line with Hargreaves (2013), that describes how 'nudging' can be a useful approach to develop new knowledge as part of a professional community.

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