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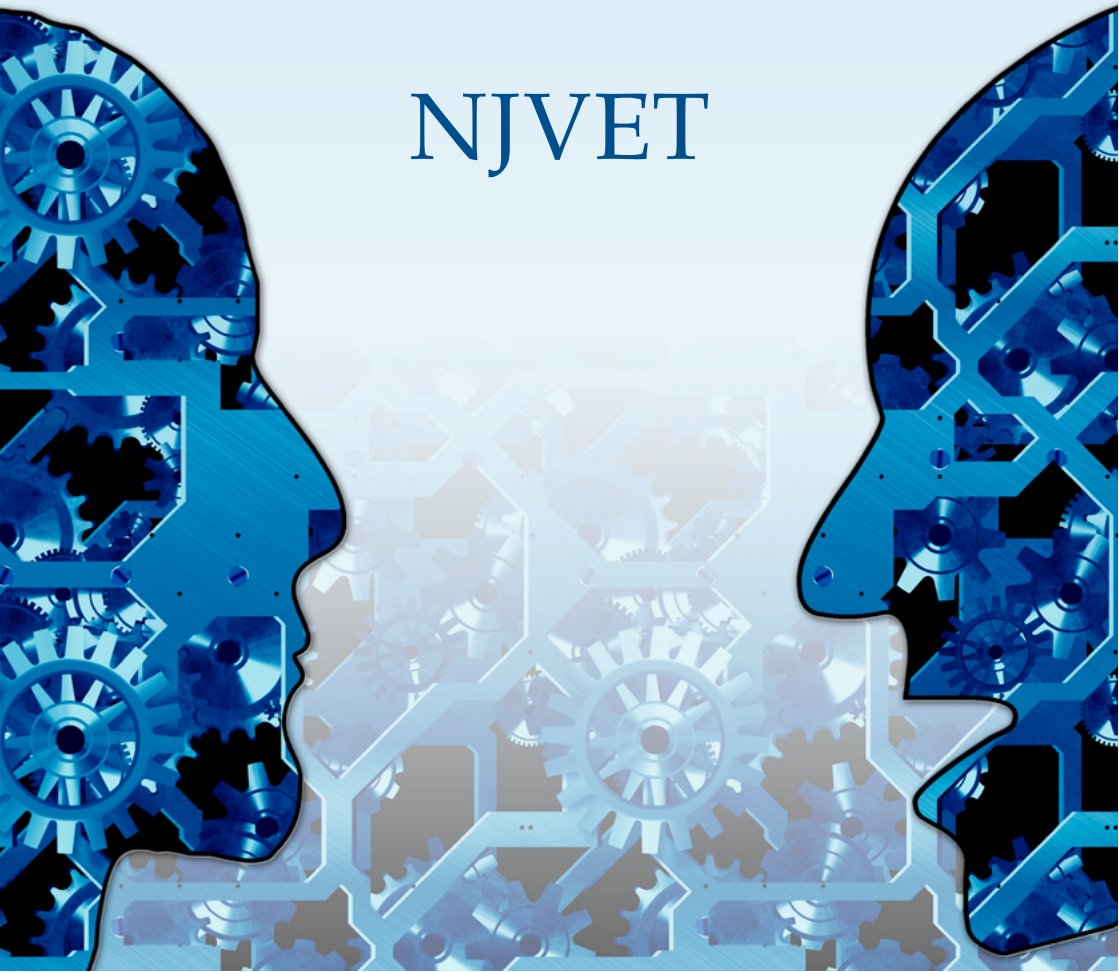

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Editorial: Vocational classroom research with a focus on teaching and learning in vocational education subjects

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Sixteen years ago, the Swedish Research Council published an overview of the development of Swedish, Nordic, and international classroom research from the 1970s onwards (Sahlström, 2008). Although studies with an interest in exploring teachers' and students' interaction and activities in the classroom were in an expansive phase when the overview was written, it is interesting to note that only one study (Lindberg, 2003) with an explicit focus on vocational learning in vocational education was represented in the overview. Not least considering that a core element in vocational education is the actual teaching and learning situations that take place when vocational teachers and students interact with each other. Through this interaction students are expected to learn and develop practical skills and theoretical knowledge that are needed in order to practice their future profession (Andersson, 2019; Asplund et al., 2022; Johansson, 2020). It is also in these situations that students can get the opportunity to communicate their knowledge and understanding of what is to be learned, which can create better conditions for the teacher to adapt the teaching to the students' needs (Hattie, 2012; Marton, 2010).

Overall, and from a historical perspective, there has been an emphasis on examining the teaching and learning activities that take shape between teachers and students in workplace-based teaching settings within the field of vocational education research. During the last decade however, a growing number of studies in vocational education have been carried out where there has been an increased interest towards studying and describing teachers' and students' interaction and activities in the vocational classroom (Asplund et al., 2022; Axelsson, 2023;

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Berner, 2010; Gåfvels, 2016; Kilbrink & Asplund, 2018; Lindberg, 2019; Schaap et al., 2012; Öhman, 2017). The vocational 'classroom' should here be viewed upon in a broader sense, including school-based learning settings in for example school workshops and method rooms as well as outdoors. What these previous interactional studies have in common is that they illuminate how a vocational content, may it be with an emphasis on theoretical or practical dimensions or both, is often taught and learned in interaction between teacher, students, and artefact. What these studies also reveal is the complex teaching and learning processes that are set into play when teachers and students interact in the vocational classroom. Asplund et al. (2021), for example, show how vocational teaching situations sometimes involves two parallel processes that include different kinds of vocational learning and knowledge, which teachers and students have to handle simultaneously. One of these processes concerns solving a practical task at hand here and now in the workshop session (for example how to unscrew some pipe fittings), while the other process involves aspects related to the practical doing that are more explicitly linked to a vocational content needed for a successful future profession (for example how to unscrew the pipe fittings in a gentle and sustainable way to enable a long working life as a professional). In another study, Heusdens et al. (2016) show that contextualising vocational knowledge involves both the processes of concretising and conceptualising. According to Heusdens et al., 'contextualising vocational knowledge leads to a growing understanding of how complex and interdisciplinary bodies of knowledge fit together, and how practitioners can decide what knowledge is relevant for a particular purpose or in a specific situation' (p. 161). However, despite the growing number of studies, the field is still relatively unexplored, not least in terms of studies that focus on students' learning in VET.

Hence, there is a need for research in vocational education that studies what happens in the vocational classroom and that focuses on teachers' and students' actions. Against this background, the *Nordic Journal of Vocational Education and Training* (NJVET) called for contributions to a special issue titled *Vocational classroom research with a focus on teaching and learning in vocational education subjects*. The call searched for papers that addressed the encounter between vocational teachers, vocational students, and vocational content in the vocational classroom. Vocational classroom research here thus referred to studies that explore what happens in the school-based settings in vocational education – with a special focus on teachers' and students' actions. This special issue is the result of that special call, and it aims to develop knowledge about how teaching in the vocational classroom can create productive conditions for students' vocational learning and the development of students' vocational knowledge in vocational subject areas. The contributions in this issue embody a variety of perspectives and methodological approaches and focus on different dimensions of the vocational classroom; vocational subject teaching in vocational school settings, vocational subject

teaching in school in relation to workplace-based learning and vocational subject teaching in the connected classroom. Together these contributions illuminate the breadth and variety in the vocational subject teaching that take place within different vocational education settings.

Five research articles

The special issue includes five research articles; four written in English and one in Swedish. In the first article, *How does it feel? An exploration of teaching perceptive sensoriality in hairdressing education*, **Anna Öhman** and **Eva Klope** explore the teaching of perceptive sensoriality in Swedish hairdressing education. The article is based on video-recordings of teacher and student interactions centered on actions such as instructions, demonstrations, and evaluations in the vocational classroom. Through a close and detailed ethnomethodology and conversation analysis Öhman and Klope show how perceptive sensoriality is used by teachers and students in establishing shared understandings of vocational knowledge. The findings suggest that in order to learn the vocational subject content students need to encounter a learning environment in which they can practice the individually embodied sense of touch as well as the vocation's verbalised collective feel.

Just like the first article in this special issue, the second article, which is the article written in Swedish, focuses on the interactions between teacher and student in the vocational classroom: *Spegeln som resurs i hår- och makeup-stylistklassrummet: Yrkesämnesundervisning på hantverksprogrammet* (The mirror as a resource in the hair and make-up stylist classroom: Subject-specific vocational education in the Handicraft programme). The vocational classroom in this study is the hair and make-up stylist classroom, where mirrors play a central role. In the article, **Minna Arvidsson, Stig-Börje Asplund, Ann-Britt Enochsson,** and **Nina Kilbrink** base their analysis on video recorded sessions in a make-up workshop and focus on the use of the mirror as a resource in the enacted teaching and learning situation focusing on application of eye shadow. By the use of conversation analysis and variation theory approach (CAVTA), the authors show when and how the mirror is made relevant in the interaction between teacher and student and what vocational content is made visible in those situations. The results show how the use of a specific artefact – the mirror – contributes to making specific aspects of the learning content possible to teach and learn. The authors highlight these processes as teaching and learning processes through which the student also is given possibilities to develop a professional vision as a hair and make-up stylist.

The third article, *From doing to learning: Students' self-evaluation and reflective practices in VET,* is a fieldwork study in the Natural Resources programme in Swedish upper secondary school. Through a variety of data such as video recordings, interviews, and observations of interaction between teachers, students and

digital driving simulators **Giulia Messina Dahlberg** and **Susanne Gustavsson** examine the interplay between vocational students' self-evaluation and reflective practices with teachers' feedback while engaging with vocational skills across different learning environments. The analysis illuminates how teachers use strategic combination of practice within digital driving simulators and authentic machines as a pedagogical design to develop students' vocational skills, as well as their ability to evaluate and assess a variety of situations in their future profession. Hence, the study by Messina Dahlberg and Gustavsson shows that simulation-based teaching and learning can create opportunities to foster and develop students' abilities to self-evaluate and reflect on their learning trajectories that relate to handling different machines in a simulation as well as in authentic situations.

In order to create productive conditions for students' vocational learning and the development of students' vocational knowledge in vocational subject areas the findings in the fourth contribution by **Sarah Würges** and **Carmela Aprea**: *Implementation of digital tools in VET: Experienced support and technology acceptance*, show the importance of working with and implementing digital technology already in the vocational classroom. Since the advent of the Internet, there have been ideas about the extended classroom, but it was during the Covid pandemic digital technology as means for teaching and learning became a reality for a larger audience. Being in the classroom can in this respect mean that teachers and students sit in places located geographically far from each other and have to rely on different kinds of technology to communicate. Students do not embrace technology the same way or to the same extent, which is showed in Würges and Aprea's contribution based on a questionnaire answered by 891 trainees. The authors highlight the importance of didactically sensitive teaching of basic digital skills to ensure progress in the sense of digitalisation.

In the fifth contribution to the special issue, *What constitutes a conducive learning environment in VET?*, **Bjarne Wahlgren** and **Vibe Aarkrog** encapsulate the key factors that contribute to a conducive learning environment in the school-based parts of dual vocational education and training (VET) based on a review of international research. These central factors are then exemplified with extensive data from an empirical study conducted on teachers and students at 13 Danish VET schools and their perception of a conducive learning environment. In the study, two main categories of key factors are identified; *curricular factors* that include factors such as form and content of teaching, and *social factors* that include relations between teacher and student and relations among students. The results show that conducive learning environments are closely dependent on teachers as persons, trainers, and professional role models. The study by Wahlgren and Aarkrog illustrates that a productive learning environment in VET requires teachers that have relevant vocational knowledge and skills, as well as a variety of social competences. As such, the article contributes to knowledge about how

vocational teachers can create productive conditions for students' vocational learning in the vocational classroom.

Together, these contributions present a multilayered picture of the dynamic and complex teaching and learning processes that are set into play in the vocational classroom. We hope that this special issue will encourage further research that explores how teaching in the vocational classroom can support students' vocational learning and the development of students' vocational knowledge in vocational subjects.

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How does it feel? An exploration of teaching perceptive sensoriality in hairdressing education

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Abstract

This study explores vocational didactics and embodied knowledge in hairdressing education by studying how perceptive sensoriality is used by teachers and students in creating shared understandings of vocational knowledge. Among multiple actions, touch is distinguished as a central resource in learning the vocation, as it emerges in interaction between teacher and student related to the ongoing teaching and its assignment. The data is based on video-recordings displaying how touch is used in manipulating objects and material, or in assessing qualities and defects. In such instances, touch becomes a diagnostic criterion (Goodwin, 1997) to investigate how the material worked with can be evaluated and handled. To bridge the gap between individual and collective vocational knowledge, metaphors are of use. The results show two approaches to the teaching of perceptive sensoriality. In order to learn the vocational subject content the teaching need to provide for and practice the individual's embodied sense of touch as well as the vocation's verbalised collective feel. This is the core of the didactical challenge.

Keywords: vocational knowledge, teaching, (perceptive) sensoriality, hairdressing, classroom, didactics, metaphors

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Introduction

One challenge in every classroom and educational situation is the didactical question of how we get to know the students' understanding and experience of what is being taught. There is no clear-cut path to make knowledge accessible and publicly accountable in order to bridge the gap between teaching and learning. This becomes even more obvious in a multi-sensorial context involving visual, tactile, and auditory sensations such as in the hairdressing classroom, but is nevertheless a fundamental question in all subject contents in which teaching the correct performance also includes students' own bodies and experiences. In our understanding of teaching and learning we align with the social perspective on the crucial role of practices displayed in embodied actions and enactments as socially accomplished and materialised in interaction between teacher and students (Goodwin, 2013). Like the sociocultural perspectives on teaching and learning, we focus on what we see and what is done between the paticipants in the displayed and co-operative actions (Hindmarsh et al., 2011).

Despite the amount of educational contexts having a sensorial content, the research of the role of sensoriality is scarce (Viktorelius & Sellberg, 2022), especially in the form of tactility and not the least in vocational education and training (VET). As stated by Goodwin and Smith (2021): '…the sensory aspect of touch – that is, the tactility of a given experience and its description – is rarely given explicit focus in the analysis of participants' actions and orientation' (p. 270). With this study we focus on *sensoriality* as the teaching and practice of *tactility* in a classroom context, essential in becoming a skilled hairdresser. We also use the concept *perceptive sensoriality* for the embodied experience and interpretation. The studied interactions are centered on actions such as instructions, demonstrations and evaluations. In the teaching, handling of objects and manipulation of materials play a central role together with verbalised description and use of metaphors. One can distinguish two dimensions in the teaching of tactility: individual sensorial experiences of *touch* and collective dimensions of the vocation to be learnt as *feel*.

This study in a vocational education and training context draws on previous results from various professional practices and learning contexts in which tactile skills or experiential learning associated with the occupation are investigated (Becvar Weddle & Hollan, 2010; Cuffari & Streeck, 2017; Goodwin, 1994; Goodwin & Smith, 2021; Hindmarsh & Pilnick, 2007; Mondada, 2016, 2021; Zemel & Koschmann, 2014). We focus on the building of vocational knowledge by studying teaching sensoriality as the practice of tactility in how to use the sense of touch, as it is visually displayed and verbalised in actions between teachers and students in the hairdressing classroom of VET. Within this teaching perceptive sensoriality is embodied as well as verbalised as feel.

This study contributes to a growing field of vocational didactics research, filling in a gap with the role of teaching sensoriality as tactility in the hairdressing education classroom. Previous research in VET focuses on topics such as visualising sound (Axelsson et al., 2023), attending to tools and machines (Asplund et al., 2022), language competencies (Paul, 2022), negotiating masculinity tied to the ability of handling tools (Kontio & Evaldsson, 2015), team-teaching and learning-space (Frejd & Muhrman, 2022), assessment literacy (Klovholt Leonardsen, 2021), and how students develop vocational knowledge (Heusdens et al., 2019). Even if learning in the vocational setting mostly involves awareness of the body's sensorial capacities, these aspects are scarcely represented in research, despite an increasing awareness of knowledge as embodied and mutually organised in interaction.

In our study we focus on the teaching of tactility as touch with an interest in its didactical dimensions as it plays a central role in meaning-making (Bezemer & Kress, 2014). Sensorial practices are important in creating a collective memory as shown when investigated in the handicraft classroom (Illum & Johansson, 2009), as taste in VET for cooks (Gåfvels 2021), sensory knowing as part of aesthetic judgement (Gåfvels, 2024), or as self-regulation in physical education (Öhman, 2017). Touching materials in floristry education while focusing on gaze has been studied (Gåfvels, 2016) as well as 'equestrian feel' in riding lessons (Lundesjö Kvart & Melander Bowden, 2021, p. 290). These studies did not explore teaching tactility though as we do in this article. Touch in hairdressing salons and education has been included in perspectives of asymmetrical positions (Horlacher, 2017) and as part of embodied knowledge in feedback interaction between teacher and student (Öhman & Tanner, 2017; Öhman, 2018). However, touch as a form of sensoriality is nevertheless underinvestigated (Goodwin & Smith, 2021) particularly with regard to touching objects (Mondada, 2021). Our study of touch adds to the very few studies of classroom interaction in the VET field. Inspired by the seminal work of Goodwin (1994), continued in Goodwin and Smith (2021) and developed in Mondada (2021), we take a particular interest in the teaching of touch for a specific vocation, studying how it is organised and practiced in the hairdressing classroom in the interaction between teacher and students.

The aim of this article is therefore to extend the knowledge in vocational didactics about the role of perceptive sensoriality in the hairdressing education classroom. This leads to the overall question addressed in this article: How is teaching done in sensory and perceptive aspects of touch, for example experience and description of the tactility?

Background

This section gives the reader an introduction to the educational context as well as the theoretical framework of the study.

Contextualisation

In order to contextualise our study, we start with a short background for the understanding of hairdressing as an occupation that has been sidelined in research despite its complexity. The educational context consists of a dynamic and multidimensional environment involving reflection as well as sensoriality related to materiality and one's own body as well as the bodies of others. The vocation has long historical traditions, and used to be trained within a master and apprentice tradition. However, in the 1970s in Sweden, education for hairdressers became more formalised and gradually moved from the workplace to become part of upper secondary school (Andersson Gustafsson, 2002; Klope, 2020). In Sweden, hairdressing qualification consists of three years of school-based vocational education within the handicraft programme including at least 15 weeks of workplace-based learning, followed by approximately two years of apprenticeship in a workplace leading to a journeyman's certificate.

Hairdressing education is multidimensional, since the basics of the vocational knowledge have to be learnt with the mind as well as the body, involving a complex mixture of material and tacit dimensions. The skills of the vocation are taught and acquired through talk and sensory experiences accessible by way of the participants' processes of perception displaying publicly their mutual understanding of the embodied craft. In this setting, participants engage in manual activities while interacting tacitly. The vocational context is mediated in simulations of the workplace environment with various spatial configurations and the presence of a range of artifacts. The classroom is thus designed to look like a hairdressing salon with its walls filled with mirrors, rolling chairs and shelves, hair products and washing basins. There are objects of simulation and instruction, such as mannequin heads in rows, handbooks, tables, and whiteboards, revealing a context of teaching and learning. During the lessons the students are working on various tasks of production, either individually or in small groups, manipulating their own mannequin heads, while the teacher is moving around to give individual feedback and supervision or modelling demonstrations to larger or smaller groups. Practical training involves simulations that mimic real situations and prepare students to execute correct actions (Viktorelius & Sellberg, 2022). The simulations are dealt with continuously in demonstrations or simply working on a section of hair attached to a mannequin head. The skills to be learnt vary from cutting, colouring, rolling, braiding, making long hair updos, and handling tools and materials, to working

with the right body position or treating the client in a professional manner. A current lesson design is to start with group instruction and demonstrations followed by students' individual practice. In this article, both formats are investigated.

Theoretical basis

Drawing on ethnomethodology and conversation analysis (Sidnell & Stivers, 2013), we study the use of touch as a mediated means and a heuristic resource in the teaching of a vocation in the interaction between teachers and students. Within this conversation analytical research, human actions are seen as collaborative, participatory, and embodied (Goodwin, 2013). We analyse how participants make sense of their own embodied conduct as well as that of others in a hairdressing classroom context. A special interest is taken in how teaching is organised in disciplinary ways, more precisely with a focus on how touch is entrained to sensorial mastery situated in an experiential learning context. The challenge here is the complexity of the instructed experience since it involves embodied sensorial qualities that are not visible to the eye, but which nevertheless constitute an important issue for the participants. There is thus a gap to be bridged between individual and collective dimensions in the teaching of the vocation.

In this bridging, the use of metaphors is a pedagogical resource, in their function of understanding and experiencing something in terms of another. While metaphors have a long use as a linguistic form and aesthetic value, metaphors also play the role of heuristic aids in pedagogical content and education (Petrie & Oshlag, 1998). Metaphors can even be regarded as pervasive in everyday life, to the extent that our way of thinking and acting is fundamentally metaphorical (Lakoff & Johnson, 1980). Recent studies in various pedagogical settings show how metaphors are used in a multimodal sense that extends the verbal level: as *imagery* (Douglah, 2021) and *activity metaphors* (Keevallik, 2014) in dance or in biology as *tools for learning* (Pettersson, 2021) and *analogical discourse* (Filliettaz et al., 2010). Common to these studies and uses is the view that metaphors serve a cognitive function in making the unknown known by drawing on a shared experiential base in making use of verbal as well as material resources. When embodied, a metaphor also provides the opportunity to be active with the new material (Petrie & Oshlag, 1998), or as in Lundesjö Kvart and Melander Bowden's (2021) study of equestrian feel in which *vocal descriptors* as well as *verbal descriptors* are used metaphorically as resources to embody this feel. Our study aligns with these results and adds the focus on the difference between handling a material such as hair that is non-responsive compared to that of dance or horseback-riding. We find the definition of 'conceptual metaphors' from Becvar Weddle and Hollan (2010, p. 139) useful as

it underscores how metaphors systematically bridge the gap between the concrete and the abstract:

> [B]odily based schematic structures also are used in human abstract thinking by the means of metaphorical projection from the worlds of bodily experience into abstract domains. The mechanism through which abstract thought is conceptualised in terms of the concrete is called conceptual metaphor.

With the understanding of these bodily based structures of projections as actions of touch that are conceptualised in metaphors with more or less abstraction, we will investigate the use of conceptual metaphors in domains relevant to the hairdressing vocation and their role of conceptualising bodily experience in teaching perceptive sensoriality.

The theoretical framework of our study draws upon Goodwin's seminal paper from 1994 on professional knowing and what he later calls 'work relevant sensory abilities' (2018, p. 352) using his concepts *calibration* and *sensorium* as analytical resources in our exploration of teaching perceptive sensoriality. Goodwin describes calibration as a co-operative and embodied experience and sensorium as the coordinated organisation of experience lodged within a community. In our analysis, these concepts are central to our understanding of the vocation being taught, in which mastery of touch is one of the main skills. Furthermore, the concepts touch and feel are described as sensory and tactile experiences made publicly accessible in collaboration and reasoning (Goodwin & Smith, 2021). According to Goodwin and Smith 'the feel' (p. 282) is nevertheless described as a pervasive tactility that practioners articulate for one another when investigating texture and composition of objects whereas 'touch' (p. 271) is described as a diagnostic tool for identification and differentiation for various features in the material. We also use Mondada's (2021) wordings *diagnostic* and *demonstrative* touch to explore various teaching practices. She explains diagnostic touch as an exploration in order to assess an object whereas demonstrative touch is of an informative type, showing tactile features of an object.

Data and method

In the following we give an overview of how the study has been designed and carried out.

Procedure

The empirical material in this article derives from a vocational school of hairdressing in Sweden, including first-year students in the beginning of their education. The analysis presented below is based on a set of audio-video recordings. The recordings were carried out in 2015 during a month featuring

beginners in simulations working on mannequin heads, with a total of approximately 30 hours, 19.6 hours with handheld camera and 9.8 hours with head-mounted camera. The focus was of naturally occurring everyday classroom interaction between teachers and students in the first year of the hairdressing programme. The use of two cameras give a simultaneous distance and close-up view of the same interaction (Öhman, 2017, 2018). Research in video-based studies shows the active involvement of the researcher in anticipating as well as contributing to the understanding of the participants' practices, thus related to the questions posed by the researcher (Cekaite & Goodwin, 2021). The use of a head-mounted camera enables following the participants' focus of attention and not merely the researchers', avoiding so-called *magnification* (Blikstad-Balas, 2016). The empirical material covers a range of settings in which a recurring feature is a sequence in which the student or the teacher uses tactile sense as a salient resource in investigating the material worked with, thereby displaying understanding to each other. Such instances identified in the material in which touch is at the center of the activity are inspecting shape/form regarding volume/hollowness in an updo, feeling weight when lifting the hair, or constructing a lasting, stable base by teasing and attaching.

Selection

This article focuses on actions of touch when hairdresser students are taught to construct a stable base for an updo. Touch constitutes a form of tactile exploration as it offers a privileged sensory access to materiality (Mondada, 2021). The emerging ways of touch are embedded in a variety of hairdressing-specific actions. Actions of evaluation such as assessing shape, volume, hold, density/weight, durability, and placement are the most frequent. Previous selections from other parts of the recordings have focused on feedback inter-actions in a wider multimodal perspective (Öhman, 2018; Öhman & Tanner, 2017).

In developing the analysis for this article while reviewing the recordings with regard to sensorial content, a significant activity seemed to be fairly critical: how to make a solid hold for an updo. In these sequences, touch was identified as the central resource, in constructions as well as evaluations. Since gestures and tactile perception are continuously recurring phenomena in the studied context, one would say constantly present in various hairdressing activities, some further criteria of selection have been necessary:

- Firstly, a pedagogical criterion for selecting a sequence of film for analysis is based on the audio-video recordings from the handheld camera showing the teacher interacting with a group of students. The sequence displays how touch is used as part of initial teaching of the vocation, thus

verbalising or modeling embodied hairdressing skills such as perceptive sensoriality (Example 1).

- Secondly, a methodological criterion concerning the angle and proximity of the camera is involved. In order to get a closer view of what in the material the participants are orienting to, the analysis is based on the audio-video recordings from the head-mounted camera giving close-ups following the gaze of the teacher interacting with one student at a time (Examples 2 and 3).
- Criterion of exclusion: Mundane/interpersonal touch. In the case where the material mediates interpersonal touch, it is included (Example 2, Figure 4).

Having identified perceptive sensoriality of touch as the target actions in the teaching of the embodied vocation, a collection of sequences was built according to the criteria above, and in which the teachers and students engage in instructional sequences where actions of touch were identified. The three selected sequences (Excerpts 1, 2, and 3) exemplify the process of recurring practices within the educational context, in which touch is an important resource in the teaching. In the analysed data, it is evident that the participants orient their participation to the exploration and production of tactile skills as well as the materiality associated with the activity and vocation. Furthermore, the data display the embodied as well as the verbal expression the participants do in order to reach a shared understanding, as part of learning the complexity of the vocation.

Three main themes of special interest to this study were identified across the data:

- Touch is used to inspect the material product and instruct correct actions.
- Perceptive sensoriality is calibrated between teacher and students in embodied guidance together with instructions and corrections.
- Actions of touch are publicly accessible and displayed in embodied demonstrations and provided for in verbal descriptions and metaphors as feel.

Ethical dimensions and transcription

Prior to the onset, teachers and students received information about the aims of the project and audio-video recordings, and gave their written consent for participation and the use of data in videos and transcripts for research purposes. To protect the anonymity of participants, pieces of information have been left out and images have been replaced by drawings[1]. In the drawings, details that could identify the participants have been changed or left out. The recordings considered here were made in Swedish, while the excerpts are two-line

transcripts with the participants' first language, followed by the translation into English. In the transcripts, the notation system developed by Jefferson (2004) is used. Furthermore, the transcripts are multi-modal in the sense that they include embodied resources other than talk, combining the textual representation with drawings of still images to visualise silent actions and the local context of the interaction (Mondada, 2018). To distinguish the teacher from the students, the teacher's shirt is colored in blue. The transcript conventions are found at the end of the article.

Although video material give access to auditory and visual representation of activities, the sensorial aspects of the interaction appear out of reach for the analyst (Ekström & Lindwall, 2014). Since transcriptions are amenable to analytical choices, they have to be seen only as partial representations. Documenting and transcribing embodied practices is thus not unproblematic and calls for renewing the emic dimension during transcription which underscores the participants' perspective in representing interactions (Greco et al., 2019). In order to assure the quality of the analysis, the transcripts and selected sequences have been analysed together with researchers from the field to gain 'communicative validity' (Kvale & Brinkmann, 2009, p. 271, our translation).

Analytic agenda and procedure

The conversation analytic (henceforth CA) approach taken in this article is to develop a comprehensive account of instances of talk in interaction, following the sequential unfolding in which each turn is responding to the preceding one, so as to build action (Schegloff, 2007). It is thus possible for the analyst to follow what the participants are orienting to. The sequences considered are in line with our aim to extend the knowledge in vocational didactics about the role of sensoriality in the hairdressing classroom, which implies use of touch in manipulation of material objects such as sections of hair, combs, pins, and rubber bands as well as interacting with others. The analysis explores the teaching done in sensory and perceptive aspects of touch with three examples to illustrate how the teacher's and students' locally produced actions of touch embody and display skills of the vocation to be learnt. In line with the theoretical and methodological framework of the study, the selected empirical material has been analysed in datasessions together with researchers from the field, as well as presented and discussed in seminars. In the analysis we distinguish how to regard touch following Goodwin and Smith (2021) in their description of didactics as 'instructing and socialising novices into competent members of the discipline' (p. 283).

The basic analytic method of CA involves moving back and forth between a detailed examination and a synoptic view, combining the video with the transcribing process. The analytical work started with repeated viewings of the

entire material, taking notes and marking episodes to return to, such as teacher-student interaction concerning teaching of tactility and embodied displays of sensoriality in gestures and talk, following what the participants are orienting to, through what is made relevant buy their actions and embodied resources. This part of the analysis ended in three examples which display the trajectory of teaching perceptive sensoriality, from an initial introductory demonstration of touch with the whole class (ex. 1) followed by two individual interactions, in which the first student (ex. 2) participates in embodied training of touch and the second student (ex. 3) participates in abstract reasoning about feel.

Classroom and lesson

The following text serves the purpose of setting the scene by introducing the studied activity situated in its local context.

The teacher starts the lesson by giving an account of the importance of the durability when it comes to the construction of an updo. Made for festivity, it has to hold for at least 12 hours. In a real hairdressing salon, the client arrives in the morning and stays at least two hours for this expensive treatment. For a successful updo, the teacher underscores the construction of hold as of utmost importance. The hold is supposed to be hidden when the updo is finished.

In figure 1 below, the teacher introduces the students to the task of the lesson, which is to make a hold for the updo: 'to get it durable then a hold is the most important thing one can do'. She demonstrates the skill to be learnt: how to tease the hair to get a hold. The students are watching her actions on the mannequin head, sitting in a circle around her.

Figure 1. Introduction to the vocational subject area of how to tease.

In figure 2 below, the teacher walks around the circle of students and tells them to touch the teased section of hair.

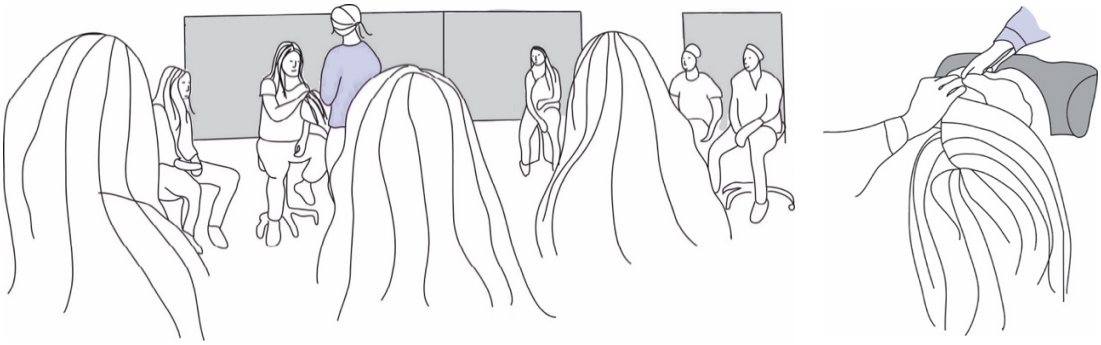


Figure 2. Introduction to the use of touch.

The students touch the teased section one after the other, as the teacher prompts them to feel the hair on the mannequin head. Her talk is done with a series of directives, addressing them with imperative verbs: 'feel a bit here' and 'put your hand on it'. When she describes what the touch of a hold should feel like, the cut-offs in her talk reveal the difficulty of putting sensory entities into words: 'you can feel that there is'. The teacher also addresses the quality of tactile experience and materiality metaphorically: 'that it grows' and 'there should be something here in the bottom'. This shows on the one hand the complexity of the activity: the difficulty in representing sensoriality in verbal description, as well as how touching material objects might appear mostly private. Sensing the tangible characteristics of a material is highly subjective, as it is embodied in the individual. The instructions and verbal descriptors such as those cited above display how conceptual metaphors (Becvar Weddle & Hollan, 2010) are used to articulate the sensory experience of touching the teased hair, alluding to growth and bottom.

Analysis and findings

The analysis consists of three examples, starting with instructed experiences of touch in a group demonstration of how to make a hold and sense its tactile qualities (ex. 1), followed by individual guidance (ex. 2), and ending with individual practice and evaluation (ex. 3).

The examples indicate three crucial aspects with regard to our research question, concerning how teaching is done in sensory and perceptive aspects of touch, for example experience and description of the tactility:

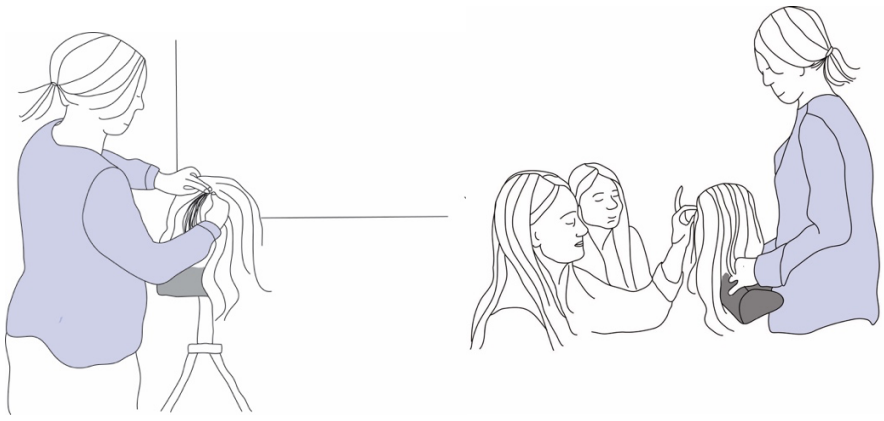
1. There is difficulty in representing sensory entities in verbal descriptors.
2. Tactility, materiality and metaphors are used in bridging the gap between embodied dimensions and verbal representations.
3. Sensing and evaluating are intertwined, albeit distinguishable in the demonstrative teaching and diagnostic touch.

Example 1. Demonstration and reference

After having involved each student's sensations by showing them how to touch as a means to experience and evaluate the material in the teased hair section, the next step in the lesson is to demonstrate the construction of a hold with the use of pins.

In figure 3 below, the teacher demonstrates how to attach pins into the teased hair section with the aim of constructing a steady hold, and then she goes on involving the students in sensorial experiences.

Excerpt 1. Sensorial teaching 00002MTS 6.20–7.55



Line 02 Line 11

Figure 3. Attaching and touching a hold.

LÄR	01	**å det jag ska göra nu (.) det är att jag snurrar in det**
TEA		and what I will do now (.) it is I twist it
	02	**här (.) så sätter jag en nål (.)**
		here (.) then I put a pin (.) ((demonstrates twist and pin))
	03	**jag ska visa så att ni ser (.) å så sätter jag två nålar**
		I'll show you so that you can see (.) and so I put in two pins
		((lifts the head off the stand and turns around in a circle to let the students see))
	04	**så att det blir som ett kors (.) en nål gör inte att**
		so it is like a cross (.) one pin does not make it
	05	**det sitter nå bra (.)**
		well attached (.)
	06	**men om ni korsar dom och sätter två(.)så blir de (.)**
		but if you cross them and put two in (.) it's going to (.)
	07	**kan känna igen**
		can touch again
		((holds out the mannequin head to a student to touch))
	08	**så kommer man att kunna fästa (.) man kommer att**
		then one is going to get it attached (.) one is going to
	09	**kunna fästa sina nåla**
		get one's pins attached
		((continues the tour so everyone can touch the hold))
	10	**när man gör sin uppsättning (.) få känna lite på den (.)**
		when one makes an updo (.) touch it a bit (.)
	11	**ska du känna hur stadigt det här fästet är här heh**
		you should feel how steady this hold is here heh
		((one after the other puts one's finger on the hair))
ELE	12	**mm**
STU		mm
LÄR	13	**heh**
TEA		heh
ELE	14	**(de känns) så fu:lt heh**
STU		(it feels) so u:gly heh
		((laughs while touching the hair and pins))
LÄR	15	**ja det kanske känns lite så där men (.) för att förstå**
TEA		yeah it may feel a bit like that but (.) to understand
	16	**när ni själva sen jobbar med fästena (.)**
		when you work on your own with the holds (.)
	17	**hur hårt det ska sitta (.) så har man nått att (schh)**
		how hard it has to be (.) so one has something (schh)
	18	**så har man nått att referera till (.)**
		so one has something as a reference (.)
	19	**alltså nått att ja just ja(.)så där som det va så**
		to refer to as oh yes (.) it's like how it was
	20	**ska det kännas (.) mitt e alldeles för löst**
		it should feel like (.) mine is far too loose
		((moves her hand back and forth))
	21	**eller va det nu kan tänkas vara**
		or whatever it could be
		((touches the teased hair section))
	22	**så det här fästet (.) schhh (.) det finns här nu**
		so this hold (.) schhh (.) it is here now

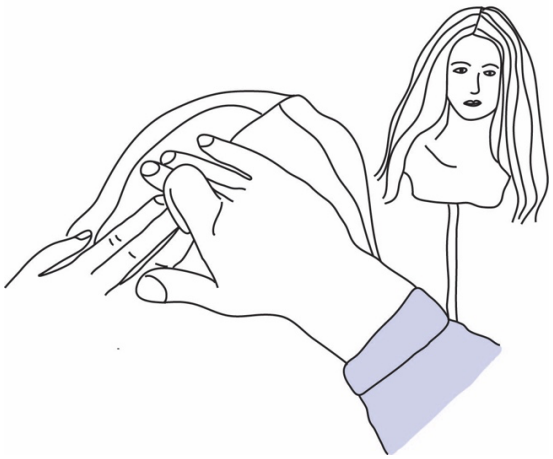
After describing and demonstrating how to attach a steady hold in lines 1 to 9, the teacher produces two tactile depictions to highlight the relevant perceptible qualities for distinguishing the use of touch, first embodied as sensoriality in line 10 and second together with a verbalised evaluation in line 20. In between these lines the aim is to understand what the feel of a hold means in 'you should feel how steady this hold is here' (line 11), the students have to get their own experience of embodied touch. At times visual displays of the material overshadow the tactile qualities, as shown in line 14, when the student laughs and comments how ugly it is. While touching the hair, the student orients to the visual aspects rather than the sensory, to which the teacher responds in re-orienting from the multisensoriality of the situation by drawing the student's attention to the disciplined tactile sensing. Even if perceptive sensoriality often relies on a dual materiality of both visible and tactile entities, the focus here is on touch. The teacher explains the reason for this ('…but (.) to understand' line 15), which can be seen as a form of instructed experience (Zemel & Koschmann, 2014) directing the student's attention to a reference (lines 18–19) with a demonstrative touch (Mondada, 2021) in lines 20–21 as she shows how to perceive the quality of the hold. In doing this, she is projecting the students' ongoing and future vocational knowledge in which sensory experience with tactile skills are important references to evaluate the quality of their work. In her demonstration, the teacher is struggling to find words to make the embodied touch verbalised as a feel. The students are being requested to use their tactile sense, and simultaneously asked to understand the activity with relation to the context in which their sensing is being disciplined. Tactile sensing is taught through instructions and explored as participation in a sensorium with the teacher (Goodwin & Smith, 2021). Despite the challenge of talking about sensory experience, teaching perceptive sensoriality is organised as a systematic practice of touch combined with the articulation of how to feel relevant structures in the complex material (Goodwin, 2018).

In the examples that follow the students are practicing holds on their individual mannequin heads, while the teacher moves around to monitor each one of them in their work.

Example 2. Calibration of touch

The excerpt below shows how the teacher demonstrates the lack of stability in the student's work and shows how to make the hold for the updo more stable. The teacher quickly taps on the teased section and moves it with her hand. The student is following her movements with her gaze and mirroring the teacher's hand movement, when she touches the hold, carefully requested to do so. In figure 4 below, the teacher puts her hand on the student's hand to demonstrate how to touch the hold.

Excerpt 2. Tactile exploration MAH00016MPA 7.09–7.58



Lines 07–08

Figure 4. Calibrating touch (left: student and right: teacher).

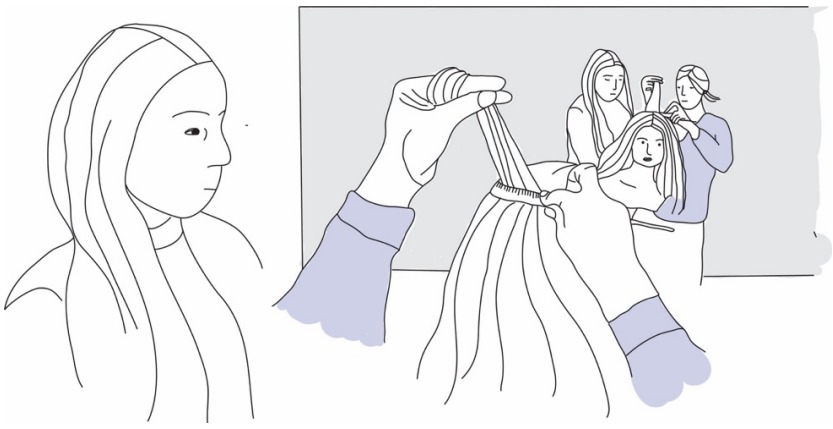
01	LÄR	**ser du man kan rucka lite granna**
	TEA	you see ((moves the teased hair)) one can move it a little bit
02	ELE	**mm**
	STU	mm
03	LÄR	**mm (.) vi provar och ser om vi kan få den å (.)**
	TEA	mm (.) we try and see if we can get it to(.)
04		**här skulle du nästan**
		here you almost could
05	LÄR	**((löser upp fästet i håret för att visa tuperingen))**
	TEA	((loosens the hold to display the teased part))
06		**känn på tuperingen lite granna**
		touch the teasing a bit
07	ELE	
	STU	((the student puts her fingers on the hair))
08	LÄR	**här vågar du**
	TEA	here you dare ((puts her hand on the hair))
09	ELE	**mm**
	STU	mm

This example shows the teacher's use of demonstrative touch (Mondada, 2021) in line 1 to calibrate the student's touch with the embodied and visible guidance of the teacher. Calibration is a way of shaping and sharing vocational knowledge (Goodwin, 2018). The student's work of teasing is not of the quality required for a hold in an updo. To demonstrate expert action, the teacher uses embodied

resources such as her own hand to mold (Becvar Weddle & Hollan, 2010) the right pressure of the touch, a practice in which the teacher physically manipulates the body of the student into vocationally established movements. At the same time, she directs the student with affiliative talk 'here you dare' (line 8) to encourage her. Guiding, by use of verbal directives combined with embodied resources and intercorporeal actions, is used to calibrate the tactility of the hand. The teacher's use of verbal directives proposing action guides the embodied response from the student who puts her fingers on the hold followed by the teacher's hand on top (line 8). This touch is visibly displayed to the student and simultaneously sensed in her hand, as a tactile evidence of the embodied expertise of the teacher. Teaching perceptive sensoriality of a particular vocation is done in co-operative action between the more experienced teacher and the less experienced student whose body is being entrained into mastery of a touching practice (Goodwin, 2018). Furthermore, touch constitutes a modality with a distinct temporal quality which has the potential to endure, as in this didactical setting of experiential learning. Through the use of the tactile modality, the student´s embodied response is mobilised without the teacher repeating her verbal proposal and only perceptible to others via sight (Goodwin & Smith, 2021). The student doesn't articulate anything but a 'mm'.

Having calibrated the tactile quality of instability in the hold with a demonstrative touch (Mondada, 2021), the teacher continues her instruction with a corrective demonstration of teasing as shown in figure 5 below.

Excerpt 2. continued



Lines 16–19

Figure 5. Demonstrating how to tease.

10	LÄR	**för att du ska få den att fästa så tycker jag att du**
	TEA	to get it to hold I think you
11		**vågar tupera lite mer faktiskt**
		dare tease it a bit more actually ((lifts the section))
12	ELE	**mm**
	STU	mm
13	LÄR	**så att du får tuperingen (.) du har tupering**
	TEA	so that you get the teasing (.) you have teasing
14		((shows and stretches out the hair))
15	ELE	**mm**
	STU	mm
16	LÄR	
	TEA	((demonstrates teasing while the student watches))
17		**du ser att jag trycker in**
		you see that I push it in ((teases slowly))
18	ELE	**ja**
	STU	yes((nods))
19	LÄR	**jag får in den i botten**
	TEA	I get it into the bottom
20	ELE	**mm**
	STU	mm
21	LÄR	
	TEA	((pushes the handle of the comb onto the hair))
22	ELE	**mm**
	STU	mm
23	LÄR	**du har fått tupering (.) men det känns som den har**
	TEA	you've got the teasing (.) but it feels like it has
24		**krupit en liten liten bit ut**
		crept out a little little bit ((shows with the comb))
25	ELE	**mm**
	STU	mm ((nods))
26	LÄR	
	TEA	((demonstrates teasing))
27		**så du ser (.) nu tar jag i nästan lite granna**
		so you see (.) now I almost pull away a bit
28	ELE	**mm**
	STU	mm ((nods))
29	LÄR	**men om du känner här**
	TEA	if you touch here ((puts her hand on the hair))
30	ELE	
	STU	((puts her hand on the hair after the teacher))
31	LÄR	**så känner du att den blir liksom mera distinkt**
	TEA	so you feel it gets like more distinct
32	ELE	**mm**
	STU	mm ((nods))
33	LÄR	**så gör det sista (.) så provar du å sätta dit**
	TEA	so make the last (.) and try to attach
34		((shows with her hands on the hair))
35		**nålarna igen**
		the pins again

The example above shows how the teacher starts by pointing out to the student that the essential part of the task is to tease sufficiently to get a solid base for the hairstyle: 'to get it to hold I think you dare tease it a bit more actually' (line 10–

11). This involves the feeling of how hard one has to pull the hair, but also how to push it so it gets connected with the scalp. This is illustrated by teaching two actions: (i) feel when the teasing is sufficiently hard and solid, and (ii) how to push the tease down to the scalp in order to make it stable, i.e. get the teasing in the right place of the hair. Both actions can be understood as demonstrative and calibrated teaching solidity.

While the teacher demonstrates how the teasing should be done to contribute to a stable base in the hairstyle, she slowly pushes the hair with the comb in order to make it visible and to give the student the opportunity to see clearly what she is doing. In her teaching she shows and explains what she does, 'you see that I push it in' (line 17). The comb is used as a resource (line 21) to make visible where the teasing has crept out a little. In order to get the teasing into the bottom, the student must learn how to sense the tactile quality in the process of teasing. This is illustrated in line 27 when the teacher says: 'so you see (.) now I almost pull away a bit', while demonstrating how to tease. The teacher then urges the student to touch the hair to feel when a base is stable, and the student puts her hand on the hair after the teacher (line 30). Here touch is not only calibrated, but also laminated (Goodwin, 2006), as layered and temporally unfolding processes of visibly deployed embodied actions. The feeling of the hair as 'distinct' (line 31), remains abstract and not a conceptual metaphor in the sense of Becvar Weddle and Hollan (2010) conceptualised in terms of the concrete. However, the teacher demonstrates in lines 16–21 how much she has to press the comb at the same time as she pulls the hair enough to get it connected to the scalp. It is only as a result that the student gets to it in line 30. When the teacher prompts the student to touch the hair, it concerns how a distinct hold should feel like, to perceive the difference between a tease that is durable and one that is not. A tease that is made by a beginner is not necessarily stable. By touching a base that is stable, or as the teacher here describes as 'distinct' (line 31), the student gains an experience of how it is supposed to be sensed tactilely. This experience that is not only described in words, but also embodied and calibrated, is supposed to give the student the opportunity to distinguish the difference in touch when the base is steady enough and when it is not. Goodwin (2018) describes this as a sensorium. What the student thinks or senses regarding the reference of the abstract metaphor 'distinct' is not displayed though, as all her verbal responses are limited to 'mm's and nodding her head. The teacher is not asking her for more response either.

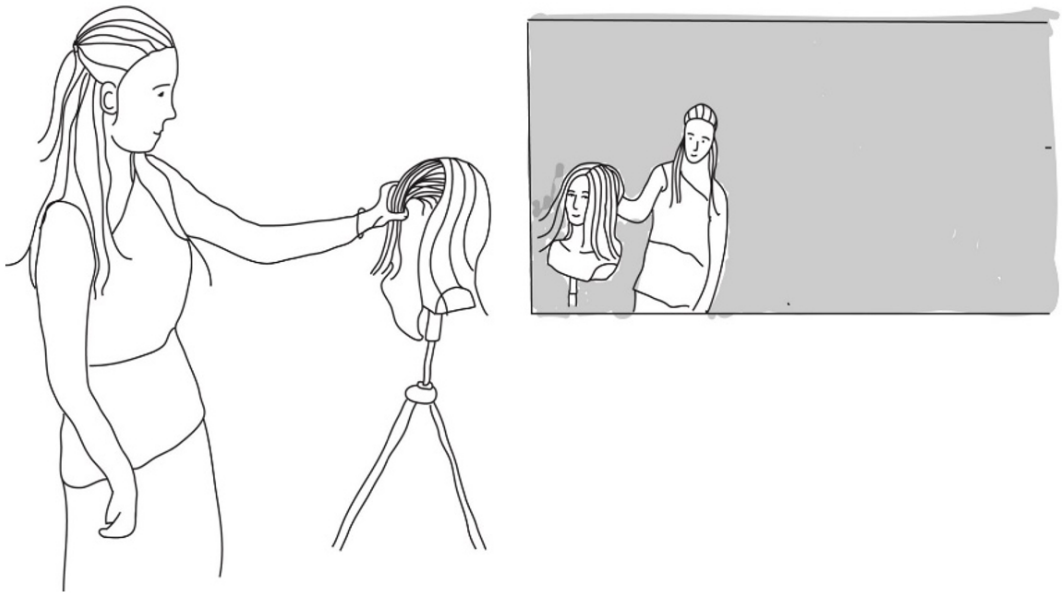
The analysis of this excerpt shows that teaching tactile skills is not organised as individual perception, rather it is displayed as participation in activities of sensation in which co-operative practices organise individual experience in a public setting, a sensorium (Goodwin, 2018). Even if touch is embodied and unarticulated, material tactility goes beyond private sensations, since it is

situated in the context of a shared material to focus on, constituted in the process of verbalising the targeted skill. In an educational context such as this, touching is made verbal and visible when the teacher draws the attention of the students to *how* and *what* they touch, despite the fact that everyone's sensing and tactility is lodged within the individual body. Making tactile actions salient is provided for via talk, albeit its origin outside the audio/visual field (Goodwin & Smith, 2021).

Example 3. Hairdressing feel

In the example above, the focus was on tactility and the work of calibration of touch in teaching sensoriality . In this example, a student has finished teasing her hold and is observing the result. She initiates an assessment with a response cry 'wo:w' followed by 'ni:ce' (lines 1–3) as she looks at the teased section of hair on her mannequin head in figure 6 below.

Excerpt 3. Evaluation MAH00016MPA 3.43–4.01



Line 01

Figure 6. Student's self-assessment.

```
01  ELE  wo:w
    STU  wo:w
02  LÄR  wo:w
    TEA  wo:w
03       sny:ggt
         ni:ce
04       hur känns det
         how does it feel ((puts her hand on the hair))
05  ELE  bra
    STU  good ((gazes in the mirror))
06       ((strong sound from somewhere))
07  LÄR  (5)
    TEA  (5)((investigates the hair with an eye on the room))
08  LÄR  ja (.)
    TEA  yes (.)(continues investigating the hair))
09  ELE  ( )
    STU  ( ) ((observes the teacher's movements))
10  LÄR  mm absolut
    TEA  mm absolutely ((takes a step back))
11       nu känner du att du har den här mattan i botten
         now you feel that you have this carpet in the bottom
12  ELE  mm
    STU  mm ((nods and starts to look for her tools))
13  LÄR  mm
    TEA  mm
```

The initial utterance of the student is ironic, since the updo is not finished, and the hold is not supposed to show. The teacher in her response repeats the 'wo:w' from line 1, and adds 'ni:ce' in line 3 before asking her: 'how does it feel' (line 4). The question could be about the student's satisfaction with her own work as well as the perceptive sensoriality of the material she has produced. The student being further along is thus responded to by the teacher re-orienting the student's response cry and expanding her assessment with an interrogative (line 4). Having had her question confirmed in line 5 'good', the focus on the task is reset as both orient their gaze to the hair on the mannequin head in lines 8–9. The teacher continues to investigate the hold by touching the teased section of hair from top to bottom, assessing the quality with a diagnostic touch (Mondada, 2021) investigating the hair and the consistency of the hold. Having completed her tactile inspection the teacher ends her turn by selecting an assessment: 'absolutely' (line 10). She then continues with a conceptual metaphor (Becvar Weddle & Hollan, 2010) to concretise how the touch of the hold is supposed to feel: 'now you feel that you have this carpet in the bottom' (line 11); a confirmation of quality indicating that the work of the student is correct. This example shows the student's status as a competent practitioner from the assessment of her work as well as how she initiates and responds to the teacher in the community of a sensorium (Goodwin, 2018) to which she directly returns displayed in her actions towards her tools.

Summary

Turning back to the initial question of the article about how teaching is done in sensory aspects of touch, for example experience and description of the tactility, we summarise briefly the following results of the analysis.

The deployment of touch has been investigated in three examples of interaction as they occur within the local context of instructed and responsive actions in the hairdressing classroom. The embodied trajectories have shown to be filled with complex sensory moments providing examples of how teaching what touching teased hair and hold should feel like. Whereas the first example shows a group learning environment with introduction to the activity, the second and third examples display two different individual stages of learning. The results underscore the didactic concern of taking the individual student's stage into account towards the same goal of becoming a proficient hairdresser.

In examples 1–3, we see how perceptive sensoriality of the vocation is at the center of the teaching, in producing a material with the aimed-for sensory qualities (teasing and constructing a stable hold in the hair), learning how to sense and evaluate these qualities through touch (touching the teased hair and its hold) and articulating a relevant vocational perception (responding to and sharing a feel). These skills are taught and practiced in groups and individually, monitored by and calibrated with the teacher as well as evaluated together in a shared sensorium. The examples show the didactical challenges involved in-between the embodied and personal tactility of touch and the abstract and collective conceptualisations of feel.

Consistent findings throughout examples 1–3 are the following:

1. The teaching of how to construct and evaluate a hold involves more than tactilely manipulating the material or visual evaluation. The what and how to sense are critical in perceiving the correct tactile skill.
2. In her instructions, the teacher uses verbal, tactile, as well as material resources to bridge the gap between the students' individual sensing and the sharing of vocational knowledge. The metaphors used to bridge the gap between the individual touch and the collective feel, are concrete (carpet) or abstract (distinct).
3. Teaching perceptive sensoriality is displayed as a laminated trajectory starting with the multi-party practice of touch, calibrated individually and ending with the articulated and co-operative feel.

Seen as a vocational didactic process it starts with practicing touch (ex. 1 and 2) and ends with articulating feel (ex. 3). Our findings show the need to distinguish personal tacit sensing (touch) from an articulated sensoriality (feel) in order to understand the multi-dimensional teaching of perceptive sensoriality.

Discussion

The aim of this article was to extend the knowledge in vocational didactics about the role of perceptive sensoriality in the hairdressing education classroom.This study has explored the teaching of tactility as an embodied skill to touch and a vocational knowledge to feel. Despite the complexity of perceptive sensoriality and the didactical challenge to bridge the gap between the student's sensory experience and the content in the vocational subject, the ways of teaching in the hairdressing classroom enable interactions between participants and materials that open for trajectories of embodied as well as verbalised dimensions of learning. Individual sensorial experiences of touch are built and calibrated over time into an articulated perception as a feel (Goodwin & Smith, 2021).

The results demonstrate how teaching perceptive sensoriality in hairdressing education is closely related to providing for access to materiality as well as to the awareness of one's own body. This has shown to be a complex multisensorial process between teacher and student to reach a shared understanding, in their displayed embodied exploration of the task under construction. In demonstrations of touch and verbal actions, the students are given access not only to participate in touching as a vocational practice, but also to the crucial practice of evaluating the quality of their work (Mondada, 2021), enabling them to develop an expert way of touching and articulating, thus touched and talked into being in calibrations and sensorium (Goodwin, 2018).

Individual sensing is not necessarily private or inaccessible for the analyst, as shown by Mondada (2016) in her studies of professional expertise and intersubjective engagement. The material tactility and embodied skill go beyond private sensation as they become mutually organised and publicly displayed. Although sensing can be regarded as personal, when participating in meaning-making activities together with others, sensing can also be seen as constituting one another (Stuart, 2017) such as in teaching and co-operating on material. When features such as texture and consistency become known by bodily actions such as touch, the individual sensing is disclosed and shared with others (Cuffari & Streeck, 2017). The sequences examined in this article show a continuous process of moves between individual sensing in touch and that of others in feel, within a framework of participatory sensory experiences.

The teaching of perceptive sensoriality of touch is displayed as systematically practiced to create competent members of a vocation, whose personal sense of touch is calibrated in processes of embodied and intercorporeal activities as a feel (cf. Lundesjö Kvart & Melander Bowden, 2021). However, the role of gaze, verbal resources, and discursive practices is not to be disregarded. In the analysed examples in this article, talk plays an important role in teaching this hairdresser feel, even if the use of metaphors as verbal resources to bridge gaps between sensory entities and verbalisation varies in precision. Conceptual metaphors,

such as carpet, are common in vocational teaching, with analogies from lived everyday experience and objects that laminate complex sensory activities with shared meaning, aiming at making tacit dimensions explicit. These descriptors also upgrade the interaction from the particular to the more general aimed for vocational knowledge. Often understood as cognitive instruments and mental representations, this study shows how the use of metaphors such as 'carpet', 'bottom', and 'growing' are of a more robust, spatial, and organic character, emerging as imagery through the various examples (Douglah, 2021). However, the results also reveal the didactical challenge in verbalising sensory entities and tactile qualities, as the talk ends in unfinished phrases like '…there is' or 'it's there'. Some are hard to conceive, such as that shown with 'distinct' which is of a more abstract representation. Metaphors structure not only how we act and live in everyday life (Lakoff & Johnson, 1980), but in a vocational educational context such as this, we can see the way metaphors function as bridges spanning gaps in their way of acting as analogical links between nature/growth and the perceived material (hair) in vocational training interactions (Filliettaz et al., 2010).

Conclusions

The results make visible how the didactical question of teaching a vocational subject in hairdressing education challenges the gap between the individual embodied sensoriality of the inexperienced student and the more experienced teacher without privilege of talk. One could with Goodwin and Smith (2021, p. 282) conceptualise the vocational didactics here as constructing 'tactile understanding'. Despite the fact that the embodied sensorial dimensions of the vocation such as the experience of touching the material is lodged within the individual, the vocational didactics displayed in the examples handles the pervasive tactility by co-operating embodiedly in touch as well as articulating the feel for one another.

Endnote

[1] The drawings are made by Camilla Gåfvels, Phd and lecturer at Department of Visual Arts and Sloyd Education, Konstfack, Stockholm.

Transcript conventions

The transcription convention used in the present article is a simple format departing from Jefferson (2004). Both the original Swedish and the translated English are included in the transcripts.

(.) A dot in parentheses indicates a micropause.
(3) Numbers within brackets indicate the length of a pause.
( ) Empty parentheses indicate inaudible speech.
: Colons indicate prolonging of the previous sound.
(( )) Text in double brackets indicates description of actions.

An indicative translation is provided line per line, in order to help reading the original. It is presented in black to discern it from the original language in bold.

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Spegeln som resurs i hår- och makeupstylistklassrummet: Yrkesämnesundervisning på hantverksprogrammet

The mirror as a resource in the hair and make-up stylist classroom: Subject-specific vocational education in the Handicraft Programme

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Abstract

This study explores the interaction between students and teachers in subject-specific vocational education, specifically focusing on the hair and make-up stylist classroom within the handicraft programme in Swedish upper secondary school. The aim is to understand the role and significance of the mirror in enabling teacher-student interaction and mutual understanding. By integrating Conversation Analysis and Variation Theory into a unified approach (CAVTA), the study seeks to provide comprehensive insights into the 'what' and 'how' aspects of learning. CAVTA enables the identification of the visible content in teaching and how it manifests in the staged vocational education setting. The findings reveal the teacher's strategic use of the mirror to emphasise critical aspects of the Object of learning, in this study referring to the application of eye shadow. This utilisation of the mirror serves as a valuable teaching tool in the interaction between the teacher and student.

Keywords: vocational education, conversation analysis, variation theory, CAVTA, vocational learning, hair- and make-up stylist classroom, interaction, object of learning

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Inledning

I yrkesklassrummen inom olika yrkesutbildningar är lärande och undervisning något som görs när lärare och elever interagerar med varandra och i relation till specifika undervisningsinnehåll som är kopplade till elevernas framtida yrke. Detta innehåll handlar ofta om ett görande, eller ett praktiskt kunnande (Kilbrink & Asplund, 2020b). Undervisnings- och lärandeprocesser inom yrkesämnesundervisning, särskilt i yrkesklassrummen, är dock sparsamt studerade, vilket gör att det saknas studier som hjälper oss att förstå dessa processer. En dimension inom yrkesutbildning som utgör en central aspekt i flera yrkesämnens särdrag är förekomsten av fysiska objekt såsom verktyg, maskiner och material i undervisnings- och lärprocesserna (Asplund m.fl., 2022; Berner, 2008; Heusdens m.fl., 2019). En annan dimension är att undervisnings- och lärandeprocesserna innefattar ett praktiskt kunnande eller görande, vilket i tidigare studier benämnts som ”praktiska lärandeobjekt” (Kilbrink & Asplund, 2020a; Kilbrink m.fl., 2022). På hantverksprogrammet med inriktning hår- och makeupstylist i svensk gymnasieutbildning sker till exempel undervisnings- och lärandeprocesser kring ett specifikt yrkesämnesinnehåll som elever är engagerade i framför speglar. Dessa klassrum består av olika arbetsstationer där varje station har en spegel framför vilken elever och lärare kan interagera. Arbetsuppgifterna i ett stylistklassrum varierar naturligtvis, men kan till exempel handla om hur olika makeuptekniker kan tillämpas för att uppnå goda resultat gällande både teknisk och estetisk kvalitet (Skolverket, 2011). En spegel kan användas på olika sätt och för skilda syften i olika undervisningskontexter (t.ex. Björklund, 2019; Martin & Sahlström, 2010; Öhman, 2017), men vi har i vårt sökande inte hittat studier om spegelns specifika roll inom hår- och makeupstylistutbildning. Eftersom spegeln har en så pass framträdande plats i ett stylistklassrum, och det finns få studier som fokuserar spegelns roll i undervisningssituationer i en sådan kontext, har vi för avsikt att fördjupa kunskapen inom området. Syftet med studien är därför att utforska vilken funktion och vilken betydelse spegeln ges när lärare och elever interagerar i relation till ett specifikt lärandeinnehåll inom hår- och makeupstylistutbildningen. De forskningsfrågor vi avser att besvara är:

1. När och hur orienterar sig lärare och elever i relation till spegeln i interaktionen i makeupundervisning?
2. Vilket yrkesämnesinnehåll synliggörs när elever och lärare orienterar sig mot spegeln i dessa situationer?

Frågorna besvaras genom en nära och detaljerad analys av den interaktion som sker mellan lärare och elever i ett yrkesklassrum på hantverksprogrammet.

Tidigare forskning

Interaktion mellan lärare och elever i undervisningssituationer är centralt för lärande, och yrkeselevers möjligheter till dialog med sina lärare har visat sig öka förutsättningarna för lärande (Kilbrink & Asplund, 2020b; Ryökkynen m.fl., 2020). Undervisningsinteraktion är ofta komplex och som stöd för utvecklingen av lärprocessen kan därför kommunikationen bestå av en kombination av visuella, verbala och förkroppsligade resurser (Lundesjö Kvart & Melander Bowden, 2021) liksom användning av artefakter (Ivaldi m.fl., 2021). Mondada (2007) har analyserat hur deltagare i samtal pekar på olika sätt och hur detta får varierande betydelse beroende på kontexten. Det är alltså inte givet att en viss gest alltid betyder samma sak. Studier där lärandet också innefattar fysisk rörelse, såsom till exempel dans eller sport, visar hur instruktioner och förevisningar med hjälp av olika semiotiska resurser blir en viktig del av undervisningen (Douglah, 2020; Evans & Reynolds, 2016). Ivaldi m.fl. visar i sin översikt hur interaktionen inom scenkonst både är multimodal och i många fall förkroppsligad (*embodied*). Elevers fokus styrs mot relevanta aspekter av instruktionerna med hjälp av kroppen. Exempelvis kan detta uppnås genom att visualisera med hjälp av kroppens positionering eller genom att låta studenter spegla rörelser mot läraren (Ivaldi m.fl., 2021).

Tidigare forskning visar alltså att undervisning ofta drar nytta av multimodalitet med hjälp av olika semiotiska resurser. Inom vissa yrkesutbildningar inkluderas artefakten spegel som en semiotisk resurs eller stöd för lärande och agerande. Martin och Sahlström (2019) visar till exempel hur fysioterapeuter använder spegeln tillsammans med patienter för att uppnå ett önskat rörelsemönster. Spegeln möjliggör, enligt Martin och Sahlström, en överföring av rörelser från fysioterapeuten till patienten och underlättar övergången till nästa steg i behandlingsprocessen. Mellan terapeuten och patienten inleds ett samspel som sedan fortsätter genom spegeln med hjälp av en uppmaning, såsom en lätt klapp på axeln, för att påminna båda parter om att rikta sina blickar och uppmärksamhet åt samma håll och betrakta samma sak. Inom frisörbranschen har användningen av handspeglar i kombination med en väggspegel traditionellt varit vanlig för att visa kunderna resultatet av en frisyr från olika vinklar. Öhman (2017) betonar spegelns centrala roll som en artefakt som möjliggör för kunden att kontinuerligt observera hela processen. Dessutom utgör spegeln en viktig resurs för frisörläraren och eleven för att möjliggöra en ömsesidig kommunikation.

Douglah (2020) visar hur spegeln kan användas i dansundervisning som ett verktyg genom vilket såväl danselever som lärare kan observera sina egna och varandras kroppar i spegeln från samma perspektiv. Detta gör det möjligt för läraren att demonstrera utifrån samma position som dansarna står i förhållande till spegeln. I detta fall fungerar spegeln som en förlängning av läraren, vilket

underlättar användningen av de multimodala demonstrationer som blir tillgängliga för alla deltagare.

I en studie med tandläkarstudenter beskrivs hur de tidigt i sin utbildning ges möjlighet att observera och lära sig genom vad deras lärare gör och uppmärksammar under tandvårdsproceduren (McClure m.fl., 2019). Eftersom tandläkare måste lära sig att arbeta med stor precision via spegeln, finns särskilt utvecklade program för att träna detta (McClure m.fl., 2019). Användning av en kamera för att följa en erfaren tandläkares blick via spegeln in i munnen kan ge tandläkarstudenter en möjlighet att se genom tandläkarens ögon (Rystedt m.fl., 2013). Detta bidrar till att öka deras förståelse för detaljerade processer kopplade till tandläkares yrkeskunnande som kan möjliggöra en fördjupad diskussion om de kliniska implikationerna. I en studie om trafikskoleundervisning (Björklund, 2018) behandlas back- och sidospegeln i en spegelrutin där läraren till en början visar de grundläggande sätten att använda speglarna på för att sedan gå över till att utföra det praktiska arbetet med hur de används. För att kunna bedöma situationerna och förebygga eventuella risker instrueras och tränas framtida förare i olika metoder för att observera trafiken rätt med hjälp av speglarna.

Exemplen ovan visar hur studenter och elever genom dessa metoder kan utveckla en kompetens som påminner om vad Goodwin (1994) kallar *professional vision*, eller professionell blick. En professionell blick handlar inte enbart om att se. Gåfvels (2016) jämför det hon väljer att kalla *skolad blick* med förtrogenhetskunskap, då det handlar om expertens agerande inom en specifik kontext. Denna blick utvecklas successivt genom interaktion i till exempel en utbildning eller ett lärlingskap och är inte enbart relaterad till användning av en spegel, men kan komma till uttryck genom en spegel.

Tidigare forskning ger alltså exempel på olika sätt att använda speglar inom olika yrken och inom yrkesdidaktisk undervisning. Det är tydligt att spegeln kan användas på olika sätt i yrkesundervisning för att möjliggöra lärande av olika ämnesinnehåll och att den därmed får olika funktion i olika kontexter. Det kan handla om att komma åt att se sådant som annars skulle vara svårt att se och att som elev få möjlighet att se saker från ett lärarperspektiv, vilket tillsammans ökar förutsättningarna för lärare och elever att etablera en gemensam förståelse för det som ska läras. Undervisning av hår- och makeupstylister sker ofta i likadana eller samma klassrum som frisörundervisning. I dessa klassrum utgör arbetet framför speglarna, i samspel med läraren, en betydande del av undervisningen också för dessa elever. I den här artikeln analyserar vi hur spegeln kan användas i relation till yrkesämnesinnehållet i den faktiska undervisningssituationen i hår- och makeupstylistklassrummet.

CAVTA som ramverk för att studera yrkeslärande

Den här studien grundar sig på samtalsanalys och variationsteori som kombineras i CAVTA (Conversation Analysis and Variation Theory Approach) (t.ex. Asplund m.fl., 2022; Kilbrink m.fl., 2023) Kärnan i denna teoretiska utgångspunkt handlar om att lärande görs i interaktion och att lärande alltid har ett innehåll. När samtalsanalys och variationsteori kombineras möjliggörs analyser som kan synliggöra både *hur-* och *vad-aspekter* av lärande (Emanuelsson & Sahlström, 2008) på ett sätt som teorierna var för sig inte gör möjligt (Asplund m.fl., 2021, 2022; Kilbrink m.fl., 2023). Samtalsanalysen intresserar sig för hur mening och förståelse konstrueras i interaktion när människor interagerar med varandra och artefakter (Goodwin, 2000; Heritage, 1984; Sacks m.fl., 1992; Schegloff, 2007). I analyser av social interaktion eftersträvas inom samtalsanalysen ett deltagarperspektiv i det att de analyser som görs utgår från det deltagarna gör i interaktion. Detta innebär mer precist att samtalsanalysen studerar hur samtalsdeltagare åstadkommer handlingar och hur de visar upp sin förståelse för varandras handlingar och vilka nya handlingar detta sedan genererar (Goodwin, 2000; Schegloff, 2006). På så vis betraktas varje samtalstur som såväl kontextberoende som kontextförnyande (Heritage, 1984). En viktig utgångspunkt för samtalsanalysen är att man genom analyser av interaktion enbart kan bygga på det som faktiskt manifesteras, och att man förväntas avstå från att tolka människors ”egentliga” avsikter eller tankar med sina handlingar. Som samtalsanalytiker kan man därför bara uttala sig om det observerbara, det vill säga de handlingar som görs igenkännbara för de andra deltagarna. När människor kommunicerar med varandra och i arbetet med att etablera en gemensam förståelse används olika semiotiska resurser, och samtalsanalytiker intresserar sig här för förhållandet mellan dessa resurser och hur dessa används i situerad interaktion (Broth & Keevallik, 2019; Goodwin, 2000). I en sådan multimodal samtalsanalys ingår transkription av deltagares handlingar, såväl tal som övriga kroppsresurser, samt av stillbilder från filmat material eller illustrationer.

Variationsteorins roll i CAVTA är att teorin ger oss verktyg att analysera det innehåll som synliggörs i undervisningssituationen. Baserat på variationsteorin betecknas lärandeinnehållet i denna studie som ett *lärandeobjekt* (Lo, 2014; Marton & Tsui, 2004). Det kan ibland skilja sig mellan det lärandeobjekt som läraren hade tänkt sig (avsett lärandeobjekt), det som är möjligt att lära i undervisningssituationen (iscensatt lärandeobjekt) och vad eleverna faktiskt lär sig (levt lärandeobjekt) (Marton & Tsui, 2004). I den här studien analyserar vi den undervisning som sker i interaktion mellan lärare och elev i klassrummet, vilket gör att vi fokuserar enbart på det som är möjligt att lära i undervisningssituationen, det vill säga det *iscensatta lärandeobjektet*. Vi kan däremot inte uttala oss om vad läraren tänkt eller vad elever faktiskt har lärt sig. Ett lärandeobjekt beskriver en

förmåga kopplad till ett specifikt undervisningsinnehåll – exempelvis *att montera en värmepanna*, eller *att förstå hur en värmepanna fungerar*. Kopplat till hår- och makeupundervisning skulle ett lärandeobjekt kunna handla om *att applicera ögonskugga* eller *att förstå hur ögonskugga kan appliceras*. De aspekter av lärandeobjektet som eleverna behöver lära sig, men ännu inte kan, betecknas som *kritiska aspekter* (Marton, 2015). Kritiska aspekter kan variera (utgöra en dimension av variation) och varje specifikt värde av en kritisk aspekt utgör ett *kritiskt drag*. I den här studien används begreppet kritiska aspekter för att referera till de aspekter av lärandeobjektet som eleverna behöver lära sig och som relevantgörs i interaktionen mellan deltagarna (Asplund m.fl., 2021; Kilbrink & Asplund, 2020b). Det kan handla om att läraren lyfter något som eleven bör förbättra eller förändra, eller något som eleven frågar om och behöver hjälp med. Exempel på kritiska aspekter kan då vara om det är svårt för eleverna att förstå hur mycket färg som ska användas, eller kunna avgöra var färgen ska placeras (vilket alltså kan variera). När elever arbetar med mängden färg, underlättas lärande om det synliggörs en variation av hur mycket färg som kan användas. Detta kan göras genom olika variationsmönster (Kilbrink m.fl., 2022; Pang & Ki, 2016). I analyserna i den här studien fokuseras variationsmönstren *generalisering* och *kontrast*. Generalisering handlar om att synliggöra olika möjliga kritiska drag. Kontrast handlar i stället om att jämföra ett önskat värde, ett *önskat kritiskt drag* (Kilbrink & Asplund, 2020b), av den kritiska aspekten, vilket kan jämföras med något värde i dimensionen av variation som inte motsvarar det önskade kritiska draget. Ett konkret exempel på variationsmönstret kontrast i relation till mängden färg när man applicerar ögonskugga kan till exempel handla om att jämföra att applicera lagom mycket färg med att applicera för mycket färg. I interaktionen mellan lärare och elever kan de kritiska aspekterna synliggöras mer eller mindre explicit (t.ex. Asplund m.fl., 2022; Kilbrink m.fl., 2022).

Material

Data består av ett urval av videoinspelningar från ett större forskningsprojekt om yrkeslärande[1], och analysen grundar sig på de inspelningar inom det större projektet som fokuserade på hantverksprogrammet och mer specifikt på hår- och stylistklassrummet. Inspelningarna i urvalet visar två olika lektioner à 90 minuter från samma lärares undervisning i makeupteknik med samma klass med 17 elever som samtliga samtyckt till att lektionerna filmades. Inspelningarna genomfördes med två kameror parallellt; en som följde lärarens synvinkel och en som användes för att fånga det som hände från andra, kompletterande vinklar. Under videoinspelningarna bar läraren en mikrofon för att dels optimera ljudet, dels undvika störningar från bakgrundsljud i klassrummet. Lärarens mikrofon

tog upp elevernas röster tillräckligt tydligt och därför behövde inte eleverna bära några egna.

Båda lektionerna inleddes med att läraren gick igenom det yrkesämnesinnehåll som eleverna skulle arbeta med parvis under lektionen. Läraren demonstrerade de olika makeupteknikerna på en av eleverna och diskuterade tips och eventuella hinder som eleverna skulle kunna stöta på under arbetets gång. Därefter fick eleverna arbeta med att lägga makeup på varandra framför speglarna parvis. Läraren gick samtidigt runt i klassrummet mellan elevparen och diskuterade och instruerade eleverna i arbetet framför speglarna. Dessa situationer var fokus för analysen.

Studien följer Vetenskapsrådets (2017) etiska rekommendationer och har genomgått en lokal etikgranskning i enlighet med riktlinjer på Karlstads universitet (2023). Mer konkret innebär det bland annat att deltagandet i studien har varit frivilligt och att lärare och elever som deltagit i studien har informerats både muntligt och skriftligt. De har också lämnat sitt skriftliga samtycke till deltagandet och vid presentation av resultat från filmerna har deltagarna anonymiserats. Alla bilder är bearbetade för anonymisering och transkriberingen är gjord enligt CA-konventioner (se Transkriptionsnyckel i slutet av artikeln) (Jefferson, 2004; Mondada, 2018).

Analys och resultat

En inledande analys av materialet tydliggjorde spegeln som en viktig resurs i undervisningen. Vid 111 tillfällen ställde sig läraren hos elever och riktade uppmärksamheten mot spegeln. Genom att använda både verbal kommunikation och gester riktade hon fokus mot det undervisningsinnehåll som eleverna för tillfället behövde hjälp med. De flesta elever följde självmant lärarens mönster, men vid 15 tillfällen fick läraren använda olika kommunikativa resurser – exempelvis beröring – för att få eleverna att ställa sig bredvid henne och på så sätt kunna rikta uppmärksamheten mot spegeln från en specifik vinkel. I dessa 15 situationer förtydligades lärarens agerande med avseende på hur hon instruerade och vägledde eleverna i användningen av spegeln vid tillämpningen av den specifika ögonmakeuptekniken där två av dessa utdrag har valts ut för att exemplifiera interaktionen i resultatdelen. Det är samma elevpar i resultatredovisningens samtliga utdrag. Den sittande eleven är ”modell” och är inte en aktiv deltagare i våra text- och bildutdrag. Exemplet, som alltså består av två situationer med samma elevpar, visar hur läraren och den elev som ska applicera ögonskugga vänder sig mot spegeln som en inledning av interaktionen där de förhandlar om viktiga aspekter av lärandet av att applicera ögonskugga i form av det fotografiska C:et. Detta är en teknik som ger ögonmakeupen en

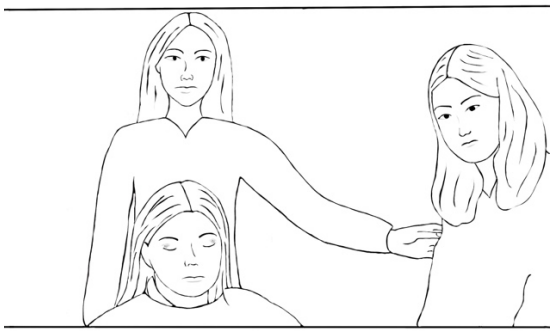
gynnsam placering för att framhäva och intensifiera effekten och är särskilt användbar inom TV- och filmproduktioner.

I exemplet presenteras detaljerade transkriptioner av verbala data kombinerat med bearbetade stillbilder från videomaterialet för att illusterara hur interaktionen utvecklas och hur läraren arbetar i klassrummet med eleven mot ett lärandeinnehåll. Alla bilder visar det som syns i spegeln och dess ram är markerad.

Situation 1: Om vi ser på helheten (29.18–29.45)

Parvis har eleverna i klassen arbetat med att applicera ögonskugga på varandra. Under cirka 15 minuters tid har elevparet i exemplet arbetat på egen hand och en av eleverna (benämnd som ELE i transkripten) applicerar ögonskugga på den andra eleven (refererad till som modell i texten nedan). I det första exemplet har eleven precis påkallat lärarens (LÄR) uppmärksamhet varpå läraren kommer dit och ställer sig bakom eleven som sitter modell i exemplet och ser in i spegeln:

1	LÄR	mm ((betraktar resultatet genom spegeln))
2		(5.6)
3	LÄR	+kom
4		*+rör lätt vid elevens arm*

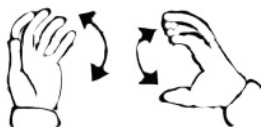


Figur 1a. Läraren instruerar eleven att byta position.

5	ELE	((flyttar över till att stå bredvid läraren och tittar i spegeln))
6	LÄR	+om vi titt-
7		*+rör vid elevens arm igen*
8	ELE	((flyttar sig närmare igen, för att stå bakom modellen, bredvid läraren))

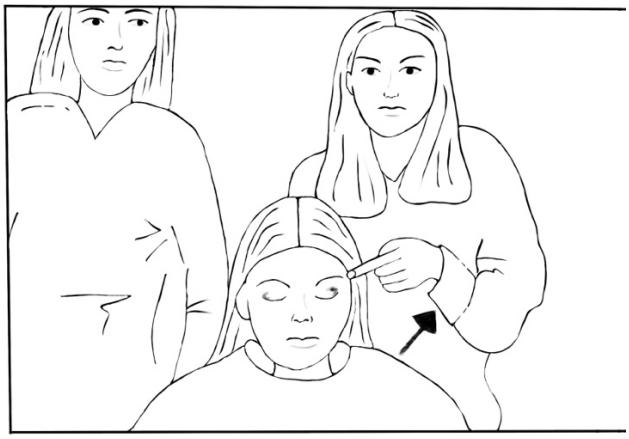
Figur 1b. Eleven har bytt position.

9	LÄR	+ser på helheten nu
10		*+cirklar händerna i luften*
11	ELE	mm
12	LÄR	+me liksom jämnheten på ögona=
13		*+rör händerna i luften*



Figur 1c. Läraren gör cirkelrörelser med sina händer.

14 +är det nånting du skulle vilja lägga till eller
15 *+rör händerna fram och tillbaka på ett balanserat sätt*
16 ELE +den här ligger typ högre upp känns [de som]
17 *+pekar med pekfingret i en uppåtsträvande rörelse*



Figur 1d. Eleven pekar ut var ojämnheten är synlig.

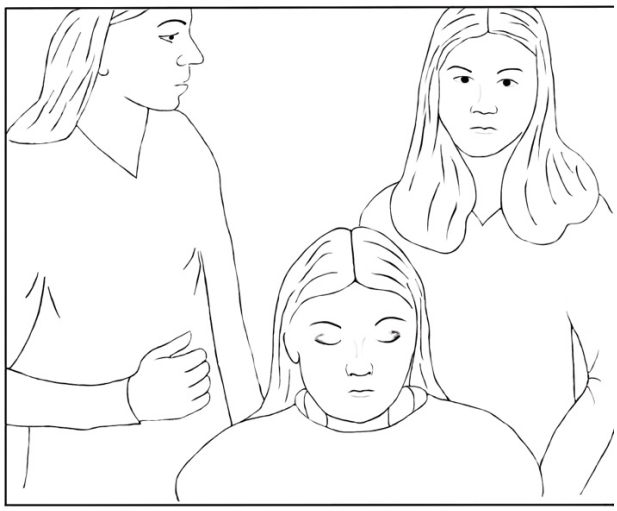
18 LÄR [.hhhh] ja, exakt
19 (2.0)
20 LÄR bra, hitta balansen i de [då] jobba på lite mer för du behöver
21 ELE [mm]
22 LÄR absolut inte ta bort +[där] utan snarare
23 *+flyttar handen till ena ögat*
24 ELE [nä]

Figur 1e. Läraren visar var eleven inte ska ta bort ögonskugga.

25	LÄR	+tvärtom, lägg in här
26		*+flyttar handen till andra ögat*

Figur 1f. Läraren visar vilket öga som behöver mer färg för att skapa balans.

27	ELE	+mm
28		*+tittar in i spegeln*
29	LÄR	+mm
30		*+tittar på eleven*



Figur 1g. Läraren ser på eleven som behåller blicken kvar i spegeln.

På rad 1 inleder läraren med att säga ”mm” varefter det uppstår en längre paus (5,6 sek) när hon och eleven tittar in i spegeln (rad 1–2). Läraren och eleven använder pausen till att titta mot modellen genom spegeln. Pausen avbryts när läraren rör vid elevens arm samtidigt som hon säger ”kom” (rad 3–4, figur 1a). Givet lärarens respons förflyttar sig eleven och byter därmed position och ställer sig bredvid läraren med blicken fortsatt riktad mot spegeln (rad 5). På rad 6–7 påbörjar läraren en tur där hon säger ”om vi titt-” och rör vid elevens arm igen; en handling som eleven besvarar genom att flytta sig ännu närmare läraren. Lärarens handlingar på rad 3–4 och 7 har således lett till en situation där a) eleven har bytt position där hon har hamnat mer bakom modellen, och b) läraren har också bytt position och gett utrymme för eleven att stå mer bakom modellen för att kunna se mot modellen genom spegeln. På rad 8 och i figur 1b flyttar sig eleven för att stå bakom modellen och bredvid läraren. När de står i den här positionen riktas blickarna mot spegeln och de har således en liknande utgångspunkt när de tittar på modellen genom spegeln. Efter elevens förflyttning säger läraren att de ska se på ”helheten nu”, samtidigt som hon gör cirkulerande rörelser med båda händerna (rad 9–10). Genom att läraren lyfter helheten av resultatet av ögonmakeupen framträder nu *helheten* som en kritisk aspekt av att applicera ögonskugga i form av det fotografiska C:et. Eleven bejakar lärarens kommentarer genom att säga ”mm” samtidigt som hon fortsätter att ha blicken kvar mot modellen genom spegeln (rad 11). På rad 12–13 (figur 1c) följer läraren upp sin tur genom att säga ”me liksom jämnheten på ögona”. På så sätt relevantgörs *jämnheten på ögonen* som en kritisk aspekt av ögonskuggans applicering. På rad 14–15 frågar läraren eleven om hon vill lägga till något samtidigt som hon med hjälp av sina händer visar en vägande rörelse, när hon för händerna upp och ner. På raderna 16–17 (se även figur 1d) för eleven sitt pekfinger mot modellens stängda vänstra ögonlock i strykande uppåtgående rörelser och säger ”den här ligger typ högre upp känns det som”. Här synliggörs att *placeringen av ögonskuggan* inte är jämn i förhållande till ögonens form, och att den behöver göras jämnare. Läraren bekräftar med ett ”bra” och ”ja exakt”, på rad 19 pausar hon i 2 sek och utvecklar därefter ett resonemang (rad 20) där hon uppmuntrar eleven att arbeta vidare för att hitta ”balansen” och ”jobba på lite mer”. Därmed använder läraren variationsmönstret kontrast genom att jämföra det eleven har gjort med hur eleven borde göra (det önskade kritiska draget av jämnheten som handlar om var ögonskuggan borde placeras). Här framträder *balansen* som ytterligare en kritisk aspekt av att applicera ögonskugga i form av det fotografiska C:et. Så snart läraren har sagt detta tydliggör hon också för eleven att hon ”absolut inte” behöver ta bort ”där” samtidigt som hon pekar med sin hand mot modellens vänstra öga, något som eleven bekräftar på rad 24 (jfr rad 20 och 22–23). Istället uppmuntrar läraren eleven att hon ”tvärtom” ska applicera mer ögonskugga på modellens högra öga (rad 25, figur 1f). Här

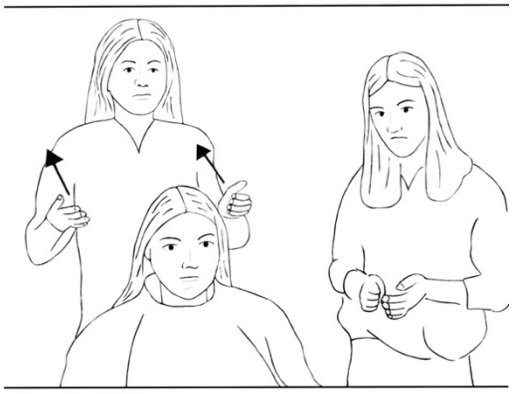
används åter variationsmönstret kontrast där *mängden ögonskugga* framträder som en kritisk aspekt, och det eleven har gjort jämförs åter med hur eleven borde ha gjort i stället (använt mer ögonskugga). Eleven bekräftar läraren med ett ”mm” samtidigt som hon har blicken riktad mot spegeln (rad 27). Läraren bekräftar i sin tur eleven med ”mm” och vänder blicken och kroppen mot eleven, medan elevens blick fortsatt är kvar i spegeln (rad 29, figur 1g). För att hitta den balans läraren pratar om uppmuntras alltså eleven att applicera mer ögonskugga på modellens högra öga.

Sammantaget kan vi se att läraren med hjälp av spegeln synliggör kritiska aspekter av lärandeobjektet ögonskuggans applicering i form av det fotografiska C:et i interaktionen med eleven. Aspekterna handlar om helhet, jämnhet och balans mellan ögonen i relation till var eleven har placerat ögonskuggan och hur mycket ögonskugga eleven har använt. Vad som också blir synligt här är att elevens position för att kunna utvärdera arbetet som har gjorts, relevantgörs av läraren i situationen. Det vill säga att för att kunna applicera ögonmakeup och utvärdera resultatet ingår också ett arbete där man behöver positionera sig på ett fördelaktigt sätt i relation till spegeln och modellen. Vidare blir det tydligt hur lärarens arbete med att få eleven att hitta rätt position och se helheten har möjliggjort att eleven har kunnat identifiera en obalans i ögonmakeupen – eleven har alltså på egen hand kunnat identifiera och explicitgöra detta både verbalt och med hjälp av en gest. När läraren och eleven har nått en gemensam förståelse för denna obalans kan de ta nästa steg i att utveckla arbetet vidare med att nå balans i ögonmakeupen.

Situation 2: Om man kommer bakom här lite längre bak (32.20–32.43)

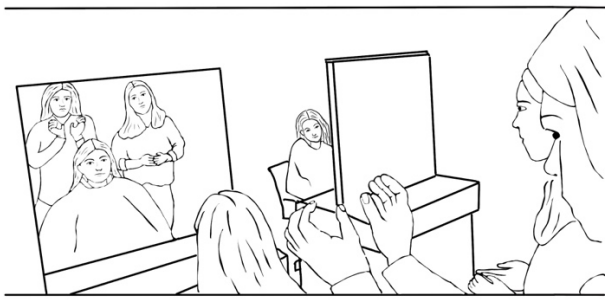
Läraren är här på väg bort från samma elevpar som ovan efter att ha väglett dem, men på väg bort tittar hon in i spegeln igen mot modellen varpå hon plötsligt stannar upp och ny sekvens inleds där hon ger instruktioner till eleven:

1 LÄR Här skulle man kunna bredda ut lite=



Figur 2a. Läraren instruerar eleven att backa.

2 +om man kommer bakom här lite längre bak=
3 *+vinkar med handen* ((för att få eleven att flytta sig till
4 sin position bakom modellen))
5 ser man att det blir väldigt på=
6 +nästan bara på locken
7 *+formar sina händer bakom modellen*



Figur 2b. Läraren formar och för ihop händerna bakom modellen.

```
8     ELE     aa
9     LÄR     hennes +bryn går ju lite längre upp hon har ju ganska=
10                   +visar med sina lillfingrar var längre upp är
11            +stor-
12            +pekar i området mellan ögonbrynet och ögonlocket
```

Figur 2c. Läraren pekar ut området där eleven kan fejda upp ögonskuggan.

```
13          utelämnade rader ((det knackar på dörren och LÄR pratar med en elev))
14   LÄR    +ehh absolut skulle kunna fejda upp lite granna
15          +visar med lillfingrarna i ögonvrårna och
16          vänder sig till eleven igen med händerna uppåt
```

Figur 2d. Lärare och elev tittar på varandra.

```
17   ELE    +mm
18          +möter lärarens blick
19   LÄR    så testa å gör [det] lite grann
20   ELE                 [mm]
21   LÄR    för jag tror du har tiden till det
22   ELE    aa
```

På rad 1 inleder läraren sin tur genom att först säga ”här skulle man kunna bredda ut lite” följt av ”om man kommer bakom här lite längre bak” samtidigt som hon gör en bakåtvinkande rörelse med båda händerna (rad 2–4, figur 2a). Till skillnad från exemplet ovan explicitgörs här *elevens placering i förhållande till att se resultatet i spegeln* som ett parallellt lärandeobjekt. Eleven besvarar därefter lärarens handling genom att förflytta sig närmare lärarens position. Läraren fortsätter sin tur med att säga ”ser man att det blir väldigt på, nästan bara på locken” (rad 5–6). När hon säger detta för hon tummarna närmare fingrarna med båda händerna (rad 7, figur 2b). På rad 8 bekräftar eleven läraren med ett kort

”aa” varpå läraren säger ”hennes bryn går ju lite längre upp hon har ju ganska stor-” samtidigt som läraren visar med sina lillfingrar på den ytan som syns under respektive ögonbryn (rad 9–12, figur 2c).

Efter att läraren har lämnat elevparet för en kort stund för en annan elev (rad 13) säger hon sedan ”absolut skulle kunna fejda upp[2] lite granna” (rad 14–16). Här återgår läraren till lärandeobjektet att applicera ögonskugga i form av det fotografiska C:et och *ögonskuggans placering* framträder som en kritisk aspekt. Återigen använder sig läraren av variationsmönstret kontrast där läraren jämför det eleven gjort med hur hon borde ha gjort istället. Även detta visar läraren med hjälp av uppåtgående rörelser mot modellens båda yttre ögonvrår. Därefter öppnar hon upp sina händer och riktar blicken mot eleven (figur 2c), vilket eleven bekräftar med ett ”mm” och med en blick som möter lärarens blick (rad 17–18). Därefter fyller läraren på med uppmaningen ”så testa gör det lite grann” eftersom hon ”tror” att eleven har tiden till det (rad 19–21). Eleven bekräftar detta med ett avslutande ”aa” (rad 22).

I likhet med i den första situationen sker i den här situationen åter en orientering mot spegeln med den skillnaden att läraren nu verbaliserar vikten av att stå på rätt position. Om eleven intar den position läraren har och ställer sig längre bak i relation till modellen ges bättre förutsättningar att se och utvärdera resultatet av ögonmakeupen. En annan skillnad är också att läraren i den här situationen inte öppnar upp för eleven att själv utvärdera sitt arbete utan läraren tar tolkningsföreträdet, utvärderar och ger instruktioner om hur eleven ska utföra sitt arbete.

Diskussion och slutsatser

I analyserna av interaktionen mellan läraren och eleven synliggörs hur läraren vid uppstarten av varje individuell konsultation relevantgör elevens position i relation till spegeln och den elev som sitter modell. I båda situationerna gör läraren detta genom kombinerandet av flera olika semiotiska resurser såsom tal och kroppsliga rörelser (Goodwin, 2000, 2020). I den första situationen (figur 1a) använder läraren en mer handfast strategi då hon samtidigt som hon säger ”kom” tar tag i elevens högra arm och drar henne intill sig så att eleven hamnar i en position mer bakom modellen, där också läraren står. Lite senare (figur 2b) vinkar läraren eleven till sig samtidigt som hon också verbalt instruerar eleven att placera sig längre bak i relation till modellen och spegeln, och närmare den position läraren själv intagit. I de inledande faserna i respektive situation är det således tydligt att elevens position i relation till spegeln och modellen relevantgörs som betydelsefull av läraren och att läraren, först efter det att eleven ändrat sin position i relation till spegeln och modellen, riktar fokus mot att tillsammans med eleven synliggöra olika kritiska aspekter av lärandeobjektet att applicera

ögonskugga i form av det fotografiska C:et. I den första situationen framträder *helheten*, *jämnheten på ögonen*, *placeringen av ögonskuggan*, *balansen* samt *mängden ögonskugga* som kritiska aspekter av lärandeobjektet att applicera ögonskugga i form av det fotografiska C:et. I den andra situationen framträder *placeringen av ögonskuggan* som en kritisk aspekt av lärandeobjektet att applicera ögonskugga i form av det fotografiska C:et.

I båda situationerna har vi alltså sett hur läraren och eleven arbetat fram en gemensam utgångspunkt i relation till spegeln, varifrån de sedan tillsammans kan utvärdera det arbete som gjorts, men också planera för det fortsatta arbetet. Detta möjliggör en gemensam förståelse för vad som ska göras, och hur det ska göras, något som också Björklund (2018), Douglah (2020), Martin och Sahlström (2010), McClure m.fl. (2019) och Rystedt m.fl. (2013) sett i studier kring andra praktiska undervisningsinnehåll. Så snart eleven har ändrat sin kroppsliga position i relation till spegeln har också läraren och eleven iscensatt en interaktion där flera kritiska aspekter av lärandeobjektet har kunnat synliggöras. Dessa kritiska aspekter har inte enbart synliggjorts utan också konkretiserats och preciserats vidare genom det samtidiga användandet av flera olika semiotiska resurser (tal, blickar, kroppspositioneringar, handrörelser etc.). Analyserna visar också att läraren fångar upp det eleven gjort och ger återkoppling på hur det skulle kunna göras istället, vilket kan ses som att hon använder sig av variationsmönstret kontrast (Kilbrink m.fl., 2023; Marton, 2015). Ivaldi m.fl. (2021) och Mondada (2007) diskuterar hur visualisering och användning av kroppen kan underlätta förståelsen och uppmärksamheten på relevanta aspekter av instruktioner i undervisning som hanterar praktiska lärandeobjekt, och detta är också något som därmed synliggörs i våra analyser (se även Lundesjö Kvart & Melander Bowden, 2021).

Vad som framträder i interaktionen mellan läraren och eleven är också att det yrkesämnesinnehåll som ska läras, synliggörs och verbaliseras på så sätt att läraren och eleven utvärderar och planerar det fortsatta arbetet genom att titta på modellen genom spegeln. Med Goodwin (1994) skulle detta arbete kunna beskrivas som en undervisningsprocess genom vilken eleven ges förutsättningar att utveckla en *professionell blick* som hår- och makeupstylist. Goodwin beskriver den professionella blicken som en förmåga att snabbt och effektivt observera, tolka och analysera situationer inom en professionell kontext, och att utveckla den professionella blicken är grundläggande i utvecklandet av det Goodwin beskriver som *professionell intersubjektivitet* med andra kompetenta yrkesutövare inom samma profession (se även Gåfvels, 2016; Sellberg, 2017). I våra analyser kan vi dock se att lärarens förflyttning till en position framför spegeln, där den professionella blicken skulle kunna relevantgöras, inte är ett innehåll som explicitgörs eller synliggörs som ett lärandeobjekt i interaktionen. Det vill säga att när läraren i undervisningen relevantgör elevens position i relation till

spegeln som betydelsefull för det fortsatta arbetet med att utvärdera och planera applicerandet av ögonmakeupen explicitgörs inte denna förflyttning verbalt av läraren. Analysen visar alltså att elevens position i förhållande till spegeln görs till en viktig aspekt i undervisningen utan att spegeln för den skull framträder som ett eget lärandeobjekt i sig. Genom att inta en viss position – densamma som läraren – kan eleven se från samma vinkel som läraren och de kan diskutera resultatet och hur eleven kan arbeta vidare. Den förändrade positionen ger möjligheter att bättre utveckla den professionella blicken.

Nevile m.fl. (2014) gör en distinktion mellan objekt som situerade resurser (*objects as situated resources*) och objekt som praktiskt utförande (*objects as practical accomplishments*). När objekt manifesteras som situerade resurser används objekt för att utföra en specifik uppgift. Exempelvis kan en spegel användas som en resurs genom vilken en makeupstylist kan applicera makeup på en modell. När objekt manifesteras som *practical accomplishment* fokuseras vad ett objekt är och kan vara och hur det ska förstås och hanteras. Detta kan exempelvis innebära att människor i en interaktion kan förhandla fram vad en spegel ska användas till, hur den ska användas och varför den ska användas på just det sättet. I vårt exempel blir det tydligt att vid de tillfällen då läraren och eleven orienterar sig mot spegeln som praktiskt utförande görs det mer implicit, något som också gör det svårt för läraren och eleven att etablera en gemensam förståelse för *varför* det är viktigt att inta en viss position i relation till spegeln, och på *vilket sätt* spegeln kan användas som en resurs i arbetet. Det är naturligtvis möjligt att läraren under andra tillfällen i undervisningen och som vi inte följt med våra videokameror explicitgjort spegeln som ett lärandeobjekt, men vi menar att ett sätt att utveckla undervisningen vidare skulle kunna vara att läraren även i sådana undervisningssituationer som uppstår i klassrummet, och vilka vi studerat närmare i artikeln, lyfter fram spegeln som ett eget lärandeobjekt för att synliggöra dess roll och funktion inom yrket som hår- och makeupstylist. Artikeln visar på så sätt betydelsen av att i en undervisning explicitgöra det specifika yrkesämnesinnehåll som elever ska lära, och där spegeln utgör ett sådant betydelsefullt innehåll. Analysen visar också på den potential spegeln har som objekt som praktiskt utförande (Nevile m.fl., 2014) där lärare och elever tillsammans förhandlar fram spegelns funktion och roll i relation till specifikt undervisningsinnehåll som har med helhet, balans och jämnhet att göra i en yrkesundervisning. En undervisning som också syftar till att stödja elever i deras utvecklande av en professionell blick och för att kunna etablera vad Goodwin (1994) kallar professionell intersubjektivitet med andra hår- och makeupstylister.

Andra studier inom yrkesutbildning har också visat att det ofta uppstår situationer i yrkesämnesundervisningen där det finns ytterligare möjligheter för lärare att fånga upp och tillsammans med elever explicitgöra undervisnings-innehåll som riskerar att hamna i bakgrunden och tas för givet (Asplund m.fl.,

2022). Ett sådant undervisningsinnehåll skulle kunna vara användningen av spegeln i professionen som hår- och makeupstylist.

En annan undervisningsaspekt som inte är helt tydlig i våra analyser av exemplen ovan är den roll som den elev som sitter modell har i undervisnings- och lärandesituationen. I exemplen deltar denna elev i undervisningen, men hennes roll i interaktionen är förhållandevis passiv. Hur spegeln skulle kunna användas för att ytterligare tydliggöra modellens roll i interaktionen är något som skulle kunna studeras vidare.

Slutnoter

[1] Vetenskapsrådet, dnr 2017-03552. Yrkeslärande i teknisk gymnasial yrkesutbildning.
[2] En försvenskning av engelskans *fade up* (tona ut).

Transkriptionsnyckel

[	vänsterställda hakparenteser på två efterföljande rader indikerar att
[	överlappande agerande/tal påbörjas
+	vänsterställda plus på två efterföljande rader indikerar överlappande tal och gester påbörjas
(.)	hörbar paus, kortare än 0,3 sekunder
(2.0)	siffror markerar en paus längd i sekunder
(( ))	dubbelparantes anger författarnas beskrivningar
<u>Ord</u>	understrukning markerar betoning
–	bindestreck markerar avbrutet tal
=	lika med tecken indikerar inga stopp eller uppehåll mellan raderna
°	gradtecken runt ord markerar att talet är märkbart tystare

Om författarna

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From doing to learning: Students' self-evaluation and reflective practices in VET

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Abstract

This study aims to investigate the conditions for students' self-evaluation and reflective practices when dealing with the learning of skills in a range of different settings in vocational education and training (VET), in the natural resource programme with simulated and authentic teaching practices and learning environments, for example digital driving simulation, as well as environments with authentic machines. The empirical basis of the study consists of extensive data generated during fieldwork in the form of interviews, field notes, and observations in simulator centres, authentic school environments and classrooms. The results show that simulation-based teaching and learning have created opportunities to develop practices that foster students' evaluation and regulation of their learning, through the implementation of specific tools that focus on triggering students' reflections on specific vocational skills and competence. The analysis also shows that feedback and reflective practices could be understood as an evaluation tool for task completion against specific set standards in pedagogical design. But also, as a practice of socialisation and transformation for the students, with the aim to provide them with the kinds of tools that may foster creativity and collaborative practices in the vocational training and their future profession.

Keywords: vocational knowledge, self-evaluation, feedback, instructional scaffolding, reflective practices, digital driving simulator

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Introduction

Students' ability to evaluate and direct their learning process has been on the agenda in formal education over the past few decades (e.g., Jossberger et al., 2010, 2020; Panadero et al., 2017). In vocational education and training (VET) this means creating conditions for students to evaluate and reflect on both vocational issues and knowledge progression. This study is concerned with practices of students' self-evaluation and teachers' formative assessment in VET. The latter refers to a teaching practice in which students receive feedback and are given the opportunity to develop their ability to evaluate progress in the development of knowledge and skills relevant to their future professions. Self-evaluation and formative assessment are constitutive parts of VET teachers' didactic strategies (e.g., Hopmann, 2007), and they contribute to increasing teachers' awareness of students' development as well as the challenges they encounter in the process. Central concepts related to practices of self-evaluation and formative assessment are self-direction and self-regulation (e.g. Jossberger et al., 2010, 2020). These concepts imply that the students work relatively independently and that they are skilled in navigating their learning trajectories. We start from the assumption that self-evaluation and feedback guide students' performance towards curricular demands and learning outcomes, as well as the skills required in their future professions. They are also pedagogical tools to identify students' challenges and progress from basic to more complex knowledge and skills (Panadero et al., 2017; Van Loon, 2018; Wyszynska Johansson et al., 2019). According to Black and William (2012) self-evaluation requires a pedagogical design that makes visible the learning goals and the kind of knowledge that is embedded in such a design, which contributes to fostering students' awareness about what this knowledge may be, and how it can be developed (Sadler, 1989). There is, in other words, a mutual relationship between self-evaluation, the tasks that students are asked to perform, and the learning goals that aim to develop specific knowledge and skills. Such a relationship is built on a specific understanding of the task and the students' capability to describe and assess it. We argue that the interaction with the tools used in the task and the feedback provided, is central to understanding the kinds of dynamics that unfold when students attempt to evaluate and reflect upon their learning. Here, digitalisation, and not least data-driven simulations that build on complex digital tools, are closely entangled with the ways in which the fields of self-directed and self-regulated learning have developed.

This study examines the ways in which digital tools enable students to work independently and receive immediate feedback, which plays a crucial role in the development of skills related to self-direction and self-assessment. Furthermore, one important tension that this study aims to critically discuss is the kinds of assumptions that lie behind teachers' pedagogical design of the different self-evaluation and assessment practices related to curricular standards but also, and

importantly, to vocational knowledge and skills that students are expected to master.

The VET programme which constitutes the context of this study prepares students for jobs in forestry, agriculture, cultivation, and animal husbandry. The teaching practices in this programme take place in various settings, including classrooms, simulated environments (using digital driving simulators), and authentic field environments, such as forests and driving areas. The simulated environment provides a controlled setting where students can perform vocational tasks, preparing them for authentic tasks and situations. The training with digital driving simulators is a recurrent practice in vocational subjects where the students develop their ability to handle different tools and vehicles, as well as their understanding of how to navigate different situations and solve issues related to vocational skills.

In the educational context where the study has been carried out, VET teachers have designed and implemented various practices to promote students' self-evaluation, where teachers' feedback aims to support students' awareness of their current knowledge, while at the same time developing their reflective ability, as well as an understanding of the meaning and purpose of vocational knowledge. Concepts like feedback, formative assessment and instructional scaffolding are used when referring to VET teachers' educational work, to understand what occurs in the self-evaluation process and its bearing on students' learning and knowledge development. The study uses a practice-based approach to investigate students' practices of self-evaluation and teachers' feedback across the boundaries of different (both simulated and authentic) learning environments in VET.

Aim and research questions

The study takes a practice-based approach to investigate the interplay between students' self-evaluation and reflective practices with teachers' feedback while engaging with vocational skills across different learning environments. Interaction between teachers, students and the school's digital driving simulator constitutes a specific focus of the study. More specifically, the study aims to address the following questions:

1. In what ways does teachers' feedback enhance students' self-evaluation towards the learning outcomes in the vocational subject?
2. What are the ways in which students' self-evaluation and teachers' feedback can contribute to the development of vocational knowledge?

Background and theoretical points of departure

Even though topics related to students' self-evaluation and self-regulation have been widely investigated in educational contexts, studies concerning the area of VET are still scarce. More specifically, there is a paucity of research about the role played by the learning environment and the teacher in supporting the development of self-regulation for students in VET (Jossberger et al., 2010). According to Jossberger et al., these skills gain different dimensions for students. They claim for instance that concepts like self-regulation and self-direction in learning should be kept separated as the former is concerned with the micro level of the learning process (for example the execution of a task) and the latter includes the macro level, namely the planning of the learning trajectory (p. 417). Both concepts imply the presence of a pedagogical design wherein the student is given the opportunity to actively participate in the learning process and evaluate the needs that are relevant at any given time. However, while self-direction is a condition for self-regulation, the opposite does not necessarily apply. A student who is skilled in successfully navigating and completing a task may not be as skilled in knowing what the next steps in the learning process may be. According to Jossberger et al. (2010), self-regulation is a meta-cognitive skill that needs to be trained at the macro level wherein the students are given opportunities to 'rehearse and practice in order to routinise their skills' (p. 420). In the context of the present study, self-evaluation is a component in the development of self-regulation skills as an instructional tool that provides students with the opportunity to evaluate their knowledge before and after a teaching session. Self-evaluation is also a key component in the development of vocational knowledge in its relationship with self-observed performance against standards and self-reflection (Panadero et al., 2018; van Loon, 2018).

Furthermore, we are concerned with the role played by teachers' formative feedback on students' performance and the ways in which it affects students' self-evaluation practices. Our conceptual point of departure is that VET teachers' feedback is contextual, forward-looking, and framed as a powerful activity that stimulates students' learning and development (Hattie & Timperley, 2007). However, depending on how it is designed and communicated, it can either have positive or negative consequences for students' learning. The message that the students perceive in connection with feedback is central to their experience and this, we argue, may entail both challenges and opportunities for their self-evaluation practices. One consequence is what Hirsh (2020) discusses in terms of an 'intensified assessment paradigm' (p. 92) where a constant feedback practice can dominate teaching, as well as the interaction between the teacher and the student. There is thus a negative side of formative feedback, according to Hirsh, that may be detrimental to learning, as students feel that they are constantly being assessed and even graded.

A review of studies on formative feedback presents three important aspects of its effect and usefulness: motives and goals, proximity to the completed task, and perceived meaningfulness (Shute, 2008). These aspects illustrate the mutual relationship between clarity of the learning objectives in a school subject, and the interaction between the teacher and the student for how feedback is received. The student's role in connection with formative feedback can shift between a passive, transmission-based approach, or a more active, dialogic approach (Van der Kleij et al., 2019). Dialogical feedback is supported by formative questions (opening, wondering, leading) that invite the student to engage in a reflective conversation (Ellegaard et al., 2018). Furthermore, the effectiveness of feedback for students relies on how the teacher communicates it. This is closely tied to the importance of formative feedback having a self-regulating quality. Wyszynska Johansson et al. (2019) discuss students' vocational conceptual knowing in VET, noting that teacher-led collective feedback, when perceived by students as constructive and meaning-making, positively affects learning and the development of professional skills. In students' experience of vocational knowledge and identity, the context and the VET teachers' approach are significant factors. According to Yan and Brown (2017), feedback is a cyclical process that integrates content, learning environment, and teaching. They further emphasise that the VET teachers' feedback on students' performance requires relevant vocational knowledge.

Panadero et al. (2018), and Van Loon (2018), point toward three dimensions in self-assessment in VET: self-assessment related to self-regulation, self-observed performance (against standards), and self-reflection. These dimensions are part of a complex process wherein the VET teacher is crucial in tasks such as defining standards, establishing reference values for performance evaluation, and, more broadly, developing sustainable and relevant assessment practices that consider both formative and summative aspects. The definition of standards in practices of self-assessment is particularly interesting in VET and can differ from other school subjects, in that VET includes critical skills and knowledge related to the future profession and working life. However, self-evaluation for learning, especially in its formative dimension that does not directly lead to grading, is a complex practice that requires specific actions from the students, as well as the teacher, in order to foster learning and knowledge development. Both Sitzmann et al. (2010) and Panadero et al. (2018) discuss the relationship between students' self-assessment practices, and the development of their skills and expertise. Research points towards the positive effect of self-evaluation for student motivation, their experience of their own learning, and their studies. According to Sitzmanns et al. (2010), students need to know what is assessed as legitimate knowledge. There is also a risk that the students overestimate their knowledge, and this may affect the learning process and motivation. Thus, it is interesting for present purposes to understand the role of teachers' feedback and the ways in

which VET teachers provide instructional scaffolding (Bruner, 1990). Bruner's scaffolding metaphor contributes to an understanding of the teacher's feedback as a form of structured assistance with the deliberate aim to support and help the student to solve problems that may occur during the learning process. More specifically, scaffolding illustrates a series of intentional tasks that the teacher performs to provide support, but also to create the conditions that are needed to make students more autonomous and thus independent in shaping their learning trajectory towards the right direction (see also Vygotsky, 1978; Wertsch, 1998). This process of fading of structure (Margolis, 2020) means also a shifting of responsibility, from the VET teacher to the student, in the handling and solving of problems that may arise during the learning process. This, in turn, has important implications for students' opportunities to develop their skills to evaluate their learning, in ways that are relevant in relation to specific tasks. This study contributes to the body of knowledge that investigates the interplay of students' self-evaluation and teacher's formative feedback to facilitate the transfer of VET knowledge and skills across various settings and learning environments.

Method

This study adopts a practice-based approach, focusing on issues that emerged from VET teachers' professional experiences, initiatives, and inquiries related to their teaching. The empirical basis of the study was generated through VET teachers' investigative processes and the development of their practice, which include mapping, implementation, follow-up, and analysis in the form of action research projects (Hardy et al., 2018). This collaborative project is based on a long-term partnership among teachers in the Natural Resource Programme at three upper secondary schools in Sweden, focusing on the development of simulator-based education. Each school's simulator centre provides a space where students engage in digital driving and manoeuvring of machines. The simulation of the driving of various machines, such as tractors or forwarders, allows for the digital representation of vocational tasks in a simulated setting, preparing students for real-world professional situations. However, digital driving simulators are just one of the learning environments available to students for acquiring driving skills. Students also drive in authentic environments at the school and in workplaces outside the school, with support from VET teachers or supervisors at these workplaces.

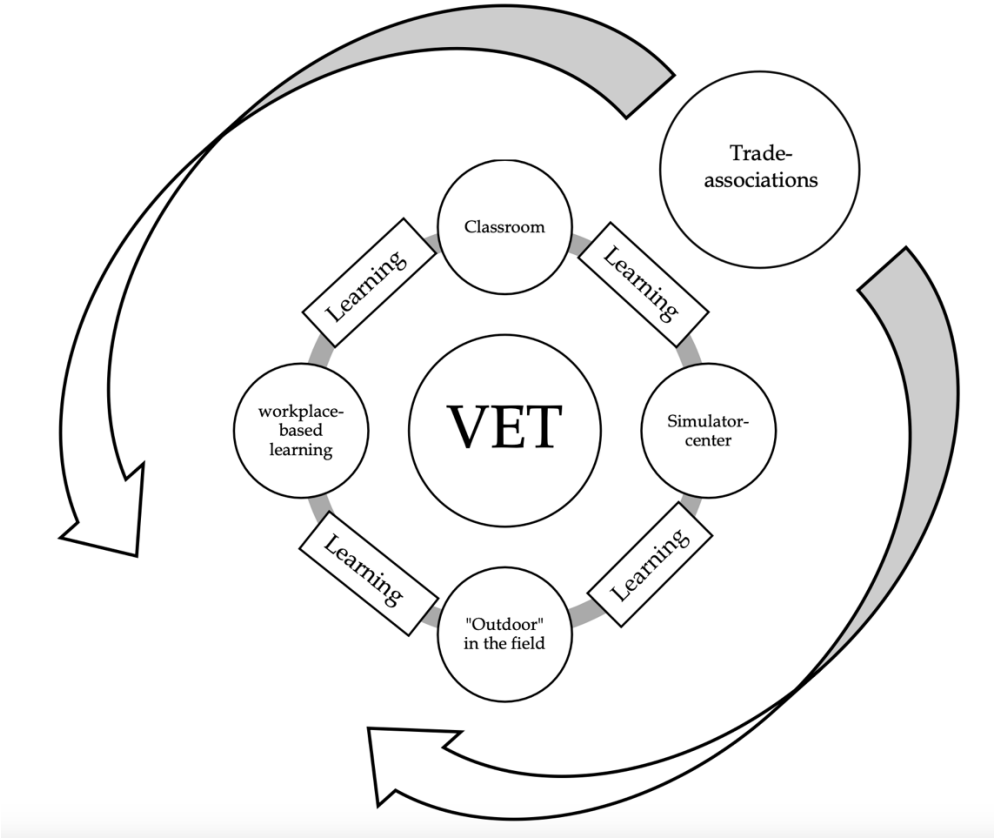

Figure 1. Learning environments in VET.

Figure 1 illustrates the different learning environments designed to complement each other in VET. Rather than focusing solely on digital technologies such as driving simulators, this study examines the ways in which the various environments are integrated with different types of training and teaching methods, with the digital simulator being only one component. Figure 1 represents this complex relationship in a system where the promotion of students' learning connects the different environments, practices, and school subjects. It is based on the assumption that, in planning simulator-based teaching, it is essential to understand how various teaching methods can collectively support the student's learning process. Thus, simulator training is considered a resource that interacts with other teaching methods (Gustavsson et al., 2020).

The involvement of vocational teachers in the creation and integration of different learning environments has sparked discussions about their teaching, the implications for students' learning processes, and the development of vocational knowledge. These discussions have generated interest in practice-

based studies that systematically examine the preconditions and effects of teaching in these environments. This study is rooted in this organic and bottom-up interest, where trade organisations also play a significant role in shaping standards and addressing future professional needs.

The empirical basis of the study consists of extensive data generated during fieldwork conducted from 2022 to 2023. For the purpose of this study, teachers and researchers generated different kinds of data, ranging from interviews and teaching material, to fieldnotes and observations in the outdoor area and the classroom, as well as recorded sessions in the simulator centre. Data was created in relation to particular instances of teaching and learning vocational subjects, where the students develop knowledge in using different types of tools and vehicles, as well as understanding and navigating vocationally related situations in their future professional life. More specifically, the data pertain to the ways in which students reflect on their learning and the tasks they have performed during simulated activities in a lesson. The data also include self-assessment sheets created by the teachers and formative feedback to students provided during or directly after their performance of the task with the simulator.

Table 1. Overview of the data.

Data	**Size**
Observation of simulator-based teaching	Nine sessions (six hours)
Observation of follow-up of self-evaluation	One session (one hour)
Observation of teaching with authentic machines	Two sessions (two hours)
Informal interview with six students	In connection to lessons (four hours) Outside the teaching (two hours)
Informal interview with three teachers	In connection to lessons (four hours) Outside the teaching (four hours)
Students' self-evaluations Students' folders (Pärmen)	Seven self-evaluations Four folders

The process of data creation and analysis was conducted in close collaboration with the teachers throughout the fieldwork period, and during regular meetings. The results of this study are the outcome of analytical work that builds upon an

exploratory and iterative process that is consistent with the steps conducted in action research (Edwards-Groves & Rönnerman, 2022; Hardy et al., 2018) and has a developmental focus. The process of data analysis involved recurrent discussions with the teachers about their practices in relation to the data and documentation that were created. The analysis employed a conceptual perspective to understand how knowledge is developed in interaction between student, teacher, and artefact within and across vocational education learning environments. It also examined how teachers' instructional strategies were reflected in both the planning of formative tasks as well as in the provision of formative feedback (Bruner, 1986; Vygotsky, 1978; Wertsch, 1998).

In the initial phase, the analysis focused on the first research question, which aimed to examine how reflective practices are expressed in the interaction between student and teacher during sessions with the driving simulator. It also focused on the effect of the teacher's feedback on students' self-evaluation against the set standards in specific situations as well as in the broader context of the vocational subject. The interaction student-teacher-artefact in the selected examples thus formed the starting point for the analysis that involved transcriptions of the interaction and the selection of analytically relevant oral and written examples that illustrate the impact of the teacher's as well as the simulator's feedback on students' reflective practices. The second question was attended to through an in-depth analysis of the overall data with the aim to shed light on the relationship between students' self-evaluation and teachers' feedback to enhance professional knowledge and its challenges, tensions and opportunities.

The empirical data used in the present study is presented in Table 1 and in further detail below.

Specialisation forestry: Students' self-evaluation and the VET teacher's direct, oral feedback

The simulator-based teaching includes training sessions for using different types of tools and vehicles, as well as executing related work tasks within the field of forestry. Self-evaluation and feedback occur in direct connection with the execution of a task where the simulator automatically generates data related to how the task was carried out, in terms of, for instance, time and precision of execution. The VET teacher supports the students in the process of making sense and interpreting the data generated after a task. Students and teachers can directly access data from the current task, but also compare it with data generated in previous sessions. Self-assessment and feedback usually occur at the individual level but can also be carried out in groups. For this study, one specific two-hour session was selected, involving two different student groups that were observed and video recorded.

Specialisation forestry: Students' self-assessment of skills before and after the sessions in the simulator centre

Within the forestry specialisation, students are expected to use technical equipment, specifically forestry machines for off-road transport, like forwarders. The VET teachers have designed a self-assessment sheet that the students are asked to fill out to evaluate a range of skills in driving and handling a forwarder, including crane handling, driving methodology, and economic and safe driving. This evaluation is done via six elements in a kind of 'rubric self-assessment' (Panadero et al., 2018). The students rate their skills on a scale from one to five (Figure 2, left). These include crane movement, use of the extension, economic crane handling, grip point, tilt of the load, and flow in crane handling. The students fill in the self-assessment sheet on three occasions. The vocational teacher compiles the student group's anonymised results on an Excel sheet that is presented to discuss the students' perceived development and the vocational teacher's observations (Figure 2, right).

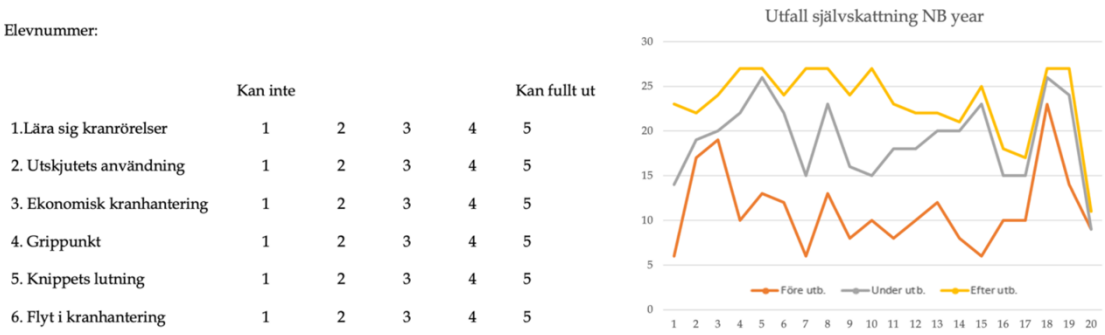

Figure 2. Student's self-assessment sheet (left) and teacher's overview of the results (right).

The analysis in this study is based on data from self-assessment sheets distributed over the past five years to various cohorts of students.

Farming as a school subject: Students' written documentation in the folder (Pärmen)

During the teaching of the vocational school subject Natural Resource, the students alternate between performing tasks in the simulator and describing and evaluating their experiences and knowledge in a folder with questions called by teachers 'Pärmen' or 'Träningshäftet simulator' (Figure 3, left).

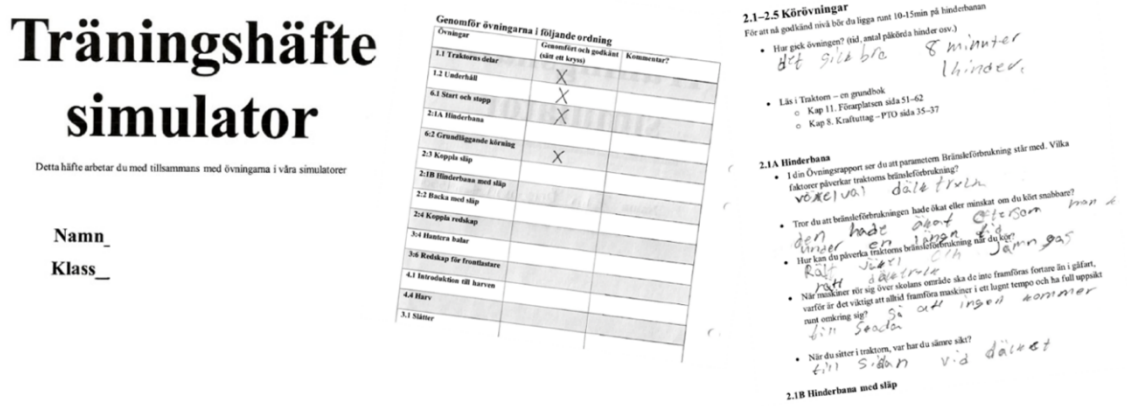

Figure 3. The students' folder, front page (left), the second page (middle), and an example of another page filled out by a student (right).

VET teachers designed the questions in the folder based on the different tasks in the simulator, the content of the vocational subject and the specific vocational skills that the students are expected to develop during the course. The questions in the folder concerns skills related to driving the tractor, its maintenance, being able to reverse with a trailer, unloading a combine harvester, haymaking, using swathers, balers, ploughs, front loaders, harrows, and driving a tractor on roadways leaned for traffic (Figure 3, middle). The folder design has the characteristic of 'script self-assessment' that includes questions or criteria that the students answer independently (Panadero et al., 2018), (Figure 3, right). The vocational teacher's feedback takes place during the performance of a task with the simulator as well as during authentic driving. For this study, we have conducted informal interviews with six students and three teachers (see also Table 1) about their perception of the importance of documentation for the learning process, starting with their experiences with the use of the folder.

All teachers and students have been informed about the data generation process, the purpose of the study and how the data is managed and used in the analysis and reporting. A practice-based study builds on ongoing collaboration between schools, making anonymisation neither possible nor necessary. However, it is ensured that participating students cannot be identified as individuals.

Results

This section includes the results of the analysis of the selected illustrative examples of practices of self-evaluation and feedback in the data presented in Table 1. These include an instance of a VET teacher's feedback to a student's self-evaluation and reflective practice after self-observed performance against the

standard values set by the driving simulator. Other examples include the analysis of the ways in which students and teachers talk about their learning and teaching practices related to the use of a range of tools for self-assessment and self-evaluation that have been designed by the teachers in their action research projects.

Example 1: A dangerous lift

Example 1 illustrates a conversation between a VET teacher and a student performing a task with the driving simulator while discussing the results after the session. The task included driving a forwarder and gripping logs from the ground by manoeuvring the forwarder's crane and grapple. The student noticed some improvements since the last time he carried out the same task (line 1). The teacher confirms this by adding 'yes, you lowered it a lot' (Swedish: ja, du har sänkt mycket – line 4). Here, the verb 'to lower' (Swedish: sänka) refers to the crane boom cycles during the session (the fewer movements and shorter paths of the crane's boom-tip, the better the results in terms of time and use of resources, as well as safety). These values are shown on the screen of the simulator, and the student uses the pointer while speaking, to show what values he refers to in his talk.

1 S: cycles [of crane motions] I had 18 here [points on screen], on the other
2 [previous training session] I had 11 so there are more logs collected, so
3 maybe that's why I lowered it too
4 T: yes, because you lowered it a lot
5 S: Ah because before I only had 11 [logs]
6 T: Just make sure you have safe lifts, and this means that the legs [of the grapple]
7 must be against each other
8 S: I took 2 [logs] the first time on something, but then I asked Erik if it is
9 possible to take 4, yes it's fine, and I saw no, then the legs [of the grapple]
10 were together
11 T: When I run a session, I always take 4
12 S: Ah, I figured it out, 4 works!
13 T: Ah it does. But then it is at the limit whether it is a safe lift or not
14 S: Ah
15 T: Well, it's open so the logs can fall out when you lift and where does the log
16 fall?
17 S: Ah then it just goes down
18 T: Then it's a dangerous lift
19 S: Mmm
20 T: Then it goes off somewhere

The excerpt above illustrates a rather common student–teacher interaction, wherein the student attempts to reflect on the results based on the data generated during the task performance with the simulator. The student in Example 1 shows

some competence in evaluating the data (lines 1–3), and in relation to the number of logs that the grapple of the forwarder can carry and move safely from the ground with the lowest possible values of boom-tip paths (lines 8–10). The teacher confirms the student's deliberations about the performance, and that the student's interpretation of the data is correct (line 4). The teacher is also a critical friend that, while confirming that four logs are the highest number that the grapple can carry, it is important to be aware of the risks that may result in a dangerous lift (lines 13–20). Thus, the data produced by the simulator after the performance of a task is used by the teacher not just as a diagnostic tool to control the process of the individual student, but also, and most importantly, as a way to analyse what has happened in light of the student's future development (Margolis, 2020). In this case, focus lies on what is needed to evaluate possible risks when handling log lifts. Furthermore, the excerpt illustrates the ways in which the student discusses with the teacher and also with other students about the data generated by the simulator. Here, one central element of students' self-evaluation and self-regulation consists of the meaning-making that occurs in interaction with the teacher and other peers (Vygotsky, 1978). In this context, the teacher plays a crucial role in supporting students' vocational knowledge. Apart from providing important knowledge and establishing standards for reasonable actions in simulator training, the teacher's role extends to creating an environment that fosters students' socialisation, creativity, and exploration as integral components of the learning experience. In addition, the simulator itself is an important game piece, because what comes out of it affects all participants' (including the teachers' and us as researchers') understanding of what a 'good' result can consist of in the simulated environment. Dialogue, collaboration, and creativity are thus central components in the interplay of practices of self-evaluation and feedback in our data. This is further illustrated by the use of particular tools for fostering self-evaluation in connection with task performance with the driving simulator.

Example 2: Self-evaluation and collegial learning (the folder – 'pärmen')

The VET teacher describes in the following how the folder (Swedish: pärmen) contributes to the processing of skill development as well as to self-evaluation of professional knowledge. According to the VET teacher, the folder clarifies the difference between simulator training and the processing and understanding of the vocational knowledge that the simulator tasks aim to develop. Students are supported in evaluating their knowledge through questions that prompt them to reflect upon what has been difficult, what has worked well, and what requires more practice.

Students' work-related experiences may present a challenge, or in some cases, a support, for their reflective practice, prompted by the questions in the folder.

Students may already have experiences and some knowledge of the topics covered in the folder. The teacher is thus flexible and makes adjustments in line with students' prior knowledge. The students report that they are verbally active while completing the questions in the folder discussing issues and supporting each other. The VET teacher describes how the teaching of vocational subjects, regardless of the type of learning environment, should be interactive both between teacher and student and among students. This rule is introduced early in the vocational training:

> There are a lot of discussions when they talk amongst themselves, and [students] gladly discuss other things and how they work with their tractors. If something has gone wrong at home, they also learn from this. […]. Something that I add very early on here is how to help each other. And we wanted to include that very early on so that they can… if someone has a problem, then you go there and help them. You don't film and laugh at them, you go there and help, and that's a big part of this. We help and support each other. (VET teacher)

Students' collaboration is thus not only natural, but also expected. In the excerpt above, the teacher describes how this collaboration can be related to the future profession. It is both part of the learning process in the here and now of the training, as well as a preparation for vocational practice: 'You can't stand there and look at each other. Running a farm is not a one-man show, you do it together. There you have to help each other. You can't do it yourself.'

Students' documentation in the folder has different dimensions and characteristics. Some students answer each question in detail, some already have the basic knowledge which leads to more summarising documentation, others discuss the understanding or interpretation of a question, and some document their process more sporadically using the folder. The VET teachers take an active role in students' documentation and conversations with each other. Teachers' formative feedback involves being available while students work with the folder, giving feedback on their documentation, participating in their conversations or initiating discussions. The feedback is direct and dialogic (Ellegaard et al., 2018).

The folder fosters reflective practice through open-ended questions. The VET teacher explains how students' answers in the folder and the dialogue in the classroom during the process contribute to understanding the students' knowledge. 'I see their level of knowledge', one of the teachers said. There is a certain level of coordination where teachers can follow students' performance through the documentation in the folder, as well as follow-up on specific questions, in a formative loop. For example, questions about safety are particularly important to discuss and clarify before the student is allowed to drive a tractor on the driving field outside the school:

> On the one hand, we go through this ourselves afterwards, so that they have done the stages [simulator training], and also what they have done theoretically. Then we'll see what they do on the driving field. If they have done the first part here, for

> example, when they have filled out this, they can go in and do the next part in the simulator. […] Then on the driving field there, we apply everything they have learned. (VET teacher)

The questions in the folder thus have different purposes. One is to take a step back from the simulator training and to evaluate the results of task performance. Another is to broaden and deepen the knowledge through open-ended questions about problems or situations that do not have a clear answer. A third purpose is to introduce more advanced knowledge of the vocational field. 'Many of the questions are above the Natural Resource level' [current vocational subject]. The aim is to make learning visible, and to challenge the student without necessarily posing too specific, content-related questions that require declarative knowledge. The students know that the folder does not have a control function but is rather used as a starting point for further knowledge development: 'A reflection on what is to come.' or 'That they get a little headache [Swedish: huvudbry], that they get to sit down and think a bit' (while answering the questions in the folder. Furthermore, the VET teacher describes the need for 'distance' and a 'wide-angle view' (Swedish: vidvinkelseende). The questions in the folder can contribute to opening up and giving knowledge a new meaning, from different perspectives.

To conclude, the folder is designed to provide structure in terms of what we have previously discussed as scaffolding: it stimulates students to evaluate their achievements and develop an understanding of the knowledge here and now, and what is required in the next step. Teachers describe how the folder can contribute to creating a meaningful context by connecting the different learning environments (both in the simulator centre and in the outdoor fields), by providing a collective documentation of students' knowledge and by identifying possible gaps. It also contains forward-looking questions, which contribute to progress toward expected vocational knowledge. The folder is envisaged as an example of the learning culture in vocational education, an artefact that through the approach of vocational teachers and students, contributes to a dialogic culture. The dialogue supports learning in that it creates possibilities to exchange experience, to mutually provide concrete advice among students, as well as discussions about solutions or ways of dealing with complex problems. We argue that what we have framed in terms of instructional scaffolding takes the shape of formative loops that through dialogue and a supportive environment prepare the students for self-regulation and help them become more autonomous and skilled in navigating their learning trajectory now, and in their future profession. A first glimpse of the teachers' instructional fading is illustrated in the next example, wherein students in year two look back and explicate their understanding of the purpose of the folder.

Example 3: Students as learners and future professionals

In year two, students continue with simulator training related to current knowledge goals in the curriculum. Although the folder is now 'out of date', it remains part of students' overall educational context. Having worked with the folder the previous year, students have had the opportunity to engage in similar reflective practices as those illustrated in Example 2. The students look back and describe their understanding of the purpose of the folder the previous year: 'you understood what you were doing', 'get a summary of the task in the simulator', 'get a look back at what you have done'. The students also confirm the dialogic, meaning-making activity while they work with the folder. 'If there is someone who needs help, we are there and explain how it is.' The VET teacher confirms such a cooperative culture. The students describe both an under-standing of the need to declare and process knowledge as something that includes 'a right answer' and the value of more creative collaboration. Now, in year two, a similar cooperative process transpires more independently in connection with the training in the simulator, and with the support of the data generated after the performance of a task. In some cases, the students evaluate the results on their own, in other cases they still need the support of VET teachers, as illustrated in the excerpt in Example 1. Students in year two find the training with the simulator motivating and engaging. However, in the previous year, both the work with the folder and the simulator training were initially described by VET teachers as tasks that the students would perform for a certain amount of time, with the students primarily wanting to 'go out and drive ' (Swedish: gå ut och köra).

> S1: We in 2nd grade have become very quiet. While students in first grade drive the tractor, the combine harvester, they learn to harrow and plough […] we are more, what should I say… entrepreneurs and drive excavators and wheel loaders, so we try to focus more on that.
>
> S2: There's a little more focus too.
>
> S1: Exactly.
>
> R: The questions in the folder made you understand what you did in the simulator.

Here, the students take on the position as future professionals, rather than students in vocational education. At the same time, there is respect for the vocational knowledge required, which contributes to concentration and focus. The students in year two have developed a clearer picture of, and motivation for their career choice. The students describe this difference in that there is currently a professional approach (as 'entrepreneurs') where each task is performed with the aim of achieving the best results: 'Now everyone is quiet in there [simulator centre]. It's only when there is a problem, that there's talk.'

The analysis in this section shows different dimensions of students' self-evaluation and reflection practices. These are discussed by the students as well

as by the teachers, who, during our fieldwork, had the opportunity to reflect on and evaluate the implementation of the action research projects they had developed over the past months. Both the observation of the interaction, as well as our discussions with the students and the teachers during the informal interviews, show an awareness of the task design by the teacher, as well as the students' own awareness of how the task is related to course goals and the developments of skills to support their future learning and profession. This is especially prominent in Example 3, where the students are more experienced and have a clearer understanding of their journey towards becoming future professionals. Example 2, on the other hand, is an illustration of the teachers' work to foster self-direction at the macro level (Jossberger et al., 2020). This aspect is also relevant in Example 1, wherein the student brings up a former conversation with another students about the number of logs that is possible to lift and move safely from the ground when driving a forwarder. Here, meta-cognitive skills are dimensions of learning that are inherently social, or collegial, in terms of students' roles as future colleagues discussing about professional 'authentic', and complex issues. This kind of reflective practice is continuously attended to by both teachers and students as a central competence that gains its meaning in interaction with the teacher, with other peers, and eventually at the future work placement and job.

Finally, the study marks a significant advancement in adopting a critical stance toward understanding students' self-regulation practices. This is particularly relevant given the tendency for overconfidence in self-regulation related to the use of digital tools in educational contexts more broadly. We know from previous research that digital tools do not promote students' autonomy and learning *per se* (e.g., Gustavsson et al., 2020; Nyström & Ahn, 2020, 2021). Instead, our study shows how VET teachers' instructional scaffolding is central and specific for these settings, wherein the teachers both take and are given different roles, as experts in the school subject but also in the industry and in students' future professional life.

Discussion

This study aimed to investigate what factors are conducive to students' self-evaluation and reflective practice when dealing with the learning of vocational skills in different learning environments. More specifically, focus lies on the kinds of reflective practices that emerged in the interaction between VET teachers, students, and the digital driving simulator, and how formative feedback practices can enhance students' self-evaluation towards the learning outcomes in the vocational subject. One important theoretical point of departure in this study builds upon the assumption that learning and development occur

through mediation with material artefacts that are central to the ways in which practices like the ones that are focused upon in this study unfold (Vygotsky, 1978; Wertsch, 1998). Self-assessment and formative feedback are based on the training sessions with the simulators, which are thus the artefact to which students initially direct their attention. The simulator training creates a learning environment that both evaluates how (well) the student has completed the task (see Example 1), and, through self-evaluation and questions in the folder, stimulates students' understanding of the specific task. There is thus a direct connection between self-evaluation and formative feedback both in terms of time and content. For instance, the strategic combination of practice with digital driving simulators and authentic machines in this particular study is used by teachers as a pedagogical design to develop not only students' vocational skills, but also their ability to evaluate and assess different situations in their future working life, where issues of safety, sustainability, and efficiency (both in economic and climate-related terms) are central. Here, the use of other tools, besides the simulators and the authentic machines, is included to provide the students with standardised models whose aim is to create a default route that can be used by students in the practices of self-evaluation. One important theoretical premise here is that knowledge is generated through students' own work, that is done autonomously 'once one has acquired the constituents of reckoning it from society' (Bruner, 1986, p. 131). It is, we argue, the development of such a skill for reflection about one's own position as learner that is at stake in the kinds of practices that are focused upon in this study. This is especially interesting when the kind of conceptual learning that is aimed at in learning to drive a machine in the forest industry or in agriculture, involves different participants and material artefacts, as students, teachers, driving simulators, and authentic machines. This entails what Bruner (1986) calls a 'collaborative enterprise' between the teacher or a more expert peer, and the student. For instance, the teachers have designed evaluation sheets with specific questions that the students are asked to complete, or other kinds of feedback that is provided by the simulator after a completed task that students can discuss together with the teacher. Here, a useful concept for meaningful feedback has been scaffolding (Bruner, 1990), which in an educational setting is related to the knowledge that the student should be given the opportunity to develop, and that in VET is also related to the knowledge about certain standards and forms of behaviour in the future profession.

Students' reflective practices and the formative feedback of the teachers are shaped as a dialogue, with the VET teacher serving as a role model (Example 1). Some vocational knowledge cannot be discussed, and instead requires conscious choices and actions. This creates a tension between declarative knowledge which indicates what is legitimate to do (or not) in a specific situation, and the creative, open-ended nature of the kinds of reflective practices discussed in relation to the

implementation of the folder. Thus, what we have framed above in terms of instructional scaffolding, can also become a double-edged sword in the practice of feedback in VET. On the one hand, the VET teacher becomes the role model, the individual who impersonates and embodies the future profession and the kinds of professional choices that students are likely to encounter in their future working life. On the other hand, the results show that teachers, in their work with the folder for instance, refrain from simply asking students what the right answer is, aiming rather at encouraging them to behave and think creatively and critically about their own knowledge. Thus, the analysis shows that formative feedback consists of both instruction and discussion depending on its content, and that a dialogical approach is what is generally aimed at, even though with different results, depending on the context in a cyclical process (Yan & Brown, 2017). Students' conversations contain both expert-led, instructional scaffolding and open-ended, explorative discussions or reflective conversations (Ellegaard et al., 2018; Van der Kleij et al., 2019).

In addition, the analysis shows that simulation-based teaching and learning create opportunities to develop practices that foster students' independence towards self-regulation and reflective practices through the implementation of specific tools and materials. These focus on triggering students' reflective practices on specific skills and competence that relate to driving and handling different machines in the simulation and in authentic situations in the field. Such practices have also created opportunities for the teachers to provide relevant feedback to the students during the educational activity in the different settings. The analysis shows that teachers' feedback and students' self-evaluation could be understood both as an evaluation tool for task completion against specific set standards in pedagogical design (in terms of teachers' action research projects), but also as a practice of socialisation and transformation for the students with the aim to provide the kinds of tools that may foster creativity and collaborative practices.

Implications for practice-based research and school development

So, what do the results of this study leave us to, in terms of its take home messages and possible implications for VET teachers and students and the coming work towards the educational development of such practices? The implementation of digital simulators has become important for the teaching practice in VET. At the schools, there was at an early stage a collegial conversation about how simulators could change teaching in the various learning environments for VET (Gustavsson, 2021). There was a perception that simulator training could not be considered as an isolated skill directly transferable to a professional, authentic context. The implementation was planned in advance,

with ideas and questions about possible development. The questions formulated in preparation for the current study are part of an ongoing conversation about teaching-related, critical issues among VET teachers within each school. The conversation also includes researchers who regularly participate in collegial discussions. Thus, there is a systematic process where teaching is followed up and developed through teachers' and students' experiences (Hirsh & Segolsson, 2019; Jarl et al., 2017). The model for practice-based action research has thus become natural and, in some cases, implicit at the schools. One strength is having a stable group of teachers who know the history and reasoning behind the collaboration, thus enabling them to introduce new teachers to the collegial work. A tension and challenge lie in preserving the critical conversation between teachers and the systematic development related to teaching, both organisationally and culturally. This also includes the presence and the role of the researcher. Is the researcher a guarantor of continuity and evidence-based teaching, or an actor in a dialogue for a common interest?

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Implementation of digital tools in VET: Experienced support and technology acceptance

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Abstract

Among pressures and challenges of the COVID-19 pandemic, progressive digitalisation has resulted in changes in vocational learning environments. Therefore, a well-planned and didactically sensible implementation of digital tools is indispensable. The aim of this article is to discuss how experienced support from teachers/trainers influences trainees' acceptance of digital note-taking apps and video conferencing systems, and what requirements there are for support. These factors were measured based on the technology acceptance model and social support theory using an online questionnaire (mixed methods) of 891 trainees from different training occupations in Germany.

The results show, that 'Support trough instruction/communication/time resources/ organisation' is relevant for the embedding of digital tools at the learning venues schools and workplaces. Experienced support influenced trainees' technology acceptance of the tools. In summary, didactically sensible teaching of basic digital skills ensures progress in the sense of digitalisation and, thus, the future employees of 'Industry 4.0' emerge from 'Vocational Education 4.0'.

Keywords: technology acceptance, digital tools, digital vocational education, experienced support, vocational learning settings

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Introduction

Anchoring digital tools in vocational education and training (VET) is an important means on the path to Industry 4.0, which is characterised by increasing digital networking, automation, flexibilisation, and complexity of business and work processes. Industry 4.0 demands skills on data evaluation and analysis with digital tools, cross-divisional process expertise, and interdisciplinary thinking. According to Bach (2016), future digital skills can only be met if the use of digital tools are established as early as possible in VET (Acatech, 2016; Bach, 2016; Tommasi et al., 2020). The introduction of digital tools has potential to create self-directed and life-long learning, independent of time and workplace (Egloffstein et al., 2012; Jenewein, 2014; Pferdt & Kremer, 2010). To best utilise this potential, a well-planned and didactically supportive implementation in vocational teaching as a pedagogical concept and learning at schools and companies is essential (Cattaneo, 2022). The adaptation of digital tools in VET can be called VET 4.0. In VET 4.0 skills, knowledge and dispositions are to be acquired that prepare trainees for the above-mentioned challenges of Industry 4.0 (Chan, 2012). These are generating/exchanging/organising content and information digitally, using digital tools, integrating prior knowledge, dealing creatively with digital conditions, and also the inner attitude towards technologies (Roll & Ifenthaler, 2020). Successful implementation depends not only on the supply side – technologies offered in VET – but also on the demand side – the involvement of trainees. Implementation can only take place if the needs of trainees in technological education and their self-adaptation are considered and if they are supported in the best possible way from teachers and trainers. To promote the use of digital tools in VET, trainees' technology acceptance needs to be addressed (He et al., 2023).

To have a closer look at the interplay between support provided by teachers/trainers and the development of acceptance, this article examines the influence of support in VET on the technology acceptance on the part of trainees. This assumption is based on the technology acceptance model and social support theory (Berkman et al., 2000; Davis, 1985). Starting point is the question: *How does the support of training and teaching staff, as experienced by trainees, influence the technology acceptance of note-taking apps[1] and video conferencing systems[2] in VET?* To answer this, a survey framed from particularities of the German dual system is used. The system is based on a cooperation between practical training in companies by trainers and theoretical training in vocational schools by teachers (Bartscher et al., 2018). Boundaries between those learning venues have often been identified and addressed in research (Akkerman & Bakker, 2011, 2012; Aprea et al., 2015; Engeström et al., 1995; Kilbrink et al., 2020). Vocational learning should not take place as a transfer of skills/knowledge, but as circular learning between learning locations (Aprea et al., 2015; Sappa et al., 2016).

Different natures of knowledge in school and workplace contexts must be considered. At school, more abstract, formal, and theoretical knowledge is important, whereas in the workplace more implicit, experience-based, and practical application knowledge is required. At school, learning in the workplace should be reflected, in order to promote critical thinking among trainees and create feedback loops (Akkerman & Bakker, 2011; Aprea et al., 2015; Sappa et al., 2016). Digital tools can be used as boundary objects to bridge gaps between learning locations by creating an 'Erfahrraum' ('experiential space') (Aprea et al., 2020; Cattaneo & Aprea, 2018; Schwendimann et al., 2015). In this space, it is possible for trainees to integrate school- and work-based knowledge, a process called integrative competence development (Aprea et al., 2020; Schwendimann et al., 2015).

Furthermore, a geographical gap between vocational schools and companies can make exchanges between teachers and trainees more difficult. The attitude gap is a communication and attitude difference between teachers and trainers. Teachers must take care to communicate all aspects of the curriculum to the trainees and liaise with companies. However, many trainers do not use communication technology in their daily work. There is also a competence gap between teachers and trainers. Teachers and trainers are confronted with different technologies in their day-to-day work and are not always equally able to help the trainees with questions. Also, there are often technological difficulties in using tools at learning locations; some trainees do not have appropriate end devices, or it is not possible to integrate them into the networks. The administrative gap, such as management of platforms/forums, control of content, and the exchange of materials between school and companies, needs to be monitored (Enochsson et al., 2020).

The special requirements of the COVID-19 pandemic have forced stronger implementation of tools in VET, by cancelling training times/opportunities and the shutdown of vocational schools and the shift in theoretical training from face-to-face to online learning. Theoretical training was conducted entirely online with video conferences. In practical training in companies, there was a lack of informal opportunities for exchange, for example about the current status of the trainees among trainers, taking into account hygiene regulations such as distancing regulations and limiting the number of people in rooms (Buschfeld et al., 2020).

Theoretical background

Technology acceptance

To operationalise the term acceptance and its mechanisms of action, this study uses the technology acceptance model, by Davis (1985). In the technology acceptance model, perceived ease of use (PEOU), perceived usefulness (PU), attitude toward using, and behavioural intention generates technology acceptance.[3] PU is '…the degree to which an individual believes that using a particular system would enhance his or her job performance' (Davis, 1985, p. 26) and PEOU '…the degree to which an individual believes that using a particular system would be free of physical and mental effort' (Davis, 1985, p. 26). A tool has a high PU if a trainee believes that the tool supports learning and helps him/her to perform better in VET. A high PEOU value indicates that the trainee experiences freedom from difficulties when using the tool, and that the effort required to use it is low. PEOU influences PU in the technology acceptance model. Attitude towards use originates from the major beliefs of PEOU and PU and refers to the personal attitude of a trainee, towards a digital tool. Behavioural intention, influenced by attitude towards use, is the subjective probability of showing a behaviour (using a tool). This process results in behavioural acceptance, the actual use of tools by trainees (Davis, 1985, 1989; Fishbein & Ajzen, 1975). The technology acceptance model, especially PEOU and PU, is influenced by external variables, such as social factors (Tick, 2018). A sufficient explanatory functionality of the technology acceptance model for development of technology acceptance by external variables, like Image, Subjective Norm, and Enjoyment has been demonstrated in studies such as those of Abdullah et al. (2016) and Venkatesh and Bala (2008). In VET, Alshahrani et al. (2023), Antonietti et al. (2022), and Zarafshani et al. (2020) validated the measurement accuracy of the technology acceptance model. A further development of the technology acceptance model, the 'Unified theory of acceptance and use of technology' by Venkatesh et al. (2003), was validated in VET by Li et al. (2022).

Not only are the influencing factors that affect the technology acceptance model relevant, but also which tools are considered. Jose and Jose (2021) investigated the perceptions of Microsoft Teams[4] by 96 students, measured using the technology acceptance model. A correlation was found between PEOU and PU. In the corporate learning context, Schwind and Yetim (2022) determined the acceptance of the use of Teams with 8 employees. Results showed that attitude and intention to use a system depends on performance, stability, usefulness, user-friendliness, and interaction. Bailey et al. (2022) utilised the technology acceptance model to explain how the use of Zoom[5] influenced the learning outcomes of 321 university students and found that PEOU had a strong influence on PU and the use of Zoom. Monterde et al. (2022), showed that PEOU and PU

significantly predicted students' intentions to use video conferencing applications in an online classroom. In summary, the technology acceptance model as a measurement model for the development of technology acceptance of video conferencing systems has mainly been used in university contexts.

Schlag and Imhof (2017) examined the development of technology acceptance when using note-taking apps. They analysed computer anxiety, job relevance, and the image of Microsoft OneNote, which influences technology acceptance. The more OneNote was rated as a useful tool for learning and teaching, the fewer challenges the test subjects perceived. Petko et al. (2023) investigated a mobile app with the possibility of multimedia note-taking for training. They found that pre-service teachers who used the app together with their mentors showed a similar level of technology acceptance as subjects who used the app exclusively for themselves. Utami et al. (2022), who studied teachers, showed that PU and PEOU do not significantly predict the use of Microsoft software, such as OneNote. The technology acceptance model, as a measurement model for note-taking apps, still raises questions due to the differing results in research. This study aims to contribute to the validation of the technology acceptance model in VET in relation to the tools.

The importance of experienced support for learning in VET

Since the development of technology acceptance is related to external influencing factors, the following sections analyse experienced support in VET contexts in relation to the technology acceptance model. Following Berkman et al.'s (2000) social support theory, experienced support by teaching and training staff could influence digital learning. According to House (1981), support flows between people and can be categorised into informal, emotional, instrumental, and evaluative support. Instrumental support refers to support in problem-solving through concrete help or information teachers/trainers give to trainees in educational settings (Semmer et al., 2008).

According to Billett (2014), learning at the workplace often works through trainees' own construction of knowledge to be learnt through implicit trial and error. Nevertheless, he emphasises the need for guidance from social partners, like trainers, to support the development of knowledge (Billett, 2014). Based on the boundary crossing approach, learning in VET is a circular process between learning venues (Aprea et al., 2015; Sappa et al., 2016). As Schutz (1970) advises, it should not be assumed that connections and synchronisations that trainees make between the knowledge acquired at the learning venues will function optimally. These processes require support and guidance from supervisors like teachers/trainers (Billett, 2014; Schutz, 1970). Furthermore, learning is a social process, even in times of social distancing and online learning during COVID-19. Online learning can complement/replace face-to-face interactions of trainees

with teachers and trainers, but requires constant and individualised support. One example of this is support from a teacher in the event of problems with boundary objects, such as video conferencing systems during online learning. Circular learning processes can only work, if the tools also work (Aprea et al., 2015; Federici & Skaalvik, 2014; Hsiao et al., 2012). The support of teachers and trainers is considered in this paper as part of the teaching process, with a special focus on support dealing with challenges in using digital tools, like issues with handling the apps, internet access and hanging functions/bugs in the apps. The experience of support on the part of trainees is a subjective feeling of receiving help from teachers/trainers (Buunk, 2002). This subjective perception of the trainee is to be measured in this study.

The relationship between experienced support and technology acceptance for learning with digital tools

A study by Weng et al. (2015) showed that social support from superiors has a significant influence on intention to use technology (measured with the technology acceptance model) from employees in training. Masood and Lodhi (2016) also confirmed the influence of experienced support by teachers on students' perceived ease of use (PEOU) and perceived usefulness (PU), regarding SPSS software. The more support the students experienced, the more likely they were to use SPSS. However, the effects found were very small, with social support accounting for 6.3% of the variance of PU and 3.6% of PEOU. The present study examines if the strength of the correlation in VET is different. He et al. (2023) examined the effects of experienced educational and emotional support on technology acceptance and, thus, the intention to use e-learning. They concluded that support has a positive and significant relationship with PEOU and PU. Hsu et al. (2018) also showed that the social support theory and the technology acceptance model are suitable models for investigating intention to use online courses. The learning contexts, such as the above-mentioned studies in higher education, rarely include VET environments. It is difficult to compare VET with those contexts, with its described challenges in Köpsén and Andersson (2018). For example, like the coordination between VET schools, teachers, working life, and the boundary processes. Antonietti et al. (2022), who evaluated the fit of the technology acceptance model in VET through the positive and significant relationship between VET teachers' beliefs and technology acceptance, argued that further investigation of the technology acceptance model in VET would contribute to the validation of the model. As they presented the viewpoint of vocational teachers, this article will present the trainees' side. Weng et al. (2015), in their study on the social influence on the technology acceptance model, also called for further expansion of research to other occupational contexts and systems.

Study approach

Based on the theories outlined above, the present study considers the influence of teachers/trainers on PEOU and PU of the tools by trainees. First, the strength of the correlation with research question 1: *To what extent does the support of training and teaching staff, as experienced by trainees, influence the technology acceptance of note-taking apps[1] and video conferencing systems[2] in VET?* is to be measured. To answer research question 1, hypotheses were formulated. Hypotheses a (1a and 2a) examine the relationship between experienced support and perceived ease of use (PEOU), and b (1b and 2b) the relationship between experienced support and perceived usefulness (PU). Hypothesis 1 deals with the investigation of note-taking apps and hypothesis 2 with video conferencing systems.

- Hypothesis 1a/b: There is a positive relationship between the support, as experienced by trainers/teachers, and the technology acceptance (PEOU (a)/PU (b)) of note-taking apps by trainees.
- Hypothesis 2a/b: There is a positive relationship between the support, as experienced by trainers/teachers, and the technology acceptance (PEOU (a)/PU (b)) of video conferencing systems by trainees.

Figure 1 depicts the hypothesised relationship between experienced support and technology acceptance.

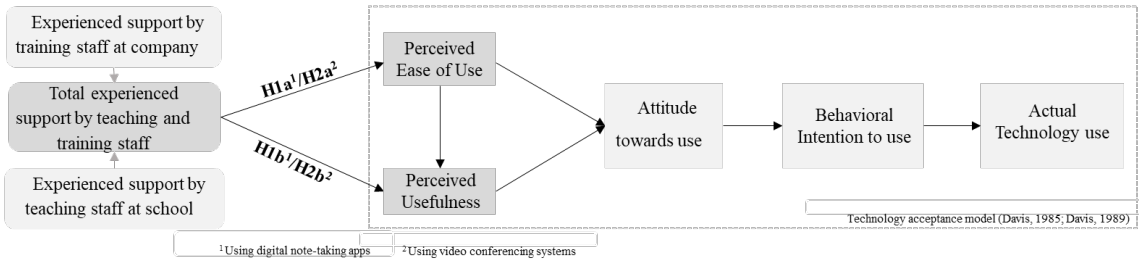

Figure 1. Hypothesised research model.

Research like Masood and Lodhi (2016) is limited to determining the relationship between support and technology acceptance. The present work contributes with knowledge about the strength of the relationship in VET to the boundary objects, video conferencing systems, and note-taking apps. It focusses on the encounter between support of teachers and trainers and the technology acceptance among the addressees of VET, the trainees. In addition, it contributes with knowledge about the specific requirements/needs of trainees for the support of trainees by teachers and trainers by addressing the identified gaps between school and workplace, from a trainees' perspective. According to He et al. (2023), it is

important to consider the needs of students when introducing technologies. Due to the requirements of COVID-19, such as the lack of personal contact between trainees and teachers/trainers, it is nevertheless essential to provide trainees with the best possible support. Therefore, this article aims to investigate research question 2: *What kind of support is perceived by trainees as relevant for learning with note-taking apps and video conferencing systems?*

Methodology and context of the study

The study's data are based on a German digitalisation project in VET, that deals with the use of note-taking apps/video conferencing systems as boundary objects in schools and companies providing training. Teachers, trainers, and trainees were provided with tablets and used the tools over three years (2019–2022). The project was evaluated at the end using a questionnaire for trainees. The aims of the project were to promote the interdisciplinary skill development of trainees, strengthen the individualisation and self-direction of learning, and network the learning location partners in vocational training in line with the requirements of Industry 4.0.

Note-taking apps were used at the learning venues for taking notes of lesson content and training topics before the COVID-19 pandemic in face-to-face teaching and during the pandemic in online learning. The apps were also used to store learning materials by teachers/trainers, and for collaborative and circular learning in learning groups between the trainees, preparation, and follow-up of content and preparation for examinations. Video conferencing systems were used as a substitute for face-to-face classroom teaching in vocational schools/ training groups, for work and feedback in the trainees' learning groups, and for supervision of tests and examinations written online. At the end of the project, various factors such as learning experiences at the dual learning centres, support experienced by teachers/trainers when using the tools and conditions for meaningful use, the acceptance, and usefulness of the tools in VET for learning, were surveyed (Lilge, 2019). Vocational subject content continued to be taught to trainees in online and offline learning environments, such as in digital classes at school or face-to-face at workplaces. Educational content that is taught in the training programmes for the natural sciences includes, for example, basic chemical knowledge of natural sciences, process engineering, health, safety, and so on (Conference of the Ministers of Education and Cultural Affairs, 2018). The primary business subjects were basic computer skills, accounting, and sales (Conference of the Ministers of Education and Cultural Affairs, 2023).

Design

First, a concept questionnaire was developed with the help of teachers/trainers and tested using cognitive interview techniques with trainees from relevant

departments (Döring & Bortz, 2016). The interview techniques used were think-aloud and probing. Think-aloud exercises are suitable for revealing interviewee's mental processes when completing the questionnaire, thus uncovering possible errors. Probing is a non-specific enquiry technique in which suggestions for improvement and errors in the questionnaire are asked after the interview (Prüfer & Rexroth, 2005). After evaluating the interviews, the questionnaire was revised to address weaknesses that had been identified in a questionnaire conference (Döring & Bortz, 2016).

To measure technology acceptance, a 4-point Likert scale of 14 items was developed based on the work of Gorovoj (2019). The trainees were able to rate statements in two questions (separate for note-taking apps and video conferencing systems) using a scale ranging from 'Strongly disagree' to 'Strongly agree'. The items used to measure technology acceptance comprised various statements listed below in Table 1.

Table 1. Survey items 'Technology acceptance'.

Item	Text
a)	Learning with digital note-taking apps/video conferencing systems helps me to better understand how what we learn at school relates to work in the workplace.
b)	Learning with digital note-taking apps/video conferencing systems supports me in adapting the pace and/or scope of learning to my own needs.
c)	Learning with digital note-taking apps/video conferencing systems supports me in organising my own learning process well.
d)	Learning with digital note-taking apps/video conferencing systems helps me to organise exchanges with teachers and/or training staff well.
e)	Learning with digital note-taking apps/video conferencing systems helps me to organise learning together with other trainees well.
f)	Learning with digital note-taking apps/video conferencing systems supports me in acquiring important skills and abilities for my professional practice.
g)	Learning with digital note-taking apps/video conferencing systems is easy for me.
h)	I am familiar with the various functional elements of digital note-taking apps/video conferencing systems.
i)	I have the necessary skills and abilities for learning with digital note-taking apps/video conferencing systems.
j)	I look forward to the areas of my education where digital note-taking apps/video conferencing systems are used.
k)	I limit my learning with digital note-taking apps/video conferencing systems to the bare essentials.
l)	I enjoy learning with digital note-taking apps/video conferencing systems.
m)	Learning with digital note-taking apps/video conferencing systems should be maintained in VET in the future.
n)	Learning with digital note-taking apps/video conferencing systems should be further developed in VET.

After designing the questionnaire, the items of technology acceptance were subjected to an item characteristic analysis (Döring & Bortz, 2016). By testing the characteristics of item variance, discriminatory power, item difficulty and Cronbach's alpha, the inverse coded item k could be excluded.

The four questions to measure experienced support by teaching/training staff, listed below in Table 2, were developed from a five-level single item. Response options were on a scale rang from 'Not well supported at all' to 'Very well supported'.

Table 2. *Survey questions 'Experienced support'.*

Question	Text
1)	How well were you supported by the teachers when learning with note-taking apps?
2)	How well were you supported by the training staff when learning with note-taking apps?
3)	How well were you supported by the teachers when learning with video conferencing systems?
4)	How well were you supported by the training staff when learning with video conferencing systems?

Another two (open) questions in the questionnaire asked the trainees about their wishes/needs for learning, including support, with note-taking apps/video conferencing systems in VET. They were instructed to name their wishes and briefly explain them in the text field. This question will be used to analyse research question 2.

Sampling

The survey was conducted via an online questionnaire and distributed to trainees around December 2021. A total of 1,000 trainees were contacted and a response rate of 89%, 891 trainees (described in Table 3 below), was achieved.

Table 3. Description of trainees' data.

Trainees' data	Numbers	Percentage in sample
Gender		
Male	662	74.3
Female	220	24.7
Diverse	8	0.9
Age range		
15–19 years	406	45.7
20–24 years	396	44.6
25–29 years	78	8.8
30 years and older	8	0.9
Vocational training programme		
Chemical technicians	546	61.28
Chemistry lab technicians	133	14.93
Plant mechanics	73	8.19
Industry mechanics	43	4.83
Physic lab technicians	39	4.38
Industrial trainees	39	4.38
Media trainees	12	1.35
Hotel trainees	3	0.34
Training year		
1st year	391	35.8
2nd year	294	33
3rd year	235	26.4
4th year	30	3.4
Training completed	12	1.3
Total	**891**	**100**

Data analysis

The collected data were evaluated using SPSS. First, using factor loading and a principal component analysis with oblimin rotation, the subscales of the construct of technology acceptance as a criterion were elicited. The scales were named after Davis' (1989) PEOU and PU. PEOU included six standardised items, and subscale PU included seven standardised items for the technology acceptance of note-taking apps. PEOU of video conferencing systems included 11 standardised items and PU two standardised items. Subsequently, the items for factors 1 (perceived ease of use (PEOU)) and 2 (perceived usefulness (PU)) were added together for each kind of tool using a mean value index formation.

The four individual items of the questions about experienced support from teaching staff at vocational schools/training staff at companies were also standardised and evaluated. Afterwards, the items, for each tool separately, were

combined with the help of an equally weighted mean index. This combination was justified because experienced support by both teachers and trainers should be summarised into a simple tangible value, namely the overall experienced support in training.[3] This summary can be justified by the fact that support at the learning venues through the cooperative supervision of trainees by those responsible is only effective if both sides strive for it equally (Federal Institute for Vocational Education and Training, 1997).

To analyse research question 1, a descriptive analysis was carried out for note-taking apps and video conferencing systems tools to test H1a/b and H2a/b. First, quantitative characteristic values were determined for all factors. Then, a regression analysis between experienced support and technology acceptance was conducted. The hypotheses were tested with analysis of variance (ANOVA) tables, with experienced support as predictor of PEOU and PU as criterion.[6] Trainees' data, shown in Table 3, were also analysed as background factors in their influence on technology acceptance using a regression analysis.[6]

To analyse research question 2, the qualitative responses in the open-text field were used. The aim was to derive the trainees' open answers regarding various factors that they considered essential in terms of support from teachers/trainers when using the tools. The answers were inductively divided into different categories. A distinction was made between responses relating to note-taking apps and those relating to video conferencing systems. Then subcategories were formed from the data material, such as 'Training on the tool' and 'Introduction week', which were categorised into superordinate categories such as 'Support trough instruction' (Mayring, 1991; Meier, 2014).

Results

Experienced support and technology acceptance for learning with video conferencing systems and note-taking apps

The following is an overview of the results of the quantitative identification of technology acceptance and a consideration of experienced support by the trainees. First, we present an overview of the evaluation of technology acceptance, the background factors, and experienced support, and then the regression results for research question 1.

An overview of the quantitative evaluation of PEOU and PU for the tools is shown in Table 4.

Table 4. Quantitative results of Technology acceptance (Perceived ease of use (PEOU) and Perceived usefulness (PU)).

	Items (PCA)	***M***	***SD***	***f***
PEOU (Note-taking apps)	6	2.18	0.69	868
PU (Note-taking apps)	7	1.82	0.7	865
PEOU (Video conferencing systems)	11	1.36	0.79	843
PU (Video conferencing systems)	2	2.15	2	854

The one-sample t-test showed that PEOU of note-taking apps and PEOU of video conferencing systems differed significantly ($p < .001$).[6] Cohen's *d* showed a value of 1.194, which indicates a larger effect size (Cohen, 1992). Therefore, PEOU of note-taking apps by trainees was higher than PEOU of the video conferencing systems. Regarding PU for note-taking apps and video conferencing systems, after an evaluation using a t-test, the *M* of 1.82 and 2.15 differed significantly ($p < .001$)[6] from each other. The size of the difference, with a Cohen's *d* of .378, was weaker than that for PEOU of the tools (Cohen, 1992). Thus, PU of video conferencing systems was statistically significantly higher than the value for note-taking apps. The note-taking apps scored slightly lower, with a *M* of 1.82 in PU. Furthermore, the assessment of the technology acceptance of individual tools was gathered for the assessment of experienced support of the teaching/training staff. The results summarised with the equally weighted mean index are shown in Table 5.

Table 5. Quantitative results: Total 'Experienced support' of teaching and training staff.

	Items (mean index)	***M***	***SD***	***f***
Total 'Experienced support' (Note-taking apps)	2	2.3	1.03	844
Total 'Experienced support' (Video conferencing systems)	2	2.15	1	820

The one-sample t-test conducted, showed that total experienced support by teaching/training staff when using note-taking apps differed significantly from the total experienced support when using video conferencing systems ($p < .001$).[6] Cohen's *d* showed a small effect size of .140 (Cohen, 1992).

In the following section, the relationship between total experienced support and technology acceptance is established. To look at the correlations of experienced support with PEOU and PU, the next section uses an ANOVA table to test H1a/b and H2a/b. We argued that experienced support, given by

teaching/training staff to the trainees, affected technology acceptance of note-taking apps and video conferencing systems. Results of the ANOVA tables indicated significant correlations of experienced support from training/teaching staff in VET settings on technology acceptance (PEOU and PU) for trainees for note-taking apps and video conferencing systems. The first hypothesis (H1a/b) suggested a positive relationship between experienced support and PEOU (a) and PU (b) of note-taking apps. These hypotheses are supported: 10% of the variance of the PEOU from note-taking apps can be explained by the experienced support in vocational classrooms ($F(1, 833) = 95.99$, $p < .001$) and 16% of the variance of PU ($F(1, 833) = 160.01$, $p < .001$).[6] The background factors (training year, age, gender, and vocational training programme) were also considered in terms of their influence on PEOU and PU, of note-taking apps. Significant influences of age and training are shown with their effect sizes in Figure 2.[6]

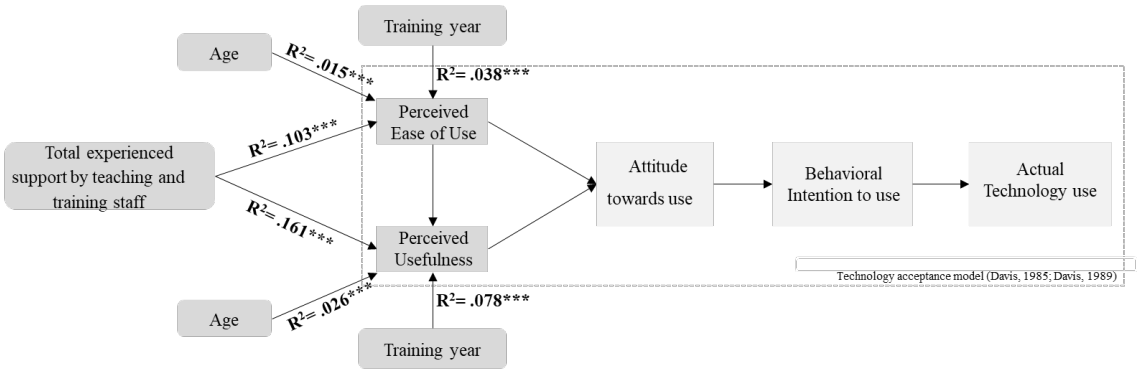

Figure 2. Influence of 'Experienced support' and background factors on 'Technology acceptance' for note-taking apps.

Regarding video conferencing systems, the second hypothesis (H2a/b) proposed a positive relationship between experienced support and PEOU (a) and PU (b) by trainees. Hypotheses H2a and H2b are supported. During the application of video conferencing systems, 21% of the variance of PEOU can be explained by experienced support ($F(1, 803) = 218.33$, $p < .001$) and around 8% of the variance of PU of the tool ($F(1, 811) = 71.63$, $p < .001$).[6] Results of the ANOVA tables of the background factors showed a significant correlation between vocational training programme and PU of video conferencing systems, as shown in Figure 3.[6]

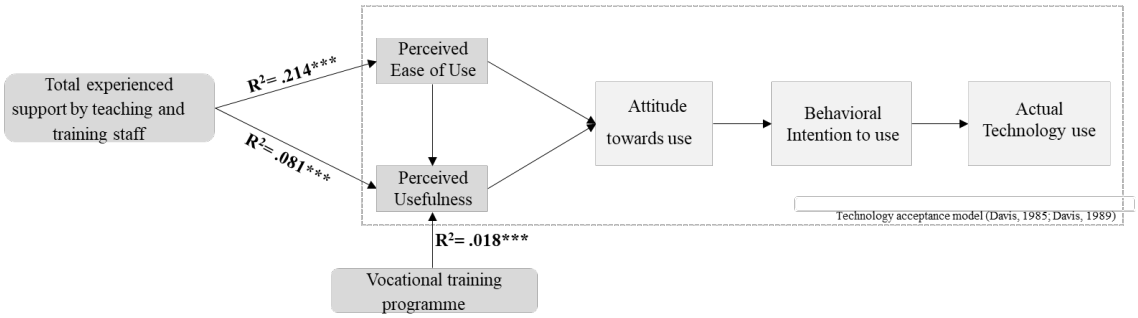

Figure 3. Influence of 'Experienced support' and background factors on 'Technology acceptance' for video conferencing systems.

Trainees' perceived needs for learning with video conferencing systems and note-taking apps

The qualitative answers of the trainees to the open question in the questionnaire about wishes/needs for learning with digital tools, in particular what kind of support from teachers/trainers is important to them when using the digital tools, were inductively categorised according to Mayring (1991).

There were several essential factors regarding support of teachers and trainers that the trainees considered as essential for learning with note-taking apps. The trainees mentioned that 'Support through instruction', such as an introductory week by teachers/trainers, with explanations of the functions of note-taking apps, could improve their use. Training, for example after app updates, was also mentioned, as well as guides to the tool. In category 'Support through communication and empathy', they called for understanding and consideration from teachers/trainers for technical problems. As well as for communication and quick consultation options for open questions about the apps and the improvement of the exchange of trainees about the app through a place of collaboration that is managed by teachers and trainers (shared documentation folder). The consideration of different learning preferences (combination of learning with printed literature and note-taking apps) was also highlighted as important. 'Support through time resources/space' included time that trainees would like to have to explore note-taking apps independently, but also the provision of a contact person for technical questions and allocation of an extra hour in lesson weeks to discuss specific issues with the apps. 'Support through organisation', referring to clear organisation of folder structure in note-taking app by teachers and trainers and provision of suitable worksheets (before the lesson), was requested.

As with note-taking apps, trainees would like 'Support through instruction' through an introductory week about video conferencing systems and training on how to use them spread over the duration of the training programmes. In online

learning, a more detailed explanation of tasks were requested. According to the trainees, 'Support through organisation' helped them to learn by structuring conferences from the outset, ideally with an overview script and a recording of meetings so that they could be viewed afterwards. Regarding learning with video conferencing systems, they also called for 'Support through time resources/ freedoms'. This referred to the time needed to independently explore the systems and understand courses, as well as provision of a specific contact person for technical questions, in addition to teachers and trainers, and the allocation of an extra hour in lesson weeks to discuss specific problems. Another identified need was 'Support through communication and empathy'. This category included the desire for understanding and consideration from teachers/trainers for technical issues, such as connection/sound difficulties in online learning, etc. The trainees also called for teachers and trainers to adapt the lessons to make them more interactive. They mentioned a detailed explanation of tasks in online learning, use of cameras/sound in meetings and incorporation of practical tasks and variety in frontal online lessons through group work in the breakout rooms. They also demanded communication between teachers/trainers and trainees, such as regular meetings to discuss tasks.

Discussion

For the selected boundary objects note-taking apps and video conferencing systems, PEOU and PU differ according to the t-test. The PEOU of the note-taking apps was higher than that of video conferencing systems. These systems were mainly used in online learning formats. It may therefore have been more difficult to fully explain the use of video conferencing systems to trainees after the sudden onset of COVID-19. Note-taking apps also had the advantage of being used in face-to-face lessons, so questions about their use could be clarified more quickly. Such experience-related differences could have led to better PEOU when using apps. They contribute to the digital generation and exchange of content, integration of prior knowledge and digital organisation of information. As boundary objects, note-taking apps therefore contribute to integrative skill development in VET 4.0 (Aprea et al., 2020; Cattaneo & Aprea, 2018; Roll & Ifenthaler, 2020; Schwendimann et al., 2015). Video conferences had a significantly higher PU value than note-taking apps. Although the video conferencing tool was less intuitive to use, it was perceived as more useful. The better results could be because video conferencing systems were used to bridge geographical gaps, such as communication and consultation in vocational learning spaces (Enochsson et al., 2020). According to Davis' definition, '...the use of a particular system would improve his or her job performance' (1985, p. 26). Video conferencing systems may therefore have contributed to the maintenance

of certain learning systems in VET, despite the pandemic. As part of VET 4.0 competences, they enabled the creative use of digital resources, integrating prior knowledge, learning how to use a PC/tablet, and exchanging digital content, for example via chat (Roll & Ifenthaler, 2020).

The results of the ANOVA table tests (H1a/b and H2a/b) are consistent with the studies by He et al. (2023), Masood and Lodhi (2023), and Weng et al. (2015), which also found a statistical correlation between experienced support and PEOU and PU. In this study, experienced support had the strongest influence on the PEOU of video conferencing systems and the least influence on the PU of video conferencing systems. Those respondents with a very positive opinion about experienced support also tended to have a higher technology acceptance. If they have a higher technology acceptance, the inner attitudes towards digital tools changes, which addresses the taxonomy level of interest of Roll and Ifenthaler (2020). Thus, the influence of experienced support and technology acceptance in VET 4.0 skills training is an influencing factor. PEOU and PU are also influenced by the various background factors. PEOU and PU for note-taking apps are also influenced by age of the trainees and their training year. PU of the video conferencing systems can also depend on the vocational training programme. No influence was found for other factors analysed, such as the gender of the trainees. In contrast to Utami et al. (2022), it can be said in the context of this study that the technology acceptance model is a good measurement model for the use of tools such as note-taking apps.

Practical implications for action that can be derived from the results are that the perceived demands of the trainees address the geographical, attitude, competence, adaptive, and the knowledge gap (Akkerman & Bakker, 2011; Aprea et al., 2015; Enochsson et al., 2020; Sappa et al., 2016). The geographical gap and the elimination of face-to-face teaching and instruction can be reduced through online learning with video conferences or through exchanges in special folders on note-taking apps. However, the prerequisite for success is 'Support through instruction'. The need for guidance addressed by Schutz (1970) and Billett (2014) is also experienced by trainees. For connection and synchronisation between the types of knowledge at the learning locations, the trainees must be guided. Circular learning can only work if the tools also work (Billett, 2014; Schutz, 1970). An introduction to the functionalities of the tools, regular training, guidelines, and explanations of tasks are essential for teaching trainees. It should not be forgotten to focus on the needs of individual trainees and not just go to vocational school classes with offers of help when needed. In addition to informational support provided by teaching/training staff, emotional support should not be neglected (House, 1981). The trainees expressed their need for 'Support through communication and empathy', which can help to bridge the attitude gap. They demand mutual understanding and empathy from teachers, trainers, and

trainees for technical problems in video conferences and supporting different learning preferences. In addition, trainees want to feel that they are supported in using tools during the learning phase. An improvement in the exchange between the people involved in the training could create a 'Place of collaboration' that everyone can access or log in to. The 'Place of collaboration' can contribute to boundary crossing, for example to record company experiences and ensure integration and reflection of this knowledge in and with school learning content (Aprea et al., 2015). 'Support through time resources' was also requested. The trainees would like support through the provision of a contact person for technical questions, but also more freedom through time to explore the tools independently. This demand may seem contradictory at first, but it is important to respond to the needs of the individual. It is also important to ask what kind of support they require individually and whether they want to be guided or free to explore the tools. Support in the form of time resources can also be helpful in bridging the attitude gap and skills gap. The provision of an external contact person for technical questions can be helpful for all trainees, trainers, and teachers involved, as well as joint training during the introduction of the tools, in order to bridge a developing skills gap from the outset. Support should be structured from the outset by the demand, according to need (He et al., 2023). There is also the administrative gap that can be bridged with the trainees thoughts on 'Support through organisation'. The trainees addressed here, for example, a clear structure of exchange folders in note-taking apps, which also facilitates the exchange between trainees with teachers and trainers, considering hygiene regulations, by giving all participants access to materials provided by the companies and schools. A clear organisation of the folder structure reduces the administrative effort for teachers/trainers responsible for managing files and facilitates access to relevant documents. The trainees also thematised the exchange via breakout rooms in video conferences with other trainees in the same training year, even if some trainees are currently at school and others at work (Enochsson et al., 2020). As a circular learning process, this exchange can help trainees to link experiences from school and the workplace that are currently present with the experiences of other trainees (Sappa et al., 2016).

Limitations and future research needs

The limitations of the present paper can be seen in its design. Although the questionnaires were tested with the help of pretests, item analysis was only carried out after data collection. Potential confusion of the trainees could have been avoided if the items that were subsequently removed, had already been removed from the Likert scale before the survey. Like the measurement of technology acceptance, the measurement of experienced support should not comprise a single item, but should instead be a scale because otherwise,

measurement errors could occur (Döring & Bortz, 2016). The study cannot distinguish between the actual support provided by teachers and trainers and the individual support experienced by trainees, as the data used for this assessment may have been distorted by the trainees' individual perceptions. Self-reported data do not necessarily reflect actual support given (He et al., 2023; Lin et al., 2015). The quasi-experimental design and the ad hoc sample further limit the validity of the quantitative results. A follow-up test and the additional selection of other training programmes would have improved the validity of the study, especially since an effect of the programme on the PU of video conferencing systems was found (Steiner & Benesch, 2018). In general, it is important to recognise that although the results of the study have confirmed the relationship between experienced support and technology acceptance, for both tools through correlation, future studies could include more background factors and calculate with structural equations. For example, no influence of gender on technology acceptance could be determined here, which could also be due to the unbalanced sample.

Conclusion

In summary, experienced support by trainers/teachers in the use of note-taking apps and video conferencing systems is a possible influencing factor in the development of technology acceptance in VET. Trainees pointed out different types of support that are relevant for learning with the tools, such as 'Support through instruction', 'Support through communication and empathy', 'Support through time resources/freedom', and 'Support through organisation'.

Because of the constant intensive contact of trainees with teachers/trainers, the influence of these persons on the VET target group in the development of technology acceptance is emphasised. It is important for VET 4.0 to consider not only supply sides of learning (schools/workplaces), but also to focus on trainees and their technology acceptance (He et al., 2023). Only if knowledge about how to use digital tools is taught as early as possible during VET, trainees will learn how to use digital tools and their possible applications in a digitally networked industry with its challenges and opportunities. Integration of basic digital skills ensures progress in the sense of digitalisation because the future employees of Industry 4.0 will emerge from VET 4.0.

Endnotes

[1] Note-taking apps considered in the study are the applications OneNote (MS Office) and GoodNotes.
[2] Video conferencing systems considered in the study are the applications MS Teams, BigBlueButton, Zoom, and WebEx.
[3] See Figure 1.
[4] Microsoft Teams is a video conferencing tool from Microsoft. It is manly used for communication in virtual meetings, chatting, and file sharing. (https://www.microsoft.com/de-de/microsoft-teams/group-chat-software).
[5] Zoom is a video conferencing tool from Zoom Video Communication, Inc.. It enables users to have virtual meetings, with chats, screen sharing and other opportunities (https://zoom.us/).
[6] The significance level is $\alpha = .01$, which is the maximum probability of error when rejecting a null hypothesis. The *p*-value is compared to this significance level to see if the results are statistically significant.

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What constitutes a conducive learning environment in VET?

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Abstract

Based on a review of international research, this article summarises the key factors identified as shaping a conducive learning environment at vocational schools. The factors are exemplified with data from an empirical study conducted at 13 Danish VET schools.

We distinguish between curricular factors, i.e., the organisation, form, and content of teaching and training, and social factors, i.e., students' relationships and social interactions with peers and teachers.

Key curricular factors include giving students authentic, vocationally relevant tasks where they play an active role in and share responsibility for their own learning. Other important factors include that teachers tailor training to the individual, convey positive expectations concerning student performance, help students to set and achieve realistic goals, and offer regular feedback. Likewise, it has impact on the learning environment that the teaching is practice-related and that the teachers work closely with trainers at workplaces offering apprenticeships.

Key social factors include teachers establishing positive relationships with their students, acting as role models. Furthermore, it is important that teachers nurture a positive social environment among students. As such, a well-functioning learning environment requires teachers to have not only the relevant vocational skills but also a range of social and personal competences.

Keywords: learning environment, curricular factors, social factors, authenticity, student-teacher relations, role model

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Introduction

The article presents the results from a review of research concerning conducive learning environments in the school-based parts of dual vocational education and training (VET). In the article, we illustrate the findings with examples form an empirical study on learning environments at different Danish VET programmes. A conducive learning environment has been defined as a learning environment that improves student learning outcome and well-being and reduces dropout rates (Rambøll, 2018; Epinion & DPU, 2020). Based on this definition, in this article, we study the following research question: *Which are the central factors contributing to a conducive learning environment?*

We define learning environment as the context or setting in which VET takes place, which includes the form and content of education and training provided at vocational schools as well as learning processes during workplace-based training such as apprenticeships.

Method

The findings in the article are based on a review of international research of the factors shaping the learning environment in VET schools.

The literature review included sources from a previous mapping (Rambøll, 2018) that was supplemented by a search in the database ERIC and in three specific journals: *International Journal for Research in Vocational Education and Training*, *Nordic Journal of Vocational Education and Training*, and *VETNET Proceeding*. The search in ERIC has applied the following search threads: 'VET' OR 'vocational education and training' or 'vocational education' or 'vocational training' or 'vocational school' AND 'learning environment' or 'education environment' or 'school environment'. In the three journals, we have chosen all articles conceptualising in the title or keywords 'learning environment' or 'teaching environment' or 'training context' or 'context'. Based on the article abstracts, we have selected the articles for analysis. The review includes all articles containing empirical findings about conditions shaping a learning environment. In accordance with the criteria, we have included articles about training in the workplace as part of the dual VET training programmes, because the workplace-based training or apprenticeship-based training has an impact on the school-based education and training as well as consequences for considerations about classroom management.

Based on the literature review, several factors were identified influencing the learning environment. The factors were categorised according to principles in a previous mapping of factors in a VET learning environment (Wahlgren, 2015). However, in the current research we found articles dealing with another aspect

of the learning environment that was not included in the previous categorisation, namely authenticity of the training, including the relationship between theory and practice. Thus, the mapping in this article comprises two main categories, each including two subcategories: *Curricular factors* including the following subcategories: 1) authenticity including the relation between theory and practice, and 2) structure of the training process including clear goals, academic support, and feedback; and *social factors* including two subcategories: 1) teacher–student relations including mutual respect and trust, and 2) relations among students.

In the review, we have not included the physical factors, not because we do not perceive these factors as essential, but because in the current review we have not found articles dealing with the impact of these factors.

Based on the review, an empirical study was conducted on teachers' and students' perception of a conducive learning environment. The main purpose of the empirical study was to locate the various factors found in the literature review at different schools within different subject areas and in different phases of the educational process. The aim of this study was to generate proposals on how the learning environment could be improved at the schools. These results and proposals of the study have been accounted for in the report *Conducive practice for learning environments in vocational education* (Epinion & DPU, 2020) and are *not* included in this article. For writing *this article*, we revisited the data from the empirical study. We went through the responses from the students and the teachers to questions concerning the learning environment and factors that constitute a learning environment, and we chose statements that illustrated and exemplified the different factors found in the literature review.

The data base for the empirical study was generated to make sure that the results could be generalised and useful to the vocational training system. Thus, the study included 13 schools and 24 study programmes representing the four main areas within Danish VET: agriculture, commercial, social and health care, and technical programmes. The study included interviews with 91 students and 41 teachers; half of the interviews were individual, and half group interviews. The themes in the interview guides were based on the findings in the literature review. The interviews began with open questions about how the respondents perceived a conducive learning environment. The respondents were asked to give examples of situations shaping a conducive learning environment.

In this article, we use the interview statements as examples of the various factors shaping a learning environment. The interview statements are used as ostensive definitions exemplifying how the teachers and students experience the factors. Furthermore, the interview statements are used to confirm that the factors from the literature review can be found in a current context at various Danish vocational schools.

Consequently, in this article, we have selected the interview excerpts that exemplify and clarify how teachers and students experience the factors and their importance for the learning environment. The purpose is to give a more detailed and differentiated understanding of how students and teachers perceive and reflect on a conducive learning environment. The choice of statements aims at providing the most obvious illustration of the relation between the theoretical concepts and the current teaching and training practice.

The students' and teachers' statements shape a relation between the general findings from the literature review and the current teaching and training practice, making the results meaningful to apply in praxis.

Including statements from teachers and students implies ethical considerations. However, since the respondents already accepted the use of their statements in relation to the previously mentioned study and published report (Epinion & DPU, 2020) in the current article we do not perceive any ethical problems in the use of data. Furthermore, the statements are not directly connected to recognisable persons at the different training programmes.

Results

The results are presented under two main categories, curricular factors, and social factors, and under the subcategories presented above.

Curricular factors

We define curricular factors as relating to the content and form of teaching and training. In general, the review of the international literature shows that there are a large number of curricular factors that play a role in constituting a (conducive) learning environment. Moreover, these factors are interrelated and sometimes overlapping. The following examples from three studies illustrate this complexity.

A German study of factors influencing the learning environment identified several vital indicators. The study concluded that 'powerful' learning environments are characterised by authentic and challenging tasks, training methods that encourage students' active participation (collaborative learning and problem-based training), differentiated training, and guidance that focuses on the student's professional development (Placklé et al., 2014, 2018, 2020, p. 224). An Italian study found a similar complexity, summarising 13 factors that influence VET learning environments, with the most important being promoting students' autonomy and sense of responsibility, as well as simulating the work context (Perini & Pentassuglia, 2018). A study from Malta indicated that a 'powerful learning environment' should be founded on a clear vocational identity and include a high degree of student participation and reflective

learning, with teachers providing comprehensive differentiated guidance and nurturing students' motivation for self-directed learning (Said, 2018, p. 42).

Among the complex patterns of factors influencing VET learning environments identified in the review of the international literature, two subcategories of factors can be constructed: 1) authenticity, and 2) structure of the training process.

Authenticity

The term 'authenticity' encapsulates different factors that contribute to a conducive learning environment. A study (Rambøll, 2017) shows that in a conducive learning environment, the students perceive the training as coherent, with a clear connection between the programme's theoretical (knowing that) and practical elements (knowing how) and between the curriculum and a future job. This coherence contributes to the students' experience of meaningfulness, which is essential for a conducive learning environment (Aarkrog & Wahlgren, 2022). It is important that the students perceive the different elements of the training as part of a coherent whole – and, not least, that they are able to see how this training relates to the intended occupational field (Rambøll, 2017). A study based on an experimental design showed that practice-based training had a favourable impact on the learning environment (Rambøll & NCK, 2017).

A Norwegian study shows that *practice-based teaching* where students solve realistic tasks and consider how these tasks relate to future jobs improves motivation. At school, being presented with examples from the world of work in the relevant vocational field is essential to students' learning and motivation to learn. Students in all areas of VET highlight the importance of access to authentic tasks (Høst, 2015). Likewise, a Norwegian study of vocational training in media production points to the importance of task authenticity – particularly at the beginning of the training programme. The authenticity of the tasks enhances the relevance of the training in the eyes of the students (Aakernes, 2018).

The importance of *authenticity* of tasks can be illustrated by the following three quotes from the empirical study showing that authenticity of task makes sense for the students and motivates them:

> We enjoy when the teachers make it [the training] relevant. When about pigs, it is 'thumbs up'; when about differential calculus, it is 'thumbs down'. In that case the teacher has lost us in advance. (Female student, agricultural education)

One of the important aspects of authentic tasks is the physical sensation of the work:

> I think it is most motivating, learning about perfumes or health products in the room for products. We have the products in our hands, and we can smell them. Having something in your hands makes you understand it. (Female student, retail training)

Another aspect of dealing with authentic tasks is that it is tied up with the feeling of professional pride:

> The teacher should exude professional pride. Excitement. Commitment. Lots of technical terms. It makes a butcher proud. I praise the students every time they do the same. It should be cool to be a butcher. And every time a student expresses professional pride, I praise it. We pay tribute to the profession and what the profession can do. (Teacher, gourmet-butcher)

Simulation is used as a tool for creating authenticity. A study of the use of simulation in healthcare education showed that students gain a better understanding of theoretical knowledge when they have the opportunity to test it in simulated practice. Thus, simulation as one form of practice-based training can help establish closer links between theory and practice – thereby creating a more coherent study environment (Aarkrog & Puge, 2019). However, teachers may find it difficult to carry out practice-based training, with an Australian study arguing that teachers must be trained to link theory and practice in authentic contexts, to base training on students' prior learning, and to employ realistic evaluation methods (Downing, 2017).

Apprenticeships or *workplace-based training* give students an opportunity to obtain a clear and coherent picture of their future occupation and have been shown to have a positive impact on students' motivation during school-based training, contributing to a conducive learning environment (Nielsen et al., 2013). The alignment of school-based education and training, and training in workplaces, can be improved through collaboration between schoolteachers and workplace trainers. To this end, a Danish study shows that a well-functioning relationship between teachers and trainers can promote students' experience of coherence. The challenge is to create a systematic working collaboration between teachers and apprenticeship trainers in workplaces and to utilise this relationship to make clear to students that the training they receive at school and during apprenticeships are interrelated (Louw & Katznelson, 2019).

A Swedish study shows that VET teachers with strong relationships with the local labour market are better able to guide and help students than teachers without such relationships. Thus, it is important that teachers are not only knowledgeable about the subjects they teach, but also about local companies and trainers (Mårtensson et al., 2019). This is confirmed in another study, which concluded that teachers' contact and relationships with local companies are important for the learning environment (Høst, 2015).

The empirical study shows that students point to the importance of creating a *close link between theory and practice*. The link should be close in terms of both time and content. The following quotation shows that the student prefers a frequent alternation between learning theory and working in the workshops:

> Concretely, learning about materials includes going through what makes the material break. Afterwards, in workshops we study the material in reality. A bad day is just sitting in the classroom all day. It is easier to remember when you have had it in your hands, when you have seen it in real life. (Male student, blacksmith training)

Another quotation illustrates that the classroom-based education serves as a break to the – at times – monotonous practical work tasks:

> I like the alternation between theory and practice, because sometimes you get tired of just cleaning the same area day in and day out. And to obtain more knowledge about why we do things the way we do, why we use this cleaning detergent on this floor. In the classroom you can reflect on what you have learned in the practical situations. (Male student, service assistant)

Close collaboration between schools and companies providing apprenticeships is vital. Such collaboration can also help ensure that students and workplaces alike enter apprenticeships with realistic expectations – failure to meet such expectations is a frequent reason for dropout (EVA, 2017b). Others have highlighted the importance of taking care of students during apprenticeships (Dyssegaard et al., 2014a). One study emphasises the need for positive interactions between the school and workplace learning environments, with students expressing that their way of learning at school changed after participating in an apprenticeship. Their practical experiences in the workplace made the school-based learning environment more meaningful for the students. This study highlights the importance of teachers encouraging and stimulating such reflections among their students (Baartman et al., 2018).

Structure of the training process

Not only the content but also the form of teaching and training affects the learning environment. The empirical study shows that according to the students, the teaching and training must be clearly structured in a way that students consider meaningful:

> There is a plan for the day, things are under control. You are in safe hands. There are fixed boundaries and a clear goal. I can see the end of it all and how it all relates to the profession. Every day you get a plan for what your work. For example, a case will be presented, followed by group work, and eventually a recap. It is important to have a clear structure for the day and for the week. You can see what you must do and why. (Female student, social and health care assistant training)

As part of a clear structure, this student emphasises that it is important that the teachers line up the plan for today's class:

> The teachers are very good at informing us in time about what we must learn in the new course and what we will do. They inform about things well in advance, so that you always know what you are heading towards. (Male student, carpentry training)

Related to this, research shows that three factors can be identified: the correlation between programme objectives and the content of training, teachers' feedback to students, and differentiated academic support.

The clearer the students' understanding of the *correlation between the programme objectives and the content of training*, the better the learning environment. A Danish study shows that when students are able to set and stick to individual goals during training, it has a positive effect on their motivation to learn and to complete the programme. Thus, it is important that teachers guide their students in formulating such goals (Mariager-Anderson et al., 2019; Aarkrog & Wahlgren, 2022). To maintain and strengthen students' goal orientation, another study argues that schools should nurture students' own interests and abilities in relation to their choice of education (Becker et al., 2018). Not least in relation to vulnerable students, it is important that counsellors and teachers help students to identify and pursue individual goals (Martínez-Serrano et al., 2019). As such, the challenge for schools and teachers is to guide students in formulating goals that are both motivating and realistic (Cedefop, 2016). Others have underlined the importance of being able to discuss goals and career paths with students (Draaisma et al., 2018).

By conveying positive expectations regarding students' performance and providing relevant *feedback*, teachers can have a positive influence on students' learning and on the learning environment (Rambøll, 2018). A study shows that when teachers provide regular feedback, assess students' development, and convey positive expectations in class, the students become more confident and achieve better results (Helaire, 2014). A Danish case study of a carpentry programme demonstrates the importance of teachers making it clear to their students what is expected of them, what regulations and norms they should follow, and the criteria for assessing their performance. The challenge is to communicate educational rules and norms to students in such a way that they take ownership of them (Louw, 2013).

According to a Norwegian study, introducing a self-assessment tool called 'station training' has resulted in an increase in student engagement. Station training structures training as a series of stations (subtasks) that the students visit in turn. The students are assessed by teachers but also assess their own performance in solving the various subtasks, which gives them a sense of progress and improvement. An important element in this regard is the teachers' continuous provision of academic, technical, and pedagogical feedback to the students (Stousland & Witsø, 2015).

The teachers' ability to provide personal and *differentiated academic support* strengthens the learning environment. Individualised support and differentiated training have a positive effect on students' well-being (Rambøll, 2016). The extensive heterogeneity among VET programmes makes differentiated training

one of the most important factors in the learning environment (EVA, 2014, 2016b, 2018). The following three quotations show that students agree on the importance of differentiation, including handling the challenges related to the students' different prerequisites. The quotations also show that differentiated teaching not only include using different material or methods of asking. Differentiation is also based on the teacher knowing the students:

> I think my teacher is good at treating us differently. For those who finish fast, he has made some extra tasks. I also like when he gives constructive criticism and challenges us. So, you get something out of the training. (Male student, baker training)

> Wanting that everyone reaches the same level, we are challenged by having different prerequisites. I am one of those who learn things relatively quickly. Sometimes we get stuck in the same thing because there are some classmates who must hear it many times before they understand it. (Female student, horticultural education)

> Some find it easier to learn than others. I mug up on the stuff, but that doesn't mean I can remember it. However, the teachers are good at finding different ways to ask us. So, they are really, really good. (Female student, waiter training)

The best teachers are considered to be those who have work experiences from the relevant vocational sector, who can support the students' self-confidence, and who can offer students personal support (Høst, 2015).

A literature study on quality in digital learning processes shows that the relationship between teacher and students is crucial. A high-quality digital learning environment requires the teacher to be able to identify their students' prerequisites, provide clear instructions, and give feedback (EVA, 2017a). In digital learning environments, the teacher must be able to interact with the individual student. As such, digital learning is best suited in courses for relatively small groups of students (EVA, 2019a). Meanwhile, digital technologies can be used to support differentiated training and feedback, to motivate students, and to link theoretical and practical elements of VET programmes (EVA, 2017a). The empirical study shows that teachers must be aware of the student's specific competencies to properly support digital learning processes, as one teacher explained:

> It requires that the teachers have a profound knowledge of the students' competences to know which students can solve the tasks themselves [only] assisted by a video and which students need help. This knowledge provides a potential for differentiated training, giving the teacher a little more time for those who need it. (Teacher, agricultural school)

Using digital technologies in training can strengthen retention. Thus, the results of a development project indicates that video-based simulations of practice-oriented projects and of systematic guidance strengthen the learning environment and reduce dropout (Salvà et al., 2018).

The social factors

We define the social learning environment as the social relationships between teacher and students and among students. A study shows that interaction between teachers, students, guidance counsellors, and school leaders has a positive impact on retention in education, as well as on the development of a conducive learning environment (Dyssegaard et al., 2014b). In general, students' level of satisfaction with the social learning environment depends on whether they are involved in developing and evaluating the environment and whether they experience mutual trust in their relationships with teachers and other students. According to the students, going to school should be fun and school life should extend beyond academic learning and incorporate other aspects, such as nurturing students' social skills (EVA, 2016a).

Teacher-student relations

Forms of training that encourage active participation, such as project work, support students' self-directed learning and have a positive effect on students' relationships with their teachers. The more teachers involve their students in decision-making processes, the greater the students' motivation and sense of responsibility for their learning (Rambøll, 2016). An Australian study identifies several factors as important for engaging students in training, including ensuring students' well-being, establishing positive teacher–student relationships, and an overall goal of strengthening students' belief in their abilities and in themselves more generally (Murray & Mitchell, 2016). A Spanish study shows that when teachers believe in and challenge students to fulfil their potential, supported by constructive evaluation and feedback, it has a positive impact in terms of preventing dropout. In addition, the teachers should establish confident relations with the students and be accessible to them (Pinya et al., 2018).

Negative relationships may develop when students do not treat their teachers with respect, or if the teacher favours some students while excluding others. On the other hand, having a friendly and caring teacher who is both professionally and personally supportive has a positive impact on students' well-being and retention in education. These kinds of relationship are promoted when schools reward teachers who seek to establish positive teacher-student relationships (Krane et al., 2016).

> It means a lot, knowing that your teacher is there for you in difficult times, not just school-wise. My teacher has a high tolerance for absences, if you are open about the fact that it may be due to some difficulties or personal problems. (Female student, butcher training)

A study shows that relational work requires certain socio-emotional competences of teachers, including exhibiting a sensitivity and responsiveness to students' emotional needs and a willingness to acknowledge and support students'

emotional development (Aspelin, 2019). Furthermore, an Australian study demonstrates that it is important that teachers are aware of their own impact on students' engagement and, ultimately, whether or not they complete the VET programme. According to one study, teachers should establish positive relationships with their students that are characterised by respect and inclusiveness, and which support the students' diverse needs. Students should feel valued and respected by their teachers (Dutschke, 2018). This is illustrated by the following quote from a student:

> I like that if you try out an answer, the teacher does not say 'no', but 'saves' you instead. As a result, you are not scared to participate in the training. (Female student, business college)

A study of VET teachers' relational competence – i.e., their ability to establish relationships with and among students – finds that relational competence has an impact on student dropout. The study's definition of relational competence includes teachers' ability to relate to students as individuals, knowing their names, and greeting and encouraging them, as well as their ability to understand each student's situation and the difficulties the student may face in and outside school. This study also indicates that teachers' relational competence can be increased through teacher training (Wahlgren & Mariager-Anderson, 2017), which has been further supported by the empirical study:

> It is important that the teacher can interact with students 'on an equal footing'. For the students, this means being treated as equals and with respect by teachers, in the same way as the students respect their teachers. They [the teachers] do not feel better or greater than the rest of us. You feel good about being on an equal footing. (Male student, landscape gardener training)

The empirical study shows that students notice attention and care from their teachers. Many students tell stories about teachers, principals, or support staff who remembered their names and hometown, forwarded an application for an apprenticeship, or asked them about how the adult VET students' children were doing or how a sporting event had gone that weekend. For students, such things signal the teacher's genuine commitment and interest (Epinion & DPU, 2020).

A pivotal aspect of teacher–student relationships is that the teachers serve as role models for the students. A German study demonstrates that students' encounter with professional practice and role models within their chosen vocational field enriches the learning environment within VET. Role models reflecting the students' wishes strengthens career guidance of the students (Neuenschwander et al., 2018). Another study shows that VET students are more engaged in workshop-based practical training at the vocational school than in theory-centred instruction in classrooms. One reason is that the students perceive the workshop trainer as a role model, while this is not the case for other teachers

(Nielsen et al., 2013). Three excerpts from our empirical study point to the importance of having teachers who act as role models. The excerpts show that the students do not ask the teachers to be role models for the vocation that the students train for, e.g., carpenter. The students want the teachers to be role models as teachers:

> The most important thing for a student at school is that the teacher shows that he wants to teach; that the teacher shows some energy, speaks loudly in a way you can understand, and is engaged in what he is showing you. We had one last week who was very engaged in showing us how to cut up a pig. (Male student, butcher training)

> Committed teachers, they make me really pleased with the training. I can feel that they are passionate about things and that it is important that we think it is interesting […] The teachers are so committed to what they do; they really do their best for us. (Female student, retail and trade training)

> There is a good chemistry between the students and the teachers. The teachers have a good 'culture'. You are greeted with a hello, a good morning, you smile at each other. You are at eye level. (Group of students, landscape gardening)

Relations among students

Working with their fellow students encourages students' active participation in their own learning process (Dyssegaard et al., 2014b). Postponing streaming of the students also has a positive effect on retention and the learning environment (Munk et al., 2015). One study in initial vocational education finds that establishing an innovative learning environment based on 'community of learners' makes the students collaborate. The learning process is shared, meaningful, reflective, and transfer oriented (Boersma et al., 2016).

A positive self-image is important if students are to have rewarding relationships with classmates (Mariager-Anderson et al., 2019). A Swiss study emphasises the importance of both the learning environment and the students' self-perception for academic progress. Self-perception is measured by three factors: self-efficacy, self-esteem, and degree of negative emotions. The study shows that a conducive learning environment helps strengthen students' self-image (Lüthi & Stalder, 2018, 2019). A Finnish study shows that having friends that support them (peer support) has an impact on students' sense of (in)security, level of commitment, and career choices, in particular during the early stages of a VET programme. The researchers therefore recommend that time be set aside during lessons for establishing such relationships (Niittylahti et al., 2019). If students from the beginning of the training programme feel that they belong and if teachers establish positive relationships with and among their students it improves the learning environment (EVA, 2017b). To create a secure learning environment, it is important that the school is aware of early signs of possible dropout and a lack of wellbeing among students (Cedefop, 2016; EVA, 2017b; Mariager-Anderson et al., 2019).

Our empirical study showed that – regardless of age, gender, and kind of educational programme – positive relationships and strong bonds between students are important motivational factors for school attendance. The following two excerpts from the empirical study illustrate this. The first excerpt shows that the social relations are important to keep the student going; the other illustrates the importance of tolerance among the students.

> A good team spirit is one of the most important things at school, because it makes you want to stay. At the same time, if you have a bad day, your friends can cheer you up again. Personally, it is what keeps me going on the bad and boring days. (Male student, horticultural training)

> Essentially, it's about giving each other space. Obviously, there are great differences between individuals, but as long as everyone is given space, then I can't ask for more. A well-functioning group is a breeding ground for many other pleasant things – learning, communication, etc. (Male student, horticultural training)

Discussion

Our findings and conclusions should be seen in the light of certain methodological limitations. Firstly, the scope of the literature review is limited. Including other data bases could have elaborated the findings by including other factors with an impact on a conducive learning environment, e.g., physical factors. We cannot conclude that studies concerning the physical environment do not exist. We can only conclude that we have not found such studies in our review. Likewise, we cannot exclude other factors having an effect. However, we can conclude that the factors that we have found in our study have an impact on the learning environment.

Secondly, our conclusions are based on studies across national contexts and different types of educational institutions providing somewhat broad and general conclusions that do not take into account specific contextual factors. The strength of this approach is that the factors have proved to have impact across different contexts. Thus, the results from our study correspond to the result found in the comprehensive German study (Plancklé, 2014, 2018, 2020). The weakness is that the approach only tells a little about the effect of the national differences. A further limitation is that the chosen method only allows us to identify various factors proved to influence VET learning environments, however, not to assess their relative importance aor how the different factors in the learning environment interact.

Thirdly, the specific examples and statements that we have included are all drawn from a study of Danish VET. Thus, the results do not include how the factors are perceived in other national and educational contexts.

Selecting empirical statements to exemplify the factors found in the literature study raises problems concerning reliability and validity.

Having not conducted an intersubjective test of the reliability of the selection of examples, it cannot be ruled out that other researchers would have selected other empirical statements from the data to exemplify the factors that promote a conducive learning environment. However, since the purpose of the chosen statements is to show that the current factors could be identified in the Danish data material, it is not important which statements are chosen. What matters is that the statements can be found in the data. In the analysis, we have not counted how often the various factors appear in the various educational contexts, this analysis requiring a different data collection method. However, such an analysis could be the focus in future research.

Are the choices of the exemplifying statements valid? Are the selected statements valid expressions of the factors they are supposed to exemplify? By reproducing the statements in the text that allows the individual statement to be interpreted in relation to the current factor, others will be able to assess the validity of the statements. Another aspect of validity is whether our choice of examples misrepresents the conditions and circumstances related to the learning environments at the VET schools by merely selecting statements that confirm the importance of the various factors in the literature review. Should we have included statements showing that the students or teachers do not recognise the current factor or do not perceive it as important? In our analysis we do not argue that the factors in question are recognised by everyone, only that they are recognisable, that they can be found, and that they are significant for some respondents.

Showing that our use of data is reliable and valid also points to the limitation of the method and the conclusions. Thus, the empirical data do not permit us to relate the factors to more specific background factors in the individual VET programmes. Nor do the data render permit us to comment on the inter-relationship of the factors. What the method renders possible is to document that the various (internationally) found factors can also be localised in a national (Danish) vocational education context. The specific statements from teachers and students contribute to understanding the content of the theoretically developed concepts in a specific (national) context.

Based on the localised factors, further research should focus on assessing the relative importance of the factors in different VET contexts and on clarifying the interrelation of the factors contributing to a conducive learning environment.

Summary

Based on a review of existing studies, we have identified several factors that have an impact on the learning environment within VET. We have categorised the various factors into *curricular factors* and *social factors*.

The curricular factors include that students perform authentic tasks related to their future occupation as skilled workers. It is furthermore shown that if students perceive the training process as having a clear structure, including differentiating in accordance with the students' prerequisites, and if they perceive the training as meaningful, it will improve the learning environment. Yet another vital factor is that teachers give students continuous feedback and convey positive expectations concerning the individual student's performance. Cooperation between teachers at VET schools and the apprenticeship trainers in workplaces has also a considerable impact on the learning environment at the school.

To summarise the social factors that strengthen the learning environment, the results from research show that it is important that teachers prioritise establishing positive relationships with their students. This includes being role models inside and outside the classroom. Furthermore, research shows that it is important that teachers encourage positive relationships among students by establishing professional and social communities. The social factors shaping a conducive learning environment are conditional on the teacher's social and personal competences.

In summary, in this article we have identified several factors that, individually and together, have been shown to influence learning environments within VET. However, precisely how and to what extent is dependent on the educational and cultural context.

Didactical consequences

Overall, the studies show – perhaps not surprisingly – that conducive learning environments are significantly tied up with teachers as persons, trainers, and professional inspirators. Based on our study the teachers' professional considerations include reflections on the curricular and social aspects of the learning environments.

To support the development of a conducive learning environment the teacher should choose topics which the students perceive as authentic. Furthermore, the students should be supported in identifying and sticking to clear goals throughout the VET programme. Related to that, it is vital that the teacher can give individual feedback and differentiate the training in accordance with the individual student's learning progression. Likewise, it is vital that the teachers function as personal and professional role models for the students.

A conducive learning environment requires teachers who possess the necessary skills to successfully implement the various factors.

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