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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.

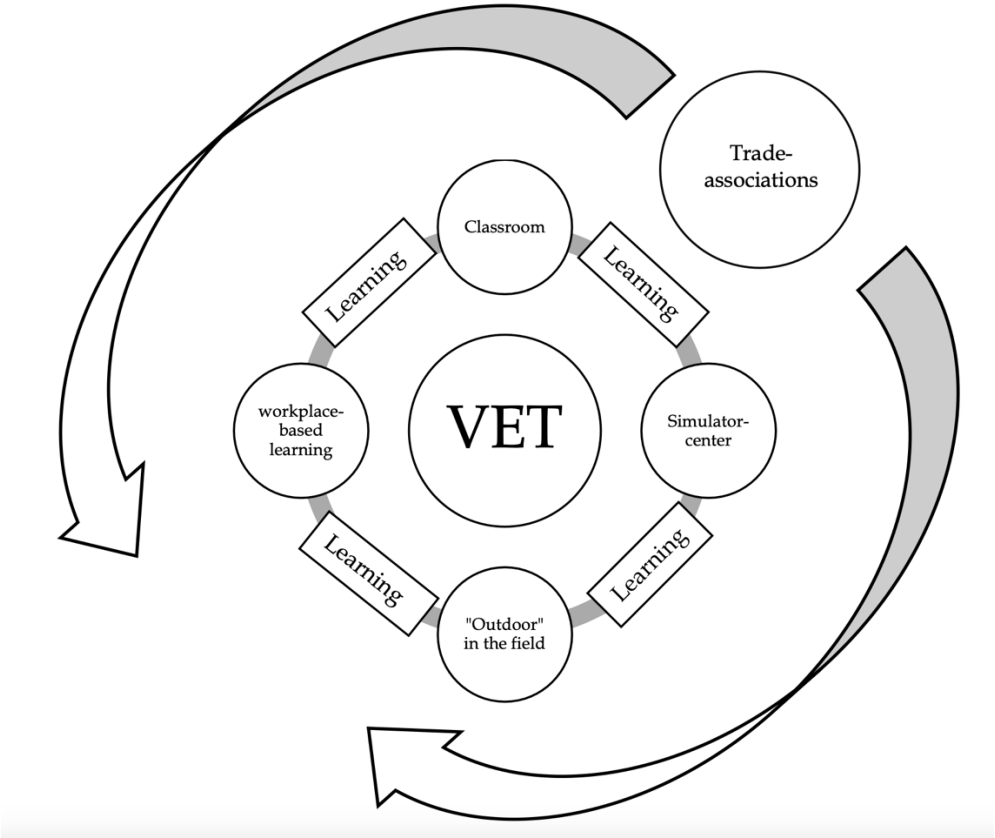

Figure 1. Learning environments in VET.

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).

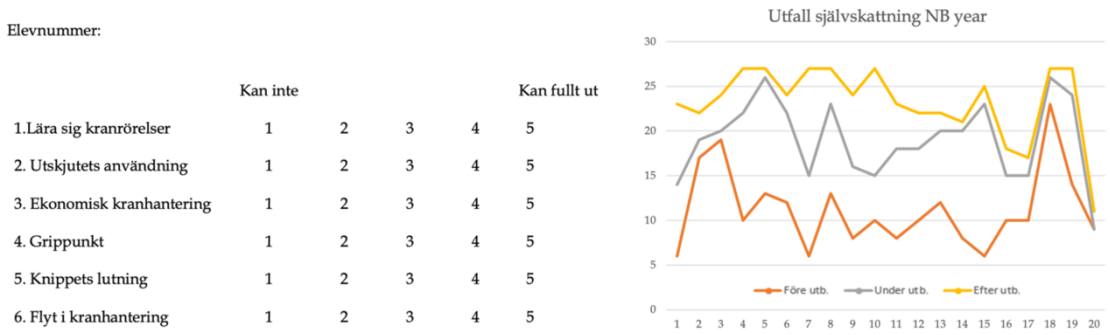

Figure 2. Student's self-assessment sheet (left) and teacher's overview of the results (right).

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).

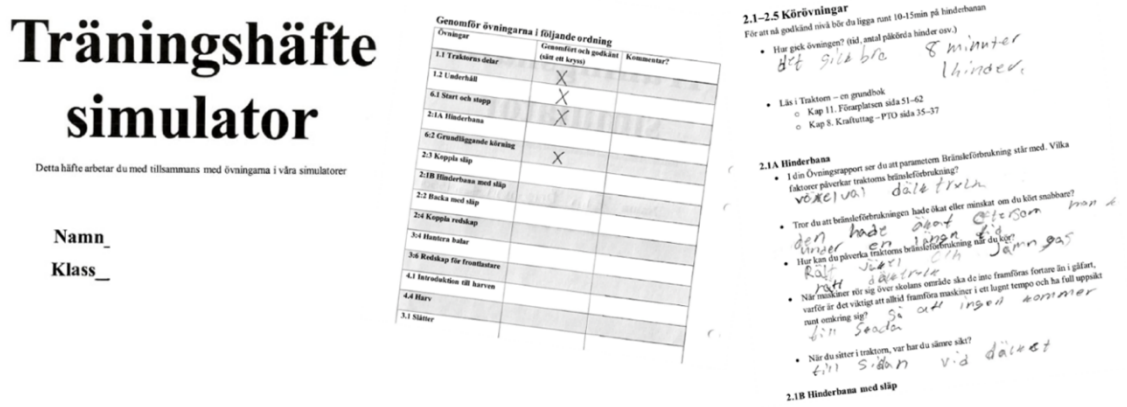

Figure 3. The students' folder, front page (left), the second page (middle), and an example of another page filled out by a student (right).

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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