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On the threshold of future learning

Student teachers' experiences of virtual educational simulation

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Abstract
This article presents an example of how teacher education could be supported by way of a digital simulation program that provides practical competence in dealing with challenging teaching situations. Virtual simulations are still relatively uncommon in teacher education. A major benefit is that they allow for individualised feedback, which is generally considered an important component of learning. The aim of the study was to deepen understanding of how student teachers experience, and think about, the use of Virtual Educational Simulation (VES). The simulation in question was developed for teacher education during 2018–2019. For the empirical study, six Master's-level student teachers were interviewed after running a simulated case where they encounter two virtual pupils having challenges with subject literacy. We used inductive qualitative content analysis in addressing the two research questions: How did the students experience specific topics of the VES design and the procedure, namely navigation, content, introductory elements, interaction, experience of the VES case as a real-life situation, assessment, feedback and student collaboration? What themes did the students topicalise in relation to their learning? The results indicate a positive attitude to VES in teacher training, although the students noted some limitations within the design of the program. Many of their comments about the design relate to their own development and learning as student teachers. Three themes emerged in their topicalisation of learning: the importance of relating to pupils' experiences and earlier knowledge, the need to pay attention to the individual student, and the key role of interaction with the teacher. Our findings confirm the importance of reflection and interaction in simulation programs with virtual cases.

Keywords
teacher training, virtual education simulation, student teachers, designs for learning

Introduction

There is growing awareness of the benefits of using digital resources and online learning in different formal, semi-formal and non-formal learning environments (Arnseth et al., 2019; Boistrup & Selander, 2022; Brooks et al., 2021; Hansen et al., 2015; Kempe & Grönlund, 2019; Sahi, 2019; Selander, 2015). There is evidence that digital learning resources stimulate and facilitate learning in higher education, and the growing need for digital literacy seems obvious in present-day society. However, various studies conducted in formal educational settings have also shown that learning objectives are not always achieved without solid pedagogical guidance (Swan et al., 2009). Consequently, both professional and student teachers need digital competence in a broad sense (Binkley et al., 2012; Saqr, 2019). In this article, we present an example of how to support teacher education, by way of a computer-based simulation program that was built on pedagogical principles, and aimed at enhancing competence in handling challenging teaching situations.

Simulations have been used in the fields of medicine and language education for a long time (e.g., Virtual Patient Simulation as in Botezatu et al., 2010a; 2010b; see also Wallinheimo & Pitkänen, 2016). They were relatively uncommon in teacher education (Kaufman & Ireland, 2016), but now there is constantly growing interest (Kangas et al., 2017; Theelen et al., 2019).

The focus of this article is on computer-based simulations, which are one type of simulation used for learning (Kaufman & Ireland, 2016). As Theelen et al. (2019) note in their systematic literature review, simulations contribute to the professional development of future teachers in bridging the gap between teacher education and educational practice. Students may apply the skills they have, or try out new teaching strategies (Rayner & Fluck, 2014), and they may enhance their sense of instructional self-efficacy more rapidly (Bautista & Boone, 2005; Christensen et al., 2011). Simulations also have considerable potential in the teaching of subject literacy to both novice and experienced teachers (Ferguson, 2017; Kelleci & Aksoy, 2020; Sahi, 2019). In particular, they provide a safe environment in which students may practise their role as teachers (Dalgarno et al., 2016; Rayner & Fluck, 2014), and serve as catalysts for reflection on and discussion about classroom teaching practice (Christensen et al., 2011). Experiencing virtual pupils acting in unpredictable ways, and noticing the impact of subtle changes teachers make during lessons, could raise awareness among student teachers of the complexity in the classroom (Dalgarno et al., 2016; Ferry et al, 2005).

Reflection is commonly used as a tool with students in teacher education, and between teachers at the training school, with a view to promoting awareness among student teachers of their own teaching strategies and methods (Toom et al., 2010). Studies in medical fields have highlighted the need for reflection in simulations (e.g., Mamede et al., 2017), the goal being to stop the students' thought processes from time to time, and make them wonder if they are on the right track. This may prevent them from drawing premature conclusions, and help them to learn more effectively about both successes and failures in diagnosis (Opitz, Fischer, Seidel & Fischer, 2022). Classroom simulations offer opportunities to develop reflection skills in other ways than in real life, because there is enough time to practise and to deal with different situations (Frasson & Blanchard, 2012).

Moreover, learners appreciate virtual-simulation systems that provide feedback, which is generally considered an important component of learning (Ferry et al, 2005; Pantziaras et al., 2014; Badilla Quintana & Meza Fernandez, 2015; Rayner & Fluck, 2014).

Simulation and the design of virtual cases

Design is a key element both *for* and *in* learning (Arnseth et al., 2019; Boistrup & Selander, 2022; Selander, 2008, 2021). It is also worth pointing out that contemporary, mul-

ti-modal knowledge representations and computer-based simulations, for example virtual cases, change learning conditions in various ways (Kress et al., 2021; Lindstrand & Selander, 2022; Selander & Kress, 2021).

In our present study, a "case" is a term used to describe a type of educational simulation where the learners (student teachers) can interact with a virtual presentation of two pupils having challenges with subject literacy. The learner can here ask questions to the virtual pupils and get answers (video clips) and suggest actions that the virtual pupils can take to improve their understanding. The learners then receive automatic feedback on their actions taken.

However, studies of virtual cases have shown that curriculum integration is crucial for learning outcomes. In other words, it is not enough just to develop interesting educational cases, they must also be in line with the curriculum. In a case in which four groups of students on a course were asked to run a set of virtual cases, Edelbring et al. (2012) showed that the type of instruction and time allocation were crucial factors affecting both motivation and learning. Studies have also been conducted on the role of "realism" in virtual cases. Students participating in a study conducted by Botezatu et al. (2010a; 2010b), for example, attached importance to realism in terms of real tasks and demands – not realism in terms of "natural" scenes and figures – in their motivation and engagement. Moreover, student participants in a study conducted by Dalgarno et al. (2016) reported that the use of text chat in the simulation made the activity more unrealistic. Problems in seeing avatars' facial expressions made it difficult for these student teachers to interpret interactions (Kim & Blankenship, 2013). In addition, confusion related to navigation in the virtual environment has been identified as a negative aspect of simulations (Dalgarno et al., 2016).

Aim

The aim of this study is to deepen understanding of the experiences and attitudes of student teachers regarding the use of virtual education simulation (VES). The research questions are:

1. How did the students experience specific topics of the VES design and the procedure, namely navigation, content, introductory elements, interaction, experience of the VES case as a real-life situation, assessment, feedback and student collaboration?
2. What themes did the students topicalise in relation to their learning?

The context of the study is a pedagogical innovation – Virtual Educational Simulation (VES) – which has been adapted for teacher education.[1] More specifically, it is one of five cases developed during 2018–2019. In the following, we introduce the VES design, using the "Nicolina – reading comprehension" example.

Method

The theoretical underpinning for this project lies in multimodal designs for learning (Selander, 2008, 2021; Selander & Kress, 2021) and experiential learning (Kolb & Kolb, 2009). We used design-oriented thinking in the case development, and an explorative method in

1. This program was first developed by Uno Fors at Stockholm University. It was later adapted to create five cases for teacher education in Sweden by Uno Fors, Staffan Selander, Eva Insulander (all at Stockholm University) in collaboration with the editor Maria Granler at Liber AB as a complement to the book *Att bli lärare (To become like a teacher*, by Insulander & Selander, 2021). A sixth case, the one here in focus, was created by Anna Slotte and Kirsi Wallinheimo, in collaboration with Uno Fors and Staffan Selander.

the interviews with the student teachers. We start by describing the case design, whereby a child acts as a student (virtual pupil), a solution that clearly differentiates VES from many other simulations. Moreover, it is one of the few computer-based simulations developed in the Swedish language.

VES case design

The case – "Nicolina – reading comprehension" – simulates different steps and conversational routes between a student teacher (ST) and a pupil. The content is subject literacy. The ST has to manage a situation in which fictitious pupils in a classroom (video recordings), represented by Nicolina (about 11 years old) and her classmate Mia, are working on a chapter in their history book.

Before entering the conversation, the ST is expected to study the case introduction. It comprises three elements: a chapter from a textbook; a video; and some key information about Nicolina, including some problems she has in relation to texts and schoolwork, which gives an insight into the problem to be solved. Having become familiar with the introduction, the ST is instructed to watch a video showing Nicolina and her classmate Mia in a short discussion before the lesson, and to read the chapter from the history textbook (Rantala et al., 2016).

There are four main points of entry into the conversation: How to start; What to discuss before the pupil starts reading; What to reflect on and do when the pupil is reading; and What to discuss after the pupil has finished reading. The following webpage shows the dialogue section in the case (Figure 1):

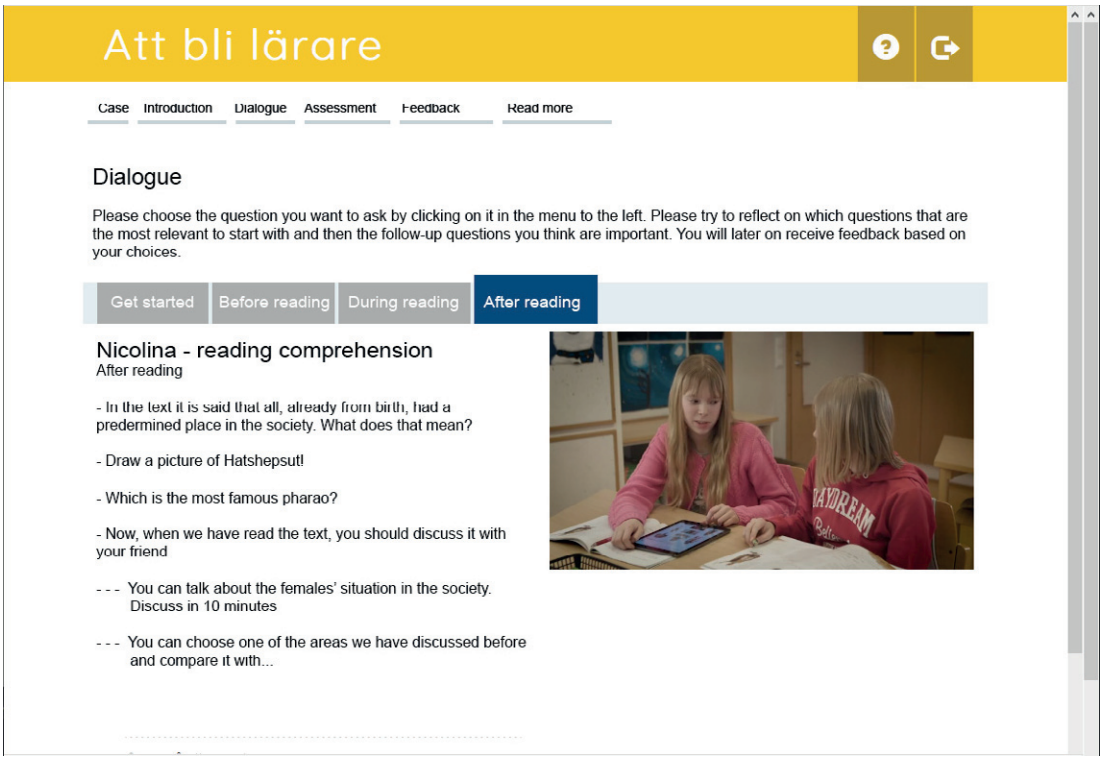

Figure 1
The dialogue section – including questions on how to start ("Komma igång"), what to talk about before the reading session ("Inför läsningen"), what to talk about during the session ("Under läsningen"), and after it ("Efter läsningen"; translated into English by U. Fors)

In the case in which the ST chooses the questions to ask, the response from the virtual pupil is shown as digital video clips – a technique that differs from most computer-based simulations of classroom practice that have been studied previously (e.g., Reynar & Fluck 2019; Theelen et al., 2019). The questions are constructed as alternatives under several headings, as well as in follow-up questions on three separate levels. The ST is free to choose any question in any order, and there are no hints as to which questions are good or less good.

The conversation is followed by an assessment section. The ST is expected to answer three questions – in free text – regarding what the problem seems to be, which strategies he or she would suggest, and which methods could be used further in the case, including didactic reflection on the subject. After this, the system gives feedback concerning the quality of the questions, the way they were asked, whether they were open or closed, and so on (Figure 2). During last part of the section (Figure 3) the ST receives feedback on three main topics: 1) How the virtual pupil experienced the encounter with "the teacher", done automatically via video clips depending on the question asked; 2) The views of an expert, also based on which question was asked; and 3) An opportunity to compare their own assessment of the case with the judgements of the experts.

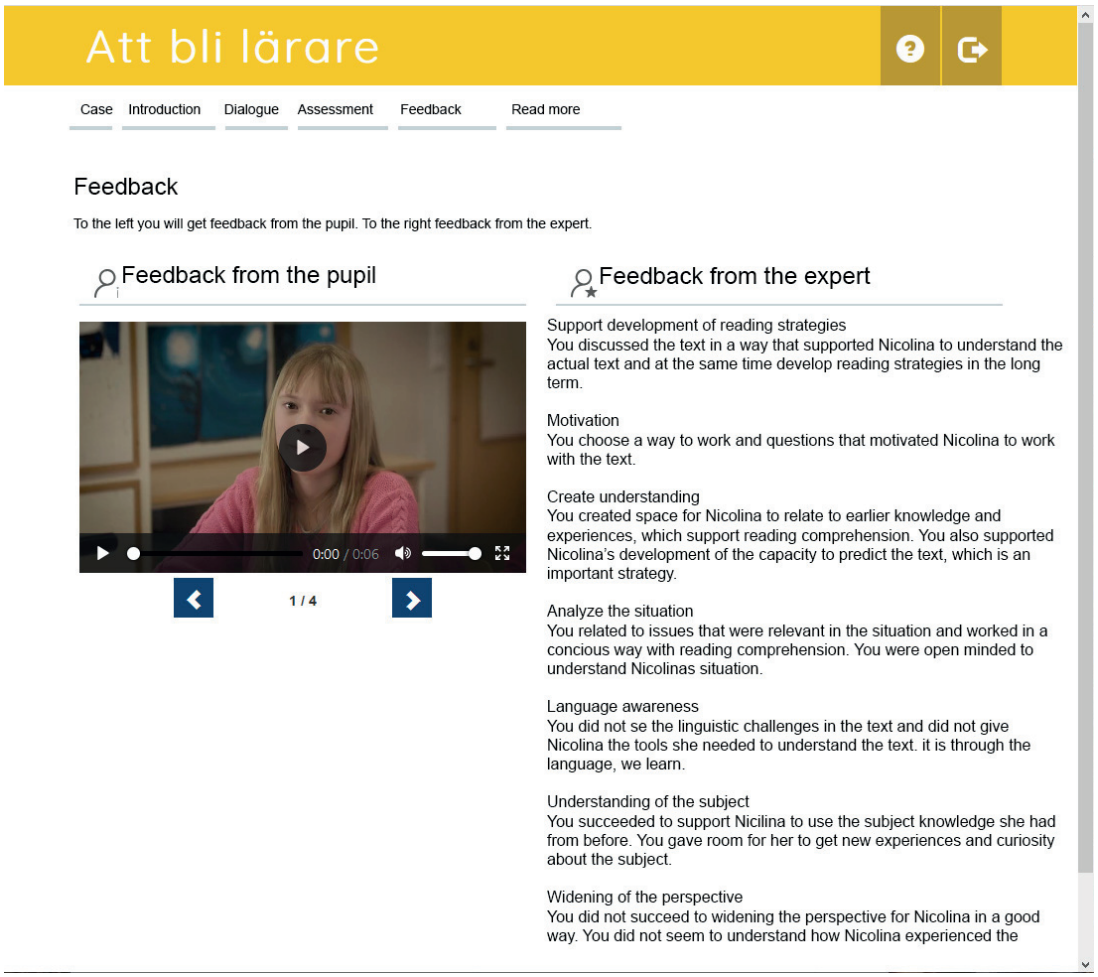

Figure 2
The Feedback section -from the virtual pupil and from the virtual expert (translated into English by U. Fors)

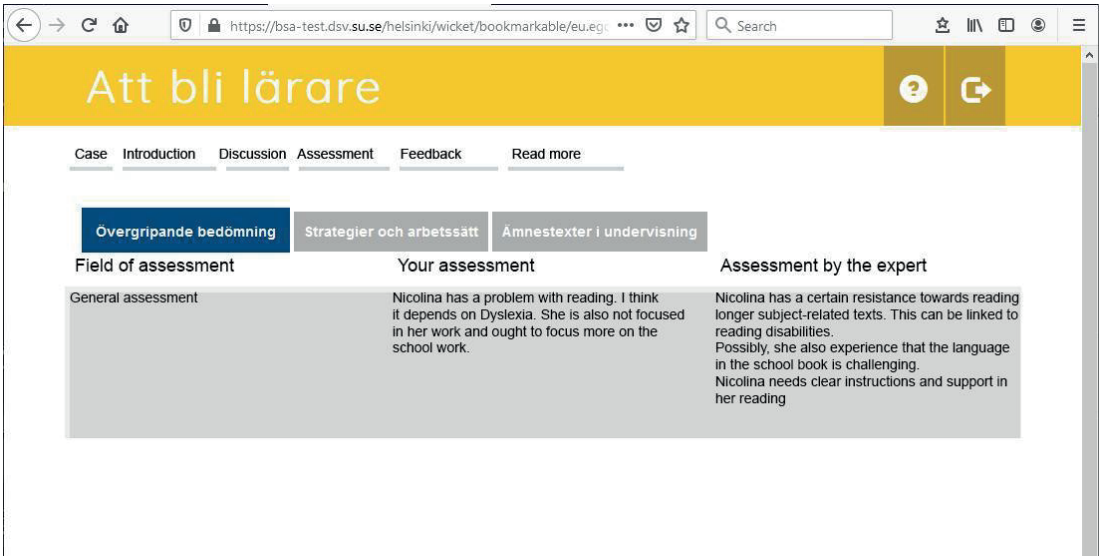

Figure 3
The final feedback session, through which the STs can compare their own assessments with what an expert suggested (translated into English by U. Fors)

The empirical study

An explorative, qualitative approach guided the empirical study, in which six volunteer Master's-level student teachers participated. One month earlier, two of them had participated in an interview concerning the same simulation, in another VES case (Jacob) (Siebrand, 2020). All the students were enrolled in the five-year class-teacher programme, which qualifies graduates to work as a teacher of children between six and 12 years of age. Four of the participants (two pairs) in this study were second-year students, and two (one pair) were fourth-year students. The students reflected jointly in pairs on how to proceed with the simulation on the screen. The study was carried out in the Experience Laboratory of Åbo Akademi University, and the physical setup included a desktop computer along with a keyboard, a monitor and a mouse.[2]

Before the students started the simulation, they were given a short introduction by a researcher (one of the authors) and a research assistant. The pairs were told how to begin and how to work through the simulation. They could ask questions if necessary, including during the session that the researcher and research assistant were following, without interfering. However, the STs did not use this opportunity. The time they needed for the simulation in the three groups differed: 26, 37 and 55 minutes, respectively.

Directly after finishing the VES, the three pairs were interviewed separately by the researcher, who had followed the simulation. These semi-structured interviews lasted approximately 30 minutes each, and were video-recorded. The main topics covered were: 1) thoughts about the VES (e.g., theme, introduction, classroom context, structure, end); 2) the different parts: discussion, assessment, feedback and how they experienced working in pairs; 3) the relation between the VES and the students' studies, including thoughts about

2. All in all, data were gathered by means of video recordings of the students' interaction, screen recordings (including interaction with the user interface, mouse clicks, user camera and audio sound) and audio- plus video-recorded interviews afterwards.

learning; and 4) the development of ideas about the VES. The students were offered the opportunity to go back to the simulation to point out a certain matter for discussion, but none of the pairs used this option.

A verbatim transcription of the Swedish original was made by a hired transcriber, and later some unclear details were completed and corrected by a research assistant. To uncover deeper research insights, the transcribed data was prepared and organised for NVivo qualitative data analysis software. We use code names for the three participating student pairs (Malva and Tristan, Micke and Tua, Olivia and Clara).

Data analysis

The data were subjected to qualitative content analysis. Authors one and two read the transcriptions, first to familiarise themselves with all the material, then to find relevant topics inductively (concerning RQ 1), and themes (concerning RQ 2) (Miles, Huberman & Saldaña, 2014). The researchers subsequently discussed the topics and themes in a finalisation process before their presentation in the results section.

The interviews as a whole constituted the analytical basis, meaning that we did not analyse the expressions of the pairs nor of the students separately. Representative quotations from the transcribed text are presented to illustrate connections between the data and the results.

Results

How the students experienced the design of the program

The students commented the design and the VES procedure, including navigation, content, the impact of different alternatives, the introductory elements (textbook, introductory text and video), the role of interaction and experiences of the case as a real-life situation, assessment, feedback and student collaboration.

Navigation

The students frequently found it difficult to know how they were expected to navigate in the dialogue section (cf. Dalgarno et al., 2016; Kim & Blankenship, 2013). Although they discovered that it was possible to navigate in different ways, they did not always experience the navigation options as logical, even though they found out how to use them: "It felt a little bit like they built on each other, that you didn't know if […] you're supposed to read the text again. What would the story be like if we changed that, but there was always a new video and then you understood that it works well" (Micke).

Some students would have preferred if the program had automatically moved them forward, because sometimes it seemed difficult to understand where they were in the process. They also discussed the potential of a design that would show other results while they were working with the virtual case. The possibility to move back and forth between the main sections was also seen as something positive, in the sense that the program allowed them to change their choices and to examine different alternatives.

Content

When the students were asked to compare the Nicolina case with another case in the VES system, they mentioned that it was more specific. According to the students' experiences, the openness in the other case also led to situations in which they discussed topics other than the most relevant.

The impact of different alternatives

In its design, the simulation is built around alternative and open follow-up questions. Some students commented on the impact of this, perceiving the opportunity to find alternatives as a way of expressing themselves or acting as a teacher. The alternatives that were provided stimulated them to look beyond their own horizons: Olivia described the simulation as an "eye-opening" experience. They also encouraged the students to investigate further options: VES gave them a chance to try out alternatives straight away, instead of waiting until the practice period.

The introduction elements (textbook, introductory text, introductory video)

Many students commented on the significance of the chapter from the textbook, which added a sense of reality to the simulation that supported the teacher role. In terms of clarity, the text could have been visible throughout the whole simulation, making it possible to check unclear issues. The length was considered suitable. According to Micke, a longer text could carry the "[…] risk that students with a slower reading pace would skip it".

The combination of the introductory text and the textbook chapter seemed to give the simulation relevance to the students on their path towards entering the teacher profession: "I felt like it was pretty good to have that introduction and then to have a text as well where you even learn something, how to work with that class" (Micke).

The text in the book was perceived as complicated by some students, who thereby understood even better the challenges with which Nicolina struggled. One student pair had not read to the end of the text, and related this to how difficult such a text could be for students: "It's demanding to remember details from such a long text" (Clara).

The pictures in the text were also perceived as necessary, in that some of the VES questions related directly to the illustrations in the textbook. The introductory video used in this case was not mentioned by any of the students at first. When they were explicitly asked about it, Malva and Tristan said it was too short.

The role of interaction

Even though the interaction in it seemed to play a vital role in how the simulation was perceived, the video clips were also criticised by some of the students, all being perceived as too short. Nicolina was: "[…] quite brief in her answers and didn't want to dig herself in and had no curiosity but it was more like she was in a hurry and wanted to answer the questions briefly and quickly" (Tristan).

Experiences of the case as a real-life situation

The students talked about the case as a real-life situation both in comments about Nicolina and in comments about their relation to her. They talked about her as "real"; she has feelings, she thinks, reacts and interacts. They also had expectations of Nicolina, and were surprised when she acted in a different way, such as in the feedback part: "[…] at the pupils' first feedback I thought that well, that wasn't as good as I experienced her feeling, that it was good to know, to be able to see how the pupils think" (Tua).

The virtual pupil's way of interacting in different situations and her relationship with her classmate attracted comment. Nicolina seemed to be a domineering pupil, according to one student: "It didn't seem like her friend was able to be a part of the discussion as actively as she was" (Tristan).

In terms of relating to Nicolina, the students talked about getting to know her and her way of learning, and they wanted to help her. "[…] if you get this response immediately after you

have…or when you have asked a question, you see the reaction immediately. I also thought, with the previous case, that you see directly how the student takes it, is it a good thing or is it not? […] You can immediately see how the student reacts, it's great" (Tua).

There were also some situations in which the students related the VES case to their own experiences. Malva mentioned that the experiences she had from teaching helped her in her talk with pupils in a classroom: "The classroom situation differed a bit, as in Jacob's situation it was after a lesson and you should speak in private, so I realised that I have more experience in how it is in class and not how you speak to a student individually. So, it was a bit easier to relate to this situation" (Malva).

However, there were moments in the interviews when the students talked about the case as an exercise and the relation with Nicolina remained more distant. They did not relate to her as somebody they could help, but rather discussed her from a meta-perspective. "So, I think that learning how to deal with situations that you maybe can't learn to handle in seminars or read about in books, but more through experience, so I do think that it is pretty good that you can get a feel for how it is in different situations." (Malva). According to Malva, experience is a vital part of learning: "Like you have to learn through experience, in that case the simulation can prepare you for that" (Malva).

Some students also mentioned the "environment" as the reason for experiencing the VES case as a real-life situation, while others were more explicit and mentioned the desks, which in a broader sense could be understood as the classroom setting. Whereas earlier simulations in the same VES were recorded in a studio, this case was recorded in a classroom.

Assessment

The students did not pay much attention to the assessments they had to write in their reflections. On the other hand, they seemed to find the feedback from the virtual expert in VES important, partly as some kind of reward, since they realised that there were similarities between their own choices and the ones made by the expert. "The expert had a bit more depth than we did, but yes, it was nice to see that they thought in approximately the same way" (Tua).

Feedback

The feedback from the virtual pupil was appreciated. When explicitly asked which parts of the simulation provided insights, Tua mentioned the importance of feedback: "Then it suddenly became really interesting to her that yes, 'but I have seen this' and she started to share, and I didn't at all think that she would've done. It's hard to know what's going to be good and what isn't […] in advance" (Tua).

Some of the students were surprised that some of the feedback was so negative. According to them, the difference between the four parts was not clear enough.

Student collaboration

The collaboration led the students into discussions and further considerations in relation to the faster decisions they probably would have made alone. "At some point it was like you said something and then the other one said that you could have done this first and then we'll do this. That you're still discussing some alternatives, if you had been by yourself you would have stuck to the first one" (Tua).

According to the students, collaboration stimulated thinking, ways to go forward together, and the perception of different opinions as interesting and part of a more complex whole. "But then if you have a partner who's actually quite different from you or has different opinions then it can lead to, well, different results" (Clara).

How the students topicalised learning

We found three different themes in relation to the research question: the importance of relating to pupils' experiences and earlier knowledge; the importance of paying attention to the individual pupil; and the importance of teacher-pupil interaction.

Relating to pupils' experiences and earlier knowledge

The students acknowledged the importance of relating to the experiences and earlier knowledge and interests of their pupils. They did not explicitly talk about this as something new, but they said that the case had drawn their attention to it. They had discussed the didactic aspect of relating to pupils' experiences when they were studying, and they also had their own experiences from school. "I think it is something that is emphasised as soon as you start studying, that it should be relevant, a part of everyday life, that they could relate it to their everyday life" (Tristan).

When Tua was asked what she had learnt, she mentioned the difficulties involved in getting to know the pupils and their interests. The feedback part of the simulation had helped her to see the importance of this: "(…) and the thing with movies, if you ask her if she's seen any movies, for example, to close her eyes and think about it, I thought that she was going to say that she hasn't seen any. Then she suddenly became really interested: 'Yes, I've seen this', and she started to explain, and I really didn't think she was going to do this. It's hard knowing in advance what is going to be good and what isn't. It's about the pupils' feedback on anything, and their reactions" (Tua).

Paying attention to the individual pupil

This theme arose from students' comments about the importance of noticing each pupil, knowing about and using their interests in the teaching, being aware of differences in relation to competence and learning preferences, and being able to adjust one's teaching and teaching methods to suit these differences. "It's hard to put yourself in the situations of pupils, and to know how they are taking this in practice, and if they feel like doing it this way. I have learned that you should try to see each pupil […]. Try to put yourself in the situation of every pupil" (Tua).

It could be demanding in a class with many children to recognise and get to know each individual pupil. Micke pointed out the significance of the simulation in focusing attention on the interests and motivation of a single pupil: "Because all pupils have thoughts like 'wow how boring', so you have to find those pupils. You discover their interests and adapt to them, and maybe you forget it because in the class you do not have a pupil like the one we have now, or there were two, you have a large group and then it is difficult to see them individually. As one should do" (Micke).

Teacher – pupil interaction

Under this theme are comments about the teacher's language use and expressions, teaching methods and the responses given to pupils. The student teachers noticed that small decisions matter to pupils: "like you get a deeper view into what you can ask, which words to choose between, and which questions can lead to which results." (Tristan). The immediate responses the student teachers received through the video clip facilitated their reflection. It is demanding for the teacher to notice the reactions of single pupils in a real classroom situation.

Discussion

The responses in the qualitative data indicate a generally positive attitude to VES for teacher training, although the student teachers experienced some limitations with the design of the program. In what follows we tie together reflections on the design of VES and on learning, thereby enabling us to comment on the options VES provides to function as a sort of "augmented practicum" (Kelleci & Aksoy, 2020).

It is striking that many of the students' comments about the design relate to their own development and learning as student teachers. They suggest that more developed initial instruction about the free navigation in the VES system and the coming assessment and feedback might be helpful. Some students asked for a stricter and more guided path through the program. It would be useful to adjust the design to enhance usability and reduce the mental workload while interacting with the simulation (see e.g., Ritter et al., 2014; Tsang & Vidulich, 2006). However, we argue that there should be a balance between a predetermined path and a flexible structure (see Kelleci & Aksoy, 2020). We also draw lines between reflection on the design and on learning when it comes to feedback: more interactive and direct continuous feedback from an expert could enhance student reflection. The students seemed to value the feedback from the virtual expert, seeing it partly as some kind of reward in that they noticed similarities between their own choices and those made by the experts. Theelen et al., in their (2019) review, highlight the receipt of feedback as one of the educational affordances of simulations.

Many of the reflections were positively related to a) having an overview of the alternatives and b) being able to go back and forth among them, both of which stimulated reflection and encouraged the students to explore didactic choices from a teaching perspective. In the words of Christensen et al. (2011), VES acts as a catalyst for reflection and discussion on classroom teaching practice. It also functioned as a safe place between theoretical studies and practice, where students could try things out before going into the practice period (see also Dalgarno et al., 2016; Rayner & Fluck, 2014). The alternatives in the program seemed to encourage the students to go beyond their own horizons of knowledge: Kim and Blankenship (2013) apply the theory of the Zone of Proximal Development to simulations.

The strength of VES was not the interface in terms of "real graphics", but rather the solving of a potential "real" problem in relation to a pupil and the feeling of being in control of the situation. The students in this study found it easy and considered it important to see the virtual pupil's reactions, which is contrary to Kim and Blankenship's (2013) study in which the students experienced problems in interpreting avatars' facial expressions.

The students appreciated the test set-up, whereby they ran the VES in pairs (see also Rayner & Fluck, 2014). It offered opportunities for systematic reflection, which is a major dimension of teacher training (see Toom et al., 2010) and could also be compared with the positive effects of discussion at a subsequent seminar (see Edelbring et al., 2012). The study confirms the importance of reflection and interaction in simulation programs involving virtual cases.

The themes the students topicalised in relation to their learning concerned the importance of relating to pupils' experiences and earlier knowledge, of paying attention to the individual pupil, and of teacher-pupil interaction. They reflected on their pupils' different learning paths in the classroom while running the simulation, and were reminded that classrooms consist of individuals with different interests, capacities and needs for interaction. It seems obvious that the students wanted to organise the lesson as well as possible for the virtual pupil. They recognised her needs, and the textbook, the introduction text and the introductory video helped them to see the challenges from the pupil's point of view. We dis-

tinguished a relationship between the VES design and the students' learning: access to the textbook proved to be of value for learning while proceeding with VES. While the students were interacting as teachers in the simulation, we analysed a gap in how they used the textbook, compared to how it would be used in a real classroom. A design allowing the textbook to be visible throughout the program may have supported the students' interaction with the text, and further their reflections on reading strategies that were relevant in the simulation dialogue.

The third theme the students raised was the importance of teacher – pupil interaction. By becoming involved in the simulation, these student teachers started to reflect on the meaning of all the small choices facing them as a teacher: their language use and expressions, the methods used and the responses given to pupils – reflections that are allocated no time in the classroom (see Dalgarno et al., 2016; Ferry et al., 2005; Frasson & Blanchard, 2012; Rayner & Fluck, 2014).

Simulations are developed in a specific context. Concerning the relationship between VES and the students' ongoing teacher studies, students talk about insights that were eye-opening. The responses from the virtual pupil involved them in a classroom dialogue and offered more real experiences on other dimensions than the activities they were used to. This emphasises the point that it is not enough merely to develop interesting educational cases: such cases must also be in line with the curriculum (see Edelbring et al., 2012). One way to support student learning even more would be to connect the VES process more closely to the book that constitutes its context (Insulander & Selander, 2021). This connection was missing in the test situation.

These findings are valuable because they come from student teachers, and refer to gaps in VES, in relation to both the design and the user experience. Developing VES in the direction of narrowing those gaps might bring users closer to real-life classroom experience, which in turn would make it usable in the practice part of teacher training. This would also be one way of renewing the design of learning in contemporary teacher education and, further on, also of developing new learning resources for pupils (Arnseth et al., 2019; Boistrup & Selander, 2021; Wallinheimo & Pitkänen, 2016).

Finally, some methodological reflections about our roles as researchers in this study ought to be mentioned. None of the STs used the possibility to ask questions concerning substantial or technical issues of the VES. As it turned out that the STs were uncertain about how to navigate in the program, we realised that, from a methodological point of view, we could have paid more attention to the instructions given at the beginning of the trial session.

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