How teacher students used digital response systems during student teaching

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Abstract

During teacher education programs, teacher students are expected to develop the digital competence necessary for their future roles as teachers. A vital aspect of this competence involves integrating digital tools into educational activities. Some digital tools, such as response systems, are designed and used to encourage student participation during educational activities. This study explores how teacher students use different functions in various response systems during their student teaching, practically applying what they learned in an ICT course during the teacher education program. Semi-structured interviews were thematically analyzed, with activity theory as a framework to discuss the themes. The findings reveal that while most teacher students used response systems during their student teaching, the extent and manner of use varied significantly. Frequent users reported positive experiences, integrating response systems as part of their teaching strategy, while occasional and non-users faced barriers related to theoretical grounding, relevance to the subject of English, community support, and the division of labor. These results highlight the importance of aligning digital tools with educational objectives and providing teacher students with theoretical and practical support during their training. The study contributes to the ongoing discourse on integrating digital tools in teacher education and provides insights into digital competence development within teacher education programs.

1 Introduction

In today's classrooms, teacher students (TSs) face multiple challenges. A recognized challenge is to bridge the gap between theoretical knowledge gained in teacher education (TE) and practical application in classroom settings (Darling-Hammond, 2000; Hatch et al., 2016; Korthagen et al., 2001; Tang et al., 2019). During TE

Published online: 25 November 2024

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programs, a bridge between theory and practice is constructed during the important period of student teaching, where the TSs practice teaching at schools (Molander & Hamza, 2021). As articulated initially by Shulman (1986), there is a mandatory dual task of conveying the "what" and "how" of the TSs' subjects. Moreover, it has been highlighted that teachers' underlying beliefs about teaching and learning and their approaches to integrating technology play a crucial role in shaping their instructional practices (Kim et al., 2013). Additionally, in Sweden, the context of this study, TSs must possess sufficient digital competence to understand how to use digital tools in educational activities to promote learning and recognize the importance of various media and digital environments within these activities (Ministry of Education and Research, 1993:100; Swedish National Agency for Education, 2022).

Previous research on TSs' dual tasks indicates that TSs who engage with digital tools during their training are better prepared to integrate them into their teaching practices effectively (Tondeur et al., 2017). However, it has been concluded that newly qualified teachers often report inadequate training in Information and Communication Technology (ICT) during their TE programs (Gudmundsdottir & Hatlevik, 2018). Similarly, it has been found that while digital tools influence TSs' knowledge acquisition, they do not necessarily enhance understanding of the tools' pedagogical applications (Edstrand & Sjöberg, 2023). Several studies claim that there is a need for more research on how to prepare TSs for using digital tools during the TE program and student teaching (Amhag et al., 2019; Lindfors et al., 2021).

This study is based on insights from previous research where we observed and interviewed a group of TSs during a course on ICT in the fall of 2022 (Authors 1). During that course, the educator and the TSs used several functions of a response system (RS) to encourage student participation during the seminars, such as multiple-choice questions, free-text questions, and game-based activities. Digital response systems (RSs), sometimes referred to as audience/student/classroom response systems, enable participants to electronically submit (anonymous) real-time responses to different types of questions through the web browser of their devices, thereby offering instantaneous feedback for educators to gauge understanding or stimulate discussion as part of formative teaching (Chen et al., 2020; Dalby & Swan, 2019; Einum, 2020; Kay & LeSage, 2009). The ICT course was followed by five weeks of student teaching, where the TSs were expected to practically apply the theoretical knowledge acquired in previous university courses through planning, implementing, documenting, evaluating, and developing the teaching (Ministry of Education and Research, 1993:100). Were they going to apply what they had learned during the ICT course – i.e., how to use RSs in teaching? What influenced their decisions? What encouraged and hindered them? We followed up these questions with the TSs after their student teaching to understand how they used digital tools, with a particular emphasis on the use of RSs.

1.1 Aim and Research Questions.

Although there is research on the different aspects of digital competence and the use of digital tools in TE settings (Amhag et al., 2019; Diaz et al., 2024; Gudmundsdottir & Hatlevik, 2018; Lindfors et al., 2021), a gap exists in understanding how TSs apply this knowledge during their student teaching. Since some TE programs include specific ICT courses, it becomes necessary to understand if TSs apply the knowledge

acquired from these courses and how they reflect upon (not) using digital tools during their student teaching. This study aims to explore what influenced the TSs' decisions to use digital tools during student teaching. The study addresses the following research questions:

1. How do TSs describe what influenced them to use RSs during student teaching?
2. How do TSs describe what influenced them to refrain from using RSs during student teaching?

2 Background: Digital competence in teacher education

Digital competence for teacher educators and teachers includes aspects of using digital tools to enhance teaching and learning. The European standard for educators' digital competence, DigCompEdu, identifies six areas focusing on educators' activities related to digital competence: professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence (Punie & Redecker, 2017). It is emphasized that the fundament related to teachers' digital competence can be found in the third aspect, "Teaching and Learning", which refers to designing, planning, and implementing digital tools in the different stages of the learning process. According to the framework, digital tools can be used to, for example, encourage interaction and participation, foster communication and collaboration, provide both formative and summative assessments of student progress, and enable students to reflect on their learning. In line with these principles, specific tools and strategies need to be identified and utilized. Previous research indicates that the interactive potential of digital tools is underutilized (Chen et al., 2020; Dalby & Swan, 2019). One way of using digital tools for the previously mentioned purposes is to use RSs, which are designed to encourage participation, engagement, and motivation among students and have been employed in educational contexts since the 1970s (Blasco-Arcas et al., 2013; Chen et al., 2020; Dalby & Swan, 2019; Einum, 2020; Han & Finkelstein, 2013; Henrie et al., 2015; Hunsu et al., 2016; Kay & LeSage, 2009).

Over the past decade, rapid technological advancements have necessitated an evolution in the educational sector, emphasizing the critical role of teachers' digital competence. Research from the last two decades has consistently highlighted the importance of equipping educators with digital competencies to enhance educational experiences and prepare TSs for teaching in modern classrooms (Ally, 2019; Basilotta-Gómez-Pablos et al., 2022; Starkey, 2019; Willermark et al., 2024). As early as 2011, Haugerud pointed out that it is insufficient for TSs to simply know how to use a computer program; they must also be able to contextualize it within a teaching environment – a highly relevant point today. Furthermore, Børte et al. (2023) found that organizing students as resources for one another can be beneficial, facilitating collaboration and enabling them to receive feedback from peers, teachers, or digital tools.

Although teachers' digital competence has been studied for decades, and scholars have suggested that TE programs should nurture digitally competent teachers who proficiently use ICT for pedagogical purposes, the need for research on how TE can foster TSs' digital skills remains (Instefjord, 2015; Krumsvik, 2014; Ottestad et al., 2014; Røkenes & Krumsvik, 2014; Uerz et al., 2024). Additionally, teacher educators often lack competence in using digital tools for pedagogical purposes and highlight a need for pedagogical support in teaching with digital tools (Amhag et al., 2019; Lindfors et al., 2021). Some institutions offer specific courses on ICT or digital tools, while others incorporate practical use and reflective discussions throughout their programs. However, substantial differences have been reported in how teacher educators deal with digital technology and prepare TSs for their future practice (Lindfors et al., 2021; Uerz et al., 2024).

3 Theoretical framework

We chose to apply activity theory as a lens to discuss the study results because it offers a comprehensive framework for understanding the connections between individual actions and the broader social and institutional contexts. Using activity theory to analyze the themes, we aim to provide a deeper understanding of the social and contextual influences on TSs' use of RSs, reflecting the realities of integrating digital tools in TE. This approach provides a deeper insight into the contextual influences on TSs' use of RSs and connects these findings to broader educational practices and structures, offering a richer understanding of digital tool integration in TE.

Activity theory, evolved through generations of research (Engeström, 2001; Leont'ev, 1978; Vygotsky, 1978), examines how tools mediate actions within social and institutional contexts, providing a framework to understand the complex connections and interrelations in human activities. Thus, to understand these relationships, one must study them together. In the past two decades, Leont'ev's theory of activity has undergone significant development and has been merged with Vygotsky's theoretical concepts (Cole & Engeström, 1993). This fusion has given rise to the Cultural-Historical Activity Theory (CHAT), a framework that integrates the ideas of both Vygotsky and Leont'ev. In CHAT, an activity system consists of several connected components that work together to facilitate understanding and analysis of complex actions: subject, object(s), mediating artifacts, community, rules, and division of labor (Engeström, 2015).

Activity theory has been extensively used to study innovations in many disciplines and settings (Karasavvidis, 2009), and it has notably been applied to examine teachers' use of digital technology (Blayone, 2019; Hubbard, 2022; Leino Lindell, 2022; Pettersson, 2021). Using activity systems has been beneficial for researchers to examine how individual and collective activities interact within specific educational contexts, providing insights into the processes through which teachers adapt and expand their knowledge in response to curricular demands and students' needs.

By analyzing activity systems and discussing the context and the connections between the components, we aim to provide further insights into digital competence

development within TE programs and contribute to the ongoing discourse on integrating digital tools in TE and during student teaching.

4 Method

This study employs a qualitative research design. By gathering insights from TSs through semi-structured interviews and conducting a thematic analysis, we aim to explore what influences their decisions to use or refrain from using RSs during student teaching. This approach provides insights into the components influencing the use of digital tools in TE.

4.1 Data collection

We conducted semi-structured interviews to explore the TSs' views and experiences. This method was selected because it facilitates the use of open-ended questions and the opportunity to delve deeper into responses.

4.1.1 Context

Before this study, we observed and interviewed a group of TSs during a course on ICT use in education (7.5 ECTS credits, corresponding to five weeks of full-time studies) at a Swedish university in the fall of 2022. The course aimed to expand the TSs' digital competence by providing them with practical knowledge about using digital tools in teaching, for instance, by using an RS to encourage student participation. The teacher educator used different functions of the RS during the seminars, for instance multiple-choice questions, free-text questions, collaborative whiteboards, and game-based activities. The course's intended learning outcomes included the ability to analyze, evaluate, and compare the advantages and disadvantages of various digital tools used in the language teaching classroom. Additionally, the TSs were expected to create learning environments that incorporate appropriate educational tools.

The ICT course was followed by five weeks of student teaching. During that period, the TSs were supposed to plan and lead teaching based on policy documents, relevant subject content knowledge, and theoretical perspectives, considering the prior knowledge, interests, and needs of the upper secondary students (referred to as "students" in the text) they met (Ministry of Education and Research, 2021:1335). Student teaching aims to prepare the TSs for their future profession, focusing on the teacher's professional role and the school as an educational environment by letting the TSs practically apply the theoretical knowledge acquired in university courses. Initially, the TSs take on a more observational role. Gradually, with the support of the student teaching supervisors, the TSs are responsible for planning and conducting lessons and other educational activities,

thereby testing their theoretical knowledge. TSs are trained to plan, implement, document, evaluate, and develop the teaching and operations and to reflect on this independently and with their supervisors (Christiansen et al., 2019; Molander & Hamza, 2021).

4.1.2 Participants

All seventeen TSs enrolled in the ICT course were invited to participate in interviews, of which eleven agreed to participate. The eleven TSs were in their third semester of a 4.5-year English teacher education program at a Swedish university. The TSs ranged in age from 21 to 27, and while all had English as their primary subject, their second subjects varied, including History, Physical Education, Psychology, Arts, Swedish, and Swedish as a second language. At the time of the interviews, the TSs had recently completed the ICT course and were either engaged in or had just completed their first five weeks of student teaching (7.5 ECTS credits).

4.1.3 Semi-structured interviews

In late 2022, we conducted and transcribed semi-structured interviews via Zoom. The interviews, guided by 20 open-ended questions, explored the TSs' backgrounds, experiences with digital tools, and their use of RSs during student teaching. Every participant received detailed information regarding the study's objectives and the management of the data. Written consent was obtained from everyone before conducting the interviews. The interviews were conducted in Swedish, transcribed verbatim, and relevant quotes were translated into English. The data collection, storage, and analysis processes adhered to the ethical standards concerning information, consent, confidentiality, and application established by The Swedish Research Council (2017) and in full compliance with the General Data Protection Regulation (GDPR, 2016).

4.2 Data analysis

4.2.1 Thematic analysis

We followed Braun and Clarke's six phases of reflexive thematic analysis (Braun & Clarke, 2019, 2021) to explore the TSs' views and experiences on what influenced their decisions to use RSs during their student teaching. The thematic analysis was underpinned by an activity system framework and its components to map the connections influencing TSs' use of RSs. The combined methodologies offer a comprehensive view of the practical and theoretical aspects of digital tools in TE. However, considering this is an explorative study, we did not use a predetermined set of codes when starting the analysis. The approach involved familiarizing ourselves with the data, generating initial codes, and creating, reviewing, defining, and naming the themes (Braun & Clarke, 2019, 2021). In the first phase of the thematic analysis, the

first author noted initial ideas, impressions, and observations while structuring the data. In the second phase, the first author performed preliminary coding by organizing short phrases or words related to particular concepts, such as participation, vocabulary/grammar, exit tickets, gaming, warm-ups, etc. Then, the codes were analyzed and discussed with co-authors to generate themes in the third phase. After that, all authors jointly reviewed, defined, and named the five themes: relating theory and practice, relevance to English as a subject, various modes of participation, balancing fun and boring, and attitudes toward digitalization.

We then related the themes to the various components of the activity system, mapping how each theme corresponded to aspects such as tools, rules, community, division of labor, and the subject's role within the system. This approach allowed for a nuanced understanding of the connections influencing the TSs' use of RSs during their student teaching, contextualizing their experiences within the framework.

5 Results

All TSs reported school environments where digital tools, including devices, networks, and administrative platforms, were frequently used. However, the use of RSs varied. Most TSs (8 of 11) used an RS during their student teaching. Although the TSs did not use the same RSs, they used similar functions; multiple-choice questions, free-text questions, and game-based activities. Three TSs (frequent users) consistently used RSs and intended to continue doing so. They reported positive experiences and integration of RSs into their teaching. Five TSs (occasional users) used RSs sporadically, with some planning to increase usage and others maintaining the same level. Three TSs (non-users) did not use RSs, with two considering future use and one rejecting it. Occasional and non-users highlighted barriers, reflecting the hindrances identified in the thematic analysis. Analyzing these user groups within the identified themes addresses what encourages or hinders RSs use.

5.1 The activity system

In this study, the activity system (see Fig. 1) consists of the following components: The object relates to developing adequate digital competence during the entire TE program – before, during, and after student teaching. The outcome is to be able to use digital tools appropriately and critically in educational activities. To accomplish this, TSs (the subject) engage in student teaching, where some use RSs as mediating artifacts in educational activities. The community includes upper secondary school students, teacher educators in the TE program, and student teaching supervisors. The rules represent guidelines for using digital tools within educational settings based on curricula and syllabi. The division of labor refers to the roles played by TSs in planning, conducting, documenting, evaluating, and reflecting on their teaching experiences and the support provided by teacher educators and supervisors.
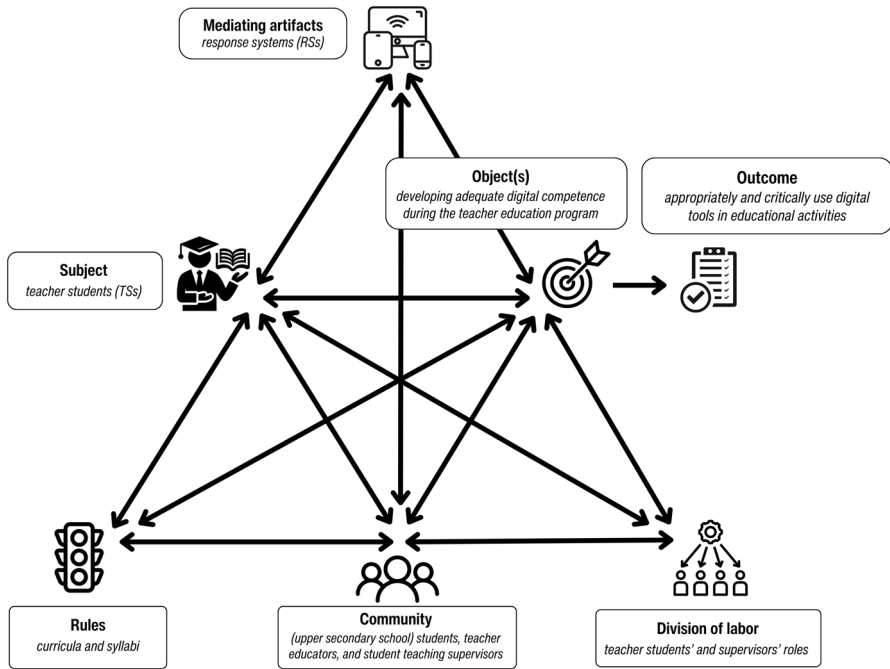
Fig. 1 The activity system in this study (illustration inspired by Engeström, 2001, p. 135)
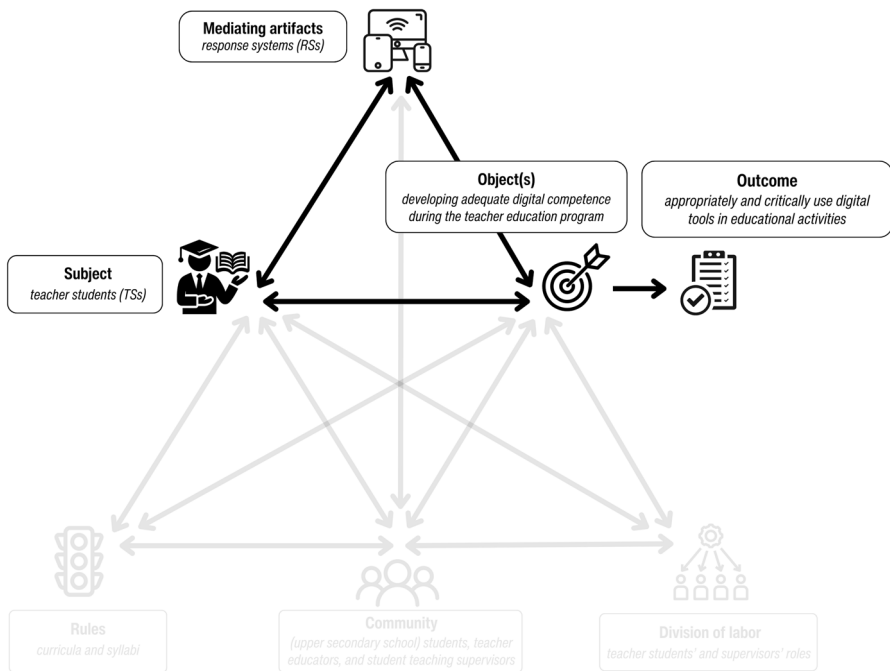

Fig. 2 The theme "Relating theory and practice" in the activity system

5.2 Relating theory and practice

The first theme describes how the TSs related their practical use, or non-use, of RSs to their prior knowledge of educational theories and how it influenced how they implemented RSs in their teaching practice. Thus, in the activity system, we saw connections between the subject, the mediating artifacts, the object, and the outcome, as illustrated in Fig. 2. Despite receiving the same education, some TSs incorporated mediating artifacts like RSs into their teaching, while others did not. The connection between the subject and the artifact is complex and related to the object, influencing whether and how the artifacts are utilized.

Most frequent and occasional users articulated a clear purpose behind integrating RSs into educational activities to support the students' learning. The TSs emphasized that using RSs facilitated a more interactive and collaborative learning environment, and they explicitly related the use of RSs to educational research concepts such as constructing knowledge collaboratively in the spirit of Vygotsky. For instance, they described how presenting all students' submissions for everyone served as a foundation for engaging discussions. According to the TSs, this procedure encourages individual contribution and enables a collaborative learning experience that they could use to adjust their teaching to the students' developmental stage, which they relate to Vygotsky's zone of proximal development.

> If we go back to this with pedagogical theories, that we should meet the students at their level and try to carry them on. To do that with a whole classroom, you have to tune in somehow to wherever the students are. And I feel like this feature [free-text question in the RS] can help with that. (Student interview 2)

Some frequent and occasional users believed that continuously recalling information during class was essential for learning. At the same time, they did not specifically use the term, their descriptions of how they used RSs during their student teaching aligned with the concept of retrieval practice.

> Even though I like to lecture, I know that students get mentally tired after 20 min of just listening and being fed with information. Somewhere around there, you need a break to reflect upon what the teacher has said and work a little with this to understand it […]. If you don't do that, it's just information that you don't know what to do with. (Student interview 1)

Further, many of the frequent and occasional users, and some of the non-users, related to formative assessment by explaining that scanning the students' grasp of the material either had helped or could have helped them to make informed decisions about future instructional strategies.

> You start with something that makes them recall or have them think about what we're going to do during the lesson. Then you conclude with something that gives you insight into what the students have learned […] and if

you need to focus on something special next time or focus more on what you have taught this time. (Student interview 1)

Some occasional and non-users shared their hesitations about using RSs due to doubts about their theoretical basis and educational value. They expressed concerns over striking a balance between critically evaluating the educational benefits of RSs and recognizing that RSs could support teaching. Despite these reservations, some reasoned about incorporating RSs into their teaching strategies, suggesting that RSs could be beneficial.

I'm afraid to incorporate them because I worry a lot about how critically I actually view my materials and what I use. And when it comes to how educational these systems really are. I think I need to… Maybe not worry so much about it. It seems pretty clear that they can be helpful and facilitate teaching. (Student interview 2)

Nevertheless, the ICT course all TSs attended before the student teaching period seemed to have sparked a tentative interest in using RSs; however, both frequent, occasional, and non-users expressed concerns regarding the course's lack of scientific grounding. This perceived weakness made some hesitant to adopt RSs during the current student teaching. Despite these reservations, several non-users planned to employ RSs in their teaching during the subsequent student teaching period.

I felt it was a bit lacking in terms of the academic aspect. It felt easy, a bit too basic. (Student interview 5)

One non-user expressed no intention of using RSs in the future since they did not see a clear link between RSs' deployment objectives and educational research principles. A need for a more substantial scientific basis to support the use of RSs, emphasizing the importance of evidence-based practices for digital tool integration in teaching, was expressed. The student expressed doubts about the effectiveness of RSs and skepticism toward their ability to improve teaching and learning outcomes. Despite recognizing potential benefits, the student could not identify any concrete added value from using RSs, suggesting a disconnection between theoretical advantages and actual practice.

5.3 Various modes of participation

This theme describes how the TSs related their practical use, or non-use, of RSs to their reasoning about how offering different ways for the students to participate affects educational activities. We identified connections between the subject, the mediating artifacts, the object, the outcome, and the community, as illustrated in Fig. 3. This community encompasses the TSs' student teaching supervisors, the teacher educators, and the students – all of whom influenced the TSs' use of RSs.

Several frequent and occasional users noted that anonymous RS submissions fostered a more open and democratic learning environment, an inclusion they deemed vital for future classrooms.
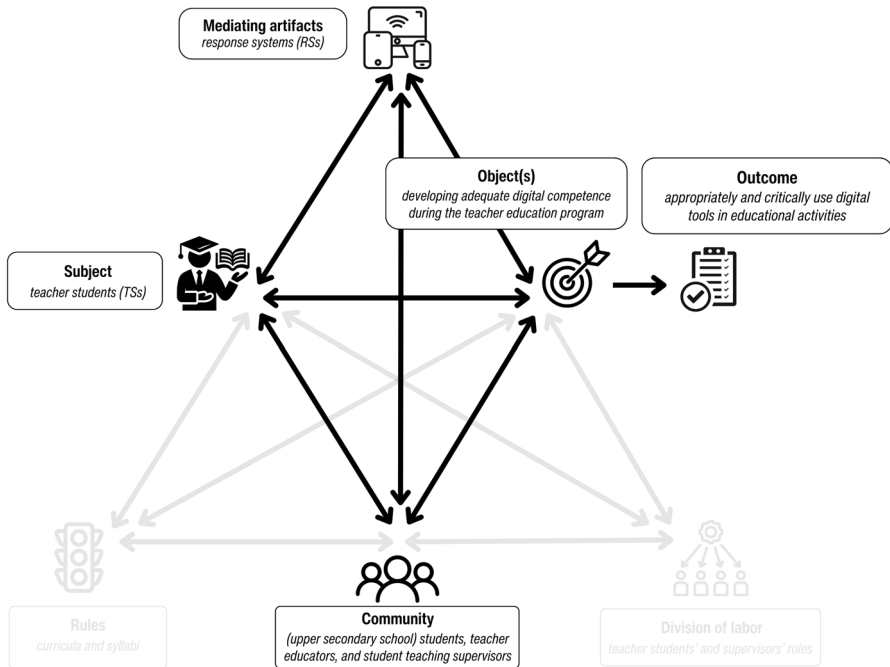
Fig. 3 The theme "Various modes of participation" in the activity system

It does have its perks, being totally anonymous and not seeing each other's answers. As a student, it can be hugely beneficial. You know, there is this pressure to think the same way everyone else does. But when that pressure is off, you are free to roam with your thoughts, to be yourself. And that freedom can make everyone more open to chiming in and sharing something. (Student interview 4)

Several TSs did, however, explain that the guidance of the student teaching supervisors was pivotal; positive reinforcement from these community members encouraged them to explore and utilize RSs, while any hesitation or skepticism from the supervisors could deter their use.

Two non-users planned on using RSs during the next student teaching period and suggested that using an RS could have encouraged broader participation. Another critical community member influenced their decision – the students – who were often hesitant or shy to participate in think-pair-share activities, often choosing to pass rather than contribute. However, according to the TSs, the anonymity provided by an RS might have alleviated these concerns, making it easier for all students to participate.

Some hesitated, were a bit shy, and didn't want to participate, which was totally okay. They could just say "Pass". But if they had had access to [an RS], it would have been anonymous, and they could have participated anyway. (Student interview 3)

In the interviews, most frequent and occasional users emphasized that they would continue to use anonymous free-text questions in their teaching, a function they had learned to utilize during the ICT course preceding their student teaching. They expressed that the teacher educator, a key community member, played a significant role in influencing their decision by modeling how to implement this function in practice. Through this guidance, the teacher educator demonstrated the function's potential to encourage active participation, which impacted the TSs' confidence in its effectiveness. As a result, these TSs considered the function valuable for encouraging the students to participate.

> I am interested in the function of being able to ask a question to a class and have everyone answer without having to address the teacher or even raise their hand. I have a great interest in that. I feel that it is almost a must if you want to develop teaching and the interaction between teacher and student. (Student interview 2)

Further, several frequent and occasional users mentioned that participating, in their opinion, is not always about contributing visibly or verbally. They highlighted that learning may occur even when not immediately observable, an insight often supported by their student teaching supervisors. They stressed that as future teachers, it is important for them to remember that learning may occur even though it is not always observable to them as teachers and that using RSs could encourage student participation that otherwise would be unobservable.
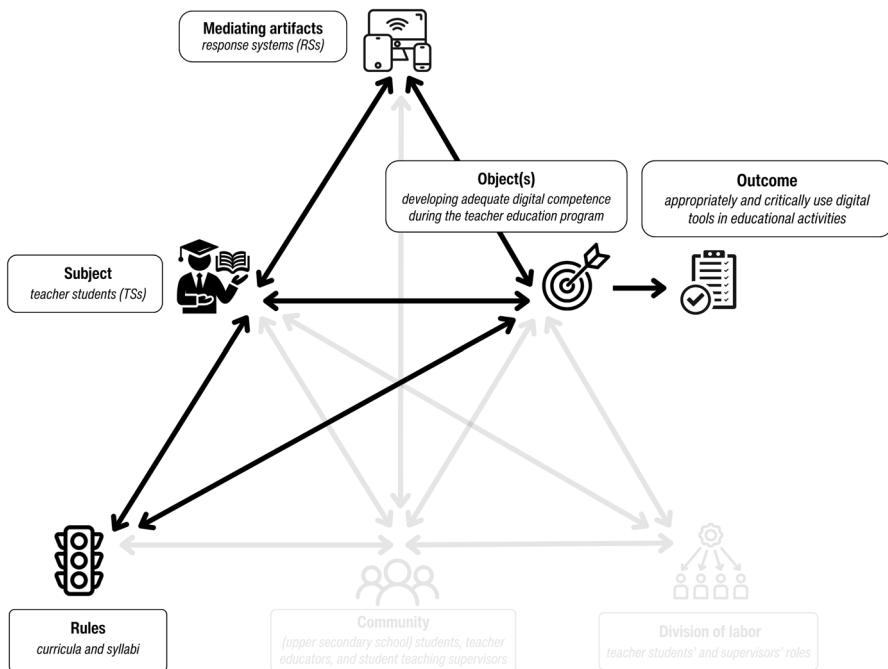

Fig. 4 The theme "Relevance to English as a subject" in the activity system

5.4 Relevance of english as a subject

This theme describes how the TSs connected their practical use, or non-use, of RSs to the syllabi and curricula, referred to as rules in the activity system (see Fig. 4). These rules play an important role in influencing the TSs' decisions on whether to employ RSs in their teaching practices, as they provide the framework within which the TSs are required to operate.

Frequent and occasional users and some non-users identified functions in RSs that were directly relevant to working with the subject content, i.e., English. The specific formulations within the curricula and syllabi influenced the TSs' choices, guiding their implementation of RSs to ensure alignment with the intended learning outcomes. For instance, the emphasis in the syllabi on vocabulary and grammar led these TSs to often employ, or envision using, multiple-choice questions as a warm-up activity to introduce or repeat specific vocabulary or grammar concepts. These activities directly addressed the intended learning outcomes outlined in the syllabi. They recognized the value of using RSs to work with vocabulary and grammar to prepare the students for more in-depth learning experiences, such as reading and writing, explicitly highlighted in the syllabi as key competencies to develop. The TSs expressed that they were also guided by curricular requirements and emphasized the importance of aligning their teaching strategies with them.

> Working on vocabulary can also be great because there are many activities [in the RS] that involve finding words, filling in the blanks in sentences, and other stuff to build vocabulary. So, that's also a solid point for using the RS. (Student interview 8)

Some frequent and occasional users used the free-text function in RSs to gather students' short reflections on texts they had read. These reflections were directly tied to the reading and writing objectives outlined in the syllabi. The TSs expressed that the purpose of letting the students submit free-text answers through an RS was multifaceted. They wanted to encourage them to participate, incorporate several small writing exercises, get a quick overview of the students' comprehension, and gather material for discussions. According to the TSs, analyzing the responses gave them insights into the students' understanding and misconceptions and guided them in adapting their teaching to align with the curricular requirements.

Some frequent and occasional users described how they used the RS for group feedback sessions, and some non-users described a similar future scenario. They started a quiz, gathered and presented the anonymous responses to the class after each question. Some included a short discussion where the students discussed the given answers. This collective review of the various answers highlighted the diversity of understandings within the group. The TSs explained that by using RSs to incorporate group feedback, they were able to better align their teaching with the learning objectives outlined in the syllabi since it allowed them to identify common areas of confusion and address them simultaneously, saving them considerable time. Further, they expressed that this cultivated a sense of community among the students since their contributions directly impacted the activity.

Students often find working with grammar boring or hard to understand, and if we use RSs, it can make the whole thing more fun; they can get immediate feedback or direct help. (Student interview 8)

5.5 Balancing fun and boring

This theme describes how TSs linked their practical use or non-use of RSs to their roles and the roles of their student teaching supervisors. Apart from the connections between the subject, mediating artifacts, object, and outcome, there is a notable connection between the mentioned components and the community and the division of labor, as illustrated in Fig. 5. The community encompasses not only the TSs themselves but also students, teacher educators in the TE program, and student teaching supervisors, all of whom influence the TSs' decisions. The division of labor refers to how responsibilities are distributed among these stakeholders: TSs take on roles in planning, conducting, documenting, evaluating, and reflecting on their teaching, while teacher educators and supervisors provide guidance, feedback, and support throughout this process.

Some non-users claimed that their prior negative experiences of using digital tools in educational activities influenced their reluctance to integrate them into teaching as TSs. Specifically, these experiences were shaped by seminars in which educators within the TE programs failed to adequately demonstrate teaching with
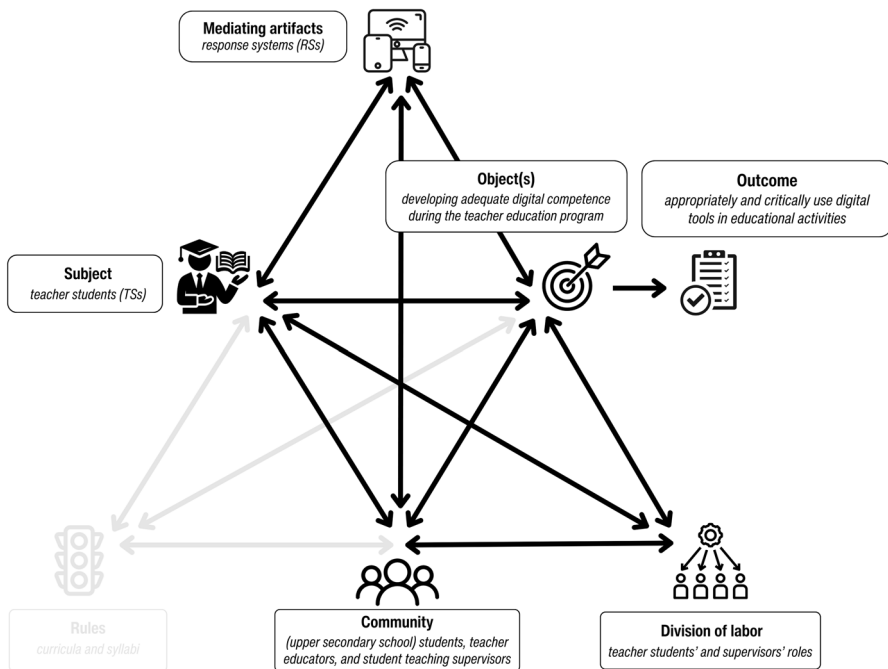

Fig. 5 The theme "Balancing fun and boring" in the activity system

digital tools in a practical context, for instance, in blended synchronous seminars during the pandemic years. The TSs claimed that some educators used RSs without an explicit purpose or "just for fun". Consequently, this lack of explicit modeling led to a cautious stance toward implementing such technologies in their teaching practices.

> It [using RS] was a bit too "flashy" – a play to the gallery somehow. It felt that it was a bit unnecessary. (Student interview 3)

The occasional users tended to integrate more game-based activities into their teaching than the frequent users. They viewed it as an enjoyable break from traditional learning methods. Some students described how a typically dull subject, like grammar, became much more engaging when interactive activities were incorporated, especially when working on irregular verbs. They noted that what could have been a tedious lesson was transformed into a fun experience, emphasizing how game-based learning can make even the most challenging or boring topics more enjoyable for both teachers and students.

While acknowledging game-based activities as a "fun way of learning", some also expressed a cautious approach to their use with future students. Their concern centered around maintaining classroom order, indicating a balance between the engagement benefits of game-based learning and the potential challenges of managing student behavior. Their decision to reuse such activities depended significantly on the dynamics of the student group.

> It depends a lot on the class. The classes I taught now would think it was far too childish and dismissed it immediately, and others would have thought it was cool – so it probably depends very much on the class. (Student interview 3)

Several frequent and occasional users noted the challenge of creating engaging and varied questions, emphasizing the risk of student disengagement due to repetitive queries. They stressed the need for creativity in question development to maintain an engaging learning experience, highlighting the difficulty of sustaining interest without falling into monotony. Some TSs mentioned that this issue is a recurring aspect of teaching. They claimed it to become even more pronounced when utilizing RSs due to the increased frequency of interactions, the diversity of student participation, the demand for questions that stimulate curiosity and critical thinking, and the necessity to maintain engagement over time without becoming predictable.

> The most challenging part for me is creating questions that feel right and aren't repetitive. I believe the students would get tired of "What have you learned from this lesson?" if it comes up three times and so on. That would be problematic: keeping up the creativity and varying the questions. And then… Well, there are many ways to check their responses. But then… It could become a bit overdone if you don't use different ways. (Student interview 6)

However, some frequent and occasional users described the game-based activities not as mere entertainment but as a deliberate method used for learning. They articulated an awareness of the intentional design behind these activities, recognizing them as carefully crafted experiences aimed at enhancing the students' understanding of concepts through engagement and interaction. The TSs claimed that, by embracing this method, the students were allowed to be more active participants in constructing knowledge.

> I don't think they really saw it as "play" but rather as something that… [pause] It was simply for learning purposes, that's why we were doing it… (Student interview 1).

5.6 Attitudes toward digitalization

This theme describes how the attitudes toward digitalization from students, student teaching supervisors, and teacher educators influence the TSs' practical use or non-use of RSs. These attitudes are further shaped by guidelines and policy documents, which mandate using digital tools according to the curriculum and syllabus. Despite these requirements, not all community members fully embrace the integration of digital tools. We identified connections with the community and the rules, as illustrated in Fig. 6. The attitudes and perceptions towards digitalization of the
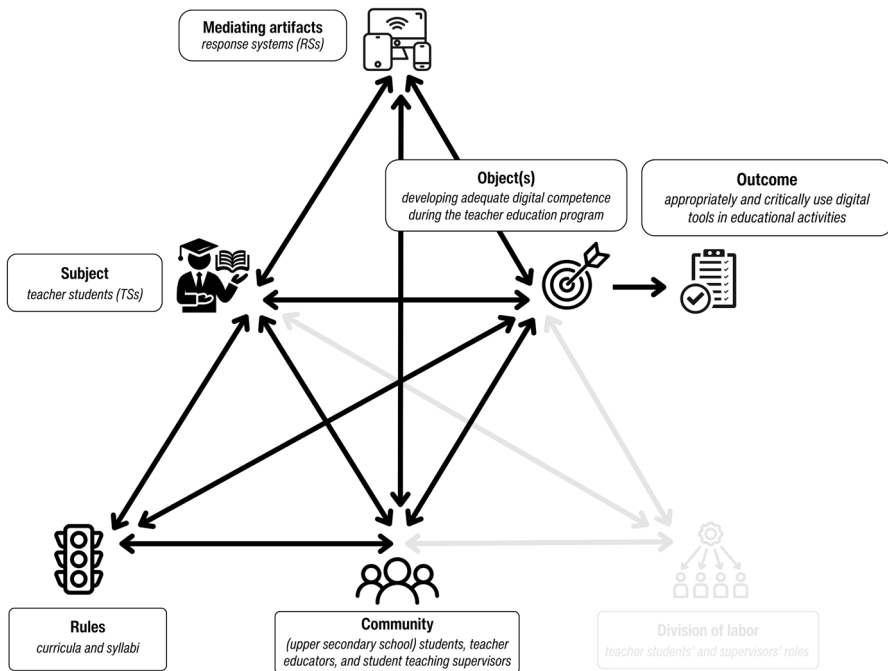

Fig. 6 The theme "Attitudes toward digitalization" in the activity system

community, encompassing all stakeholders involved, influenced the TSs' approach, willingness, and ability to incorporate RSs into their teaching.

The mandatory nature of digital tool usage, as stipulated by curriculum guidelines (the rules in the activity system), sets standards and influences the TSs' perceptions and implementations of RSs. However, the acceptance of these tools by students and student teaching supervisors varies, with some not fully embracing them. Thus, while the curriculum enforces the use of digital tools, the TSs must navigate diverse attitudes from the community, balancing adherence to policy with practical realities. This illustrates the interplay between systemic guidelines and the practical experiences of TSs.

A few non-users believed that using digital tools, in general, could be disruptive and distracting for the students, as they often were given free access to the internet. Some reasoned that it was simplest not to use digital tools at all to avoid disruptive elements. One non-user even extended their skepticism, suggesting that the use of digital tools could be harmful to students' learning by being overly distractive. Further, some expressed a generally negative stance towards digitalization overall, questioning the broader implications and benefits of integrating digital tools into educational settings. They highlighted concerns about the potential for diminished face-to-face interaction and the loss of traditional learning methods, suggesting a cautious approach to adopting digital tools in education.

> I'm generally skeptical about digital usage in the classroom… I even believe it could be harmful. (Student interview 4)

The TSs' RS integration occurred at varying levels of the community's involvement and attitudes. One part of the community mentioned explicitly was the student teaching supervisors. Even though the TSs argued that the supervisors' positive or neutral stance likely contributed to a more supportive learning environment for exploring and utilizing digital tools, this was considered less important by the TSs who used digital tools. However, the non-users claimed that the negative perceptions of supervisors' attitudes and competence regarding digital tools in general affected their willingness to engage with RSs during their student teaching.

> My [student teaching] supervisor generally prefers to run things without digitalization because it's easy for students to, for example, use cheats like AI, or maybe they end up playing games instead. So, it's better to have them sit and get them to focus on work through manual methods instead, like with pen and paper. (Student interview 6)

Two non-users planned on using RSs in the future or during the next student teaching period and expressed insecurity regarding their professionality as teachers related to using digital tools and, therefore, did not dare to introduce something "new" during their student teaching.

> I think the problem is that I'm not really where I need to be to include such things. I feel that I want to establish a professional foundation in my work, and in the small vision I have of a professional foundation, I might not yet

be using RSs. And it's really the same with the materials I use to clarify what I mean by not quite daring to be creative. That I don't really dare to use websites and such with my materials. (Student interview 2)

Despite some non-users and occasional users' skepticism, frequent users generally held a cautiously positive outlook toward digitalization. They recognized the potential benefits of incorporating digital tools into teaching and learning processes, viewing them as resources in educational activities. Their cautious optimism was often rooted in their ability to relate to previous educational research, as described in the first theme of this study.

I didn't favor the digitalization of schools initially, but now I see it from a different perspective […], and I realized how easy and interactive teaching with [an RS] could be. (Student interview 1)

6 Discussion

This section addresses the research questions by discussing the findings through the lens of the activity system described previously. Even though all components relate to and affect each other in an activity system, there were some specific connections between components in the activity system in this study that became visible when we created the themes. By examining these connections, we can better understand how themes and components are interwoven, providing insights into the overall functioning of the activity system to address the research questions.

6.1 Components influencing TSs to use RSs during student teaching

In this study, the activity system's object, or goal, is for the TSs to develop adequate digital competence during their student teaching using digital tools. The results reveal that even though some digital tools were readily available, the extent to which RSs were integrated varied significantly. The TSs had varying levels of digital competence and pedagogical beliefs, influencing their overall use of RSs.

The theme of relating theory and practice was a central influence on TSs' use of RSs. In line with previous research, all TSs highlighted the importance of bridging the gap between theoretical knowledge and practical application (Darling-Hammond, 2000; Hatch et al., 2016; Korthagen et al., 2001) and agreed that student teaching would be a suitable place for relating theory and practice. All TSs explicitly connected their (non) use to how they either managed or did not manage to relate theory and practice. Frequent and some occasional users of RSs saw benefits in integrating RSs into their teaching and grounded their use in established educational theories. They were able to draw direct connections between the theoretical concepts learned in their TE programs and the practical use of RSs in the classroom. Non-users struggled to make these connections, which led to uncertainty about the pedagogical value of RSs and, ultimately, their reluctance to use them. This finding is consistent with previous research, emphasizing the importance of pedagogical

underpinnings in effectively integrating digital tools into teaching and learning processes (Børte et al., 2023; Haugerud, 2011; Instefjord, 2015; Ottestad et al., 2014).

The distinction between frequent, occasional, and non-users highlights a crucial connection within the activity system between the subject (TSs), the mediating artifact (RSs), and the object (developing digital competence). For the activity system to function, the tools (in this case, RSs) must align with the subject's needs and the object, facilitated by a theoretical foundation in TE (Engeström, 2001, 2015). Such a foundation in TE supports TSs in applying digital tools effectively and critically during their student teaching, an essential part of developing digital competence (Punie & Redecker, 2017; Ministry of Education and Research, 1993:100).

A pertinent question arises: Why do some TSs interpret and apply the theory they learned in the TE program differently? This difference in interpretation could be influenced by several factors within the activity system. For instance, the community component, particularly the influence of supervisors and teacher educators, plays a significant role, which we can see in the themes of various modes of participation and attitudes toward digitalization. Supervisors who model effective integration of theory and practice may encourage TSs to do the same, whereas those who do not may inadvertently contribute to a disconnect between theory and practice. Furthermore, how theory is presented in the TE program – whether integrated with practical examples or treated as abstract knowledge – can significantly impact how TSs perceive and apply it during their student teaching.

The frequent and occasional users made a clear connection between using RSs and the relevance of English as a subject. They clearly understood the content they were expected to teach based on the content of the syllabi of the English courses they taught. Also, they were well aware of the overarching formulations in the curriculum regarding using digital tools to promote learning. This awareness demonstrates that the TSs were not merely using RSs as a technological add-on but as a deliberate pedagogical tool aligned with curricular goals.

This alignment with the rules component of the activity system indicates that TSs approached the use of digital tools, like RSs, with a deliberate focus on meeting curricular requirements. Their integration of RSs in line with these guidelines reflects a reflective practice, where they actively sought to harmonize their use of digital tools with the intended learning outcomes. These curricular rules significantly shaped TSs' behavior and encouraged them to use RSs purposefully.

In the interviews, several TSs explained how they integrated RSs into educational activities for different purposes, directly addressing key language acquisition components essential for students' progress, as highlighted in the syllabi. However, some TSs did not perceive this connection as clearly as others due to several factors within the activity system, which we continue discussing below.

6.2 Components influencing TSs to refrain from using RSs during student teaching

A well-defined division of labor could enhance the use of RSs by clarifying roles in planning and executing educational activities. For example, as highlighted in the

study, TSs are often responsible for planning and executing lessons, while their student teaching supervisors are expected to offer guidance and feedback. When these roles are unclear or inadequately supported, TSs may feel uncertain about integrating digital tools like RSs into their teaching, which can lead to the underutilization of available digital tools, as highlighted in previous research (Chen et al., 2020; Dalby & Swan, 2019). In addition, some TSs' perceptions – shaped by occasional and non-users' experiences – influenced their willingness to use RSs. Negative prior experiences and doubts about the practical utility of digital tools resulted in reluctance to integrate them into teaching practices. For instance, some TSs perceived RSs as flashy or unnecessary, indicating a misalignment between their intended educational purpose and actual use. These factors underscore the importance of effective planning, implementation, documentation, evaluation, and reflection when using digital tools, as highlighted in the DigCompEdu framework (Punie & Redecker, 2017), which requires collaboration and support. While some TSs found RSs to be an enjoyable break from traditional methods, others expressed concerns about maintaining classroom order and avoiding activities that might feel too childish or repetitive. Striking this balance was crucial in determining whether RSs were perceived as beneficial or merely entertaining.

Additionally, TSs who struggled with repetitive question development noted that the lack of guidance in creating content for RSs revealed a gap in the division of labor, which sometimes led them to refrain from using RSs altogether. Without clear support in designing varied and engaging questions, TSs felt unsure of how to utilize RSs effectively. This gap in the division of labor had broader implications for the activity system as a whole, as it disrupted the alignment between the tools, the subjects, and the community. When roles and responsibilities are unclear or unsupported, it hinders the collaborative processes between TSs and supervisors necessary for the successful integration of RSs, leading to a breakdown in the intended functionality of the activity system. This misalignment within the system reduces the likelihood that the TSs would use RSs.

Several TSs used RSs as mediating artifacts to bridge the gap between theoretical knowledge and practical application, reporting positive outcomes when using RSs to facilitate formative assessments and engage students in vocabulary and grammar activities. However, some TSs expressed doubts about the pedagogical value of RSs or their abilities to effectively integrate such tools into their teaching, reflecting concerns similar to those identified in previous studies (Edstrand & Sjöberg, 2023; Gudmundsdottir & Hatlevik, 2018). This suggests that the issue is not merely one of access or availability but is deeply rooted in a broader disconnect between the theoretical training provided and the practical realities of teaching with digital tools. The apprehension among some TSs regarding the educational value and theoretical basis of RSs indicates a gap in their education related to digital competence. This misalignment within the activity system suggests that when tools like RSs do not resonate with TSs' pedagogical beliefs or perceived competencies, they are unlikely to be utilized effectively, leading to a breakdown in the system's intended functionality. The perceived lack of scientific grounding and practical modeling by educators limited the TSs' confidence in making informed decisions about integrating RSs into their teaching practice or not. This observation aligns with previous findings

emphasizing the need for TE programs to provide more effective, evidence-based training in digital tools (Børte et al., 2023; Gudmundsdottir & Hatlevik, 2018). By providing structured opportunities for TSs to apply digital tools in real teaching scenarios during their TE program, alongside reflective practices, TSs would acquire practical experience and the reflective insight necessary to bridge the gap between theoretical knowledge and practical application. This approach could help ensure that when TSs choose to integrate digital tools into their teaching, they do so with an understanding of the pedagogical value and implications, leading to meaningful use of digital tools in education.

The community component included the upper secondary school students, the teacher educators involved in the TE program, and the student teaching supervisors. Their norms, support, expectations, and attitudes contributed to shaping how the TSs in this study used RSs, which aligns with previous research on digital tools in teaching (Amhag et al., 2019; Instefjord, 2015; Lindfors et al., 2021; Ottestad et al., 2014). For instance, while positive support from the community encouraged TSs to use RSs, skepticism or a lack of enthusiasm from teacher educators or supervisors often deterred them. This gap in the division of labor, where supervisors failed to model the use of RSs effectively, i.e. demonstrate the practical use of RSs in real teaching scenarios, played a crucial role. When the modeling was absent or inadequate, TSs struggled to see the value of RSs, leading to a breakdown in the activity system. This misalignment reduced the likelihood that TSs would effectively use RSs, as their roles and responsibilities were not clearly supported or defined.

The critical attitudes expressed by some TSs toward digital tools, including RSs, reflect a tension within the activity system between the community and rules. This tension underscores the need for clear guidelines and strong community support to align the use of digital tools with pedagogical objectives. Furthermore, the rules that govern digitalization practices influence these dynamics, shaping the TSs' attitudes and practices. Official documents and guidelines provide the structure within which these attitudes and practices develop, and these regulations can either facilitate or hinder the integration of RSs, depending on how they address the needs and challenges of digitalization in education. However, the TSs' critical stance towards using digital tools should not be seen as a limitation. Instead, it is a crucial component of developing critical thinking in digital competence (Punie & Redecker, 2017). This discernment reflects a growing understanding that integrating digital tools in education is not about mere adoption but thoughtful, evaluative use. The ability to critically assess when, how, and why digital tools are used aligns with the broader educational aim of ensuring that technology is employed appropriately and critically (Ministry of Education and Research, 1993:100). This critical approach should be acknowledged and actively nurtured within TE programs. Encouraging TSs to question and evaluate the use of digital tools fosters a deeper pedagogical insight, equipping them to make informed decisions in their future classrooms.

7 Conclusion

This study aimed to explore to explore what influenced the TSs' decisions to use digital tools during student teaching. It highlights that achieving the object of the activity system – developing digital competence – depends on the alignment between the tools (RSs), the subject's needs (TSs), and the other components of the system. When coherence exists among these elements, TSs are more likely to integrate RSs into their teaching effectively. However, misalignments in the form of a lack of theoretical grounding, unclear rules or division of labor, or insufficient community support lead to inconsistent RS use among TSs.

In conclusion, this study contributes to the ongoing discourse on digital competence in TE by addressing a previously overlooked gap: how TSs translate their theoretical and practical understanding of using digital tools into practice during student teaching. By discussing the context and connections between the components in the activity system, we provide further insights into digital competence development within TE programs and contribute to the ongoing discourse on integrating digital tools in both TE and student teaching. While digital tools like RSs offer the potential for bridging theoretical knowledge with practical application, their effective integration is challenged by misalignments between theoretical frameworks and classroom realities. By examining the use of RSs, the study highlights the complexities involved in this process and suggests ways better to align TE with the practical demands of current classrooms. These findings underscore the need for ongoing discussions on enhancing digital competence within TE programs.

7.1 Contributions

This study offers theoretical and practical contributions by illustrating how digital tools can be effectively integrated into TE programs by aligning components within the activity system. It expands on existing research on digital competence by highlighting the critical connection between theoretical knowledge and practical application. Practically, the study underscores the need for TE programs to enhance digital competence through training that links theory with practice and provides hands-on experiences to demonstrate the relevance of digital tools in teaching.

To address the gap between theory and practice, TE programs should adopt a more integrated approach that embeds digital tools within a pedagogical framework to encourage TSs to use them appropriately and critically. This approach ensures that digital tools like RSs are not only introduced but are also meaningfully incorporated into TSs' teaching practices during their student teaching.

7.2 Limitations and further research

Based on a limited sample of TSs from a single program in Sweden, this study only captures some possible perspectives on digital tool integration. However, its focused

and in-depth analysis offers valuable insights. Semi-structured interviews provide a detailed exploration of TSs' perceptions and experiences. The study's focus on a specific digital tool, RSs, allows for a concentrated analysis. Although the short teacher training period limits understanding of long-term trends, it offers a snapshot of current practices that can contribute to developing TE programs.

Future research should consider more extensive, more diverse samples and longer study durations to track the evolution of digital tool integration by TSs over time. A multi-theoretical approach could provide a more comprehensive understanding of the factors influencing digital competence development in TE. Despite its limitations, this study contributes to the ongoing exploration of digital tools in TE, paving the way for further research to build on its findings.

Data availability The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Competing interests The authors report there are no competing interests to declare.

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