

PAPER

Teachers' Perspectives on Using Technology to Enhance Pupil Participation

Johanna Öberg(✉), Uno Fors, Jelena Zdravkovic

Department of Computer and Systems Sciences, Stockholm, Sweden

johanna.oberg@dsv.su.se

ABSTRACT

In the current digital era, technology plays a crucial role in facilitating diverse interactions that are essential for pupil engagement in the learning process. This article delves into the perspectives of secondary school teachers regarding the active participation of pupils in school activities through the utilization of digital technologies. The concept of participation is approached from two dimensions: passive presence and active involvement, with a specific focus on the latter, emphasizing active engagement. The study centers on the application of digital resources in Swedish grades 7–9 to promote pupil participation and enhance the learning experience. We examine the use, effectiveness, and areas requiring improvement of existing digital resources. Drawing from prior workshops involving teachers, we aim to elucidate educators' viewpoints on the role of technology in enhancing pupil participation. Grounded in the Garrison and Andersson's theoretical framework, the study advances the comprehension of the interactions necessary to foster an effective learning environment, as perceived by educators. The results derived from the thematic analysis yield four themes: 1) Interaction between teacher and pupil, 2) Interaction between pupil and content, 3) Interaction between pupil and pupil and 4) Extended interaction. The study concludes by outlining a set of guidelines in how digital resources can support pupil participation as the response to identified challenges.

KEYWORDS

technology enabled learning, digital learning environment, participation, secondary school

1 INTRODUCTION

In the ongoing digital transformation time, digital resources are showing the potential to facilitate a wide range of interactions that are important for engaging pupils in the learning process. This study investigates the utilization of digital resources by secondary school teachers to enhance pupil engagement in educational settings, aiming to identify the types of interactions supported within their instructional practices. Previous research has emphasized the importance of

Öberg, J., Fors, U., Zdravkovic, J. (2024). Teachers' Perspectives on Using Technology to Enhance Pupil Participation. *International Journal of Emerging Technologies in Learning (iJET)*, 19(2), pp. 14–40. <https://doi.org/10.3991/ijet.v19i02.45931>

Article submitted 2023-10-17. Revision uploaded 2023-11-20. Final acceptance 2023-11-28.

© 2024 by the authors of this article. Published under CC-BY.

teachers possessing pedagogically grounded digital competence and serving as the role models for Information- and Communication Technology (ICT)-based teaching [1]. Teachers' willingness to embrace Technology-Enhanced Learning (TEL) is closely linked to their perception of its utility, followed by a greater likelihood of its integration into a learning environment when they perceive it as valuable [2]. In [3], the authors asserted that digital technologies by their nature are protean (i.e., have many different areas of usage), unstable (rapidly changing), and opaque (the inner workings are hidden from the users), unlike traditional pedagogical technologies. Nowadays, teachers need to acquire competence in teaching practice that is in sync with the context and needs of the digital age [4], thereby presenting challenges for the educators with limited training and experience [3, 5]. Therefore, it is essential to investigate teachers' professional practice development and the use of digital tools in education to enhance pupil participation in their learning process.

In the setting of our research, the notion of "participation" refers to *an active and committed involvement in educational contexts, underscoring the role of interaction and participation in meaningful contexts* [6]. Researchers argue that active participation is a necessary (but insufficient) condition for most of the forms of learning [6]. The way pupils participate within specific cultural and social contexts influences their cognition [7], and learning is seen as a cognitive change facilitated through meaningful social participation [8]. This perspective also extends to learning involving digital resources, where the level of participation in online discussions predicts pupils' active information processing [9]. Consequently, the rapid evolution of the digital realm has emerged as a medium for integrating educational objectives into technological innovation [10].

Our research endeavors to pinpoint the specific educational contexts in which digital resources can exert a significant influence in fostering pupil participation. When marked disparities exist in the conditions governing access to and utilization of digital resources between the school environment and pupils' private lives, it accentuates pupils' perceptions of having fewer opportunities for participation. By scrutinizing teachers' viewpoints on how digital resources can strengthen pupil participation, the article aims to contribute to the development of teachers' pedagogical and didactic digital competence, guided by the final recommended guidelines.

The remainder of the study is structured as follows: Section 2 offers a concise introduction to the background and relevant literature concerning participation and learning in relation to digital resources. Section 3 describes the research methodology and process, elucidates the utilization of focus groups, and the selection of samples. In Section 4, we present the study's findings, divided into two parts: *How Teachers Use Digital Resources for Pupil Participation* and *Opportunities and Obstacles for Teacher Development in Using Digital Resources for Pupil Participation*. Additionally, the four generated themes are expounded upon. Sections 5 and 6 are dedicated to discussion and conclusions, respectively.

1.1 Aim and research questions of the study

The primary objective was to improve the understanding of teachers' viewpoints regarding the utilization of digital resources and the challenges associated with using them to facilitate pupil participation. The study sought to address the existing gap in knowledge concerning the utilization of digital resources in terms of their application, functionality within the school environment, and potential areas for improvements. The following research questions are defined:

1. *Do secondary school teachers use digital resources to support the pupil's participation in their learning?*
2. *How do secondary school teachers use digital resources to support the pupil's participation in their learning?*

By engaging teachers in the form of focus groups, the study was designed with the aim of enhancing generic knowledge and understanding of how teachers can utilize digital resources to enhance pupil participation. It also addresses teachers' perceptions of their own capacity to develop pedagogical practices in this context, potential obstacles, challenges, and strategies for resolution. These focus groups offer valuable insights into teachers' perspectives on how and why they employ technology (i.e. ICT) to foster pupil participation, thus advancing our understanding of the essential interactions necessary for creating and enabling a progressive learning environment, as perceived by educators in middle school settings. Given the rapid evolution of technology in society, where young people have access to and interest in digital exploration, it is imperative to investigate how digitalization can facilitate various interaction types that support pupils' participation in the learning process.

2 BACKGROUND AND RELATED WORK

The following sections provide the background, previous research, and relevant literature related to participation and learning in relation to digital resources.

2.1 The importance of interaction in education

The concepts of participation and interaction are intricately linked, particularly in the field of education, where the meaning of interaction has been the subject of extensive discourse. The difference between these two concepts and the determination of situations characterized by interaction as opposed to those characterized by minimal participation are analytical decisions dependent on the specific case and its contextual characteristics [11]. This identification process is often influenced by the researcher's own epistemological beliefs about the role of human interaction in education and the learning process [12]. Early reasoning about the meaning of "interaction" can be exemplified by John Dewey's assertion that interaction constitutes a fundamental element of the educational process [13]. Throughout history, interaction has consistently remained a central and defining element in the field of education and learning [12]. Although interaction in education is a multifaceted concept, this study adopts Wagner's definition, which characterizes it as "reciprocal events requiring at least two objects and two actions, which occur when these objects and events mutually influence each other" [14, p. 8]. Different models of interaction have been developed, which include dyadic interaction relationships between pupils, teachers, content [15], learning environments [16], and institutions [17]. Interactions at different levels can influence the effectiveness of learning outcomes, with a predominant focus in research articles on peer-instructor interactions [18].

"Three Types of Interaction" framework in a digital learning environment. Moore's framework [15] categorizes the interactions in the learning environment into three types to analyze various aspects of teachers' educational use of digital resources and how they can enhance their practice to facilitate pupil participation (see Figure 1). Moore's theory, known as the theory of transactional distance, provides a pedagogical

and technological understanding of all forms of education involving the separation of pupils and teachers [19]. This theoretical framework was chosen due to its contributions to insights and understanding in previous studies, as well as its frequent citation and alignment with recent theories [18]. Moore's theory of transactional distance [15] is pivotal in defining distance education as a subdiscipline of education, distinct from the theory and practice of correspondence studies [20]. Moore's theory encompasses three essential constructs: (i) structure, (ii) conversation or dialogue as components of communicative action, and (iii) pupil autonomy. Structure refers to the educational or learning experiences shaped by learning activities. Communicative action or dialogue underscores the importance of the pupil-facilitator relationship and the role of experience in learning. Pupil autonomy relates to the extent to which pupils can influence their own educational parameters, such as goals, objectives, assessment, and evaluation. A meta-analysis [21] identified the same three interaction patterns [15] in distance education (pupil-pupil, pupil-teacher, and pupil-content), providing evidence that more vs. less interaction affected all three realms, producing significant moderation effects.

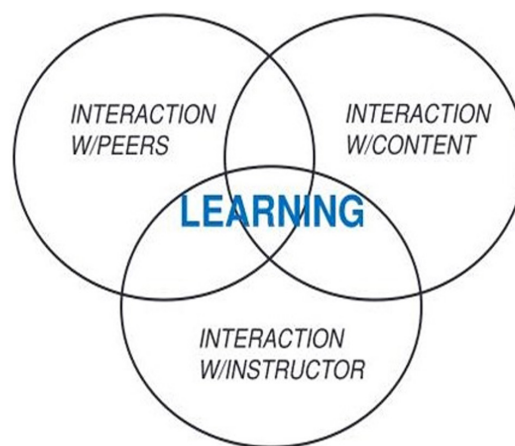


Fig. 1. Three types of interactions in learning environments [15]

Moore's theory has been influential in defining distance education, emphasizing the separation between teaching and learning behaviors, requiring facilitated communication between the pupil and the teacher through various means, including digital resources. Importantly, the theory addresses both geographical and psychological distance, emphasizing the psychological aspect of distance, which pertains to a gap in understanding between the pupil and the facilitator [22]. This perspective underscores the aim of bridging the psychological gap, regardless of the pupil's geographical location, to facilitate the development of knowledge.

2.2 Related works

Prior research on pupil participation has revealed that pupils often have limited influence over matters of genuine significance for their learning, with a substantial portion of surveyed ninth-grade pupils not perceiving themselves as having an impact on teaching content and methodologies. Overall, past studies have shown that pupils' experiences of participation and involvement have typically been negative. While pupils may express a desire for participation, they often feel that they do not have a significant degree of influence [23] – [26]. Pupils sometimes view participatory discussions as mere theatrics, with teachers ultimately making the decisions.

Additionally, pupils may feel a sense of deception in terms of false promises [27] – [29]. Some studies suggest that the representative democracy within schools does not effectively promote participation and involvement among pupils [24]. When asked about their desired areas of influence, pupils often mention material conditions, lunch arrangements, restrooms, and the learning environment, with requests for influence over teaching being exceptional [30]. Such experiences risk shaping young people's perspectives on participation in broader democratic processes, leading them to question why it would function differently in society [31]. Within this article, the term “learning environment” aligns with Edlinger's interpretation. It serves as an umbrella term, encompassing synonymous expressions like learning space, learning setting, learning arrangement, or learning location, and these terms lack clear distinctions from one another [32]. The active participation of children and pupils yields practical advantages, particularly in educational settings, where the sharing of information and decision-making can be highly beneficial [33]. Participating pupils acknowledge the pivotal role of their engagement in their learning journey [34]. Educators also underline the importance of engaging in continuous professional development to nurture a lifelong learning mindset, which, in turn, can contribute to career success [35]. To enhance and improve pupils' participation in accordance with their preferences, it is essential to bolster the technology-based interaction opportunities [36].

Beyond the aforementioned considerations, the core concept of interaction emerges as a vital component of supporting learning, aligning with the idea that learning is closely linked to participation within meaningful contexts [37]. Childhood is subject to various structural influences shaped by economic, ideological, cultural, and political factors, with experiences and knowledge of childhood representing a dynamic commodity [38][39].

International research on children's influence primarily focuses on teachers exploring their perspectives on ‘children's influence,’ their attitudes toward influencing children, and their practical actions [40] – [43]. Teachers exhibit uncertainty concerning the broader meaning of influence, and studies have identified discrepancies between what teachers espouse and their actions in practice. Effective leadership within the teaching staff is crucial for nurturing and involving pupils in democratic processes to achieve the goal of fostering pupils' participation in democratic processes and enhancing their critical thinking in everyday life [44] perspectives is pivotal in facilitating pupil participation since teachers' professional practice and approach significantly impact classroom outcomes and pupils' academic success [45][46]. Additional factors influencing pupil participation include time constraints, discipline issues, pupil motivation, supportive colleagues, collective school culture, and alignment with values [47].

While international research on ‘children and influence’ often pertains to freedom of expression and children's opinions being considered, there has been a tendency toward a one-sided focus on the extent to which children and young people are heard in education. This focus includes studying how preschools and schools consider children's opinions [48] – [50] and conducting interviews with children to gauge the importance they attach to being listened to and the degree to which this occurs [41][51], thereby establishing a child/pupil perspective on influence.

2.3 Previous studies on participation

This study draws upon a series of previous workshops with teachers [52] as a foundational framework to understand participation. The results obtained from those workshops informed the development of categories (themes and sub-themes)

to guide focus group interview questions and the subsequent data collection in this study. The workshops involved six teachers from the same primary school, spanning various subject areas and levels of professional experience. The research design incorporated a series of four workshops, fostering opportunities for teacher reflection on their pedagogical practice between sessions. The aim was to encourage teachers to discuss their professional challenges based on their experiences [53] – [56] and engage in reflective practices [57]. These workshops leveraged teachers' professional expertise and knowledge [58], exploring diverse approaches to promote pupil participation, and fostering ongoing collegial learning [59]. The preceding study offered insights into teachers' perspectives as they developed a pedagogical model to support pupil participation and contributed assessment data related to pupils' knowledge outcomes and progression. These insights provided a deeper understanding of how a pedagogical approach, in the context of broader school considerations, should be structured, as well as the challenges associated with using digital resources to facilitate pupil participation and pedagogical reasoning.

3 RESEARCH METHOD AND PROCESS

The methodological approach employed in the study was the participatory research in terms of focus groups. This approach involved engaging with teachers who possess significant experience and expertise in the learning context. These teachers played a crucial role in contributing their insights and reasoning on how the learning process could be further developed.

3.1 Focus groups

This qualitative investigation was primarily conducted to explore educators' viewpoints on the potential of digital resources in enhancing pupil participation. To achieve this objective, a focus group methodology was adopted, aligning with a qualitative approach that prioritizes the naturalistic study of individuals in real, non-artificial settings, rather than isolating them [60]. The study comprised of 13 participants, all of whom were employed as secondary school teachers and possessed previous experience in incorporating technology into their teaching practices. The formulation of questions for the focus group interviews was influenced by a prior study in which educators collaborated in workshops to examine the possibilities of a shared pedagogical model and the role of technology in fostering pupil participation.

The findings from this earlier research, analyzed using Braun and Clarke's thematic data analysis method [61], in conjunction with Moore's theoretical framework encompassing three types of interactions [15], contributed to a deeper comprehension of how teachers perceive the contribution of digital resources to pupil learning. Moore's framework [15], centered on interactions among core actors, including pupils, teachers, and subject content, provided a valuable foundation for further exploration and meaningful scientific contributions in the current study involving teachers participating in focus groups. The focus group sessions were organized into two separate meetings, involving six teachers in one session and seven teachers in the other. Throughout these sessions, participants engaged in discussions centered around the question: "Do teachers utilize digital resources to support pupil participation in their learning, and if so, in what ways?" The overarching goal was to encourage teachers to reflect more deeply on the utilization of digital resources in school settings to enhance pupil participation.

The focus group sessions were audio recorded and subsequently transcribed verbatim.

3.2 Qualitative sampling selection

The study sample comprised of professional secondary school teachers who had experience in utilizing digital resources to facilitate pupil participation. The sampling methods were based on purposive sampling with a flexible and pragmatic approach, aimed at generating data to enhance the comprehension of complex human issues [62]. The study's objective was to investigate teachers' perspectives regarding the role of digital resources in supporting pupil participation, including the negotiation and development of individual and collective perceptions, ideas, opinions, and values. This exploration was conducted through moderated focus group discussions [63] where the method involved data collection through "interaction in a group discussion as the source of data" [64, p. 130]. Given that the research questions were specifically focused on the context of secondary school education, inclusion criteria necessitated that the participating teachers were well-acquainted with the same educational framework. This requirement enabled access to their insights, perspectives, and shared views within this specific educational setting [65][66], facilitating the possibility of both conceptual discussions and reasoning at the level of detail due to the co-understanding of their shared educational context [67]. The goal was to ensure that the participants in the focus groups adhered to the same rules and guidelines. Exclusion criteria were applied to schools whose practices did not align with the secondary school curriculum, including cases where teachers were from special secondary schools and those who were in the induction phase with an experienced teacher as a mentor.

A decisive factor was the pragmatic choice of place for the focus group sessions, as the teachers did not need a demanding effort to participate, as they worked full-time, and they were part of the research project in their spare time. The distribution between the two focus groups was made solely based on who had the opportunity to meet, i.e., were geographically close enough to meet. This formed the basis for choosing pragmatic in the selection of place, and that the meeting place was in a group room in a library instead of a school. The teachers who chose to participate in the digital focus group had more geographical spread than the digitally conducted focus group could accommodate. This also contributed to a somewhat greater difference in the pupil base belonging to the various schools. Two focus groups were chosen because, in contrast to one focus group, the larger data base should have contributed to more aspects being captured and thus constitute a more representative material with representation of more participants who contributed with their experience, opinions and reasoning. The choice for creating good opportunities to gain increased insight and knowledge within the selected issues led to the selection of a judgment sample based on a critical case sample. This approach is combined with subjects possessing special expertise, i.e., key informant sample, to provide "rich" information to the focus groups and the subject area. Before the interview began, the participants received verbal and written information about the purpose of the study, how the data would be collected and stored and who would have access to the database and how anonymity would be secured. The participants were also informed that the aim of the subsequent data analysis was for scientific publication, and that participation was voluntary, consent to the study could be withdrawn without motivation and that participation could be ended at any time during the process.

A compilation of the selection of participating teachers in this qualitative study was guided by several criteria and practical considerations:

- *Inclusion criteria:* The study comprised secondary school teachers who were professionals with significant experience in incorporating digital resources into their teaching practices to enhance pupil participation.
- *Pragmatic choice of location:* The selection of the research location considered the practicality for the participating teachers, who had full-time teaching commitments. The aim was to minimize any inconvenience or effort required for their participation in the study. Therefore, a group room in a library, rather than a school setting, was chosen as the meeting place.
- *Geographic convenience:* The distribution of teachers into two focus groups was primarily based on geographic proximity. This approach ensured that teachers could easily meet in person, which was essential due to their full-time work schedules. However, for some teachers with a broader geographic spread, a digital focus group was conducted to accommodate their participation.
- *Diverse pupil bases:* The inclusion of teachers from various schools contributed to a diversity in pupil populations, allowing for a broader range of perspectives and experiences.
- *Use of two focus groups:* Two focus groups were chosen over a single group to collect a larger and more diverse dataset. This approach aimed to capture a wider range of insights, opinions, experiences, and reasoning.
- *Sampling approach:* The participant selection followed a judgment sampling method, focusing on critical cases, and included individuals with specialized expertise, serving as key informants. This strategy aimed to provide rich and valuable insights during the focus group discussions.
- *Informed consent:* Prior to the interviews, participants were given both verbal and written information about the study's objectives, data collection and storage procedures, data access, and the assurance of participant anonymity. They were also informed that the study's data analysis might be included in scientific publications. Participants were reminded that their participation was voluntary, and they had the option to withdraw their consent or discontinue their participation at any point during the study.

4 RESULTS

The focus group discussions with the participating teachers covered a series of questions aimed at understanding their perspectives on the use of digital resources to enhance pupil participation. The obtained information from these discussions is presented in two distinct parts, which are presented briefly below.

Section 4.1 *How Teachers Use Digital Resources for Pupil Participation* provides insights into how teachers utilize digital resources to facilitate and enhance pupil participation in their learning. It highlights the strategies, methods, and practices employed by teachers to promote active engagement among their pupils.

Section 4.2 *Opportunities and Obstacles for Teacher Development in Using Digital Resources for Pupil Participation* focuses on the opportunities and challenges that teachers encounter when seeking to develop their use of digital resources to support pupil participation in the learning process.

By presenting the findings in these two parts, the study aims to provide a comprehensive understanding of teachers' perspectives on the role of digital resources in fostering pupil participation, as well as the factors that influence their professional development in this context. Lastly, there is an examination of the study's overall results in section 4.3.

4.1 How teachers use digital resources to facilitate pupil participation

In this first part, we have analyzed how the teachers in the focus groups utilized digital resources. While the primary focus of the questions was on how digital resources could support pupils' participation in their own learning, responses also included ways in which digital resources can facilitate participation among other stakeholders to support pupil learning.

The initial set of questions in the focus group sought to understand whether digital resources were used, and if so, which specific resources were employed to enable pupil participation. The questions posed in the focus group discussions were as follows:

- Question 1: *Do you use digital resources to facilitate pupil participation?*
- Question 2: *If not, why?*
- Question 3: *Which digital resources then? Give some examples...*
- Question 4: *How do you use digital resources to support the pupil's participation in their learning?*

The results on the use of digital resources to facilitate pupil participation are divided into four different themes based on the different combinations of the end-actors. Building upon Moore's [15] framework of "Three types of interactions" involving actors such as peer/instructor/peer/content, this study introduces four themes relevant to the context of high school and a digital learning environment, focusing on pupil/teacher/pupil/content interactions:

- Theme 1. Interaction between teacher and pupil (in 4.1.1)
- Theme 2. Interaction between pupil and content (in 4.1.2)
- Theme 3. Interaction between pupil and pupil (in 4.1.3)
- Theme 4. Extended interaction (in 4.1.4)

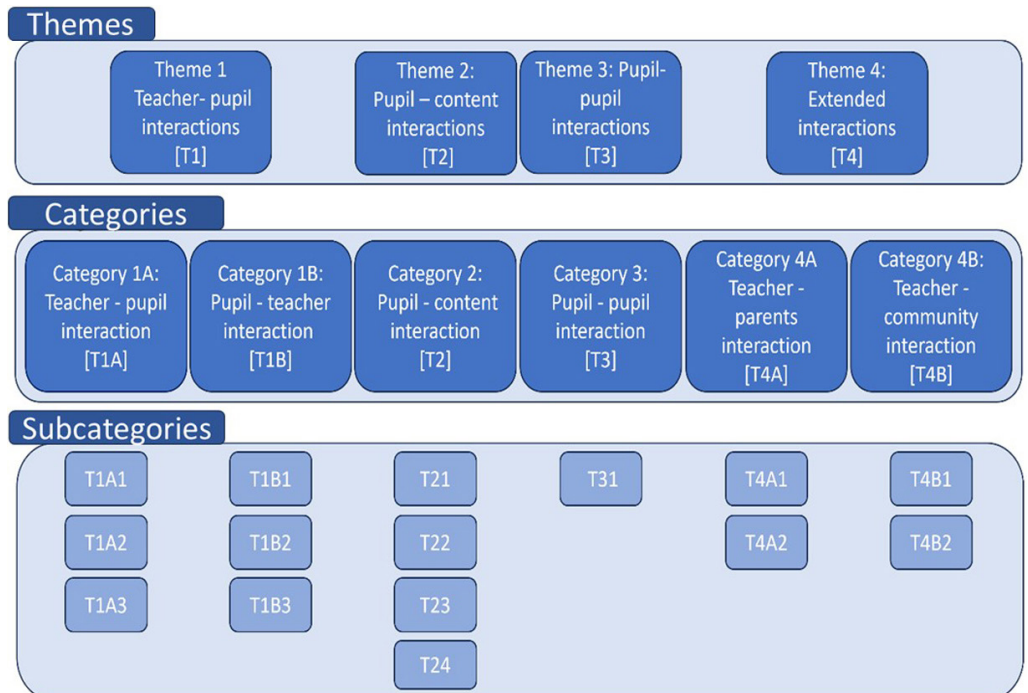


Fig. 2. Overview of themes, categories, and subcategories

The various themes consist of categories and subcategories (see Figure 2) of how these elements relate to one another. A comprehensive overview of the results is available in the Appendix, which includes subcategories along with a description of the code for each subcategory and a selection of descriptive quotes. Since all teachers in the study affirmed that they used digital resources to support pupil participation, we will not report extensively on that sub-question. The term “parent” will be used uniformly, whether it refers to the pupil’s parents or guardian. Additionally, the term “pupils” will be used in contexts that include pupils, peers, or pupil-related situations.

Theme 1: Teacher-Pupil interaction. The first theme encompasses the interactions between teachers and pupils and delves into the interactions that teachers in the focus groups discuss concerning their role in supporting pupil participation with digital resources. Theme 1: Teacher-pupil interactions embody bidirectional engagement between the teacher and pupil. This theme encompasses two categories, each further divided into three sub-categories.

Category 1A: Teacher to pupil interaction. The “Teacher to Pupil Interaction” category is centered on teacher to pupil interactions. The category’s content predominantly comprises interactive dialogues and includes elements like pedagogical guidance, scaffolding, and learning support, which entail providing information to pupils. In this context, teachers employ digital resources to transmit information to pupils through general information transfer and aggregation platforms. Typically, this distribution of information occurs at a group or class level, such as making plans accessible through the school’s platform.

Engagement with pupils is another facet of this interaction, where teachers initiate discussions with the aim of enhancing pupils’ cognitive abilities. Additionally, motivating pupils in their own development is described as supporting pupils’ progression by tailoring efforts to meet their individual needs. This motivation aims to stimulate pupils’ interest and provide them with the motivation to learn and excel.

Category 1B: Pupil to teacher interaction. The category “Pupil to teacher interaction” is centered on pupil to teacher communication. Teachers’ perspectives on how digital resources can support the interaction from pupil to teacher are focused on three key aspects:

- The first aspect involves digital resources providing pupils with their own access to an overview of their submissions, knowledge achievements, and progression. This access allows pupils to stay updated on their own learning journey and monitor their performance.
- The second aspect relates to digital resources facilitating non-verbal communication pathways that are individualized and situation specific. These resources enable pupils to engage in participatory learning by expressing themselves through various digital means, which can be especially valuable for those who may find verbal communication challenging.
- The third aspect emphasizes that digital resources can help pupils demonstrate their knowledge. This can be achieved through support functions provided by these resources or by making the learning process more enjoyable and engaging, which can motivate pupils to actively showcase their understanding and skills.

Summary on pedagogical practice from theme 1; Interaction between teacher and pupils. The pedagogical practice of interest regarding how digital resources can facilitate pupils’ participation by supporting teacher-to-pupil interaction involves several key aspects, with guidelines through:

- *Direct messaging function:* The use of the direct messaging function in digital resources is highlighted as a transformative practice. It allows teachers to communicate easily with specific groups of pupils, individuals, or the entire class. This flexibility in communication enables teachers to tailor messages and information to the relevant recipients, ensuring that pupils receive only the information that is necessary for their situations. This approach enhances the learning environment by reducing information overload and allowing for focused communication.
- *Access to subject planning and progression:* Digital resources provide pupils with easy access to essential information such as subject planning, upcoming homework, tests, and their individual progression and achievements. This accessibility empowers pupils to take an active role in their learning journey, enabling them to stay organized and informed about their academic responsibilities and progress.
- *Alternative assessment methods:* Digital resources can support alternative assessment methods that strengthen formative assessment practices. By offering opportunities for continuous feedback throughout the learning process, and not just on the final product, pupils can engage in self-assessment and reflection, fostering a deeper understanding of the subject matter.
- *Visual presentation of school days:* Some digital resources enable the presentation of school days' content through images and videos, typically shared with guardians and with GDPR permissions. Visual representations can enhance communication between the school and parents or guardians, providing them with insights into classroom activities and events. This transparency can contribute to a more collaborative educational experience.

Overall, these pedagogical practices demonstrate how digital resources can be effectively leveraged to enhance teacher-to-pupil interaction, support pupils' learning needs, and foster a more engaging and participatory learning environment.

Theme 2: Pupil – Content interaction. The theme pupil – content interaction pertains to engagement with course materials, encompassing educational videos, diverse forms of media (such as tutorials and web-based courses), game-based activities, and collaborative projects. Within this interaction category, online content serves as the catalyst for cognitive educational processes.

Category 2: Pupil-Content interaction. In consideration of how digital resources can enhance pupil participation in content interaction, educators have highlighted several key aspects. Accessibility to educational content plays a pivotal role in facilitating prior understanding. Ensuring easy access to their own progress, including formative assessment, allows pupils to improve their work or other outputs. Furthermore, digital resources offer support by affording pupils the autonomy to select resources aligned with their preferred learning styles, receive materials tailored to their demonstrated knowledge levels, or meet unique needs.

To delve deeper into this, teachers emphasize the importance of presenting subject matter in an accessible, relevant, and contemporary manner from the pupils' perspective. Allowing pupils to engage with content prior to formal instruction helps them build foundational knowledge of the context, thus enhancing their willingness and capacity to participate.

Digital resources play a crucial role in bridging the gap between pupils and content by providing a transparent overview of pupils' progress, enabling them to refine their materials. Moreover, these resources facilitate interaction between pupils and content by empowering pupils to choose resources that align with their needs for effective participation and learning. Digital resources are regarded as essential tools in supporting this interaction, offering individually tailored learning materials that

cater to diverse learning styles. These materials may include interactive resources, content adjusted to pupils' demonstrated knowledge levels, and the flexibility to select from various media types, such as text, images, videos, and presentation formats such as PowerPoint, digital posters, or graphics.

Summary on pedagogical practice from theme 2; Interaction between pupil and content. The pedagogical practice of interest regarding how digital resources can facilitate pupils' participation by supporting pupil – content interaction, as described in the context of digital education, encompasses the dynamic relationship between pupils and the educational materials or content they engage with. This interaction is fundamental to the learning process and involves various key aspects, with best practice through:

- *Educational videos:* Video content serves as a valuable resource for delivering educational information. Pupils can interact with educational videos by watching, pausing, rewinding, and replaying segments to ensure comprehension. This type of content often includes lectures, demonstrations, and explanations.
- *Media resources:* Digital education platforms offer diverse forms of media, such as tutorials and web-based courses. Pupils interact with these resources by accessing and navigating through multimedia content. This can include interactive simulations, slideshows, infographics, and multimedia presentations.
- *Game-based activities:* Educational games and gamified learning experiences engage pupils with content in an interactive and entertaining manner. Pupils participate in challenges, quests, and activities within the game environment, which often incorporate educational content and objectives.
- *Collaborative Projects:* Collaborative projects involve pupils working together on assignments, group activities, or research projects that require them to interact with course materials. This interaction fosters teamwork, problem-solving, and peer-to-peer learning.

In pupil-content interaction, the educational content serves as the stimulus that triggers cognitive processes in pupils. Pupils engage with this content to acquire knowledge, develop skills, and achieve learning objectives. This interaction can take various forms, from watching videos and exploring multimedia resources to actively participating in gamified activities and collaborative projects. Ultimately, pupil-content interaction is a fundamental component of digital education, shaping how pupils engage with and derive meaning from educational materials.

Theme 3: Pupil-Pupil interaction. Pupil-pupil interaction encompasses group work scenarios with or without teacher supervision, involving collaboration, discussion, and peer review.

Category 3: Pupil – Pupil interaction. Pupils maintain communication and access information through platforms such as Snapchat. They engage in collaborative activities, such as peer reading texts in Google Docs and working on group assignments using resources in Google Drive. Additionally, they use methods like SMS and Snapchat to keep each other informed about assignment requirements.

Summary on pedagogical practice from theme 3; Interaction between pupils. The pedagogical practice of interest regarding how digital resources can facilitate pupils' participation by supporting pupil-pupil interaction involves several key aspects, with guidelines. These include the following:

Involve digital resources supporting pupils in enhancing their knowledge and understanding through self-motivated engagement with subject matter. Pupils collaborate, for example, through buddy reading, to improve their own learning

outcomes as well as contribute to their peers' learning. Using shared documents, enabling pupils to co-construct knowledge content by sharing, creating, improving, and reviewing notes, mind maps, or questions of interest.

Theme 4 extended interaction. This theme describes interaction that is facilitated among individuals both within and outside the school environment, encompassing both school-related activities and external engagements. The theme "Extended interactions" consists of two categories and are divided into if the interaction is between teacher – parent's, or if the teacher interacts with other actors in the community.

Category 4A: Teacher parent's interaction. This introduced category delineates how digital resources can facilitate diverse interactions between teachers and the parents of underage pupils. When the teachers refer to "inclusion," it primarily pertains to parents gaining access to information rather than active two-way interaction.

The teachers explained that the goal of including parents is to support individual pupils based on their performance or behavior. This support includes providing access to detailed and regularly updated daily/weekly plans, which pupils also have access to through platforms like Classroom and Informentor. The pupil version of the school platform contains dynamic information, including deadlines for homework, project completion, and exam schedules. In cases where a pupil does not meet the required standards, such as failing to achieve a 'Passed' level, an Individual Development Plan (IUP) may be created. Information regarding undesirable behavior can be communicated to parents via the school platform, email, or SMS, depending on the urgency or the most convenient mode of contact. Parents can also be included through the dissemination of general information and plans for groups or classes, often made accessible through the school platform. This platform contains static information related to term plans and activity dates, such as predefined events where no response is expected from guardians. The most frequently mentioned form of parent inclusion is related to reporting individual pupil results, often done by granting access to assessments through the school platform.

Regarding interactions initiated by parents toward teachers, a few examples of user-friendly contact were provided. For instance, one teacher mentioned their use of a shared email account, which was established because teachers of practical aesthetic subjects oversee all pupils in their respective subject areas (e.g., needlework and woodwork) rather than having mentor roles. The shared email address allowed parents to communicate with a single point of contact without needing to determine their child's subject area for the current semester.

Category 4B: Teacher community interaction. This category focuses on interactions in which the teacher is involved but typically does not hold a directive role. It encompasses scenarios where pupils have created and utilize social media platforms intended for the entire class, facilitating discussions about seeking educational answers, reaching agreements, or catching up if someone has been absent. Teachers are often invited to participate in these online forums. Additionally, this category addresses situations where the teacher's governing responsibilities have diminished as a result of digital transformation and the widespread use of technology.

Summary on pedagogical practice from theme 4; Interaction between teacher and community. The pedagogical interest regarding how digital resources can facilitate pupil interaction through extended interaction includes key considerations: system flexibility for information access and safeguarding student privacy. Guidelines are needed for tailored information access to different groups.

Digitalisation of data and processes, transforming them into a digital format to establish secure information exchange within the Pupil Care Team. This digital transformation offers enhanced security by eliminating the risk of losing physical

documents when parents physically carry them between different agencies. It also provides effective solutions, leveraging technology to create shared documentation accessible to all members of the Pupil Care Team, ensuring they have background information on individual pupils. In some isolated cases, adjustments were made for specific pupils where sensitive information was involved, and parents were not granted access. This example pertains to information regarding illnesses, parental meeting attendance, and parental support efforts, which may be deemed important for certain professional groups to access but not for all.

Furthermore, there is an interest in exploring how digital resources can be employed to cater to the needs of various groups.

4.2 Opportunities and obstacles for teacher development in using digital resources

In this second section, following the initial part which presents the results on “How Teachers Use Digital Resources for Pupil Participation” (4.1), we compile the teachers' perspectives regarding their future development in utilizing digital resources to support pupil participation. This section delves into how digital resources can aid teachers in enhancing pupil participation. The subsequent subsection in the Results section concentrates on the opportunities and challenges that teachers confront during the process of improving their utilization of digital resources to support pupil participation in the learning process. It also explores potential benefits and barriers linked to the integration of digital tools into teaching practices.

Enhancing pupil participation through digital resources. Within this context, teachers provide insights into the obstacles and challenges they encounter in their own development and propose potential solutions to address these hindrances. The specific questions posed to them were as follows:

- Question 1: *How can you enhance your use of digital resources to facilitate pupil participation?*
- Question 2: *What obstacles might impede your improvement efforts?*
- Question 3: *How can these potential obstacles be overcome?*

The data gathered from both focus groups exhibited striking similarities, with a common consensus among the participants. They expressed that significant weaknesses in concentration are challenging to overcome, irrespective of the presence or absence of digital resource support. Throughout the discussions, teachers provided examples of how they were enhancing their digital competence by exploring opportunities available within centrally procured school platforms. Teachers largely agreed on the conditions that should be met by existing or expanded digital resources. They emphasized factors such as quick access (short start-up time), flexibility (sufficient digital resources to accommodate the entire class), and robust functionality (described as “stable usage”). A recurring theme was the persistent obstacles that teachers face, including a lack of technical support during class time if issues with digital resources arise. Moreover, challenges included potential data loss or loss of database access when system updates or transitions occur, as it is common for school administrators to forgo data transfer during system changes due to financial considerations. Consequently, individual teachers are often tasked with transferring essential content to the new platform, including plans, task descriptions, documentation of pupils' learning processes, and learning outcomes. Teachers highlighted the

importance of preparedness for potential data loss, leading to the common practice of utilizing double storage areas and private backups.

Further challenges encompassed situations where updates or system changes occurred with minimal notice or none at all. Additionally, teachers noted that technology-based features often rely on free versions with limited capabilities and user-friendliness. Despite these obstacles, teachers described the positive experience of knowledge sharing among colleagues, who informally exchange information about potential changes and offer recommendations on effective digital resources based on their own experiences. The digital learning environment's positive aspects include its natural integration into pupils' support systems, where both teachers and peers provide assistance. Pupils are generally accepting of the idea that individuals have different needs, which can be addressed by using a limited set of digital resources. This open-mindedness has led to pupils being more willing to explore new approaches to tasks, even if there are noticeable challenges related to reduced endurance among pupils.

There are varying opinions regarding the practice of basing pupils' participation in learning on a personal level, such as using their own private mobile devices or subject content aligned with their individual interests. While this approach can enhance accessibility to subject content, it also requires careful consideration of the underlying values, particularly in cases where group affiliation or an individual's private life becomes the central focus. For example, issues related to an artist's message, the desire to maintain a clear boundary between private life and school, or socio-economic disparities related to the type of mobile device a pupil owns compared to their peers should be taken into account.

Challenges persist when it comes to utilizing digital resources to facilitate pupil participation. It is noted that pupils with fast cognitive abilities tend to benefit more, as evident in the use of tools like Kahoot!. In contrast, pupils who have difficulty deciphering symbolic values may struggle in symbol-heavy technology-based learning environments. Additionally, the lack of access to didactic image support can be a hindrance.

On a positive note, digital resources are recognized for their ability to grant all pupils access to content, not just those with pronounced needs. Features like the possibility to review recorded materials multiple times to achieve a deeper understanding and improved opportunities for pupils with motor difficulties (such as using fine motor skills for writing or drawing) are considered transformative.

The teachers express interest in exploring digital resources further, particularly in terms of increasing the use of instructional videos to enhance pre-understanding. They are keen to understand how digital resources can be integrated into their teaching practices, learn from the experiences of other teachers in similar educational contexts, and develop effective working methods. Throughout their discussions, teachers acknowledge that navigating the use of digital resources is rewarding, exciting, and simultaneously challenging.

In this context, the teachers emphasize that the answer to the question of "how digital resources can best support pupils in their participation in the learning process" is highly situational and context dependent.

Summary regarding how digital resources can support teachers to enhance pupil participation. It appears that a guideline emerging from the study is that teachers believe they should actively seek opportunities to enhance their digital competence. This approach involves teachers taking the initiative to explore available opportunities, conducting their own needs analysis, and independently developing their digital competence and proficiency in using digital resources for teaching.

However, this self-driven development process might be lengthy and uncoordinated, especially when there is limited central coordination or support.

The teachers also have a consensus in the goal of creating and supporting the pupils' development in being less consumers of the digital information flow, and more producers of information.

5 DISCUSSION

5.1 Discussion on results

This article places a heightened focus on gaining insight into teachers' perspectives on using technology as a medium to facilitate and support pupil participation and the utilization of digital resources within their instructional practices. By examining the digital resources employed, their functionalities, and areas for further development to enhance pupil participation, teachers' perspectives provide critical insights into the interactions they believe should be integrated into the offered learning environments to facilitate learning. The study's findings aim to deepen our understanding of how teachers can enhance their pedagogical practices to align with the increasing demands of technological advancements in society and meet pupils' expectations for digital resources that support their participation in the learning process. The utilization of technology and digitization to facilitate diverse interaction types in the age of digital transformation in pupil involvement during the learning process is emphasized. The study's outcomes will inform the development of strategic recommendations for enhancing pupil participation through digitalization, aligned with Moore's Three Types of Interaction framework [15]. The result from the data analysis consists of four overarching themes on the question of what teachers' perspective is on how digital resources can support pupil participation. Connections are made to guidelines and how the use of technology can increase goal achievement by enabling pupil participation. In addition, the guidelines that have emerged regarding how teachers can support their own development in digital competence are discussed. The discussion section ends with the method discussion.

Building upon Moore's [15] framework of three types of interactions involving actors such as peer/instructor/peer/content, this study introduces four themes relevant to the context of high school and a digital learning environment, focusing on pupil/teacher/pupil/content interactions.

The three interaction patterns in distance education theory (interaction between peer and instructor/peer/content) [15], evidence has identified that more vs. less interaction, in all three realms, produced significant moderation effects [21]. In order to contextualize the study's results, these will be discussed and presented categorized according to the 4 generated themes from the data analysis. The applied theoretical framework of Moore's distance education theory [15] contributes with the ability to consider aspects of learning with new technologies, aspects of distance education regarding the psychological aspect of distance, and aspects of bridging the understanding and communication gap between the pupil and the learning facilitator. As the research questions in the study concern how digital resources can be used in teaching to support pupils' participation in their learning, the categorization of the included interactions contributes to making their importance visible. The aim of the article is to investigate which guidelines teachers can contribute regarding digital resources facilitating pupil participation. This means processes of creating the right structure and determining the appropriate form of dialogue for pupil, group of

pupils and subject matter, where the aim is to build a bridge over an imagined distance. The research questions concern how teachers believe they can support pupils via technology in learning processes, which can be supported in Moore's perspective by the fact that a learning process that is relatively unbound by the concept "a distance or gap in what a pupil understands about a reality, and the understanding of that same reality by the person or persons charged with helping that pupil in the development of his or her knowledge" [22, p. 34].

Theme 1: Teacher – Pupil interaction. Teachers interact with pupils when they use communication technology in the task of creating knowledge through dialogue [22]. In their study, the participating teachers gave examples of using both synchronous and asynchronous communication and the use of multimodal feedback was highlighted as a successful way to reach out with information.

[68] concluded that virtual high school pupils do not place a high value on virtual learning communities. Similarly, [69] found that what pupils value most is interaction with the course material, followed by interaction with the teacher. These findings support the interpretation that in interactions initiated by pupils themselves, such as through the use of social media, the central focus is not on the virtual learning community but rather on belonging to the community itself [70].

Theme 2: Pupil – Content interaction. The results obtained from addressing the research questions primarily focus on identifying the opportunities and obstacles that teachers encounter in their efforts to develop their competence in using digital resources to support pupil participation in their learning. A prevailing perspective among teachers is that they should proactively seek opportunities for enhancing their digital competence. However, this self-driven approach to professional development in digital competence could potentially explain why the teachers participating in the focus group discussions provided relatively few examples of interactions between content and pupils. The findings suggest that having access to all three types of interaction is associated with enhanced learning outcomes. However, it is important to note that the findings do not conclusively demonstrate whether interactivity itself directly leads to improved learning. There is a need for further integration of these interactive elements into teaching practices [71].

Theme 3: Pupil – Pupil interaction. An important observation stemming from this self-initiated approach to professional development is the limited occurrence of situations where a pupil's demonstrated level of knowledge is used as the basis for designing subsequent learning tasks. This suggests that discrepancies in teachers' digital competencies and the integration of digital resources into their teaching practices may arise due to the absence of centralized coordination and support. Therefore, the presence of central coordination and support mechanisms may be essential in ensuring a more consistent and effective utilization of digital resources in educational settings.

It is worth noting that while a moderator variable is intended to elucidate the variance in effect size, the analysis of moderator variables in educational contexts should be considered as providing fragmented findings. In several studies on interaction patterns, a common trend emerges where pupil interaction, collaboration, and discussion are identified as moderating influences [72].

Theme 4: Extended interaction. This theme expands upon Moore's model [15] to illustrate how digital resources can facilitate interactions between teachers and various stakeholders, including school nurses and parents. The inclusion of this category is essential due to the pupils' status as minors, which requires communication and collaboration with these additional parties. A defining characteristic of these extended interactions is the recognition of their importance in ensuring successful

collaboration. The next challenge lies in facilitating intentional design for these interactions to create added value beyond merely providing interaction capabilities such as email, chat rooms, discussion boards, and synchronous video chat [73].

Concluding reflections on the study's design and the resulting recommended guidelines. Pupil participation encompasses the entirety of the learning process, including pre-existing knowledge, interactions with learning materials, and the presentation of acquired knowledge. Therefore, digital communication media must offer pupils the necessary tools to acquire and demonstrate their knowledge. This necessitates a diverse array of digital resources. These resources should encompass various digital communication methods, such as synchronous and asynchronous communication, video cameras, iPads, projectors, and the capability to facilitate multimodal digital presentations. Consequently, these resources enable pupils to present their knowledge through means like film production in the chemistry laboratory or photographic documentation of their creative process in craft subjects. When considering the utilization of digital resources, it is imperative to evaluate the strengths and weaknesses of each resource. The pedagogical suitability of these resources' hinges on the specific educational context in which they are deployed. The overarching objective is to empower pupils not only to exhibit their knowledge but also to enrich the learning process itself. These recommendations are as follows and are rooted in teachers' perception on how digital resources can facilitate pupil participation. These intricate relationships will be reflected in the required design of the study.

5.2 Discussion methods

The focus group, consisting of 6–7 participants, provided ample opportunities to gather data related to the exploration of individual and collective perceptions, ideas, views, and values through moderated focus group discussions [64] [74]. A well-established approach to judgment sampling, where the selection of participants is deliberately aimed at obtaining the most productive sample for addressing the research question, was employed [60]. The framework for this approach was developed based on the researcher's practical knowledge of the research area, existing literature, and insights from previous studies. The criteria for selecting participating teachers included being high school educators with experience in utilizing digital resources to support pupil participation within the current study curriculum.

Variables within demographic stratification, such as age, gender, and social class, were considered important for this study. A more purposeful sampling strategy was adopted, focusing on teachers with previous experience in studies related to the use of digital resources to facilitate pupil participation. This choice was made as many teachers were reluctant to participate due to their perceived lack of digital competence and pedagogical and didactic insecurities in subjects other than their primary areas of expertise. The study thus delved into exploring controversial and sensitive topics, making focus groups a suitable approach [75].

In the context of participant-based research, where data collection relies on "interaction in group discussions as the primary source of data" [64, p. 130], informants play a vital role. To access rich information, various selection methods were applied. Given the challenges of recruiting teachers with diverse perspectives, access was primarily gained through previously completed studies, a process akin to experience-based sampling. This method led to a selection focusing on critical cases or key informants with specific experiences and expertise. Snowball sampling was

also employed, allowing initial informants to recommend potential candidates for the study. This approach enabled stratification based on known public attitudes or beliefs. Participants were asked to invite individuals who could provide different viewpoints, including those in agreement and disagreement with the study's objectives. Qualitative sampling typically necessitates a flexible, pragmatic approach [60].

Digital focus groups were conducted due to the geographical dispersion of participating teachers. The first focus group, with 6 participants, was held in person, followed by the technology-based focus group with 7 participants. This sequencing was chosen to capture nuances in the physical focus group, which might be more challenging to discern in the technology-based setting.

Ensuring the quality of the thematic analysis was a crucial step in the process. A colleague with expertise in the subject matter critically reviewed the identified themes, subgroups, and categories, along with their descriptions. As a result of this revision, two subcategories within the theme "T3: pupil-pupil interactions" were merged into a single category. This decision was made because the subcategories, pertaining to pupils' collaboration channels and their choice of medium for updates, could not be differentiated sufficiently to warrant separate categorization.

5.3 Recommendations for technology-mediated digital environment enhancing pupil participation

Pupil participation spans the entire learning process, requiring diverse digital resources for vital interactions. Consequently, digital resources need to provide pupils with the essential means to acquire and showcase their knowledge. To facilitate pupil participation entails a range of digital resources with the capacity to facilitate multimodal digital presentations that support pupils' participation in their learning.

Recommended guidelines aiming at "Technology-based mediated interaction". *Access to Information and Communication Technology (ICT) that can cater to the diverse individual learning styles of pupils across various learning activities and objectives.*

Ensure the availability of a communication medium that can accommodate individual adaptations across various learning activities and objectives, as well as support various types of interactions. Providing access to both synchronous and asynchronous communication methods in teaching and enabling the digital facilitation of multimodal representations enhances the flexibility of the learning environment. This approach aims to address the diverse learning styles and needs of pupils, thereby fostering pupil interactions, collaborations, and discussions – all of which are essential factors for promoting pupils' participation and learning. A compilation of recommended guideline no. 1 can be found in the table below under the column "Technology-Based Mediated Communication."

Recommended guideline aiming at "Facilitate producers". *Establish an environment that enables pupils to take on a role as producers within the learning process.*

Establish an environment where pupils take on a more prominent role as producers and reduce their role as consumers. This approach leverages pupils' competencies acquired outside the school context, enriching the learning experience and granting access to diverse communities. Encouraging pupils to actively engage in content creation enhances their critical thinking as they gain firsthand experience in manipulating various forms of media, such as images, text, and videos, allowing them to understand the process and outcomes of such activities. A compilation of

recommended guideline no. 2 can be found in the table below under the column “Facilitate producers”.

Recommended guideline aimed at “Central coordination”. *Leverage central coordination to facilitate connections with internal networks that have sought-after digital skills and experience in educational settings.*

Implement central coordination to facilitate the sharing of knowledge held by individuals or groups within educational institutions. Organize thematic meetings that concentrate on specific aspects of digital resource utilization or explore how diverse digital tools can enhance subject-specific teaching. Such activities are instrumental in ensuring the efficient integration of digital resources within educational settings. Moreover, the presence of readily accessible support individuals, often referred to as “experts,” enhances teachers’ ability to explore how digital resources can align with diverse educational objectives.

A compilation of recommended guideline no. 3 can be found in the Table 1 below under the column “Central coordination”.

Table 1. An overview of recommended guidelines for how digital resources can enable pupils’ participation

	Guideline 1 Technology Based Mediated Interaction	Guideline 2 Facilitate Producers	Guideline 3 Central Coordination
Challenge	The learning environment should be designed to accommodate pupils who employ various learning techniques and styles.	Pupils need to critically assess sources.	Knowledge transfer to the teachers is sub-optimal.
Description	The digital communication medium (ICT) must provide effective tools for knowledge demonstration by the pupil.	By producing digital media the pupils can get first-hand information on how easy it is to fool others.	Use central coordination to convey knowledge held by individuals or groups in municipalities to be easily accessible to teachers in all schools.
Example	A pupil who is nervous during presentations can pre-record a movie when there is no audience present.	Create your own video using a video editing tool (e.g. faceswap).	A teachers knowledge within a specific program or area can quickly be spread to other teachers.
Purpose	To provide a base for fair assessment and not only for the median pupil.	To learn how easy it is to create believable videos and images.	To quickly and easily spread knowledge between teachers in a municipality.
Benefits	A fairer assessment and grades.	Higher proficiency in critical thinking.	The teachers can learn more things more easily and the teacher can get recognized for it.
Resources	Access to cameras to record movies and sound. Access to a digital collaboration space for peer-review etc.	Access to relevant software and support from teacher or other facilitator.	Access to a digital platform where examples and instructions can be stored, together with a good search system or viewing algorithm.
Conclusion/ Discussion	A versatile digital platform can accommodate the needs of different pupils, making sure that assessment can be done in an unbiased way.	Pupils with a high proficiency in critical thinking will make excellent citizens.	Supporting continuous learning consist of striving for the willingness characteristic of informal learning rather than the obligation of learning.

6 CONCLUSIONS

Upon reviewing the findings of this study, certain recurring aims become evident within the four identified themes and their associated pedagogical practices. The pedagogical practice of interest consists of proposed innovative ways of working and areas of use, exploring thus the extent of usage of digital resources and how, in combination with the teaching structure, they can facilitate pupil participation.

These best practices with their underlying principles have, through teachers' experience and development, enhanced the ability to strengthen participation in learning interactions. Thereby, the best practices represent an effective path for achieving purposeful learning environments that are relevant for a rapidly developing and ever changing digital transforming society. The purpose of the study was to develop and describe some best practices aimed at achieving and supporting pupil participation, and that can be divided depending on what kind of achievement they are aiming at.

The three aims consist of enabling pupil participation by contributing to the interactions that are part of a pupil's learning environment becoming: i) easily accessible, ii) supportive with the ability to meet individual adaptations e.g., learning style, and iii) strengthen the experience of contributing and belonging to a community.

Digital resources used to increase pupils' participation in their learning process need to be linked to the understanding that successful execution rests on fundamental principles. The principle that information should be easily accessible strengthens the possibilities of supporting pupil participation by enabling the pupil's independence, which is the basis for supporting the individual to develop their ability to take personal responsibility. The principle of interactions in the learning process needs to be supportive and scaffolding, and thereby able to meet individual adaptations e.g., learning style, as they can tailor learning, enabling pupils to perform by utilizing their full potential. The principle of interaction is to strengthen the experience of belonging to a community, which constitutes the basic idea that learning is closely related to interaction and participation in meaningful contexts. The different types of interactions support the pupil participation, and thereby facilitate learning and needs to be represented in the provided learning environments. Interactions are therefore an important part of supporting learning, where learning is seen as cognitive changes in an individual that are facilitated through meaningful social participation.

The article aims to contribute to the development of teachers' pedagogical and didactic digital competence, guided by the final recommended guidelines. The technology plays a crucial role in facilitating diverse interactions that are essential for pupil engagement in the learning process. It then follows that pupils needs to have access to digital resources in their learning environment.

7 REFERENCES

- [1] O. A. Ungar and A. F. Baruch, "Perceptions of teacher educators regarding ICT implementation in Israeli colleges of education," *Interdisciplinary Journal of E-Learning & Learning Objects*, vol. 12, 2016. <https://doi.org/10.28945/3606>
- [2] A. T. Ottenbreit-Leftwich, K. D. Glazewski, T. J. Newby, and P. A. Ertmer, "Teacher value beliefs associated with using technology: Addressing professional and student needs," *Computers & Education*, vol. 55, no. 3, pp. 1321–1335, 2010. <https://doi.org/10.1016/j.compedu.2010.06.002>
- [3] M. J. Koehler, P. Mishra, and W. Cain, "What is technological pedagogical content knowledge (TPACK)?" *Journal of Education*, vol. 193, no. 3, pp. 13–19, 2013. <https://doi.org/10.1177/002205741319300303>
- [4] N. Peeraphan, "ICT competency and pedagogical innovations," in *International Conference on Advanced Information Networking and Applications*, 2020, pp. 1–12.
- [5] L. Amhag, L. Hellström, and M. Stigmar, "Teacher educators' use of digital tools and needs for digital competence in higher education," *Journal of Digital Learning in Teacher Education*, vol. 35, no. 4, pp. 203–220, 2019. <https://doi.org/10.1080/21532974.2019.1646169>

- [6] J. Eberle, K. Stegmann, and F. Fischer, "Legitimate peripheral participation in communities of practice: Participation support structures for newcomers in faculty student councils," *Journal of the Learning Sciences*, vol. 23, no. 2, pp. 216–244, 2014. <https://doi.org/10.1080/10508406.2014.883978>
- [7] L. S. Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*. Harvard University Press, 1978.
- [8] A. D. Cohen, *Assessing Language Ability in the Classroom*, 2nd ed. (Vol. 1, No. 3). Boston: Heinle & Heinle. Pp. vi + 394. 1994.
- [9] K. Stegmann, C. Wecker, A. Weinberger, and F. Fischer, "Collaborative argumentation and cognitive elaboration in a computer-supported collaborative learning environment," *Instructional Science*, vol. 40, pp. 297–323, 2012. <https://doi.org/10.1007/s11251-011-9174-5>
- [10] S. M. Santoveña, "Communication processes in virtual learning environments and their impact on online lifelong learning," *Rev. U. Soc. Conocimiento*, vol. 8, no. 1, p. 111, 2011. <https://doi.org/10.7238/rusc.v8i1.982>
- [11] N. Carpentier, "Differentiating between access, interaction and participation," *Conjunctions Transdisciplinary Journal of Cultural Participation*, vol. 2, no. 2, pp. 7–28, 2015. <https://doi.org/10.7146/tjcp.v2i2.23117>
- [12] T. Anderson, "Getting the mix right again: An updated and theoretical rationale for interaction," *The International Review of Research in Open and Distributed Learning*, vol. 4, no. 2, 2003. <https://doi.org/10.19173/irrodl.v4i2.149>
- [13] J. Dewey, "Democracy and education: An introduction to the philosophy of education," Macmillan, 1916.
- [14] M. Wagner, "Interaction theory and children's learning: A framework for understanding children's learning online," Elsevier, 1994.
- [15] M. Moore, "Three types of interaction," *The American Journal of Distance Education*, vol. 3, no. 2, pp. 1–6, 1989. <https://doi.org/10.1080/08923648909526659>
- [16] T. D. Woods and J. D. Baker, "Interaction and learning: The differential effects of rehearsal on multimedia learning," *Instructional Science*, vol. 32, nos. 1–2, pp. 19–38, 2004.
- [17] J. A. Paul and J. D. Cochran, "Key interactions for online programs between faculty, students, technologies, and educational institutions: A holistic framework," *Quarterly Review of Distance Education*, vol. 14, no. 1, pp. 49–62, 2013.
- [18] T. Dwyer "Persistence in higher education through student-faculty interactions in the classroom of a commuter institution," *Innov. Educ. Teach. Int.*, vol. 2017, no. 54, pp. 325–334. <https://doi.org/10.1080/14703297.2015.1112297>
- [19] D. Vlachopoulos and A. Makri, "Online communication and interaction in distance higher education: A framework study of good practice," *International Review of Education*, vol. 65, pp. 605–632, 2019. <https://doi.org/10.1007/s11159-019-09792-3>
- [20] T. Rekkedal, S. Qvist-Eriksen, D. Keegan, G. Ó. Súilleabháin, R. Coughlan, and H. Fritsch, "Internet based e-learning, pedagogy and support systems," Norway: NKI Distance Education, 2003.
- [21] R. M. Bernard, P. C. Abrami, E. Borokhovski, C. A. Wade, R. M. Tamim, M. A. Surkes, and E. C. Bethel, "A meta-analysis of three types of interaction treatments in distance education," *Review of Educational research*, vol. 79, no. 3, pp. 1243–1289, 2009. <https://doi.org/10.3102/0034654309333844>
- [22] S. Moore, "Digital orientations: Non-media-centric media studies and non-representational theories of practice," Peter Lang, 2018.
- [23] E. Elvstrand, "Demokrati i skolan: Elevinflytande och elevers åsikter om inflytande," Karlstad University, 2009.

- [24] E. Johansson and A. Emilson, "Conflicts and resistance: Potentials for democracy learning in preschool," *International Journal of Early Years Education*, vol. 24, no. 1, pp. 19–35, 2016. <https://doi.org/10.1080/09669760.2015.1133073>
- [25] J. Rönnlund, "Kampen om större inflytande: En studie av samspelet mellan idéer, aktörer och strukturer i den svenska skolpolitiken," Karlstad University, 2011.
- [26] M. Tholander, "Värdegrund, demokrati och inflytande ur ett elevperspektiv," *Utbildning & Demokrati-tidskrift för didaktik och utbildningspolitik*, vol. 14, no. 3, pp. 7–30, 2005. <https://doi.org/10.48059/uod.v14i3.804>
- [27] M. Grannäs, "Elevers möjligheter till påverkan i skolarbetet – En studie om elevers delaktighet i gymnasieskolans beslutsstrukturer," Karlstad University, 2011.
- [28] R. Thornberg, "The lack of professional knowledge in values education," *Teaching and Teacher Education*, vol. 24, no. 7, pp. 1791–1798, 2008. <https://doi.org/10.1016/j.tate.2008.04.004>
- [29] R. Thornberg, "School democratic meetings: Pupil control discourse in disguise," *Teaching and Teacher Education*, vol. 26, no. 4, pp. 924–932, 2010. <https://doi.org/10.1016/j.tate.2009.10.033>
- [30] Rönnlund, Maria, "Elevinflytande i en skola i förändring," *Utbildning & Demokrati-tidskrift för didaktik och utbildningspolitik*, vol. 22, no. 1, pp. 65–83, 2013. <https://doi.org/10.48059/uod.v22i1.985>
- [31] R. Thornberg and E. Elvstrand, "Att forska om det komplexa begreppet elevinflytande," i *Skolans och lärares arbete*, Studentlitteratur, 2012.
- [32] H. Edlinger, "Gestaltete Lernumgebungen zur Förderung individualisierter Lernprozesse (Doctoral thesis)," Vienna: University of Vienna, 2017.
- [33] B. A. Frederickson and V. Cline, "Innovative strategies for promoting social and emotional well-being in schools," The Guilford Press, 2015.
- [34] R. J. Kennedy, "Minding the gap: A cross-cultural study of mindfulness across three Western countries," *International Journal of Higher Education*, vol. 4, no. 3, pp. 116–125, 2015.
- [35] L. Drewery *et al.*, "Using online technologies for health communication: A pilot study for university student online health course," *Procedia – Social and Behavioral Sciences*, vol. 197, pp. 1110–1114, 2020.
- [36] J. Öberg, J. Nouri, T. Cerratto-Pargman, and N. Aghaee, "Pupils' perspective on the use of digital tools for participation in the school/classroom," in *10th International Conference on Education and New Learning Technologies (EDULEARN)*, JUL 02-04, 2018, Palma, SPAIN. International Association for Technology, Education and Development, 2018, pp. 5291–5297. <https://doi.org/10.21125/edulearn.2018.1282>
- [37] J. Eberle, K. Stegmann, and F. Fischer, "Legitimate peripheral participation in communities of practice: Participation support structures for newcomers in faculty pupil councils," *Journal of the Learning Sciences*, vol. 23, no. 2, pp. 216–244, 2014. <https://doi.org/10.1080/10508406.2014.883978>
- [38] S. Ingold, "Educational influences on young children's computer use," Swedish National Agency for Education, 2021.
- [39] A. Qvortrup and L. Qvortrup, "Inclusion: Dimensions of inclusion in education," *International Journal of Inclusive Education*, vol. 22, no. 7, pp. 803–817, 2018. <https://doi.org/10.1080/13603116.2017.1412506>
- [40] A. Grover, "Studying children's use of computers in the Home: Methods and concepts," *International Journal of Human-Computer Interaction*, vol. 21, no. 2, pp. 177–190, 2006.
- [41] P. Hudson, "How can schools support beginning teachers?: A call for timely induction and mentoring for effective teaching," *Australian Journal of Teacher Education (Online)*, vol. 37, no. 7, pp. 71–84, 2012. <https://doi.org/10.14221/ajte.2012v37n7.1>

- [42] L. Lundy, "'Voice' is not enough: Conceptualising Article 12 of the United Nations convention on the rights of the child," *British Educational Research Journal*, vol. 33, no. 6, pp. 927–942, 2007. <https://doi.org/10.1080/01411920701657033>
- [43] M. Pedler, S. Hudson, and T. Yeigh, "The teachers' role in student engagement: A review," *Australian Journal of Teacher Education (Online)*, vol. 45, no. 3, pp. 48–62, 2020. <https://doi.org/10.14221/ajte.2020v45n3.4>
- [44] "Curriculum for the Preschool Lpfo 98. Revised 2019," Swedish National Agency for Education, 2022.
- [45] M. J. Emer and L. B. Evertson, "A new paradigm for classroom practice and management," *TESOL Journal*, vol. 3, no. 2, pp. 215–241, 1994.
- [46] C. M. Evertson and C. S. Weinstein, Eds., "Handbook of classroom management: Research, practice, and contemporary issues," Routledge, 2013. <https://doi.org/10.4324/9780203874783>
- [47] R. M. Skaalvik and E. M. Skaalvik, "Teacher job satisfaction and motivation to leave the teaching profession: Relations with school context, feeling of belonging, and emotional exhaustion," *Teaching and Teacher Education*, vol. 75, pp. 166–176, 2018.
- [48] B. Bae, "Children's right to participate—challenges in everyday interactions," *European Early Childhood Education Research Journal*, vol. 17, no. 3, pp. 391–406, 2009. <https://doi.org/10.1080/13502930903101594>
- [49] E. Kennedy, E. Dunphy, B. Dwyer, G. Hayes, T. McPhillips, J. Marsh, ... and G. Shiel, *Literacy in Early Childhood and Primary Education (3–8 Years)*. National Council for Curriculum and Assessment, 2012.
- [50] M. Theobald, S. Danby, and J. Ailwood, "Child participation in the early years: Challenges for education," *Australasian Journal of Early Childhood*, vol. 36, no. 3, pp. 19–26, 2011. <https://doi.org/10.1177/183693911103600304>
- [51] S. R. Smith, "Making sense of multiple informants in child and adolescent psychopathology: A guide for clinicians," *Journal of Psychoeducational Assessment*, vol. 25, no. 2, pp. 139–149, 2007. <https://doi.org/10.1177/0734282906296233>
- [52] J. Öberg and P. Hernwall, "Participatory design with teachers: Designing the workshops," in *Designs for Learning, Proceedings of the 5th International Conference on Designs for Learning*, 2016, pp. 269–282.
- [53] P. F. de Salas and S. Pastor, "Relic neutrino decoupling with flavour oscillations revisited," *Journal of Cosmology and Astroparticle Physics*, vol. 2016, no. 7, p. 051, 2016. <https://doi.org/10.1088/1475-7516/2016/07/051>
- [54] S. McKenney and T. C. Reeves, "Educational design research," *Handbook of Research on Educational Communications and Technology*, pp. 131–140, 2014. https://doi.org/10.1007/978-1-4614-3185-5_11
- [55] S. McKenney and T. C. Reeves, "Conducting educational design research," Routledge, 2018. <https://doi.org/10.4324/9781315105642>
- [56] T. Plomp, "Educational design research: An introduction," *Educational design research*, pp. 11–50, 2013. <https://doi.org/10.1080/09523987.2013.843832>
- [57] S. G. Hartman, K. Roth, and N. Rönström, "John Dewey: om reflektivt lärande i skola och samhälle," HLS Förlag, 2003.
- [58] T. Haldin-Herrgård, "Hur höra tyst kunskap? Utveckling av en metod för studier av tyst kunnande," Svenska handelshögskolan, 2005.
- [59] N. Kirsten and S. Carlbaum, "Kompetensutveckling för professionella lärare? Introduktionen av kollegialt lärande i svensk skola," *Pedagogisk forskning i Sverige*, vol. 25, no. 1, pp. 7–34, 2020. <https://doi.org/10.15626/pfs25.01.01>
- [60] M. N. Marshall, "Sampling for qualitative research," *Family Practice*, vol. 13, no. 6, pp. 522–526, 1996. <https://doi.org/10.1093/fampra/13.6.522>

- [61] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative Research in Psychology*, vol. 3, no. 2, pp. 77–101, 2006. <https://doi.org/10.1191/1478088706qp063oa>
- [62] M. N. Marshall, "The key informant technique," *Family Practice*, vol. 13, pp. 92–97, 1996. <https://doi.org/10.1093/fampra/13.1.92>
- [63] J. Dias and I. Menezes, "Focus group research: History, theory, and practice," *International Journal of Qualitative Methods*, vol. 13, no. 1, pp. 206–220, 2014.
- [64] D. L. Morgan, "Focus groups," *Annual Review of Sociology*, vol. 22, pp. 129–152, 1996. <https://doi.org/10.1146/annurev.soc.22.1.129>
- [65] D. Stern, C. Dayton, and M. Raby, "Career academies: A proven strategy to prepare high school students for college and careers," Career Academy Support Network, 2010.
- [66] M. Bloor, J. Frankland, M. Thomas, and K. Robson, "Focus groups in social research," London: Sage, 2001. <https://doi.org/10.4135/9781849209175>
- [67] A. Williams and L. Katz, "The use of focus group methodology in education: Some theoretical and practical considerations," *IEJLL: International Electronic Journal for Leadership in Learning*, vol. 5, no. 3, 2001.
- [68] Y. Joglekar, D. Purdy, S. Brock, A. Tandon, and A. Dong, "Developing digital communication competency in the business classroom," *Business and Professional Communication Quarterly*, vol. 85, no. 2, pp. 141–168, 2022. <https://doi.org/10.1177/23294906221089887>
- [69] C. L. Nwankwo, "Examining the impact of online social networking on the adjustment and integration of international pupils," *Doctoral Dissertation*. University of Florida, 2015.
- [70] P. West, F. Paige, W. Lee, N. Watts, and G. Scales, "Using learning analytics and student perceptions to explore student interactions in an online construction management course," *Journal of Civil Engineering Education*, vol. 148, no. 4, p. 05022001, 2022. [https://doi.org/10.1061/\(ASCE\)EI.2643-9115.0000066](https://doi.org/10.1061/(ASCE)EI.2643-9115.0000066)
- [71] B. Oyarzun, J. Stefaniak, L. Bol, and G. R. Morrison, "Effects of learner-to-learner interactions on social presence, achievement and satisfaction," *Journal of Computing in Higher Education*, vol. 30, pp. 154–175, 2018. <https://doi.org/10.1007/s12528-017-9157-x>
- [72] R. M. Bernard, E. Borokhovski, R. F. Schmid, and R. M. Tamim, "Gauging the effectiveness of educational technology integration in education: What the best-quality meta-analyses tell us," *Learning, Design, and Technology*, pp. 1–25, 2018. https://doi.org/10.1007/978-3-319-17727-4_109-2
- [73] R. M. Bernard, E. Borokhovski, and R.M. Tamim, "The state of research on distance, online, and blended learning: Meta-analyses and qualitative systematic reviews," in *Handbook of Distance Education*, Routledge, 2018, pp. 92–104. <https://doi.org/10.4324/9781315296135-8>
- [74] M. T. Huss *et al.*, "Moderated focus groups: Data collection and analysis," *Qualitative Market Research: An International Journal*, vol. 18, no. 2, pp. 191–209, 2015.
- [75] F. Hintermann *et al.*, "Exploring controversial and sensitive topics through focus groups: The case of educational research," *Qualitative Research*, vol. 21, no. 4, pp. 467–482, 2021.

8 APPENDICES

The following four appendices presents the coding generated for each theme based on the thematic analysis from the focus group discussions with the participating teachers.

8.1 Theme 1: Teacher – Pupil, interaction between teacher and pupil

Category 1A: Teacher to pupil interaction. The interaction from pupil to teacher focuses on interactive dialogue and involves pedagogical guidance, scaffolding and

learning support, e.g. providing information. The teacher's goal is to stimulate or maintain the pupil's interest and provide motivation to learn.

T1A1. Information to pupils through general information transfer and compilation platforms, on a group/class basis, for example, by making plans available via the school platform.

T1A2. Engaging in discussions with pupils to enhance their cognitive abilities.

T1A3. Motivate pupils in their own development to support progression through individualized efforts, for example, by saying 'I see you, and I understand your needs, and I will try to meet them.'

Category 1B: Pupil to teacher interaction. Teachers' perspectives on how digital resources can support the interaction between Pupil and Teacher include the following aspects;

T1B1. Digital resources can support the pupil's learning by providing the pupil with their own access to an overview and being updated on their submissions and knowledge achievements and progression.

T1B2. Digital resources can contribute to the pupil's participatory learning by facilitating a non-verbal communication pathway that is individual and situation specific.

T1B3. Digital resources can facilitate pupils in demonstrating their knowledge, for example, through support functions or by incorporating more enjoyment.

8.2 Theme 2: Pupil – Content, interaction between pupil and content

Digital resources can support the interaction between the Pupil and Content by facilitation.

T21. Subject matter accessible to pupils (from their perspective, in a relevant and contemporary manner) beforehand to help them build prior understanding and the current context, thereby increasing pupils' opportunities and willingness to participate.

T22. Digital resources support the interaction between the Pupil and Content by allowing pupils to choose the resources they need to support their participation in the instruction.

T23. Digital resources support the interaction between the Pupil and Content by providing pupils with access to individually tailored learning materials to meet individuals' various learning styles, such as receiving materials adapted to the pupil's demonstrated level of knowledge (e.g., interactive resources) and/or choosing resources themselves, including reading services and selecting/combining various types of media (text, images, videos, and presentation formats such as PowerPoint, digital posters/graphics).

T24. Digital resources support the interaction between the Pupil and Content by providing a clear overview of the pupil's own progress and enabling the pupil to improve their materials.

8.3 Theme 3: Pupil – Pupil, interaction between pupils

These interactions encompass group work scenarios with or without teacher supervision, involving collaboration, discussion, and peer review.

T3. Pupils stay in touch with each other by using platforms like Snapchat and/or learning from each other, i.e., collaborating (e.g., peer reading texts in Google Docs

and completing group assignments via resources in Google Drive) and/or keeping each other updated on what needs to be delivered (teachers have heard pupils mention Snapchat, SMS).

8.4 Theme 4: Extended interaction

Category 4A: Teacher to parents' interaction. This category describes how digital resources can support the various types of interactions teachers can have with parents.

T4A1. Inclusion of parents to support individual pupils due to results or behaviors, for example, by providing access to more detailed, updated daily/weekly plans that pupils have access to (e.g., Classroom, Informentor). The pupil version of the school platform contains information that can change and is divided into smaller sub-plans, such as when homework should be completed, projects should be finished, and when exams are scheduled. Documentation is created, for example, if the pupil does not meet the 'Passed' level (an Individual Development Plan, IUP, is written). Information about unwanted behavior can be sent via the school platform, email, or SMS, depending on the urgency or the easiest way to contact the guardian.

T4A2. Inclusion of parents through general information transfer and compilation platforms, on a group/class basis, for example, by making plans available via the school platform. The school platform contains static information related to term plans and activity dates, i.e., predetermined events where no response is expected from the guardians.

Category 4B: Teacher to community interaction. This category focuses on interactions in which the teacher is involved but typically does not hold a directive role.

T4B1. It encompasses scenarios where pupils have created and utilize social media platforms intended for the entire class, facilitating discussions about seeking educational answers, reaching agreements, or catching up if someone has been absent. Teachers are often invited to participate in these online forums.

T4B2. Additionally, this category on secure exchange of information about sensitive pupil personal data addresses situations where the teacher's governing responsibilities have diminished as a result of digital transformation and the widespread use of technology.

9 AUTHORS

Johanna Öberg, Department of Computer and Systems Sciences, Stockholm, Sweden (E-mail: johanna.oberg@dsv.su.se).

Uno Fors, Department of Computer and Systems Sciences, Stockholm, Sweden.

Jelena Zdravkovic, Department of Computer and Systems Sciences, Stockholm, Sweden.