Classroom Digital Technology Integration – A Double-Edged Sword? Engaging and Practical yet Harmful

Doris Kristina Raave(✉), Eric Roldan Roa, Margus Pedaste, and Katrin Saks

University of Tartu, 51009 Tartu, Estonia
doris.raave@ut.ee

Abstract. Despite the prominence of technology in contemporary education, studies on technology-enhanced learning are most focused on barriers affecting technology's integration. Overshadowed by this mainly unilateral approach, a precursory question of why technology should be integrated into the classroom has often been overlooked. However, without knowledge of this sort, we cannot underpin the need for classroom digital technology integration (CDTI). This study aims to gain exploratory insight into teachers' perceptions of CDTI that allow advocating for CDTI. We conducted a qualitative study with inductive content analysis with data collected from semi-structured interviews with 18 teachers to understand better the deemed effects of CDTI and what it might depend on. Generally, the main reasons for the CDTI lay in its affordance to improve engagement and practicality in teaching-learning processes. CDTI's main detriment was its hindering effect on health and fine motor development. These results imply CDTI's beneficence, and hence it should be supported. To minimise CDTI's hindering effects, we recommend reconsidering how technology is integrated into the process.

Keywords: Classroom digital technology integration · Technology-enhanced learning · Primary school · Secondary school

1 Introduction

Classroom digital technology integration (CDTI) is a prominent aspect of contemporary education, rendering CDTI an increasingly common practice among educators [1], also supported by educational policies [2, 3]. The commonality of CDTI implicitly indicates that it somehow benefits the learning process [1, 4], advocating hence for technology-enhanced learning. Previous studies suggest that the successful CDTI is foremost defined by enhancing student learning outcomes [5], and research on the evaluation of CDTI is mainly focused on its effect on learning [6].

Technology-mediated learning theory proposed by Brower in 2019 posits that technology serves only as a mediator of users' intents [7]. The latter indicates the importance of studying stakeholders' underlying aims when using technology to enhance learning. Previous studies suggest that teachers are the key stakeholders in determining CDTI, e.g., [8, 9] and that there is an alignment between teachers' pedagogical reasoning and

Y.-M. Huang et al. (Eds.): ICITL 2022, LNCS 13449, pp. 241–251, 2022.
https://doi.org/10.1007/978-3-031-15273-3_27

practices, e.g., [10–12]. Therefore, researchers in the field are increasingly focusing on teachers' pedagogical reasoning, e.g., [11, 13–16], which could be regarded as the key commencement for facilitating purposeful CDTI's practices to support technology-enhanced learning. For example, previous research has found that teachers value CDTI's affordance to facilitate content presentation, support knowledge acquisition, and motivate students [5, 15–17]. Equivalent aspects of optimisation and qualitative and quantitative improvement of the teaching and learning processes have been identified as characteristics of technology-enhanced learning [18], indicating a shared perspective of CDTI's affordances for teaching and learning processes.

Nevertheless, previous research posits that contextual and personal factors cause teachers to have different views on CDTI [14, 19, 20]. The same technology may be perceived and used differently by teachers due to their personal characteristics such as knowledge, experience, and dispositions, e.g., beliefs and attitudes [8–11, 17], as well as context-specific characteristics, such as grade, subject, and school [12, 14, 19–21]. Cultural context can further be seen as a relevant context-specific characteristic worth considering when seeking insight into teachers' perceptions of the CDTI [10, 21, 22]. Commonly researched factors affecting CDTI have been noted at the student, teacher, and institutional levels, indicating, for example, aspects related to resource availability and digital competence [16].

Research suggests also looking into why teachers do not practice CDTI to understand better different teachers' perceptions for a more holistic understanding of the field [16]. Understanding better the underpinnings of CDTI and how to better support this process serves as valuable information for stakeholders when considering and evaluating CDTI for technology-enhanced learning. Teachers' reasonings for CDTI contribute to supporting and changing teachers' practices of CDTI and considering technology's different affordances to support students' learning [11, 15, 16, 21].

This study aims to contribute to the growing research on factors affecting CDTI by offering an exploratory insight into Estonian teachers' perceptions of CDTI. In Estonia, using digital technology in teaching and learning is a part of teachers' professional standards framework [23]. Digital readiness is high amongst Estonian teachers [22], and CDTI is a relatively common practice [24]. Estonia's education system is among the best-performing, according to PISA 2018 results [25]. For these reasons, it is considered interesting to investigate the perceptions of CDTI in Estonia as it may shed light on the relationship between CDTI practices and achievement. More specifically, this study, adopting an exploratory qualitative study design, seeks to find answers to the following research question: what are Estonian primary and secondary school teachers' perceived benefits, detriments, and challenges of CDTI?

2 Method

2.1 Context and Sample of the Study

This study seeks to gain exploratory insight into the perceived benefits and detriments of CDTI. An exploratory qualitative research design with inductive content analysis was adopted to this end. This study is part of piloting studies of a larger research project, namely Digiefekt. The Digiefekt project has adopted purposive sampling to ensure a

diverse study sample. The recruited schools were from different regions across the country. Amongst these schools, there were both high- and low-performing schools in terms of students' results in academic tests, school results in the school's satisfaction survey and self-assessment of digital competence conducted among teachers, students, and parents. From each school, the end grades teachers at each school level, primary and lower secondary school, i.e., the third (9–10 y/o), sixth (12–13 y/o) and ninth (15–16 y/o) grade, were recruited. Within these grades, we further selected teachers in the subjects of Estonian, mathematics, and natural sciences.

For this study, a smaller sample of volunteering schools and teachers to participate in pilot studies of their interest were recruited from the research project's sample. This study includes a convenience sample of teachers from five Estonian primary and lower secondary schools with different levels of digital competence. The end sample consists of 17 in-service teachers with varying times of service. In-service teachers have been found to hold more varied perceptions of CDTI due to more experience in the field [16]. To that end, their insights may be considered a richer data source than pre-service teachers' perceptions.

2.2 Data Collection and Analysis

Data were collected through semi-structured interviews by the first author, whose research expertise lies in purposeful CDTI to support subject-specific learning outcomes. The first author is also an in-service teacher in Estonia, which was also made known to the participants to diminish perceptions of power differences and thus increase openness [26]. Further, as the first author has five years of experience in CDTI, this contributes to her competence to interpret the answers given, acknowledging and embracing thus the subjectivity often critiqued in qualitative studies [26].

One interview lasted for an average of 15 min. The participants were asked questions about their perceived benefits, detriments and challenges regarding CDTI. When necessary for better comprehension, the interviewer asked further specifying questions. For trustworthiness, as suggested by Thomas in 2006 [27], member checks were done during the interviews where the interviewer summarised the interpretations of the collected data to allow respondents to specify their answers.

Following the coding process in the inductive analysis presented by Thomas in 2006 [27], meaningful utterances, i.e., utterances related to the research questions, were identified and transcribed for coding. In total, 160 utterances were noted. Around one-third of these utterances (50 in total), directly translated from English to Estonian by the first author, underwent an independent parallel coding to create inductive categories by the first two authors of this study. Inductive content analysis was adapted as it allows unrestricted insight into a topic [27]. The authors, however, acknowledge that the qualitative data analysis might have been, and likely was, influenced by the findings in the previous research. However, as similar results have been noted on multiple occasions, the authors do not consider the possible influences as limitations as these contribute to a more convergent understanding of the topic.

The preliminary codes were then discussed, evaluated and overlaps, commonly named. Moreover, utterances with similar content were grouped into relevant (sub)categories. In total, 29 different codes were identified; these codes were followingly grouped under eight subcategories that made up three larger categories: beneficial effects of CDTI, detrimental effects of CDTI and challenges related to CDTI.

3 Results

Our data collected via semi-structured interviews with 17 Estonian primary and secondary school teachers consisted of 160 transcribed utterances. Teachers' demographics and their input to the data can be seen in Table 1 below.

Table 1. Teachers' demographics and utterances percentage.

Teacher ID	School ID	Grade	Subject	Utterances %
1	1	3	Estonian, Natural sciences, Mathematics	2
2	1	6	Natural sciences	5
3	1	6	Mathematics	2
4	1	6	Mathematics	3
5	1	6	Estonian	5
6	2	3	Estonian, Natural sciences, Mathematics	6
7	2	3	Estonian, Natural sciences, Mathematics	5
8	2	6	Estonian	3
9	3	3	Estonian, Natural sciences, Mathematics	8
10	3	9	Mathematics	8
11	3	9	Estonian	4
12	4	3	Estonian, Natural sciences, Mathematics	12
13	4	6	Mathematics	8
14	4	9	Natural sciences	9
15	4	3	Estonian, Natural sciences, Mathematics	12
16	4	6	Estonian	5
17	5	9	Natural sciences	4

Teachers noted several benefits and detriments of CDTI on teaching-learning processes (see Table 2). The results are further discussed in the categories below. It is also relevant to note that some utterances belonged simultaneously to various groups as they touched upon diverse aspects of CDTI.

Table 2. The benefits, detriments, and challenges of CDTI.

Category	Subcategory	Codes
Benefits	Improved practicality (in teaching & learning)	Time-saving, flexible, convenient
	Improved engagement	Facilitating different activities, motivational, change in routine
	Improved learning opportunities	Deeper understanding, digital competence, personalisation, collaborative learning, discovery-based learning
Detriments	Negative effects on health	Mental health, physical health
	Hinders development	Cognitive development, fine-motor development, social development
	Hinders classroom management	
Challenges	Digital competence (teachers' & students')	Attitudes, know-what, know-how
	Resources (digital content & devices)	Resource availability, resource quality

Amongst benefits, teachers mentioned improved practicality, engagement and learning opportunities. Regarding detriments, teachers commented on adverse health, development, and classroom management consequences. As challenges, teachers pointed out insufficient digital competence, both teachers' and students', as well as low quality and availability of suitable digital content and devices.

3.1 Benefits of CDTI

By the teachers, the most mentioned benefit of CDTI was improved engagement (45.2% of all the teachers' utterances fell under this category). Teachers noted that CDTI captures students' attention by facilitating different activities, like hands-on and practical tasks and gamification. Moreover, CDTI offers a change in routine and is motivating for students. One teacher noted that "*… seeking information by themselves in digital devices raises their interest in the topic"*.

The second most mentioned benefit of CDTI was its improved practicality (35.5% of the utterances). Under this category fell utterances referring to operational improvements for both teaching-learning processes. The CDTI was mostly viewed as time-saving, flexible and convenient.

For teaching, time-saving aspects principally commented were in relation to automated control. Teacher 14 specifies that "Checking students' answers is way easier, faster and more convenient with digital devices". Also, premade materials were commented as time-saving, as specified, for example, by Teacher 17 "When I can't bring in "the real thing", I can easily look up and showcase some videos or photos to illustrate whatever". Flexibility and convenience were illustrated by the teachers' habits in their teaching

practice, e.g., Teacher 1 commented, "I integrate digital technology in the classroom because it is really comfortable and habitual for me as I am used to it".

For learning, the time-saving was primarily seen in faster and smoother task completion, information availability (e.g., Teacher 16: "*It's an instant source of a lot of information that students can find fast.")* and instant feedback. Teacher 3 noted the latter's importance: "*They can see instantly if they answered incorrectly. It's better this way because if some time passes, then they don't remember or sometimes even don't care about the feedback really"*. Regarding flexibility and convenience, Teacher 9 commented that with the support of digital devices, "*Students can work independently without needing the teacher"*.

The least frequently mentioned was CDTI's affordance to support learning opportunities (19.3% of the utterances). Under this category, teachers said CDTI endorses the development of digital literacy, personalisation, and collaborative and discovery-based learning and facilitates more profound understanding. One teacher commented as follows: "*With videos, photos, etc. I can show the students the organisms in their environment. This is vital for making them understand how ecosystems work"*.

3.2 Detriments of CDTI

The most commonly (50% of the utterances) mentioned detriment was related to health. Here, effects on physical and mental health were commented on. Regarding the former, adverse impact on the eyesight, posture and hand muscles were mentioned. E.g., Teacher 14 noted that posture is affected by "being seated in one forced position when using a digital device", and Teacher 16 commented that "*Students' hand muscles have gotten weak as they use them in a rather limited way"*.

Concerning mental health, teachers noted that digital devices could scare and intimidate some students, mainly ones who are not that accustomed to using them. Teacher 9 pointed out that "*… tools cause stress to the students, who are by their nature a bit more anxious"*. Teachers also mentioned cyberbullying and some emotional consequences of gamification, e.g., Teacher 10 commented, "*Gaming platforms like 99math do not support the weak ones. It is a competition of strong ones and losing affects students emotionally"*.

In addition to concerns related to health, teachers (on 37.5% of the utterances) pointed out that digital technology can impede development, namely fine motor, cognitive and social development. Concerning fine-motor development, teachers brought out suffering handwriting. Teacher 17 made a connection between fine motor skills and cognitive abilities: "*Activities requiring fine motor skills are directly related to brain development…. When using digital devices, we use our hands in a very limited manner, just one or two fingers, tapping or scrolling movements"*.

Furthermore, teachers noted that digital devices hinder cognitive development. Mostly, teachers referred to developing different skills, like reading and writing, but also hampering acquisition, in general, was mentioned. Teacher 10 explained, "*learning on a computer does not cause a permanent change in the brain, which requires effort"*.

In addition, aspects related to social development were mentioned, mainly regarding the form of communication shifting from the real world to the virtual, which hampers students' skills to interact. Teacher 11 commented on the issue as follows: "*They don't*

know how to communicate with each other anymore, they are always on their phones,…. And not only to each other, they are not able to make proper sentences or explain their ideas orally. So, I want to use the classroom time to give them at least some opportunities to speak, especially to each other".

Moreover, teachers stated that CDTI affects classroom management (12.5% of the utterances) as it embodies a distraction. Teacher 17 commented, "*Students don't really focus on the task at hand. They often use social media or do other things they are not supposed to"*. Teacher 9 pointed out a different nuance: "*Students get restless with digital devices. And students who have limited use of digital use at home want only to play, they don't perceive used study environments as a play, so they want to open games they have used or heard of, and then it's really hard to get them to do the task at hand"*.

3.3 Challenges of CDTI

In the interviews, teachers pointed out CDTI's challenges related to resources and digital competence. The most common challenge noted was the availability and quality of resources. Under availability, teachers mainly mentioned that bringing the device to the classroom is not easy. Often, schools have only one set of tablets that need to be prebooked and thus "needs and extra effort", as noted by Teacher 3, or only one computer classroom. Further, computer classrooms do not sometimes have space for every student in the classroom, resulting in mixing and matching computers and laptops, which, as Teacher 17 points out, "creates inequity". Furthermore, "… going to the computer classroom takes away a lot of time from the actual lesson", as commented by Teacher 12. Moreover, not all students have their own digital devices with an unlimited volume of mobile data, challenge pointed out by example by Teacher 13 "*… not every student has their own device that they could use so when adopting this strategy instead of "fighting" for a computer class, some students are still left out"*.

Furthermore, it is hard to find suitable premade materials amid all the available content; thus, including digital content in the lesson is often very time-consuming as teachers need to surf for a long time or create it themselves. Teacher 19 comments that her CDTI practices are challenged by a lack of "*… available suitable resource list to use to facilitate easy access for teachers to the learning materials"*. Moreover, appropriate digital content usually costs and is thus out of reach for the teachers.

Both digital devices and digital content's qualities were noted concerning the quality of resources. Teachers pointed out that available digital devices are often old and slow, and thus their use is frustrating. Furthermore, teachers noted limitations in digital content's affordances, e.g., teacher 2 noted that "*Automated control is very helpful for teachers, but there is no automated control for high-level thinking exercises which actually show me something about how the student is doing"*. Moreover, the limited affordances of digital devices for mathematical languages were mentioned on multiple occasions, noting that drafting mathematical tasks on a piece of paper is more efficient than on a digital device. The latter may also be seen as an attitude toward the CDTI.

Attitudes related to digital devices are regarded as one of the dimensions of digital competence, besides know-what and know-how. Teachers also expressed other negative attitudes to CDTI regarding energy and time costs. For example, teacher 12 noted that "*… it takes too much energy and time to get into what and how to use. There are just too*

many platforms to handle, it gets confusing". Teacher 10 commented that she does not believe that CDTI "helps with anything". Teachers further pointed out that often they lack or do not feel comfortable about their skills and knowledge for CDTI. Teacher 2 precises "*… I really feel like I don't know the possibilities for CDTI. I have too limited experience using it"*.

As one of the challenges for CDTI, teachers also remarked on students' lack of know-how in working with a digital device, e.g., how to look at and critically assess information and generally how to use tools, programs, and platforms. Teachers noted that students have very different skill sets, but in-class time barely leaves room for teaching these. Teacher 12 commented: "*Students need guidance on how to use programs and platforms. I can teach them as much as I know, but it takes away the time from the content, and not all the students need the extra guidance"*.

4 Discussion and Conclusion

This study aimed to gain exploratory insight into teachers' perceptions of CDTI to contribute to knowledge for underpinning the need for classroom technology integration for technology-enhanced learning and how to support this process better. For that aim, exploratory qualitative research with inductive content analysis was conducted. From semi-structured interviews with 17 teachers of different grades and subjects (Estonian, mathematics, and natural sciences; 3rd, 6th, and 9th grades), benefits, detriments and challenges related to CDTI were found.

In the interviews, teachers pointed out the several benefits, detriments, and challenges of CDTI. As benefits, teachers perceived improved practicality, both teaching and learning-related, and improved engagement and learning opportunities. Under enhanced practicality, teachers noted aspects regarding efficiency demonstrated in time-saving, flexibility and convenience. As improved engagement, teachers mentioned digital technologies affordances to facilitate different activities, provide a change in routine and motivate. Comments related to learning approaches, such as personalisation, discovery-based and collaborative learning, and notions on facilitating deeper understanding and supporting digital competence development were categorised as improved learning opportunities. These results advocate for CDTI, indicating an argument for the affordances of digital technologies to enhance teaching and learning processes.

Regarding detriments, adverse effects on health (physical and mental) and development (fine motor, cognitive and social) were mentioned. Furthermore, teachers noted CDTI's hindering effect on classroom management. These results may indicate the need to rethink the use of CDTI to minimise the adverse effects of its implementation. Considering challenges, limitations related to resource availability and quality and teachers' and students' digital competence were noted, indicating issues still needed to be tackled to support CDTI.

Obtained results provide insight into understanding the underpinnings of CDTI in Estonia, one of the top-performing countries in K-12 settings [25], where CDTI is a relatively common practice [24]. Therefore, these insights are of value to support CDTI as they serve as information for stakeholders when considering and evaluating CDTI for technology-enhanced learning. Insights to teachers' CDTI reasonings support other

teachers' CDTI practices by helping them consider digital technology's additional affordances in teaching-learning, contributing to changes in their practices [11, 15, 16, 21]. Moreover, based on our results, we can still posit the need to (i) provide accessible and good-quality resources (both devices and content) and (ii) support the development of both teachers' and students' digital competence.

The emerged categories on the benefits, detriments, and challenges of CDTI were similar in their content to the results presented by previous related studies, e.g., [5, 15–18], which indicates a validation of these results across different subjects and grades as were included in the scope of this study. Furthermore, these results contribute to a convergent understanding of the state-of-art grasp of perception of CDTI.

We acknowledge that our study has certain limitations. First, regarding the limited sample size, as perceptions of CDTI may differ from teacher to teacher, it would be more insightful to get opinions from more teachers on the matter. Furthermore, the teachers did not evenly represent different contexts (school, grade, subject), nor were their input even when considering the percentage of total utterances, which may have led to somewhat biased results. Even if results cannot be thus generalised, these limitations may contribute to evaluating the transferability of this study's results to different settings by providing light on the study's population and context [26].

Second, owing to the inductive qualitative design of this study, this study might have limitations regarding the researchers' subjectivity. Although the subjectivity was noted and embraced throughout the study by drawing upon the authors' experience and expertise in the field, we nevertheless acknowledge the likely, somewhat biased data collection and interpretation. To tackle this, we adopted member checking and included two coders with acceptable inter-rater reliability in the analysis process.

Suggestions for future research are threefold. As previous research posits that teachers may have different context-specific perceptions of the CDTI [10, 13] that are related to their practices [14], we recommend researching (i) the associations between the perceptions and the implementation of CDTI, (ii) distinguishing profiles of teachers regarding their perceptions and practices of CDTI, and to (iii) measure the possible effects of the CDTI to make the connection between the perceptions, the implementation (regarding the use and its purpose), and the actual effect on the learning outcomes, which ultimately contributes to understanding how to better support meaningful and purposeful CDTI.

References

1. Bower, M.: Design of Technology-Enhanced Learning: Integrating Research and Practice. Emerald Group Publishing, Bingley (2017)
2. EMER (Estonian Ministry of Education and Research), Education strategy 2021–2035 (2020). https://www.hm.ee/et/sites/default/files/haridusvaldkonna_arengukava_2035_kinnitt aud_vv_eng_0.pdf%2C. Accessed 15 May 2022
3. European Commission, Directorate-General for Education, Youth, Sport and Culture, McGrath, C., Frohlich Hougaard, K., O'Shea, M.: Supporting key competence development: learning approaches and environments in school education: input paper. Publications Office of the European Union, Luxembourg (2020). https://data.europa.eu/doi/10.2766/8227. Accessed 15 May 2022

4. Yeung, K.L., Carpenter, S.K., Corral, D.: A comprehensive review of educational technology on objective learning outcomes in academic contexts. Educ. Psychol. Rev. **33**(4), 1583–1630 (2021)
5. Kohler, E.A., Molloy Elreda, L., Tindle, K.: Teachers' definitions of successful education technology implementation. J. Res. Technol. Educ. 1–20 (2022)
6. Lai, J.W., Bower, M.: Evaluation of technology use in education: findings from a critical analysis of systematic literature reviews. J. Comput. Assist. Learn. **36**(3), 241–259 (2019)
7. Bower, M.: Technology-mediated learning theory. Br. J. Educ. Technol. **50**(3), 1035–1048 (2019)
8. Adov, L., Must, O., Pedaste, M.: Attitudes towards mobile devices in estonian basic education: using the framework of the UTAUT model. In: Zaphiris, P., Ioannou, A. (eds.) LCT 2017. LNCS, vol. 10296, pp. 319–329. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-58515-4_25
9. Adov, L., Pedaste, M., Leijen, Ä., Rannikmäe, M.: Does it have to be easy, useful, or do we need something else? STEM teachers' attitudes towards mobile device use in teaching. Technol. Pedagog. Educ. **29**(4), 511–526 (2020)
10. Ertmer, P.A., Ottenbreit-Leftwich, A.T., Sadik, O., Sendurur, E., Sendurur, P.: Teacher beliefs and technology integration practices: a critical relationship. Comput. Educ. **59**(2), 423–435 (2012)
11. Tondeur, J., Van Braak, J., Ertmer, P.A., Ottenbreit-Leftwich, A.: Understanding the relationship between teachers' pedagogical beliefs and technology use in education: a systematic review of qualitative evidence. Educ. Tech. Res. Dev. **65**(3), 555–575 (2017)
12. Backfisch, I., Lachner, A., Stürmer, K., Scheiter, K.: Variability of teachers' technology integration in the classroom: a matter of utility! Comput Educ. **166**, 104159 (2021)
13. Aubrey-Smith, F.: An exploration of the relationship between teachers' pedagogical stance and the use of ICT in their classroom practice. Doctoral Dissertation. The Open University. Milton Keynes (2021)
14. Holmberg, J., Fransson, G., Fors, U.: Teachers' pedagogical reasoning and reframing of practice in digital contexts. Int. J. Inf. Learn. Technol. (2018)
15. Forkosh-Baruch, A., Phillips, M., Smits, A.: Reconsidering teachers' pedagogical reasoning and decision making for technology integration as an agenda for policy, practice and research. Educ. Tech. Res. Dev. **69**(4), 2209–2224 (2021)
16. Hughes, J.E., Cheah, Y.H., Shi, Y., Hsiao, K.H.: Preservice and inservice teachers' pedagogical reasoning underlying their most-valued technology-supported instructional activities. J. Comput. Assist. Learn. **36**(4), 549–568 (2020)
17. Alberola-Mulet, I., Iglesias-Martínez, M.J., Lozano-Cabezas, I.: Teachers' beliefs about the role of digital educational resources in educational practice: a qualitative study. Educ. Sci. **11**(5), 239 (2021)
18. Kirkwood, A., Price, L.: Technology-enhanced learning and teaching in higher education: what is "enhanced" and how do we know? A critical literature review. Learn. Media Technol. **39**(1), 6–36 (2014)
19. Chen, C.H., Tsai, C.C.: In-service teachers' conceptions of mobile technology-integrated instruction: tendency towards student-centered learning. Comput. Educ. **170**, 104224 (2021)
20. Wallace, R.M.: A framework for understanding teaching with the internet. Am. Educ. Res. J. **41**(2), 447–488 (2004)
21. Pozas, M., Letzel, V.: Do you think you have what it takes?– exploring predictors of pre-service teachers' prospective ICT use. Technol. Knowl. Learn. 1–19 (2021)
22. Schmitz, M.L., Antonietti, C., Cattaneo, A., Gonon, P., Petko, D.: When barriers are not an issue: tracing the relationship between hindering factors and technology use in secondary schools across Europe. Comput. Educ. **179**, 104411 (2022)

23. Pedaste, M., Leijen, Ä., Poom-Valickis, K., Eisenschmidt, E.: Teacher professional standards to support teacher quality in Estonia. Eur. J. Educ. **54**(3), 389–399 (2019)
24. Pedaste, M., Leijen, Ä., Kallas, K., Raave, D.K.: How to increase the potential of digital learning in achieving both cognitive and non-cognitive learning outcomes? CO:RE Short Report Series on Key Topics, Hamburg (2022)
25. OECD: PISA 2018 Results (Volume V): Effective Policies, Successful Schools. OECD Publishing. Paris (2020)
26. Olmos-Vega, F.M., Stalmeijer, R.E., Varpio, L., Kahlke, R.: A practical guide to reflexivity in qualitative research: AMEE guide, vol. 149, pp. 1–11 (2022)
27. Thomas, D.R.: A general inductive approach for analysing qualitative evaluation data. Am. J. Eval. **27**(2), 237–246 (2006)