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Why do some teachers teach media literacy while others do not? Exploring predictors along the "will, skill, tool, pedagogy" model

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ABSTRACT

The present study aims to identify factors that predict whether teachers engage in teaching about digital technologies (media education), which is an under-researched topic compared to the research about teaching with digital technologies (technology integration). Thus, a popular model of technology integration—the "will, skill, tool, pedagogy" model—guided our research on media education. Based on a survey of 2247 Swiss upper secondary school teachers, we found that for most of the media education topics, only a minority of teachers indicated that they have addressed them in class. Multilevel binomial regression analyses revealed that teachers' responsibility beliefs (will) were one of the most important predictors of discussing media education topics. Furthermore, teachers' self-assessed technical skills (skill) positively predicted whether they taught media literacy, whereas skills in teaching with digital technologies perceived by teachers (pedagogy) only promoted the likelihood that teachers would address topics of critical evaluation of online information and ethical questions of automation. The quality of the schools' infrastructure (tool) seemed to be of minor importance or to have even detrimental effects in the context of media education. Moreover, we observed differences between subjects in engagement in media education, with language, arts, and humanities teachers being particularly more likely to cover aspects of media literacy in class.

Credit author statement

Maria-Luisa Schmitz: Data Curation, Investigation, Formal analysis, Conceptualization, Writing – original draft, Writing – review and editing; **Tessa Consoli:** Data Curation, Investigation, Writing – review and editing; **Chiara Antonietti**: Data Curation, Investigation, Writing – review and editing; **Alberto Cattaneo**: Project administration, Funding acquisition, Supervision, Writing – review and editing; **Philipp Gonon**: Project administration, Funding acquisition, Supervision, Writing – review and editing; **Dominik Petko**: Project administration, Funding acquisition, Supervision, Conceptualization, Writing – review and editing.

1. Introduction

Apart from teaching with digital technologies (technology integration), schools have the duty to teach students skills and insights about digital technologies. This approach has been labeled under many different concepts, including media education, media literacy education, computer and information literacy education, and digital literacy education, among others (Potter, 2013). The goal of these concepts is to develop students' skills, knowledge, ethical frameworks, and self-confidence needed to fully participate in digital culture (Jenkins, 2007). Thus, media literacy, which should be promoted by media education, is defined as a set of skills and knowledge that enables people to participate in the digital world. For example, Glister (1997) and Calvani et al. (2010) distinguished three components of digital literacy: technological, ethical, and cognitive. The technological component relates to exploring technological contexts in a flexible way, whereas the ethical component concerns interacting through information and communication technology (ICT) in a responsible way. The cognitive component of digital literacy deals with the access, selection, and critical evaluation of information. According to Hobbs (2010, 2019) media literacy includes making responsible choices and accessing information, analyzing

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messages, creating content reflecting on one's own conduct and communication, and taking social action by working individually and collaboratively (Hobbs, 2010, 2019). Thus, media education is a combination of hands-on creative production and, above all, critical reflection, building up on students' daily experiences with digital technologies. It includes defensive and protectionist approaches and discusses problematic aspects of digitization and extends to considering students' positive experiences with digital technologies and empowering them to profit from technology (Buckingham, 1998, 2007, 2020; Livingstone et al., 2020).

Although across contexts approaches to media education may differ in their focus and methods, a common task is to foster students' skills and knowledge about the digital media and technologies they confront daily (Buckingham, 2020; Hobbs, 2019; Jenkins, 2007). However, there is no consensus on a clear definition of media literacy (Leaning, 2019; Potter, 2013). All of the different concepts overlap in being broad enough to consider all kinds of digital technologies and stress the importance of not just focusing on knowledge or skills but both and how they work together (Potter, 2013). This broad conceptualization of media literacy becomes apparent in overarching competence frameworks, such as the European DigComp 2.2 and DigCompEdu Frameworks or the American International Society for Technology in Education Standards or the Swiss digital strategy (International Society for Technology in Education, 2000; Redecker & Punie, 2017; Swiss Confederation, 2017, 2018, 2019; Vuorikari Rina et al., 2022). For example, in the DigComp 2.2. framework the main areas of digital competency consist of information and data literacy, communication and collaboration, digital content and creation, safety and problem solving (Vuorikari Rina et al., 2022). By contrast, Swiss policies show a slightly different conceptualization of media literacy. The Swiss digital strategy has defined basic ICT competencies for adults: They should know how to use digital devices, the internet, and online services, how to communicate when using ICT, and how to guarantee their own safety when using ICT (Swiss Confederation, 2019). Similarly, in the new curricula for general education in upper secondary schools, a module called media and informatics has been introduced, which defines the following competencies in the area of media education: Students should acquire an understanding of the social, political, cultural, and personal implications of digital technologies. They should use digital technologies competently and should be aware of their opportunities and risks. Students should know the rules of conduct and legal principles for safe and socially responsible behavior using digital technologies (Deutschschweizer Erziehungsdirektorinnen und -direktoren -Konferenz [D-EDK], 2016a). Although vocational schools do not have such an overarching curriculum, there have been similar attempts to promote these competencies (Swiss Confederation, 2018). Regarding this broad variety of frameworks and policies of media literacy, it might be useful to search for consensus in research studies and identify areas of media literacy that are supported by various studies.

More recently frameworks and studies overlap in identifying the following areas for media literacy: critical thinking and reflecting on media and information systems, using digital technology for individual and societal purposes, operational competencies (production skills such as integrating and elaborating digital content), and communication and collaboration (see Berger, 2019, 2021; Fraillon et al., 2013; 2020; Siddiq et al., 2016). However, most studies focusing on teachers' engagement in promoting students' media literacy only examine critical thinking and reflecting media and information systems with particular emphasis on computer and data safety or other problematic aspects of digital technology use, critical evaluation of online information, and ethical questions of digital technology use (Berger, 2019, 2021; Berger & Wolling, 2019; Claro et al., 2018; Guggemos & Seufert, 2021; Hatlevik & Hatlevik, 2018; Sadaf & Gezer, 2020; Sadaf & Johnson, 2017; Siddiq et al., 2016; Wu et al., 2022; Zhu et al., 2019). Thus, critical thinking and reflecting on media and information systems seems to be the key component of media literacy when considering teachers' engagement in media literacy.

In order to align with the strain of research on teachers' engagement in media education, we focus in our study on the following aspects of media literacy: critical thinking and reflection with regard to computer and data safety, problematic and positive aspects of digital technologies, evaluation of online information and ethical questions of automation. It would also be worthwhile to focus on these aspects of media literacy in our study, as it would fit well with our research context. In Switzerland, students at the upper secondary level are primarily expected to acquire critical thinking and reflection skills in relation to digital media. For example, they should be aware of the social, political, and cultural implications of digital media, as well as their opportunities and dangers, and deal with ethical issues of digital technology use (D-EDK, 2016a; Swiss Confederation, 2018).

Jenkins (2007) identified three reasons to not only use technology as a teaching tool but also to explicitly teach about digital technologies and foster critical thinking and reflection. First, teachers should attempt to bridge the gap in digital literacy skills between students who are skilled because they are digitally well-equipped and supported at home and students who are less skilled because they lack the equipment or support at home. Large-scale assessment studies have consistently shown variations in students' access to, competent use of, and potential harmful experiences with digital technologies in European countries. For example, the EU Kids Online Study 2020 showed that students not only spend more and more time online but a significant proportion have also had potentially harmful experiences (Smahel et al., 2020). In this case, most students turn toward parents and friends and not toward teachers. This finding is in line with other studies underlining the importance of bridging this gap (European Commission, 2019; Fraillon et al., 2014; Fraillon et al., 2020; OECD, 2020). Furthermore, Berger's (2019) study showed a negative correlation between students' socioeconomic status and their learning of digital literacy from teachers. This supports Jenkins' (2007) assertion that teachers play an important role in fostering equality so that students, independent of their social background and technical equipment at home, can develop digital literacy skills.

Second, Jenkins (2007) stressed the transparency problems of digital technologies, which lead to the issue that many students are unable to critically evaluate the information provided by digital technologies without the professional supervision of teachers. Empirical studies have confirmed that students lack skills in this area and advise teachers to address this topic more often in class (e.g., Ladbrook & Probert, 2011; McGrew et al., 2018). Third, digital technologies confront students with new ethical problems that should be addressed in class (Jenkins, 2007). Currently, innovations such as ChatGPT are shaping discussions about plagiarism and academic integrity in educational contexts in new ways (e.g., Cotton et al., 2023). Thus, it is not surprising that teaching about digital technologies and addressing media education topics in class has been an essential part of various policies and curricula for upper secondary schools in Europe (Ottestad & Gudmundsdottir, 2018). The Swiss digital strategy also states that the teaching of creative and critical thinking with regard to digital technologies is essential (Swiss Confederation, 2018). However, it remains unclear whether and under what circumstances these skills and knowledge about digital technologies are actually taught by teachers.

Compared to research on factors that affect teaching *with* digital technologies (technology integration), there is less quantitative empirical evidence on factors influencing teaching *about* digital technologies, especially regarding media education (see Consoli et al., 2023). Studies, such as the European second survey of information technologies in schools, have shown that although a majority of teachers feel confident about teaching information literacy and online safety, evidence from the data does not clarify whether this leads to actual coverage of these topics in class (European Commission, 2019). This concern has been addressed by only a few large-scale studies. The ICILS study reported that about half of the teachers addressed media literacy education topics in class in 2013 (Fraillon et al., 2014), and almost two-thirds to three quarters seemed to place emphasis on these topics in 2018 (Fraillon et al., 2020).

Other smaller studies revealed that teachers engage in media education from a small to moderate degree (Berger, 2021; Berger & Wolling, 2019; Guggemos & Seufert, 2021; Hatlevik & Hatlevik, 2018; Ladbrook & Probert, 2011; Siddiq et al., 2016). However, there is a significant variation between countries and schools in this regard, and it remains an open question as to whether models from the well-researched field of technology integration can guide research in media education teaching.

1.1. The "will, skill, tool, pedagogy" model

One possible model that could guide research on factors influencing the actual media education practices of teachers is the "will, skill, tool" (WST) model. It is one of the most prominent models for general technology integration in educational research (Knezek et al., 2003; Niederhauser & Lindstrom, 2018; Sailer et al., 2021; Tondeur et al., 2021). In the model, the will component is described as teachers' beliefs about digital technologies. Although most studies operationalize will as teachers' positive beliefs about digital technologies (Knezek & Christensen, 2016; Niederhauser & Lindstrom, 2018), beliefs in the context of digital technologies can be regarded as a complex multifaceted concept that could also include teachers' pedagogical beliefs (Tondeur et al., 2017).

The skill component relates to teachers' ability or self-efficacy to use digital technologies (Niederhauser & Lindstrom, 2018). Originally, skill was measured in studies as the basic handling of computer functions and technical applications. However, this assessment of skill seems to be outdated, and recent research has focused on more complex and advanced digital competencies (Schmitz et al., 2022). For example, skill can be operationalized as technological knowledge (TK; see, e.g., Farjon et al., 2019) from the TPACK framework by Mishra and Koehler (2006). This model consists of three components—the purely technical component TK, content knowledge, and pedagogical knowledge—and the reciprocal overlaps of these three components—resulting in the technological pedagogical content knowledge (TPCK) at the center of the framework (Mishra & Koehler, 2006). In most studies, the technological skills of teachers as depicted in the TPACK framework are self-assessed and can be described as teachers' technical self-efficacy although more recent studies indicate that teachers' self-assessment regarding the TPACK knowledge components should be supplemented by more objective performance measures (see for example Drummond & Sweeney, 2017; Max et al., 2022). Furthermore, the tool component of the WST model is defined as the availability, accessibility, and quality of the schools' digital equipment and infrastructure (Niederhauser & Lindstrom, 2018).

Petko's (2012b) findings prompted the extension of the model with the addition of pedagogy as the fourth component, resulting in a "will, skill, tool, pedagogy" (WSTP) model. Following Christensen and Knezek (2016), we describe pedagogy as the teachers' skills to teach with digital technologies and as TPCK—the overlap of TK, content knowledge, and pedagogical knowledge—from the TPACK model by Mishra and Koehler (2006). Similarly, to the skill component operationalized as TK, TPCK is also self-assessed by teachers and reflects their self-efficacy to teach with digital technologies. A growing body of research has shown that these four components explain a high degree of variance in various indicators of technology integration (Agyei & Voogt, 2011; Farjon et al., 2019; Knezek & Christensen, 2008, 2016; Knezek et al., 2003; Morales Velazquez, 2007; Petko, 2012a, 2012b; Pozas & Letzel, 2021; Sasota et al., 2021; Sawyerr & Agyei, 2022).

Measurements, such as the stages of technology adoption and level of use of technology relating to beliefs, skills, and familiarity with technology, are very common in operationalizing technology integration (see, e.g., Agyei & Voogt, 2011; Knezek et al., 2003; Knezek & Christensen, 2016; Sawyerr & Agyei, 2022). However, these measures might be confounded with the will and skill components of the WSTP model (Petko, 2012b). A useful orientation for measuring technology integration while avoiding confounding with the enablers of the WSTP model was provided by Backfisch et al. (2021), who suggested that technology integration consists of two main aspects: quantitative and qualitative (Backfisch et al., 2021). Quantitative aspects of technology integration refer to the frequency of technology use. By contrast, qualitative aspects of technology integration address teaching quality when teachers use digital technologies in class and teachers' use of technology to transform learning activities (Backfisch et al., 2021).

More recent studies have used the frequency of technology use as a dependent variable (see, e.g., Sasota et al., 2021), and there is evidence that, especially among European in-service teachers, the quantitative predictors of the WST model no longer explain a high degree of variance (see Schmitz et al., 2022). Instead, the enablers of the WSTP model might be more relevant when investigating the effects on other aspects of technology integration apart from mere frequency. For example, enablers of the WSTP model might have stronger effects on teachers' engagement in media education than on the mere frequency of technology use in class (Guggemos & Seufert, 2021).

1.2. Will-, skill-, tool-, and pedagogy-related factors influencing media education

Models in the context of media education describe many different factors that condition the effective teaching of media literacy. These factors overlap in that teachers' beliefs, skills, and a school's technical equipment are postulated as key factors in effective media education (see, e.g., Eickelmann & Schulz-Zander, 2008; Lorenz & Bos, 2017; Sadaf & Gezer, 2020; Sadaf & Johnson, 2017). There is some empirical evidence that teachers' beliefs, skills, and a school's technical equipment are significant and mostly positive predictors of teachers' engagement in media education, although all of those factors have never been studied in parallel (Berger, 2021; Berger & Wolling, 2019; Botturi, 2019; Hatlevik & Hatlevik, 2018; Lorenz et al., 2019; Sadaf & Gezer, 2020; Sadaf & Johnson, 2017; Siddiq et al., 2016; Wu et al., 2022; Zhu et al., 2019). Petko (2012b) investigated media education-related competencies in the context of the WST model. However, Guggemos and Seufert (2021) were the first to explicitly introduce the WSTP model as a helpful model to predict whether teachers engage in media education. They found that will (attitudes toward digital technology as the content in class), skill (TK), and pedagogy scores (TPCK) are significantly and positively correlated with the frequency of teachers teaching about digital technologies in class. However, they examined only the effects of the will, skill, and pedagogy components of the WSTP model without investigating the potential effects of the tool component. Moreover, their sample cannot account for the multilevel structure of the data. Furthermore, their research could be complemented by a more fine-grained measure for teaching about digital technologies that accurately differentiate digitization topics.

Guggemos and Seufert (2021) only asked teachers to indicate how often they address the topic of digitization in class, engage in cross-disciplinary teaching on digitization topics, and promote the interdisciplinary competencies of learners in dealing with online information without specifying digitization topics. More nuanced insights may emerge from examining the differential effects of the enablers of the WSTP model on the different aspects of media education, such as problematic aspects, positive aspects of digital technologies, critical evaluation of online information, and ethical questions of automation. Moreover, many studies have stressed the importance of gender, age, subject, and school type in the context of media education (Berger, 2021; Berger & Wolling, 2019; Claro et al., 2018; Siddiq et al., 2016). This stream of literature could be further extended by investigating these factors within the context of the WSTP model.

1.3. Research questions

Based on previous research, the following research questions were raised:

1. How many upper secondary school teachers report addressing media education topics in class?
2. What are the core factors that influence whether teachers address these topics in class, and are they aligned with the WSTP model, which is often used to explain teachers' technology integration in general?
3. How do other factors, such as gender, age, number of teaching years, school type, and subjects, influence whether teachers cover aspects of media education?

With regard to the first research question, previous studies indicate that teachers are moderately or scarcely involved in media education regarding critical reflection and thinking, especially at the upper secondary level (Berger, 2021; Berger & Wolling, 2019; Guggemos & Seufert, 2021; Hatlevik & Hatlevik, 2018; Ladbrook & Probert, 2011; Siddiq et al., 2016). Regarding the second research question, we expect that the factors of the WSTP model have a significant and positive impact on whether teachers engage in media literacy topics in class.

For the third research question, no clear hypothesis can be formulated, as the extant studies present widely conflicting findings. For example, Siddiq et al. (2016) found no significant gender differences in teachers' engagement with the topic of information evaluation. However, it is unclear whether gender differences are significant for other aspects of media education. Similarly, no clear expectations can be formulated for age and teaching years. Berger and Wolling's (2019) study provided empirical evidence that age is significantly positively associated with teachers' frequency of engaging in the topic of protection of the private sphere. Claro et al. (2018) found that younger teachers with more teaching experience have a significantly higher capacity to develop students' digital information and communication skills than older teachers and teachers with less experience. Nevertheless, findings about the relationship between age or teaching years and teaching other media literacy topics are lacking.

With regard to school type, German studies indicate that gymnasium teachers are less likely to tackle media education topics than teachers from other school types (Berger, 2021; Berger & Wolling, 2019), but no conclusions can be drawn for other countries. Regarding subjects, Siddiq et al. (2016) indicated that language, arts, and humanities teachers report teaching media literacy significantly more frequently than mathematics, information technology, natural science and technology (MINT) teachers or teachers who teach other subjects such as sports. Berger (2021) found that MINT teachers address media education topics significantly less frequently than teachers responsible for other subjects. By contrast, beyond languages, arts, and humanities, Berger and Wolling (2019) also found that computer science teachers and humans, nature, and technology teachers engage significantly more frequently in media education than teachers with other subjects. Claro et al. (2018) found that science teachers have a significantly higher capacity to develop students' digital information and communication skills than those teaching languages, arts, and humanities, or even mathematics.

2. Materials and methods

2.1. Participants and procedure

We conducted two survey waves: First, the canton of Zurich from September 20th to November 8th, 2021, followed by all other cantons in Switzerland from May 1st to August 1st, 2022. All teachers who teach in the second and third years of upper secondary schools were invited to complete an online survey. The online survey was configured so that teachers could not proceed to the next item until they had answered the previous item. Therefore, there was no missing data. Our sample consisted of 2248 teachers from 113 schools. One case was excluded from the analyses because the teacher was the only one representing the school, which led to a final sample of 2247 teachers from 112 schools. For some analyses, teachers who did not report a correct age or the correct number of years of teaching experience or a subject that did not fit into the subject categories were removed.

Regarding the sample characteristics, 50.5% of teachers were male, 47.3% were female, and 2.2% chose the response option "other" for their gender. On average, teachers had 16 years of teaching experience (SD = 10) and were 46 years old (SD = 10). Overall, 41.8% of teachers taught in a general education track, 40.7% in a vocational education track, and 17.5% of teachers were in schools with both educational tracks. Further, 37.4% of teachers taught subjects from the category languages, arts, and humanities; 20.0% of the teachers were in the area of MINT; 15% were responsible for vocational subjects; 5.3% taught sports, music, and other subjects; and 22.2% taught at least two subjects that fell into at least two of the three previously mentioned categories (mixed). Regarding the language region, 79.2% of teachers came from the German-speaking part of Switzerland, 9.5% of teachers were employed in schools from the francophone region, and 11.3% of teachers were located in the Italian-speaking part.

2.2. Measurement instruments

2.2.1. The "will, skill tool, pedagogy" model

The will component of the WSTP model was measured using three items. Teachers were asked to indicate how much they agreed with statements about teachers and the school being responsible for sensitizing and educating students about digital technologies (e.g., "As a teacher, I need to make all students aware of the role that digital technologies play in our society"; all other items can be found in the appendix). The answer options ranged from 1 *(totally disagree)* to 5 *(totally agree)*. Originally, the scale contained an additional item ("Schools do not have to necessarily address digital technologies in the classroom, as already happens enough elsewhere") that was excluded from all further analyses, since it caused the reliability of the entire scale to drop to an unacceptable level of 0.69. After excluding this item, the reliability for the will component was .73 each for Cronbach's α and 0.74 for McDonald's ω.

The skill component was measured with three items related to the teachers' technological knowledge and skills, following Schmid et al. (2020) (e.g., "I keep up to date with important new digital technologies"; all other items are reported in the appendix). The answer options were the same as for the will component. For the skill component, the reliability was .86 for Cronbach's α and 0.87 for McDonald's ω.

The tool component was covered with three items, following Petko et al. (2018). Teachers were asked to rate the quality of the school's computer infrastructure (e.g., "How would you rate your school's overall computer infrastructure?"; all other items can be found in the appendix), considering hardware, internet connectivity, and technical support. The answer options ranged from 1 (*very bad*) to 5 (*very good*). The reliability of the tool component was .76 for Cronbach's α and 0.77 for McDonald's ω.

The pedagogy component was measured with three items related to TPCK, following Schmid et al. (2020) (e.g., "I can select digital technologies that enhance the content of a lesson"; all other items are reported in the appendix). The answer options were the same as for the will and skill components. For the pedagogy component, Cronbach's α and McDonald's ω each had a reliability of 0.87.

Confirmatory factor analysis supported differentiating the enablers according to the WSTP model without any modifications (chi^2 (48) = 267; $p < .001$; TLI = 0.972; CFI = 0.980; RMSEA = 0.045; SRMR = 0.034). For the TLI and CFI, values higher than 0.95 are considered a good fit, as are values of RMSEA and SRMR lower than 0.05 (Hu & Bentler, 1999). More detailed results for the confirmatory factor analysis and a correlation between the constructs of the WSTP model can be found in the appendix (Appendix B and C).

2.2.2. Media education

Media education was measured using six items. The teachers were

asked whether they addressed the six following topics in class (e.g., Please indicate whether you address the following aspects in your teaching): computer and data security, problematic content (e.g., pornography, racism, extremism, violence), problematic behavior (e.g., cyberbullying, Internet addiction, online gambling), selecting and critically evaluating information (e.g., fake news), social movements and prosocial behavior on the internet, and ethical questions of automation (e.g., artificial intelligence and robotics). Computer and data security, problematic content, and problematic behavior can be categorized as topics covering the problematic aspects of media education, whereas social movements and prosocial behavior on the internet reflect the positive aspects of digital technologies in media education. Selecting and critically evaluating information as well as ethical questions of automation are topics concerning other aspects of media education. The answer options were 0 *(No)* and 1 *(Yes)*. Our first attempt was to form a dichotomous Rasch scale (see Rasch, 1993) to have a single indicator for teachers' engagement in media education. However, the six items do not form a Rasch scale because the Rasch reliability of a dichotomous Rasch model is 0.55. Thus, despite acceptable infit and outfit values of the items within the range of 0.5–1.5 (see Wright et al., 1994) there was no accuracy of measurement (see Adams, 2006; Bond et al., 2020). Moreover, Rasch modeling is used for performance testing rather than for self-reported questionnaire items and requires a large number of items to form the data basis of a construct (Andrich & Marais, 2019; Rasch, 1993). Given that we have only six items as indicators of teachers' engagement in media literacy and that these items are based on teachers' subjective assessments rather than objective measures of performance, it seems appropriate not to form a Rasch scale. Hence, we used the six items as single items for further analysis. This approach has the advantage that differential effects of predictors on teachers' likelihood to address different media education topics can be examined.

Table 1
Percentage of teachers per subject category who addressed media literacy topics.

	Languages, arts, and humanities	MINT	Vocational subjects	Sports, music, and other subjects	Mixed
Security	31.0%	25.7%	42.3%	15.9%	44.2%
Problematic content	57.6%	21.5%	38.7%	28.4%	52.5%
Problematic behavior	55.5%	24.4%	39.5%	30.7%	51.5%
Information evaluation	85.8%	71.0%	65.1%	45.5%	88.6%
Social movement	45.9%	11.6%	31.8%	27.3%	47.6%
Ethical questions	48.0%%	27.2%	29.5%	16.1%	44.0%

Note. N = 2244, 3 teachers were excluded from the analysis as their subjects did not fit into a category. The percentages are weighted. MINT = mathematics, information technology, natural science and technology.

2.2.3. Additional variables

Since previous studies have shown that gender, teaching years, age, and school type seem to be important control variables in the context of media education (Berger, 2021; Berger & Wolling, 2019; Claro et al., 2018), teachers were asked to indicate their age, their years of teaching experience, and their gender: The answer options for the gender were 1 *(male)*, 2 *(female)*, and 3 *(other)*. Moreover, we categorized each of the participating schools as 1 *(general education school)*, 2 *(vocational education school)*, or 3 *(a school with combined general and vocational education, combined)*. Since various studies have stressed the importance of investigating subjects in the context of media education (Berger, 2021; Berger & Wolling, 2019; Claro et al., 2018; Siddiq et al., 2016), we also asked the teachers to indicate their subject(s). All of these subjects were categorized into six teacher profiles: 1 *(languages, arts, and humanities)*, 2 (*MINT*), 3 (*sports, music, and other subjects*), 4 (*vocational subjects*), and 5 (*teachers who taught subjects from different categories, mixed*).

2.3. Quantitative analysis

2.3.1. Descriptive statistics

For the descriptive statistics, means and standard deviations are reported for the will, skill, tool, and pedagogy constructs. Regarding the six media education items, the percentage of teachers indicating that they addressed a certain topic is presented for all teachers and split by subject categories. Since a survey with a full population was not achieved, sampling weights were applied to account for the uneven distribution of participant numbers per school, language region, and school type using SPSS 25 (Kish & Frankel, 1974; Meinck, 2015). The following weighting formula was used:

$$\text{Weight} = a(N\text{of teachers who taught in the school} \,/\, N\text{of respondents in the school}) \times b(N\text{of teachers in a language region} \,/N\text{of respondents in a language region}) \times c(N\text{of teachers who taught in a school type} \,/N\text{of respondents in a school type}) \times (\text{mean}\ (a \times b \times c))$$

For the multilevel binomial regression models, we used unweighted data to avoid distorted results (see Gelman, 2007; Winship & Radbill, 1994).

2.3.2. Inferential statistics

Given that our data were clustered (teachers were nested in schools), multilevel binomial regression analyses with random intercepts were conducted for each of the six media education items as a dependent variable. For each of the six media education items, a baseline model was calculated with a random intercept only to check the significance of the random effects (intercepts) and intraclass correlation. Six binomial regression models (models 1) were then conducted, including the enablers of the WSTP model as predictors and the teachers' age, years of teaching experience, gender, school type, and subject categories as additional variables. All predictors (except for gender, subject categories, and school type, which are categorical variables) were cluster mean-centered, since we are interested in individual effects at the teacher level (see Enders & Tofighi, 2007; Lüdtke et al., 2009). The baseline models were compared to the models 1 using the information criteria AIC and BIC (see Nakagawa & Schielzeth, 2013; Vonesh et al., 1996). Moreover, we used the R-squared conditional and the R-squared marginal as indicators for the effect size of the models. While R-squared marginal relates to the variance explained by fixed factors, R-squared conditional refers to the variance explained by both fixed and random factors (Nakagawa & Schielzeth, 2013; Vonesh et al., 1996). Although there is no consensus on the most plausible definition of R-squared for multilevel models with binary outcome variables (Jaeger et al., 2017), these two indicators for variance explanation are quite common in research (see Nakagawa & Schielzeth, 2013; Vonesh et al., 1996). Finally, post hoc tests with Bonferroni correction were performed to discover differences between the groups of categorical predictors of engagement in media education. For all these inferential analyses we used the software Jamovi (version 2.3).

3. Results

3.1. Descriptive statistics

Only a minority of teachers (35.1%) reported that they discussed computers and data security in class. In total, 44.5% of the teachers addressed the topic of problematic online content during a lesson, and 44.4% of all teachers indicated that they tackled the topic of problematic online behavior. Most teachers covered how to evaluate online information (77.7%). By contrast, only a few teachers discussed social movements (36.3%) and ethical questions of automation (37.9%). Considering the subject categories, Table 1 illustrates that teachers who taught languages, arts, and humanities and subjects from different categories (mixed) most frequently indicated that they covered media literacy topics in class. The only exception relates to the security topic, where more teachers who taught vocational subjects reported discussing this topic than teachers from the languages, arts, and humanities. Overall, MINT teachers, as well as teachers who taught sports, music, and other subjects, engaged the least frequently in media literacy topics. For information evaluation, a high percentage of teachers from all the different subject profiles reported that they tackled this topic, whereas for the security topic, the percentage of teachers per subject covering this topic was very low.

Table 2 displays the mean values and standard deviations for the enablers of the WSTP model.

3.2. Multilevel binomial regressions

The random intercept baseline models revealed that for all models except for the model with the dependent variable social movements, the random effects (intercepts) became significant, confirming the clustering of the data. The intraclass correlation ranged from 0.11 to < 0.01, indicating that less than 1% up to 11% of the variance in the dependent variables can be explained by the differences between schools. However, even with an intraclass correlation as low as 0.01, the Type I error rate may be four times higher than the conventionally used alpha level. Therefore, it is advisable to consider clustered data, as long as simple size requirements are met (see Huang, 2018). Simulation analyses indicated that multilevel binomial regression analysis with a binary outcome variable needed around 80 clusters for bias-free estimations (Schoeneberger, 2016). Since in our sample 2247 teachers were nested in 112 schools (clusters), we were able to perform multilevel binomial regression analyses.

Table 3 shows the fixed effects and random effects for all six multilevel binomial regression models. Since AIC and BIC were smaller for Model 1 than for the null model for every dependent variable, Model 1 had a better fit. The R-squared conditional indices indicated that between 17% and 29% of the variance in the dependent variables (media education aspects) could be explained by the fixed and random effects of the model. For all six media education topics, will scores were positive, significant, and the strongest predictor of media literacy education activities. Skill scores also had a significant impact on all aspects of teachers' engagement in media education. Further, the multilevel binomial regression models revealed that tool scores had a significant and negative influence on whether teachers addressed the topics of problematic behavior, evaluating online information, and social movements. Pedagogy scores significantly and positively influenced whether teachers discussed evaluating online information and the ethical questions of automation in class.

Regarding the additional variables, the years of teaching experience and the age of the teachers seemed to play no important role in whether they tackled topics of media education during a lesson. The multilevel binomial regression analyses showed that male teachers were significantly more likely to discuss computer and data security and ethical questions of automation than female teachers, whereas female teachers were more likely to address online social movements than male teachers. However, post hoc analysis with Bonferroni correction showed that the difference between male and female teachers for computer and data security ($z = 2.10$, $p = .107$), social movements ($z = -2.16$, $p = .093$), and ethical questions of automation ($z = 2.12$, $p = .102$) was non-significant. Furthermore, multilevel binomial regression and post hoc analysis showed that teachers who indicated "other" for their gender were more likely to tackle computer and data security during a lesson than male ($z = 2.88$, $p = .012$) and female ($z = 3.53$, $p = .001$) teachers. Regarding school type, multilevel binomial regression and post hoc analysis showed that in vocational schools, teachers were more likely to discuss computer and data security in class than in general education schools. Furthermore, teachers in general education were more likely to address evaluating online information and ethical questions of automation than teachers in vocational education. The difference between general and vocational education for ethical questions of automation was not significant in the post hoc tests ($z = 0.238$, $p = .052$). Moreover, post hoc tests revealed that teachers in vocational schools were less likely to tackle ethical questions of automation than teachers in schools combining vocational and general education ($z = -3.61$, $p < .001$).

Regarding the subject profiles of teachers, multilevel binomial regression analyses and post hoc tests showed that teachers who taught languages, arts, and humanities were significantly more likely to address media literacy in class than teachers who taught MINT, vocational subjects, or subjects from the category sports, music, and other subjects. The only exception was the computer and data security topic, as there were no significant differences between languages, humanities, and arts teachers and MINT or vocational subjects teachers. Moreover, there was no significant difference between language, arts, and humanities teachers and those who taught subjects from different categories for all media education topics. Again, the only exception was that teachers who taught subjects from different categories showed a higher probability of discussing the security topic of media education than language, arts, and humanities teachers, which was not significant in the post hoc test ($z = 2.48$, $p = .131$). Additionally, post hoc tests indicated that teachers who taught subjects from the category music, sports, and other subjects were significantly less likely to tackle computer and data security than teachers who taught subjects from different categories ($z = -4.33$, $p < .001$) or vocational subjects ($z = -3.50$, $p = .005$). Post hoc tests also indicated that teachers with subjects from different categories exhibited a significantly higher probability of discussing problematic content, problematic behavior, information evaluation, social movements, and ethical questions of automation than teachers who taught MINT, vocational subjects, or subjects from the category music, sports, and other subjects. MINT teachers were significantly less likely to address the topics of problematic content ($z = -4.27$, $p < .001$) and social movements ($z = -617$, $p < .001$) than teachers who taught vocational subjects. Moreover, teachers who taught vocational subjects were significantly more likely to tackle the topics of information evaluation ($z = 4.22$, $p < .001$) and ethical questions of automation ($z = 3.79$, $p = .002$) than teachers with subjects from the category music, sports, and other. MINT teachers were significantly more likely to cover the topic information evaluation than teachers with subjects from the category music, sports, and other subjects ($z = 5.75$, $p < .001$). However, teachers who taught subjects from the category music, sports, and other tended significantly more to deal with the topic of social movements in class

Table 2
Descriptive statistics.

	Mean	SD
Will	4.17	0.72
Skill	3.21	1.05
Tool	3.70	0.95
Pedagogy	3.91	0.85

Note. Means and standard deviations (SD) are weighted. All measures are on 5-point scales.

Table 3
Multilevel binomial regression models.

	Security		Problematic content		Problematic behavior		Information evaluation		Social movements		Ethical questions	
	Null model	Model 1	Null model	Model 1	Null model	Model 1	Null model	Model 1	Null model	Model 1	Null model	Model 1
Fixed effects												
Intercept	−0.81*** (0.08)	−1.22*** (0.16)	−0.24*** (0.07)	0.29* (0.14)	−0.31*** (0.06)	−0.14 (0.13)	1.31*** (0.06)	2.14*** (0.15)	−0.63*** (0.05)	−0.30** (0.11)	−0.45*** (0.05)	0.03 (0.11)
Will		0.62*** (0.08)		0.62*** (0.08)		0.60*** (0.08)		0.47*** (0.08)		0.56*** (0.08)		0.55*** (0.07)
Skill		0.58*** (0.06)		0.18** (0.06)		0.28*** (0.05)		0.17** (0.06)		0.27*** (0.06)		0.26*** (0.05)
Tool		−0.02 (0.06)		−0.05 (0.06)		−0.14* (0.06)		−0.21** (0.07)		−0.12* (0.06)		−0.07 (0.06)
Pedagogy		0.14 (0.08)		0.04 (0.07)		0.04 (0.07)		0.31*** (0.08)		0.02 (0.07)		0.22** (0.07)
Teaching years		0.02* (0.01)		0.03*** (0.01)		0.03*** (0.01)		0.02 (0.01)		0.01 (0.01)		0.02** (0.01)
Age		0.02 (0.01)		−0.02* (0.01)		−0.01 (0.01)		−0.01 (0.01)		−0.01 (0.01)		−0.02* (0.01)
Female - Male		−0.24* (0.11)		0.08 (0.10)		0.14 (0.10)		0.10 (0.12)		0.22* (0.10)		−0.21* (0.10)
Other - Male		1.00** (0.35)		0.53 (0.35)		0.59 (0.34)		0.56 (0.44)		0.61 (0.35)		0.51 (0.33)
Vocational – general education		0.72*** (0.19)		−0.07 (0.17)		0.29 (0.16)		−0.46** (0.16)		−0.15 (0.12)		−0.32* (0.13)
Combined – general education		0.14 (0.25)		−0.30 (0.23)		0.08 (0.21)		−0.30 (0.18)		0.18 (0.14)		0.28 (0.15)
MINT – Languages, Arts, and Humanities		−0.13 (0.16)		−1.81*** (0.16)		−1.16*** (0.15)		−0.88*** (0.16)		−2.01*** (0.18)		−0.95*** (0.14)
Vocational - Languages, Arts, and Humanities		0.17 (0.18)		−0.88*** (0.18)		−0.83*** (0.17)		−1.22*** (0.19)		−0.61*** (0.17)		−0.55** (0.17)
Other - Languages, Arts, and Humanities		−0.99*** (0.30)		−1.30*** (0.23)		−1.01*** (0.23)		−2.20*** (0.23)		−0.88*** (0.23)		−1.71*** (0.27)
Mixed - Languages, Arts, and Humanities		0.34* (0.14)		−0.04 (0.13)		−0.10 (0.13)		0.07 (0.18)		−0.09 (0.12)		−0.04 (0.12)
Random Effect												
Intercept Variance	0.42 (0.65)	0.34 (0.59)	0.23 (0.48)	0.29 (0.54)	0.18 (0.43)	0.22 (0.47)	0.09 (0.29)	0.04 (0.19)	0.02 (0.13)	0.01 (0.10)	0.07 (0.26)	0.05 (0.22)
Model fit												
Deviance	2553.09	2244.29	2922.01	2526.99	2916.19	2624.11	2282.01	2009.32	2891.49	2544.97	2953.99	2671.20
AIC	2718.67	2408.90	3051.84	2689.48	3030.44	2769.12	2335.72	2062.47	2910.21	2585.08	3011.61	2741.80
BIC	2730.11	2500.23	3063.28	2780.81	3041.87	2860.44	2347.16	2153.79	2921.64	2676.40	3023.05	2833.12
R-Squared Marginal	–	.21	–	.21	–	.16	–	.19	–	.22	–	.16
R-Squared Conditional	.11	.29	.06	.27	.05	.21	.03	.20	.00	.22	.02	.17

Note. For fixed effects, the estimate and standard error in brackets are reported. For random intercepts, the variance and standard deviation in brackets are reported. For Model 1: N = 2225 (22 cases were excluded because age and/or teaching years and/or subject category were coded as missing), Clusters = 112. * $p < .05$, ** $p < .01$, *** $p < .001$.

than MINT teachers ($z = 4.20$, $p < .001$). None of the other differences between subject categories were significant in the post hoc tests.

4. Discussion

4.1. Summary of the results

For most of the media education topics (computer and data security, social movements, and ethical questions of automation), only a minority of teachers reported that they addressed this topic. Almost half of the teachers reported that they discussed problematic behavior and problematic online content during a lesson, which are fairly frequent media literacy education topics. In contrast to previous results (see Ladbrook & Probert, 2011), evaluating online information is addressed by a large majority of teachers in class (77.7%).

Considering the subject matter, a high percentage of teachers who taught languages, arts, and humanities seem to engage in media literacy topics, whereas for MINT teachers and teachers in the category sports, music, and other subjects, much lower percentages can be found. This aligns with Siddiq et al.'s (2016) findings that language, humanities, and arts teachers are more engaged in teaching media literacy than teachers with MINT or sports, music, and other subjects. Berger (2021) provided empirical evidence that teaching MINT subjects is negatively associated with engagement in media education.

In line with Guggemos and Seufert's (2021) findings, teachers' self-reported will, skill (TK), and pedagogy (TPCK) scores significantly and positively predict whether teachers teach about media education topics in class. Will scores were significant, positive, and the most important predictor of the WSTP model for all media education topics. Similarly, there is much evidence that teachers' beliefs and attitudes toward media education are crucial for the successful implementation of media education concepts across different European countries (Berger, 2021; Berger & Wolling, 2019; Lorenz et al., 2019; Sadaf & Gezer, 2020; Sadaf & Johnson, 2017; Siddiq et al., 2016; Trültzsch-Wijnen et al., 2019). Ertmer's (2005) statement that teachers' beliefs are the final frontier for technology integration also seems to apply to teaching about digital technologies, particularly critical reflection and thinking of media education.

Multilevel binomial regressions revealed that teachers reporting higher skill scores tended to address media literacy topics with a higher probability. This finding is also in line with previous studies showing that teachers with more formal training in teaching with and about digital technologies feel more prepared to engage in media education or address significantly more frequently the topic of protection of the private sphere and evaluation of online information in class (Berger, 2021; Berger & Wolling, 2019; Botturi, 2019). In addition, teachers' ICT self-efficacy was a positive predictor of students' skills to critically evaluate online information (Zhu et al., 2019). Furthermore, another study showed that teachers' skills in integrating digital literacy can significantly and positively predict teachers' intention to integrate digital literacy into their teaching (Sadaf & Gezer, 2020). In addition, this finding goes beyond the study by Guggemos and Seufert (2021), who only investigated whether teachers' technical skills operationalized as TK have an indirect effect on whether teachers address media education topics in class. Our findings provide empirical evidence that teachers' skill scores operationalized as teachers' self-assessed TK have a significant positive direct effect on all media education topics. In our study, pedagogy scores operationalized as teachers' self-assessed TPCK, were only a significant predictor of whether teachers discussed information evaluation and the ethical questions of automation. In line with these findings, previous studies indicated that teachers' self-efficacy in teaching with digital technologies was a positive predictor of teachers' engagement in fostering students' competencies in evaluating online information (Hatlevik & Hatlevik, 2018; Siddiq et al., 2016). The findings of our study also align with Guggemos and Seufert (2021) showing that TPCK has a significant and positive effect on the frequency of teaching about digital technologies.

Our multilevel analyses showed that tool scores could not significantly predict whether teachers tackled the topics of computer and data security, problematic content, and ethical questions of automation. Similar to the findings for technology integration (see Petko & Prasse, 2018; Schmitz et al., 2022), tool-related factors seem to play no important role in a technologically developed country, such as Switzerland; however, will-, skill-, and pedagogy-related enablers seem to be relevant for media education. Furthermore, previous studies have revealed that the technological resources of the school are not an important predictor of the frequency of teachers addressing problematic media education topics and critical evaluation of online information (Berger, 2021; Berger & Wolling, 2019). However, tool scores significantly and negatively predicted whether teachers discussed problematic behavior, the evaluation of online information, and social movements. This is contrary to the findings of Wu et al. (2022), who found that schools' technical resources had a positive impact on teachers' competence in fostering students' digital information literacy. However, Lorenz et al. (2019) found that the technical equipment of the school had a significant and negative effect on teachers' engagement in media education. According to them, these findings can be interpreted in two ways: On the one hand, the more satisfied teachers are with the technical equipment, the less effort they put into fostering students' digital literacy. On the other hand, the results could indicate that insufficient technical equipment demands more intensive engagement in media education (Lorenz et al., 2019).

Regarding the additional variables, age, teaching years, and gender seemed to be of minor importance for the probability of teaching about digital technologies in class, which aligns with the findings of Wu et al. (2022). School type played only an important role in the topics of security, evaluation of online information, and ethical questions of automation. However, the subject profiles seemed to matter for teachers who covered media literacy. In particular, language, arts, and humanities teachers are engaged in media education. This is in line with Siddiq et al.'s (2016) findings that teachers who teach subjects from this category report dealing significantly more often with the topic of evaluation of online information than teachers responsible for other subjects. However, in this study, language, arts, and humanities teachers did not particularly discuss data security extensively. This is contrary to the findings of Berger and Wolling (2019), who reported that humanities and language teachers foster students' protective skills more frequently than teachers from other subjects. The higher engagement of language, arts, and humanities teachers in media education compared to other teacher profiles could also be explained by the curricula. For example, in the curricula for general education, scholars have called for critically engaging students in language classes in different forms of media, and researchers in the social sciences have emphasized reflecting on the social and political implications of technologies (see, e.g., Lehrplan 21, technologies; Deutschschweizer Erziehungsdirektorinnen und -direktoren-Konferenz [D-EDK], 2016b). This could encourage more frequent classroom discussions of media education topics. By contrast, for subjects such as mathematics or natural sciences, the focus is on an understanding of mathematical or subject-specific problems and computational procedures. Similarly, for sports, it is primarily movement experiences and motor skills that should be promoted (D-EDK, 2016b). These curricular goals are more difficult to reconcile with a media education mandate.

4.2. Limitations

Overall, this study faces various limitations, one of which concerns mono-source bias. Students could have been asked to indicate whether the different topics of media education in class were addressed. However, each class has a changing set of teachers; thus, it is not possible to reliably match students and teachers at the class level in multilevel analyses. Another limitation is the measurement of the dependent

variables (media education topics). Future studies could use a Likert scale to ask more fine-grained questions about how often teachers tackle media education topics in class. This approach would also allow future researchers to build scales instead of using single items. Moreover, our operationalization of media education allows no conclusion on how media education is actually taught in class or whether the topic of media literacy is addressed in an effective way. Another limitation concerning the operationalization of media education relates to the fact that we only focused on one competence area of media literacy (critical thinking and reflection) which should also be considered when interpreting the differences between subjects. Future research should consider other competence areas of media literacy such as using digital technology for individual and societal purposes, operational competencies, and communication and collaboration (see Berger, 2019, 2021; Fraillon et al., 2014, 2020; Siddiq et al., 2016; Swiss Confederation, 2019; Vuorikari Rina et al., 2022) and reexamine the differences between subjects. Furthermore, teachers' technical skills and their skills in teaching with digital technologies were measured through self-assessment and reflected their technical self-efficacy and their self-efficacy in teaching with digital technologies. However, numerous studies indicate that teachers' self-efficacy measures regarding TPACK should be supplemented with objective performance measures (see for example Drummond & Sweeney, 2017; Max et al., 2022). Compared to the actual performance tests teachers tend to overestimate their skills in a self-assessment (Kopcha & Sullivan, 2007; Max et al., 2022). An additional limitation relates to our sample spread since we have only data from Swiss upper-secondary schools, and no inferences can be drawn for other school levels or countries. Another critical point concerning the sample is that we did not have an unbiased random sample but rather teachers volunteered to participate in our study, which could have led to a self-selection bias in our data.

4.3. Theoretical and practical implications

This study reveals several main directions for future research. First, we demonstrated that the enablers of the WSTP model significantly and—with the exception of tool scores—positively predicted whether teachers addressed topics of media education in schools. Although there is no consensus in the statistical literature for the most plausible definition of R-squared in the context of multilevel models with binary outcome variables (Jaeger et al., 2017), necessitating a cautious interpretation of the results, our R-squared marginal and conditional indices did not exceed .30, indicating that less than 30% of the variance in the dependent variables can be explained by the other variables of the models. Therefore, future research should consider additional factors that could explain whether teachers are more likely to engage in media education in class, such as curriculum, technological pedagogical knowledge from the TPACK model, technological collaboration knowledge, teachers' knowledge about plans and guidelines for media education, and ICT-related collaboration (Berger & Wolling, 2019; Guggemos & Seufert, 2021; Hatlevik & Hatlevik, 2018; Lorenz et al., 2019; Siddiq et al., 2016). Aside from additional factors, other models of technology integration such as the technology acceptance model (TAM) could also be applied to the research on teachers' engagement in media education. Numerous studies have shown that the predictors of TAM, in particular attitude towards technology, perceived usefulness of technology, and perceived ease of use, have a significant and positive impact on the behavioral intention to use digital technologies and the actual use of digital technologies in class (Scherer et al., 2019, 2020; Scherer & Teo, 2019). Moreover, the study by Antonietti et al. (2022) already examined teachers' competence beliefs in facilitating students' digital competencies (such as dealing with online information and using digital technologies safely and responsibly) in the context of TAM.

Moreover, we were only able to distinguish between teachers who addressed media education topics and those who did not. In future research, it would be interesting to use a more fine-grained measure and ask teachers to indicate how often they address media education topics on a Likert scale. Furthermore, future studies should not only focus on whether teachers address certain topics of media literacy but also on how they address these topics and whether engagement in media education is done in an effective manner. For example, Leaning (2019) distinguished between three different approaches to media education that could be used in future studies. First, the protectionist and inoculation approaches focus on the detrimental impact of digital technologies and aim to protect students from digital technologies. Second, the demystification approach aims to empower students against the problematic aspects of digital technologies. Third, the creative participation mode engages learners in creative and productive activities using digital technologies. As we only collected data from Swiss upper secondary school teachers, future studies should investigate whether the effects of this study can be transferred to other school levels or cultural contexts.

In terms of practical implications, we recommend that policymakers focus not only on providing schools with sufficient technical equipment to promote teachers' engagement in media education topics. Further, it is important to offer professional development that convinces teachers that they and the school are responsible for the media education of their students and promotes the technical skills of the teachers, as the present study has shown that teachers' beliefs and technical skills play an important role in whether they teach about digital technologies. If students should be encouraged to critically evaluate online information or discuss ethical questions of automation, it could also be helpful to provide training for teachers' ability to teach with digital technologies (pedagogy).

4.4. Conclusions

Teachers' beliefs about their and the schools' responsibility to tackle media education topics are the most important factors in the WSTP model for teachers' engagement in teaching about media education topics. Moreover, teachers' technical skills as depicted in the TPACK model are useful when they address media education topics in class. This finding extends the study by Guggemos and Seufert (2021) who investigated the indirect effects of TK on the frequency of teachers' engagement in media education. Furthermore, teachers' skills in teaching with digital technologies, in particular, TPCK as depicted in the TPACK model, are helpful when teachers aim to foster critical evaluation of online information and discussing ethical questions of automation. This is in line with the previous study by Guggemos and Seufert (2021) showing that TPCK is significantly and positively correlated with the frequency of teachers promoting interdisciplinary competencies of students such as dealing with online information. Similarly as research on technology integration (see Farjon et al., 2019; Knezek & Christensen, 2016; Schmitz et al., 2022), more advanced digital competencies, as depicted by the TPACK framework, rather than basic skills of computer functions seem to matter for teachers' engagement in media education. However, our findings suggest that the tool factor of the WSTP model plays only a marginal role and may even have detrimental effects in the context of media education. Since our findings indicate that a model of technology integration such as the WSTP model is helpful in identifying factors that have a positive influence on teacher engagement in media education, this opens up the possibility of using further models of technology integration for research on media education. One possibility would be TAM as there is already preliminary evidence that teachers' competence beliefs in facilitating students' digital competencies are positively related to components of TAM such as perceived usefulness and perceived ease of use (Antonietti et al., 2022). Overall, this study provides evidence that the WSTP model is useful in predicting whether teachers discuss media education topics in class and clarifies the subjects within which this engagement occurs.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data will be publicly available in 2024.

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There are no conflicts of interest.

Our study complies with the ethical standards of the Swiss Academy of Social Sciences and Humanities.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.chb.2023.108004.

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