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Teachers' Perspective on Artificial Intelligence Education: an Initial Investigation

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ABSTRACT

Learning about Artificial Intelligence (AI) from a young age can help students become competent citizens able to move through our increasingly digital world with confidence and responsibility. This contribution presents a preliminary investigation in Bulgaria, Greece, Italy, and Romania to understand middle school teachers' perspective on how to best teach digital competencies for AI. It uses the *Will, Skill, Tool* model as a theoretical lens, and it aims to inform the design of educational content and online platforms to enable teachers to integrate AI education into their classroom. Through a human-centred design process – including focus groups and a survey – needs and requirements were identified for a supportive online educational platform that aids teachers in AI education. The research results showed a positive attitude towards AI education and high motivation to introduce AI-related content at school, which translates to a positive *Will* factor. Regarding the *Skill* factor, teachers seem to have a basic level of digital skills but low AI-related skills. No significant problems emerged regarding the availability of resources, but further research investigating whether the *Tool* factor is accounted for would be desirable. Based on the results, six design implications for a web-based educational platform on AI have been formulated: (i) provide the required basics; (ii) make it relevant; (iii). make it interactive and collaborative; (iv) keep everyone in the loop; (v) make it accessible; (vi) motivate the user. These implications are further discussed to extend computational thinking frameworks to incorporate AI-related concepts and perspectives.

1 INTRODUCTION

Artificial Intelligence (AI) is increasingly present in our daily lives; therefore, middle school students (11-14 years old) should develop the right competencies to deal with AI technologies responsibly. Initiatives for AI education are increasing [8, 13] and most studies about integrating AI education and digital skills in the classroom focus on the student perspective [3, 13], or school or government policies [17, 18]. Only recent works have started to investigate teachers' perspectives on K-12 AI education [14, 21, 24], exploring how to support them in implementing AI teaching. Teachers are key actors in bringing innovation to the classroom and for developing innovative educational paths, thus it is important to understand their attitude and perceptions' around AI Education. This work investigates the point of view of teachers from four European countries (Bulgaria, Greece, Italy, and Romania) on teaching digital competencies for AI to their students adopting the theoretical lens of the *Will, Skill, Tool* model [10]. This model considers three key aspects to influence the use of technologies by teachers in the classroom: teachers' attitudes towards technologies (*Will*), their perception of digital competencies (*Skill*), and the availability of digital resources for them to use (*Tool*). Four focus group discussions with teachers, school psychologists, and educational managers were organized to frame the context of use. From the focus groups, a general need for a direct investigation of the teachers' perspective became apparent. Therefore, a survey was administered to 135 educators to elicit their needs and requirements as main users of platforms for AI education.

2 DIGITAL COMPETENCIES AND AI EDUCATION

The recent developments in AI and the renewed general interest in this technology have sparked discussion of the role of digital competencies related to AI and how to teach and train them from early educational stages. In this respect, some authors are arguing that the traditional definition of information literacy, or more generally digital literacy, on its own is no longer enough to adapt students to the developments in AI [7]. There is indeed a need to translate and update existing frameworks for digital competencies to include the notion of AI. For this purpose, the European Commission's Joint Research Centre has recently opened a call for contribution for revising the European Digital Competence Framework, also known as DigComp [1]. DigComp is a framework created by the

European Commission that lists the most important digital competencies for European citizens in the areas of Information and Data Literacy, Communication and Collaboration, Digital Content creation, Safety and Problem Solving. The next revision of DigComp will also include elements related to Artificial Intelligence (AI) literacy, including data-related skills and competencies linked to emerging technologies such as virtual reality, social robotics, and the Internet of things. Although the term AI literacy is relatively new, previous efforts to adapt the notion of Digital Competence to the developments in AI have been presented in the literature. For example, Heck and colleagues [7] have looked into the changes needed in information literacy to adapt to the developments in AI, as such new technology creates the need for new competencies in teachers and students. They found that two important aspects of this translation are user empowerment and self-management. Users of AI technologies need to be aware of their use and intentions for responsible use.

Moreover, in existing efforts to increase AI literacy in middle school students, topics that have been highlighted include teaching basic AI concepts, raising awareness of AI adoption in future jobs, and teaching about the ethical and social issues in AI [13]. Next to these suggested adaptations, there is a set of frameworks specifically aimed at AI education. For example, the Association for the Advancement of Artificial Intelligence (AAAI) and the Computer Science Teachers Association (CSTA) have formulated five big ideas about AI, which they believe every student in K-12 Education should learn about [23]. Examples are the idea that computers can learn from data and that AI applications can impact society in both positive and negative ways. Other frameworks such as the Machine Learning Education Framework [12] describe several knowledge indicators (e.g. general machine learning knowledge), skill indicators (e.g. independent out-of-class learning), and attitude indicators (e.g. interest) for consumers of ML or AI technologies, including young citizens. Long and Magerko [15] recently formulated a more elaborate set of competencies for AI literacy and related design considerations, based on this first identification of the most important themes in AI education. Their framework includes five themes: What is AI?, What can AI do?, How does AI work?, How should AI be used?, and How do people perceive AI?. Within each theme, related competencies and design considerations are identified. Zhou, Van Brummelen, and Lin [25] built upon the two previous works to define future opportunities for AI education (e.g. address identity, values, and background), specifically in the K-12 context and presented a design framework more directed towards educators.

When looking at the different AI frameworks, the development of AI competencies encompasses an extensive range of skills, knowledge, and attitude requirements. Some of these are specific to AI, but others are an adapted version of digital competencies that have been identified in earlier works. For example, data literacy and the critical interpretation of data are already part of the European DigComp framework [1] and can also be applied in an AI context. Similarly, problem-solving and consideration of the surrounding context are necessary competencies, regardless of the use of technology. For competencies specific to AI, programmability and following steps of Machine Learning are popular, just like the reflection of AI's strengths and weaknesses on the user and society. This work presents a human-centred design process for identifying needs and requirements for enabling teachers to integrate AI education into their classrooms.

3 THEORETICAL LENS: THE WILL, SKILL, TOOL MODEL

The *Will, Skill, and Tool* (WST) model [9, 10] is a theoretical framework explaining the conditions influencing the acceptance of digital tools in the classroom. The three primary factors of the model are *Will, Skill,* and *Tool*, referring respectively to the attitude and the competencies of teachers and the instruments available to them. A teacher's *Will* refers to their attitude towards certain technologies. In other words, if the teacher thinks that using technology in the classroom can improve their students' learning. It includes motivation, values, and beliefs concerning technology. These can be positive (if the belief that technology can aid in the learning process prevails) or negative (if the fear of related risks such as isolation or problematic use prevails). The *Skill* aspect is related to teachers' digital competencies and how convinced they are of this. In a study by Petko [20], the skill element has been found to have the largest explanatory power among the elements of the WST model. It is important to note, though, that this is about the perceived level of skills, which could mean that teachers do not necessarily need to achieve the highest level of Digital Competence, as long as they believe that they have the appropriate competence level to use digital technologies in teaching. Within the skill factor of the WST model, "Emerging Tech Skills" is a significant variable for technology integration in the classroom [9]. This is important because some of the other variables in the skill construct might be relatively outdated for AI education (e.g., skills related to email writing). The last element, tool, refers to the actual availability of digital tools (computers, laptops, tablets; and also software) to use in teaching. In general, it has been found that schools are relatively slow to adopt digital technologies and to maintain existing technology up-to-date and functioning [20]. A common practice is for schools to invest in digital devices, positively influencing the number of tools. However, this often happens without attention to the teachers' development and attitudes – disregarding the other elements of the WST model – meaning that the purchases will go unused [6, 9]. The factors of the WST model can help explain technology acceptance in the classroom. For example, it was found that perceptions of efficiency and effectiveness (i.e., positive will) have significant positive relations with technology use in education [20]. On the other hand, teachers might suffer from technology anxiety. Therefore they can show a negative attitude towards the fast change of technology or be less open to change, indicating a negative will. Other barriers can be formed by the teacher's vision of technology or their belief about its usefulness [11]. Even when teachers believe that technological development is a positive trend in society, this does not directly mean that they believe it to be valuable in their classroom [20]. Furthermore, teachers need to be aware of the link between what they are learning and their work in the classroom: otherwise, they might consider the introduction of some new topic such as AI as a waste of time [5]. Teachers need to recognise how their newly learned knowledge will help students in their (educational) development, for example, by making a connection between teaching content and real life [2].

4 PRELIMINARY INVESTIGATION ON TEACHERS' PERSPECTIVE

This study encompasses an initial qualitative study with 14 teachers, school psychologists, and education managers from several schools in four European countries (Bulgaria, Greece, Italy, and Romania). A survey targeting a larger group of European teachers has been designed to collect their needs and expectations.

4.1 Focus groups

The focus groups were aimed at understanding the general perspectives on introducing AI education. Each focus group lasted one hour, following a discussion of 17 statements (e.g. "Teachers/educators [in AI education] should have a specific background related to AI"), with follow-up questions allowing deeper discussion when desired. The discussion was semi-structured, meaning that the statements and questions were intended as a guideline, but the facilitator might adjust the order of topics or ask additional questions to clarify statements from the participants. Four topics were chosen to discuss: (1) teachers and educators, (2) students, (3) learning content and resources, and (4) technology. The first topic concerns teachers and educators, the main target group. The teachers' profile was discussed together with their background in terms of teaching level, skills, and motivation. Next, students were discussed as those receiving the AI education, and for whom it is important to increase the level of digital competencies for AI. We deemed it important to get an idea of how to support teachers in learning more about the needs of their students, which could help to understand what they are dealing with in the classroom. Therefore, students' backgrounds and educational needs were also discussed. Then, we tried to get an idea of the content that should be made available to teachers (and the students) and what resources they require. A discussion was held about the materials they would need and how they would like to receive this material. Finally, the technology was discussed in an initial investigation on what an educational platform on AI should contain and how it should be presented. A total of 14 participants (three from Bulgaria, three from Greece, four from Italy, and three from Romania) (see Table 1) took part in four focus groups that were held in an online setting. Participants were selected among middle school teachers and educators involved in a European international project, targeting a variety of contexts. None of the participants had specific experience in AI education. However, they all had previous experience in educational projects designed to improve digital skills and competencies of young people, even from disadvantaged backgrounds. Seven of them were school teachers, three education managers, two educators in after-school environments, and two school psychologists.

Results. From a thematic analysis of the focus group data (i.e. focus group transcripts), five themes emerged, which have been framed as a question summarising the theme: What to teach?, Who is teaching?, Who is learning?, What is the learning context?, and How to teach? These themes and their sub-themes have been visualised in Figure 1.

What to teach? - Concerning teaching content, it was emphasized that students mainly need digital skills they can use directly in an online teaching environment. For example, students were described as having no problems finding their way on social media platforms, but these same students did not know how to attach a homework file to an email to their teacher. More generally, it was found that the focus on competencies should be relatively broad, not only looking at educational competencies but also socioemotional competencies. Participants felt like it would be better to focus on competencies for life that can not only be useful inside the classroom but also in the students' (and teachers') daily lives. Within this AI education, a need to discuss ethical issues in AI was expressed. Across the different focus groups, AI education was seen as complementary to existing subjects in schools rather than a new separate subject. Participants could see elements of the AI education program implemented in the existing curriculum of STEM subjects and less technical subjects (for example, Personal Development or Citizenship Education) were also mentioned.

Who is teaching? - Even though teachers are the main actors in teaching, they are not the only decision-makers about teaching. It became apparent during the focus groups that both teachers and school management should be aware of the relevance and opportunities of AI education. Furthermore, teachers' need to increase their specific digital competencies strongly emerged. To achieve such improvement, motivation among teachers is crucial. Participants agreed that motivation in teachers is more important than a pre-existing knowledge of technology to make the education program a success.

What is the learning context? - Regarding the learning context, differences in language, parental support, geographic area, and available resources (including potential privacy issues) should be considered for successful AI education.

Who is learning? - It is essential to also address potential limitations due to a lack of personal digital resources or disadvantaged social background. Especially in online teaching, the differences between students with more and fewer resources become apparent, leaving students from disadvantaged areas behind.

Table 1: Overview of focus group participants

ID	Focus group	Gender	Occupation	Country
P1	1	Female	Education manager	Bulgaria
P2	1	Female	School psychologist	Bulgaria
P3	1	Female	Teacher	Bulgaria
P4	2	Female	Education manager	Romania
P5	2	Female	Teacher	Romania
P6	2	Female	Educator in after-school	Romania
P7	3	Female	Teacher	Italy
P8	3	Female	Educator in after-school	Italy
P9	3	Male	Teacher	Italy
P10	3	Female	School psychologist	Italy
P11	3	Female	Teacher	Italy
P12	4	Female	Education manager	Greece
P13	4	Male	Teacher	Greece
P14	4	Female	Teacher	Greece

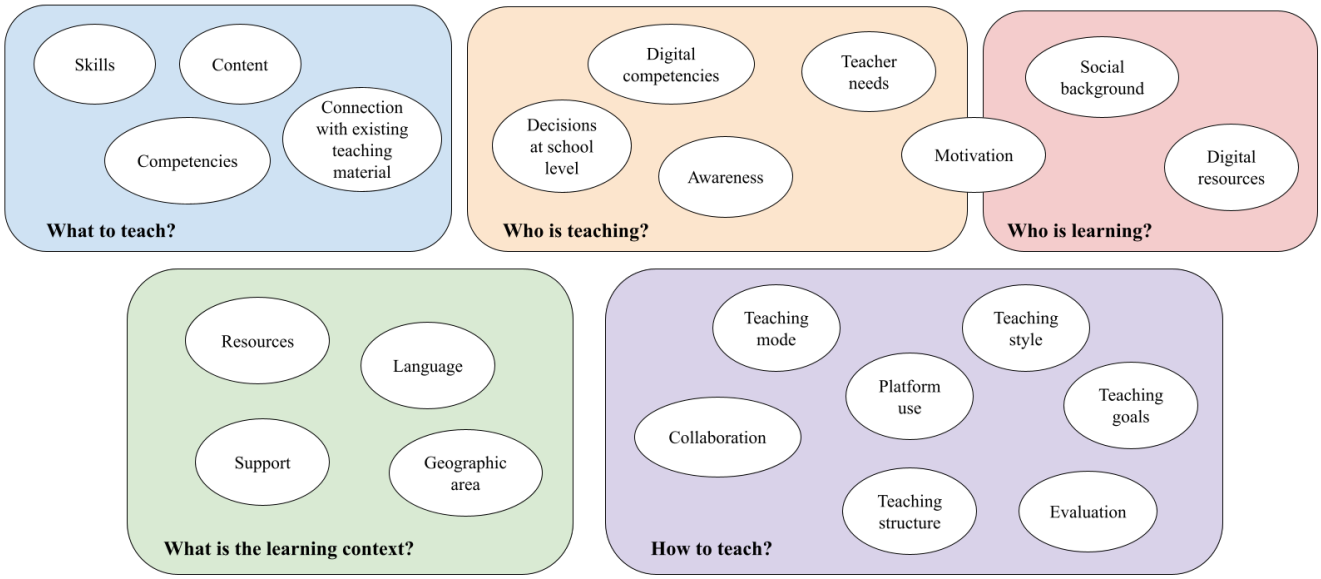

Figure 1: Themes resulting from focus group data

How to teach? - The most critical consideration for focus group participants was "How to teach it?". As AI is not yet a standard topic in middle schools, there are different factors to consider for the teachers that want to integrate AI education in their classroom. In general, teachers seem to like constructive teaching: involving students to collaborate in working towards a positive outcome. A partially online format could help as long as it keeps education interactive. In the end, the most important goal of AI education should be to meet the educational needs of their students, ideally supported by a digital platform that supports teachers' teaching styles and goals.

4.2 Teacher Surveys

Throughout the focus groups, all elements of the WST model were discussed (e.g., sub-themes such as motivation, digital competencies and (digital) resources). Still, participants stressed that a larger group of teachers should be involved in further investigation to explore teachers' attitudes and knowledge regarding AI as well the skill levels in the classroom and the possibility for digital teaching. This was done through an online questionnaire which included five sections: the first one collected demographic data, including the type of school the respondent works for, the area this school is in, the respondents' occupation, gender, their field of teaching, and the number of years in service. The following section was dedicated to the digital competencies of teachers, which arose as one of the sub-themes from the focus groups. Respondents were asked about their perceived level of digital competence according to the levels described in the DigCompEdu framework [4]. The DigCompEdu is a translation of the DigComp framework to the educational context, describing digital competencies that are required for educators. Teachers were also asked about their level of satisfaction with these digital competencies, and which specific competencies they would like to improve. Next, respondents were asked about their perceived level of students' digital competence according to the levels described in the DigComp framework [1], both in general and for specific competencies. This section was included because, even though the main focus was the teachers' perspective, the learning context and the students' background arose as important considerations during the focus groups. The following section focused on respondents' viewpoint towards AI since the participants of the focus groups indicated that the teachers' viewpoints should be highlighted. Questions were asked about their perceived understanding of AI and specific AI technologies and their interest in learning more about AI and integrating it into their teaching practice, reflecting the importance of the question "How to teach?" in the focus group results. In this work, we present the results from the responses to this last section.

The questionnaire was distributed across professional educational networks in Bulgaria, Greece, Italy, and Romania. A total of 135 people (7% male) from 89 schools/educational centres responded to the online questionnaire. All respondents reported to work with middle school students (11-14 years old): 87% of the responses came from middle school teachers, whereas 9% and 4% came from educators in youth centres and high school teachers, respectively. Most of the educational institutions where these teachers and educators work are in urban areas (56%), 21% of the educational institutions are in peri-urban areas and another 23% are in rural areas. Many of the teachers and educators teach science (29%) or literature (28%) subjects, followed by foreign language (14%) and support teachers (7%). The rest of the respondents were almost equally spread over religion/ethics (3%), art (3%), music (3%), social science (4%), multiple subjects (4%), after-school (2%) or other (2%). 73% of the respondents had over ten years of experience (38% had 11-20 years of experience, 26% had 21-30 years of experience, and 10% had over

30 years of experience). Approximately 15% of respondents had 6-10 years of experience, whereas 12% had only up to five years of experience.

Results. Regarding respondents' familiarity with AI concepts, most teachers had heard of terms such as machine learning or strong AI (N= 44, 33%) and had a vague understanding of what they mean (N= 41, 30%). Another group of teachers felt like they already had some basic knowledge in the field (N= 25, 19%), but only a handful of teachers felt that this was a good working knowledge (N= 8, 6%). At the same time, a large group of teachers also felt like they did not understand AI and its basic concepts at all (N= 17, 13%). Apart from their knowledge or understanding of AI, there was also an interest in their attitude towards AI. Even though, or maybe because of, the relatively low levels of AI literacy in the classroom, there was a great interest in learning more about the topic. Only two respondents were not interested at all (1%), and a handful was not sure (N= 8, 6%), but the rest of the respondents were at least moderately interested (N= 41, 30%), with the majority being totally interested (N= 83, 61%) to learn more about AI and integrate the topic into their classes.

To dive deeper into their attitude towards AI, teachers were presented with a list of statements regarding AI at school. They were asked to indicate to what extent they agreed with the statements on a scale from 1 (Strongly disagree) to 5 (Strongly agree). The results show a general agreement with all the statements. A Wilcoxon signed-rank test shows that for every statement, the median is statistically different (p <.001) from a value of 3, indicating that the results show a moderate agreement with the statements. When analysing the different statements, teachers' agreement is highest for the importance of learning about the impacts of AI in everyday life and developing a personal critical view on AI. Teachers agree slightly less on the importance of learning about the basic AI concepts or how to use AI technology. What stands out is the fact that the lowest agreement is reached for the statement that AI is a topic that should be taught in school (M= 3.75, SD= 1.06). However, it should not be forgotten that, on average, teachers still agree with this statement, just slightly less than they do with the other presented statements. Their background might influence a teacher's attitude towards AI and AI Education. Due to the non-normality of the data, the Mann-Whitney U test was used to investigate this difference in agreement with the statements between science (N= 39) and non-science teachers (N= 96) (see Table 2). The test showed a statistically significant difference (p <.05) between the groups for three of the statements. For the statement "Teachers/educators in my school should learn the basic concepts behind AI technology", science teachers seem to agree more (M= 4.26, SD= 0.88) than their colleagues from non-science subjects (M= 3.77, SD= 1.09). The same holds for the statements "Teachers/educators in my school should learn how to actually use AI technology" (M= 4.18, SD= 0.97 for science teachers while M= 3.75, SD= 1.13 for non-science teachers) and "Students in my school should learn how to actually use AI technology" (M= 4.18, SD= 0.91 for science teachers while M= 3.69, SD= 1.10 for non-science teachers). Another factor that might be influential is the perceived level of digital competence, which could reflect their confidence in working with concepts such as AI. The teachers can be divided into two groups: those who perceive their level of digital competence to be between level A1 and B2 (low DC level, N= 73), and those who perceive their level of digital competence to be between level B2 and C2 (high DC level, N= 62). When running a Mann-Whitney U test, there is no statistically significant difference (p >.05) in the average rating of the statements between teachers with a low level of Digital Competence and teachers with a high level of digital competence (see Table 2).

5 DISCUSSION

The results highlighted a very positive attitude towards AI education and, accordingly, high motivation to be possibly involved in AI education, which translates to a positive will factor. At the same time, there seems to be a basic level of digital skills but low AI-related skills among teachers and students. The respondents did not report significant issues regarding the availability of resources, which means that in our study context the *Tool* factor is accounted for, but further investigation in this area is desirable. It would therefore be essential to focus on *Skill* to better support teachers.

From the focus groups, it is clear that motivation to learn about AI and use digital tools in the classroom is one of the most important factors for the successful integration of AI education. Even if a teacher starts at a basic level of digital competence, their motivation to learn and improve can still make the platform successful. On the other hand, if this motivation is lacking, it will be hard for a

Table 2: Ratings on Likert statements about teachers' attitude towards AI Education and comparisons between Science (S, N=39) and non-Science teachers (NS, N=96) and between teachers with reported low (low DC, N= 73) and high (high DC, N= 62) Digital Competences

ID	Statement	M (SD)	S vs NS	Low vs High DC
1	Artificial Intelligence is a topic that should be taught in my school	3.75 (1.06)	U= 1533, p = 0.08	U= 2329, p = 0.76
2	Teachers/educators in my school should learn the basic concepts behind AI technology	3.91 (1.05)	**U= 1410, p = 0.02**	U= 2597, p = 0.12
3	Teachers/educators in my school should learn how to actually use AI technology	3.87 (1.10)	**U= 1480, p = 0.04**	U= 2504, p = 0.26
4	Teachers/educators in my school should learn about the impacts of AI in everyday life	4.00 (1.04)	U= 1492, p = 0.05	U= 2562, p = 0.16
5	Teachers/educators in my school should develop a personal critical view on AI	3.95 (1.09)	U= 1493, p = 0.05	U= 2542, p = 0.19
6	Students in my school should learn the basic concepts behind AI technology	3.83 (1.08)	U= 1485, p = 0.05	U= 2476, p = 0.32
7	Students in my school should learn how to actually use AI technology	3.83 (1.07)	**U= 1407, p = 0.02**	U= 2506, p = 0.26
8	Students in my school should learn about the impacts of AI in everyday life	3.93 (1.05)	U= 1520, p = 0.07	U= 2547, p = 0.19
9	Students in my school should develop a personal critical view on AI	3.92 (1.07)	U= 1500, p = 0.06	U= 2641, p = 0.08

teacher to integrate AI education successfully into their lessons. This reflects the findings of Heck and colleagues [7] that user empowerment is essential in the context of AI literacy. Furthermore, a desire for skill improvement became apparent, as participants in the focus groups saw digital competencies as an important part of AI education. Indeed, digital competence is well known to be a prerequisite for AI literacy [15, 18] and, therefore, a relevant element of AI education. The survey respondents also agreed with the importance of digital competence in education and that its improvement is desirable for both teachers and students. The development of digital competencies among teachers is important as their lack can hinder students' digital competence development [17]. Teachers need to gain digital competencies themselves to be able to use digital tools such as our envisioned platform for AI education. Teachers' perception remains essential even when talking about *Skill*, rather than *Will*. For teachers to use digital tools in the classroom, it is more important that they are confident about their current skills rather than to reach full proficiency in the topic [20]. Participants in the focus groups indeed believed that digital competencies should not refrain teachers from integrating AI education into their practice. The survey seems to support this view by the lack of significant difference in attitude towards AI education between teachers with a high and a low digital competence level. Nevertheless, there is already a sufficient level of satisfaction with the current situation; in this respect, it seems that our respondents have enough digital competencies, although they recognize the need to improve the ones specific to AI. Again, for the *Tool* factor, although there seem to be few problems, at least on the teacher's side, some concerns arose for the availability of tools among students. From our findings, *Will* emerges as the most important factor, closely followed by *Skill*, whereas tool was more of a concern for later, especially in the student context.

The interaction among *Will*, *Skill*, and *Tool* factors is crucial too. Even when one or two of these factors are present in abundance, the effect will be limited when not all factors are taken care of. For example, even if all necessary technologies were available in school, AI education would never succeed without a positive teacher attitude [16]. The difference between teachers' specializations (the subject they teach) does not emerge as an important factor. All teachers have a similar positive attitude towards AI education and digital technologies. We did find a statistically significant difference in attitude between science and non-science teachers. Nevertheless, it mainly regards the need to learn about the background and use of technologies. The latter finding contrasts with those reported by Sasota and colleagues [22], who found science teachers to score higher on the WST model than mathematics teachers. It might be noted that their research was done among teachers in the Philippines: therefore, this difference might be explained by the different contexts. However, the lower explanatory value of *Tool* that they found was confirmed in our study.

Based on the results, a set of six design implications for AI education through an online platform has been formulated: **(i) provide the required basics:** technologies keep changing fast, making it hard for teachers to keep up, especially if it is not their field of expertise. This was clearly reflected in our findings as the level of competencies was seen as a problem in the focus groups. At the same time, the level of competencies reported by teachers in the survey was relatively low, specifically regarding AI. To provide them with the most relevant skills and teaching material, Digital Competence and AI literacy frameworks are a good starting point; **(ii) make it relevant:** even though AI might be more relevant than ever, it can be challenging for teachers and students to see this. Therefore, the teachers should be assisted with integrating AI topics into their teaching subject. This was shown by the sub-theme "Connection with existing teacher material". At the same time, the teaching materials and activities must show a clear connection with everyday life, meaning that attention should be paid to both digital and socioemotional development [13]. This was confirmed by teachers' agreement in the survey with statements regarding the importance of learning about the impacts of AI in daily life; **(iii) make it interactive and collaborative:** hands-on, interactive learning activities in which students collaborate are a great way to keep students engaged, which is one of the primary goals in the classroom as was agreed upon in the focus groups; **(iv) keep everyone in the loop:** to make the adoption of an educational platform successful, it is important to look further than the direct user (i.e., teachers). Needs from school management and students can have significant consequences and should therefore be considered as well, as was stressed by participants of the focus groups; **(v) make it accessible:** multiple factors can reduce the accessibility of the platform, such as privacy requirements, AI anxiety among teachers, language barriers, and lack of digital competencies, which were indicated both in the focus groups and the survey responses. Therefore, removing the need for registration, allowing student access, providing extra teacher training, and adaptability of the available options on the platform should be considered; **(vi) motivate the user:** motivation was found to be crucial during the focus groups, mostly among teachers but also among students. The platform can have great usability and provide a set of materials that are perfectly fit for developing digital competencies for AI. However, if there is no motivation to work on this, it will most likely quickly be abandoned. At the same time, a minimum amount of motivation can compensate for the lack of digital skills and give the first nudge needed to make the adoption of the platform, and AI education in general, successful. The survey responses indicate that this motivation is indeed present.

Limitations and future work. This study has several limitations. First, the small size in terms of the number of participants and geographical and social contexts prevents proper generalizability of results. The implementation of digital competence in education can differ substantially between countries [19]; therefore, those elements found worthwhile in this study might not be as successful in contexts outside of the countries that were investigated. Then, the voluntary participation of our participants might influence the results as they are likely to have a motivation towards AI education which made them participate in the research activities. Therefore, it might be that the positive attitudes towards AI education and digital technologies in the classroom – in terms of a high level of will – might be overestimated. Nevertheless, we believe that this study can contribute to shedding new light on AI education as part of the general theme of teaching digital competence to children. Future work will continue this process by widening the size of the study and by developing prototypes for a platform that provides content and tools for teachers. Furthermore, we will pursue our research on

the theoretical framework by investigating pupils' perspectives and including them and their parents in co-design activities to properly consider the risk of digital divide [3, 25].

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