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Research

A snapshot of Bulgarian school teachers' familiarity with, use of, and opinions on artificial intelligence at the threshold of its incorporation into the educational process

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Abstract
The current study was designed within a survey-based quantitative research methodology in order to investigate Bulgarian teachers' familiarity with, use of, and attitudes toward artificial intelligence (AI) at the nascent stage of its integration into the Bulgarian education system. The survey was completed by 2252 teachers, of whom 16.30% were men and 83.70% were women. The majority of the teachers (72%) reported some level of familiarity with AI technology. Higher levels of familiarity were significantly associated with younger teachers (aged 20 to 29), mathematics, sciences, and technology subject areas, as well as the male gender. More than 50% of the teachers reported using AI technology in their instruction. Familiarity with AI technology was the only significant predictor of AI use, overriding the effect of other variables. The teachers used AI technology to prepare teaching, assessment, and homework materials; design individual and team tasks; and grade students' work. The teachers who regularly used AI technology were more favorable towards AI in contrast to those who seldom or never employed AI. The majority of the respondents recognized the need for teacher training in AI technology and expressed willingness to participate in teacher training initiatives. Therefore, the current situation requires teacher education programs to harness teachers' needs by equipping them with relevant AI literacy and skills that they could apply to the critical adoption of suitable AI tools. Educational institutions and stakeholders should provide guidelines and consultancy regarding technical, methodological, and ethical issues concerning the instructional use of AI technology.

Keywords Artificial intelligence · School teachers · Familiarity · Use · Opinions · Teacher training

1 Introduction

The onset of the 2020s has marked a growing fascination with artificial intelligence (AI) and an expansion of its use across different social domains, including education [7, 26, 42]. The trend was set off by the release of generative AI systems that can support human effort in various areas when given the right instructions, also known as prompts. Examples of generative AI include chatbots (e.g., GPT-4), image and video generators (e.g., Dall-E2), and text-to-speech transformers [14, 27, 45].

The concept of artificial intelligence in education (AIED) has gained popularity with the launch of the International AIED Society (IAIED) in 1997 [42]. However, up until recently, the majority of AIED research was focused on theoretical

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and speculative topics, with only few studies discussing the practical use of AI in the education process [28, 39, 41]. The focus of AIED research is now shifting to various aspects of AI implementation, including how teachers and students perceive AI-based technology, the pedagogical, instructional, and assessment strategies and methods used for AI-based teaching, the establishment of ethical standards, and how to ensure adherence to these standards [4, 5, 15, 42].

In response to the growing popularity of generative AI applications and public discussions of their inevitable role in society at large and education in particular, the Ministry of Education and Science in Bulgaria released a 41-page document at the beginning of 2024 that aimed to provide essential information and instructions for the use of AI technology for instructional purposes. The document covers a variety of aspects of using AI, including pedagogical principles, risks, effectiveness evaluation, teacher training, examples of use, and others [25].

The current research was initiated at that pivotal moment to capture a snapshot of Bulgarian teachers' familiarity with, use of, and perspectives on artificial intelligence during its early incorporation into the educational process. The study's results would provide valuable insights for educational institutions and stakeholders while also establishing a reference point for future advancements in AIED.

2 Literature review

The potential of AI-based technology to revolutionize education is already clear, offering numerous opportunities for both educators and learners. However, this also brings up a range of problems that arise from the unknown [17, 19, 27]. One of the main challenges is the insufficient teacher preparation for AI-based technology, which, if offered at all, is rather sporadic and unsystematized [3, 34, 38]. The rapid release of new applications widens the gap in foundational AI literacy, making it challenging for teachers to stay up-to-date with the latest developments, make appropriate choices, and learn practical applications [34]. Furthermore, the controversy surrounding the benefits and downsides of AI technology adds to teachers' hesitations about implementing AI-based technology in the education process [9, 28]. As a result, teachers' attitudes towards AI vary based on demographic, psychological, pedagogical, and other influences. The next section provides an overview of current research that has investigated teachers' views on AI from different perspectives and in different contexts.

2.1 Teachers' attitudes to AI

Recently, a number of studies have investigated educators' perspectives on AI and the variables that influence those perspectives. Yue et al. examined the influence of demographic variables and technological pedagogical content knowledge (TPACK) on attitudes toward artificial intelligence (AI) through an online survey of 1664 Chinese K–12 teachers [39]. The authors concluded that whether or not instructors utilized AI in the classroom was the primary factor significantly associated with their attitudes toward AI. Teachers who were more familiar with and already utilizing AI-based technology demonstrated greater enthusiasm and confidence in AI's instructional potential. Other variables, such as the instructors' overall technological proficiency, pedagogical expertise, and knowledge of AI content, did not influence their level of interest or confidence when it came to utilizing AI. Based on their findings, the authors recommend that teacher preparation programs provide practical training in the use of AI for pedagogical purposes.

Several studies have highlighted the connection between teachers' perceived usefulness of technology and their readiness to utilize it in their instructional practices [1, 3, 11, 30, 44]. According to Nazaretsky et al. teachers who had confidence in the effectiveness and precision of AI-based technologies were more likely to have more favorable inclinations toward them [28, 29]. A study with 452 pre-service German teachers showed that teachers' inclination to utilize AI technology was significantly associated with their perceptions of AI's utility and ease of use. The authors also noted significant gender differences in the acceptance of AI that were associated with anxiety, with female teachers displaying a higher level of apprehension [44].

Another study involving 368 K–12 in-service teachers in Nigeria found that the teachers' confidence and perceptions of the relevance of AI to educational goals were strong predictors of their readiness to implement AI in their teaching practice [3]. Similar to Yue et al. [41], the main recommendation of the authors is for investment in professional development programs that will prepare teachers with the necessary knowledge, skills, and confidence to work with AI technology.

Kim and Kim [21] emphasized the importance of practical experience in influencing educators' acceptance of AI technology. They found that teachers' attitudes toward AI could change in a favorable way after receiving hands-on

training. Having experienced a specific AI tool, the teachers were more positive about its potential for teaching and learning. Kim and Kim also observed that younger teachers were associated with the greatest change in attitudes and more enthusiasm about adopting AI technology in their teaching [21]. Their findings align with several studies that link the generational traits of teacher populations to variations in attitudes towards technology [16, 32, 35, 36]. For example, teachers born after 1980 (also known as Generation Y or Millenials) and those born in or after 1995 (also known as Generation Z or technoholics) were more favorably inclined towards AI technology than their older counterparts [8]. The age-related differences are attributed to the younger generations' familiarity with and inherent proclivity towards technology, which they acquire as they grow up in a technologically advanced society [10, 22, 37]. Prensky used the term 'digital natives' to describe individuals who acquire technological abilities in a way that is comparable to how they learn their first language [31].

2.2 Teachers' views on ChatGPT

ChatGPT, a chatbot launched by OpenAI, is the most popular and most discussed AI application in educational research [4, 19]. As a natural language processing model, ChatGPT can assist humans in completing various tasks in minimal time, such as answering specific questions, generating and summarizing information, providing outlines for projects, and many others [4]. These capabilities of ChatGPT open up numerous opportunities that can be utilized by instructors in various aspects of their teaching [43]. ChatGPT also poses challenges to fair assessment, ethical conduct, and academic integrity, as discussed in Ipek et al. [19].

While there is an increasing amount of scientific literature on ChatGPT, the majority of it provides hypothetical projections of its benefits and drawbacks for various educational contexts [2, 4, 6, 13, 15, 24]. On the other hand, the opinions and practices of instructors directly impacted by the emergence of AI technology have not received sufficient investigation.

One of the few studies on this issue, based on a survey of Bulgarian university instructors, reported relatively positive views on the educational potential of ChatGPT for generating information, creating teaching and testing materials, stirring learners' motivation, increasing their engagement, and stimulating their critical and creative thinking [23]. In contrast, a study by Iqbal et al. with university instructors in Pakistan concluded that, although some instructors acknowledged the potential advantages of ChatGPT, the prevailing sentiment was one of negativity and skepticism [20]. Nonetheless, when it comes to the teachers' most common concerns, both studies reported ethical issues as the reason for major apprehensions. In both studies, the instructors saw ChatGPT as a possible threat to academic integrity and fair assessment, with cheating and plagiarism being the most frequently mentioned concerns [20, 23].

Beyond ChatGPT, a variety of AI applications exist, including chatbots like Google Bard/Gemini, video and audio generators like DALL-E, virtual human generators like PlayHT, and others not covered in the current AIED research. The present study builds on the existing framework by analyzing data from a large-scale survey with Bulgarian school teachers about their familiarity with and actual use of trending AI apps in their teaching practice.

3 Methodology

3.1 Research background

The current investigation was conducted within the Bulgarian educational system, which is overseen by the Bulgarian Ministry of Education and Science. Basic education encompasses three tiers: primary school (grades I–IV), lower secondary school (grades V–VII), and upper secondary school (grades VIII–XII). The designated age for commencing primary school is 7 years; however, parents have the option to register their children at the age of 6. While a small number of Bulgarian schools are privately owned, the vast majority are public institutions that provide education free of charge. The Bulgarian education system prohibits any kind of discrimination based on ethnicity, race, gender, religion, or socioeconomic class.

Teachers in Bulgarian schools are hired depending on their credentials. Based on the 2023 statistics released by the National Statistical Institute, 94.40% of school teachers have either a bachelor's or a master's degree. According to the same source, the overall count of teachers working in general schools was 55,850. Among them, 86% were female and 14% were male [33].

3.2 Research design

The current study was designed within a survey-based quantitative research methodology in order to investigate Bulgarian teachers' familiarity with, use of, and attitudes toward artificial intelligence (AI) at the nascent stage of its integration into the Bulgarian school system. The survey was created on Google Forms, and a link was sent to school directors throughout all 28 regions of Bulgaria. After being fully informed about the survey's goal, its voluntary nature, and its anonymity, they were asked to share the link with the teachers in their schools and to encourage them to participate in the survey.

The study was granted ethical permission by the committee of scientific ethics in the faculty of mathematics and informatics at Plovdiv University "Paisii Hilendarski" under protocol №1252, issued on January 31, 2024. Before responding to any survey questions, the teachers provided informed consent about their involvement in the research and use of the data in scholarly publications. They also received assurance about the anonymity of their answers.

The survey included 33 items, seven of which were demographic. The remaining items were thematically categorized into four sections: (1) familiarity with AI applications; (2) use of AI-based technology in teaching; (3) opinions on the benefits and drawbacks of AI as an educational tool; (4) readiness to participate in AI training. The majority of the items were coded on a Likert scale with 5 levels (1 = strongly disagree and 5 = strongly agree; or 1 = never and 5 = very frequently); others were categorical; two had three options (yes, no, not sure); and two were open-ended, requiring short illustrative responses.

Before the survey was officially administered, we conducted a pilot test with 30 teachers, ten from primary schools, ten from lower secondary schools, and ten from upper secondary schools. This enabled us to identify some omissions and issues with the stems and/or options, which we then edited in consultation with some of the respondents and specialists in this field. The reliability analysis on the Likert scale items (n = 18) showed a high level of internal consistency with Cronbach's alpha = 0.930 (standardized alpha = 0.910; lower 95% CI limit = 0.90). There were no items whose removal would significantly improve the instrument's overall reliability on the Likert scale.

3.3 Participants

The survey was completed by 2252 public school teachers, of whom 366 (16.30%) were men and 1886 (83.70%) were women. The proportions correspond to the real gender distribution among Bulgarian school teachers, as reported by the National Statistical Institute [33]. The respondents were from all 28 regions of Bulgaria, quite evenly distributed, with the exception of six regions, which had only a few respondents (three to seven). The participants were categorized into five age groups, with the youngest (20 to 29 years old) and oldest (≥ 60 years old) having the lowest representation. The largest proportion of the teachers taught at upper secondary school (47.80%), and the majority worked in a regional city (65.50%). The most represented subject areas were the humanities (56.50%) and mathematics, sciences, and technology (33.50%) (Table 1).

3.4 Research problem and questions

The primary goal of the present study was to provide information about the current status of AI-based technology in Bulgaria's public education system at the nascent stage of its utilization for instructional purposes. The research aimed to assist educational institutions and stakeholders by focusing on Bulgarian school teachers' familiarity with current AI applications, utilization of AI technology in the educational process, opinions on the benefits and drawbacks of AI technology, and willingness to engage in AI training. The research questions were formulated as follows:

Q1. How familiar are teachers with trending AI applications? Is teachers' level of familiarity with AI influenced by demographic factors, such as age, gender, school level, school location, and subject area?

Q2. Which are the most popular AI applications among Bulgarian school teachers?

To address question 2, one of the survey items listed current AI apps and asked teachers to check all that they were familiar with. The list of AI applications was created following the guidelines about the use of artificial intelligence issued by the Ministry of Education and Science in Bulgaria [24]. The document provisionally categorizes the current AI applications into three main groups (p. 11).

Table 1 Demographic data about the teachers who participated in the survey

Variables	n	Percentage
Gender		
Men	**366**	16.30
Women	1886	83.70
Age		
20–29 years	129	5.70
30–39 years	390	17.30
40–49 years	674	29.90
50–59 years	843	37.40
≥ 60 years	216	9.60
School level		
Primary (grades I–IV)	546	24.20
Lower secondary (grades V to VII)	630	28.00
Upper secondary (grades VIII to XII)	1076	47.80
School location		
Regional city	1474	65.50
Small town	502	22.30
Village	276	12.30
Subject area		
Humanities	1272	56.50
Mathematics, sciences and technology	755	33.50
Arts and music	95	4.20
Physical education and health	67	3.00
Social sciences	63	2.80

- **Chatbots** (e.g. ChatGPT, Google Bard/Gemini, Microsoft Bing AI/ GitHub CoPilot, Perplexity) They generate human-like text based on textual prompts and directions.
- **Video**, **audio**, and **image generators**: Creation of images and design, music, audio, video, presentations (e.g. DALL-E, Stable Diffusion, Midjourney, Bing Image Creator).
- **Virtual human generators**: These systems generate verbalize/speak language and generate audio or video from written text (e.g. Syntehsia, Play HT).

Q3. Do teachers use AI applications in their teaching practice, and for what purposes? Is there a relationship between teachers' familiarity with AI and their use of it? Do demographic factors (e.g., age, gender, school level, school location, subject area) play a role in the use of AI?

Q4. What are the teachers' attitudes toward AI as an educational tool? Is there a relationship between teachers' use of AI and their attitudes toward AI? Do demographic factors (e.g., age, gender, school level, school location, subject area) play a role in the use of AI?

Q5. What is the teachers' inclination to engage in AI training? Is there a relationship between teachers' use of AI and their willingness to participate in AI training? Do demographic factors (e.g., age, gender, school level, school location, subject area) influence teachers' willingness to engage in AI training?

3.5 Statistical analysis

The statistical software for the Social Sciences (SPSS) Version 27 (2020) was used to analyze the data. The Likert scale items were treated as continuous variables, and their distributions were checked for normality through Kolmogorov–Smirnov's test. When normality was present, the central tendency was described with the means and standard deviations (SDs), whereas in the absence of normality, the medians and interquartile ranges (IQRs) were used. Categorical variables were summarized by frequencies and percentages, and associations were established through the Chi-square test and z-test comparisons of paired proportions.

Backward multiple linear regression analysis was applied to identify factors that have an effect on the following dependent variables: (1) familiarity with AI; (2) use of AI; (3) opinions on AI; and (4) inclination to engage in AI training. The categorical independent variables were dummy-coded. When the dependent variable in the regression analysis was not normally distributed, the plots of the residuals versus the predictor variables were examined to check if the assumption of normality was satisfied and that there was no autocorrelation in the residuals [18]. All statistical tests were two-tailed and performed at a Type I error (α) of 0.05.

4 Results

4.1 Familiarity with AI

The responses to the question about how familiar the teachers were with AI technology were not normally distributed (Kolmogorov–Smirnov, $p < 0.001$). The median value of 3.00 (IQR = 2) showed a central tendency, corresponding to the option *somewhat familiar*. Figure 1 illustrates the distribution of the responses among the five options: very familiar (n = 243, 10.80%); familiar (n = 518, 23.00%); somewhat familiar (n = 867, 38.50%); rather unfamiliar (n = 520, 23.10%); and unfamiliar (n = 104, 4.60%).

A multiple linear regression analysis was conducted to assess the impact of demographic factors, such as age, gender, school level, subject area, and school location. Although the dependent variable was not normally distributed, the plots of the residuals versus all predictor variables revealed that the assumption of normality was satisfied and that there was no autocorrelation in the residuals (Durbin-Watson statistic = 1.993).

The multiple regression analysis revealed three demographic factors that were significantly associated with AI familiarity (Table 2). First, in terms of gender, male teachers had a higher average level of familiarity with AI compared to female teachers (mean 3.35, SD = 1.13 versus mean 3.08, SD = 1.00). Second, among different age groups, the youngest group (aged 20 to 29) had the highest level of AI familiarity (mean 3.62, SD = 1.00) compared to 3.28, SD = 1.02 for ages 30–39; 3.16, SD = 1.05 for ages 40–49; 3.01, SD = 0.989 for ages 50–59; and 2.88, SD = 1.03 for those aged 60 or older. Third, regarding subject area, the highest level of familiarity was associated with the teachers in *mathematics, sciences, and technology* (mean 3.28, SD = 1.04), followed by those in *social sciences* (3.25, SD = 1.04), *humanities* (3.04, SD = 1.01), *physical education and health* (3.04, SD = 0.991), whereas the lowest level was associated with teachers in *arts and music* (2.98, SD = 0.922). The backward regression analysis removed two demographic variables, school location ($F = 2.45$, $df = 2$, $p = 0.087$) and school level ($F = 1.93$, $df = 2$, $p = 0.145$), as they did not show significant associations with the dependent variable familiarity with AI.

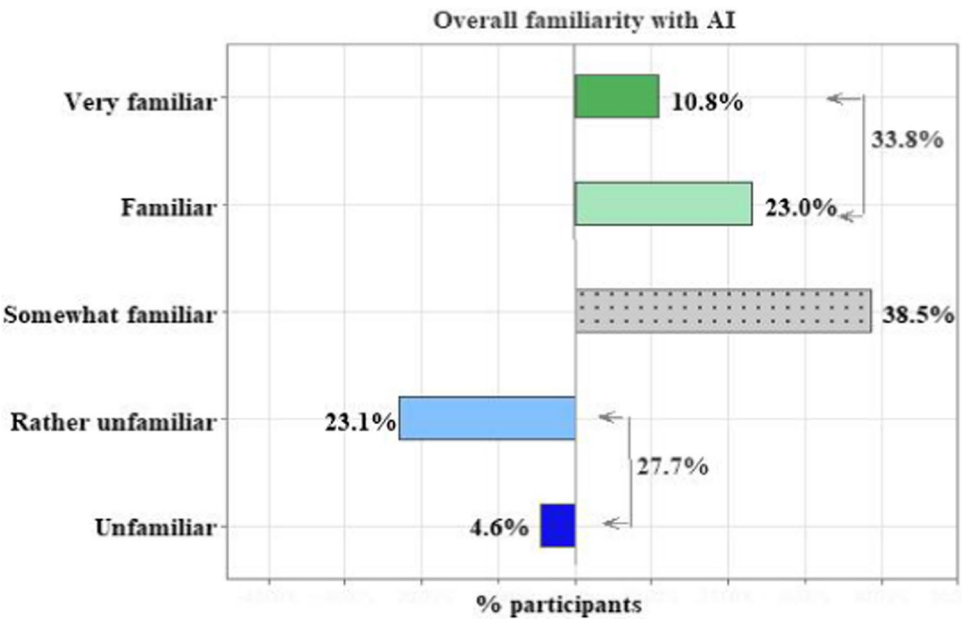

Fig. 1 Teachers' responses regarding their familiarity with AI

Table 2 Multiple linear regression results for variables associated with familiarity with AI

Predictors	Coefficient	t-value	p-value	VIF
Gender (against male)				
Female	− 0.185	− 2.49	0.013	1.09
Age (against 20–29 years)				
30–39 years	− 0.387	− 3.16	0.002	3.23
40–49 years	− 0.488	− 4.20	< 0.001	3.24
50–59 years	− 0.631	− 5.52	< 0.001	3.62
≥ 60 years	− 0.779	− 5.80	< 0.001	2.36
Subject area (against math, sciences and technology)				
Humanities	− 0.210	− 3.66	< 0.001	1.23
Arts and music	− 0.319	− 2.45	0.014	1.09
Physical education and health	− 0.490	− 3.11	0.002	1.09
Social sciences	0.080	0.530	0.598	1.08
Constant	3.931	27.96	< 0.001	

Values below 5 indicate low or lack of multicollinearity [18]

VIF a variance inflation factor

4.2 Use of AI

Of the 2252 teachers who completed the survey, 51.30% (n = 1132) indicated using AI applications in their teaching, versus 49.70% (n = 1120) who never used AI. Of those who used AI, 9.00% (n = 203) marked frequent use (including options very often and often), 17.10% (n = 385) indicated occasional use, and 24.20% (n = 544) used AI rarely. The multiple linear regression revealed that *familiarity with AI* was the only significant predictor of AI use (B-coefficient = 0.523, SE = 0.19, t = 27.30, VIF = 1.04, p < 0.001). The teachers who showed the highest familiarity with AI were the most likely to use it in their teaching. This effect was over and above the demographic variables, including age (p = 0.694), gender (p = 0.094), school level (p = 0.708), subject area (p = 0.905), and school location (p = 0.458). Given the significant relationship between age and teachers' level of familiarity, as demonstrated in the previous section and supported by several related studies [10, 22, 37], we have illustrated the dominant influence of familiarity over age in Fig. 2.

From the different types of AI apps that were included in the survey, chatbots were the most popular among the respondents and the most frequently used. They were indicated as *familiar* in 130.50% of the responses and as *used* in teaching by 56.50%. Because the question allowed the inclusion of all apps that were known to the teachers, some percentages may exceed 100%. Among the chatbots, ChatGPT ranked first, marked as *familiar* in 82.10% of the responses and as *used* in 38.20%. Video, audio, and image generators were marked as *familiar* in 24.8% of the responses and as *used* in 7.60%. Among them, Bing Image Creator was the most *familiar* (10.7%) and the most *used* (3.60%). Virtual human

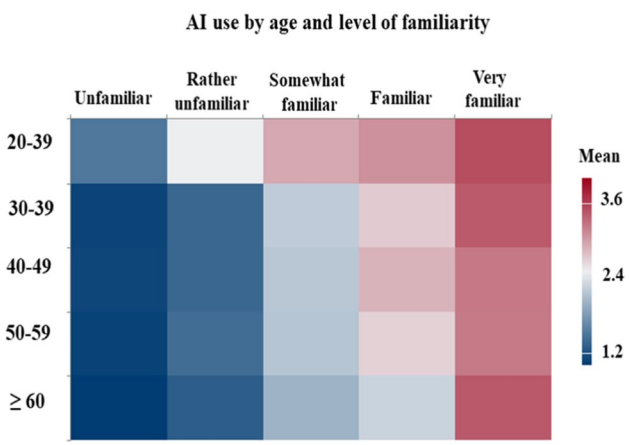

Fig. 2 Heat map of the influence of familiarity with AI on AI use over age differences. Red shades, which change from lighter to deeper tones, are associated with increasing AI use. Lighter to deeper shades of blue demonstrate decreasing AI use

generators were the least popular (5.83%) and the least used (1.30%). The option "other" was present in 6.70% of the responses on familiarity and in 5.10% of those on use. Open AI Playground, YouChat, Jasper AI, and Claude were among the most frequently mentioned apps under the "other" option, both for familiarity and for use. The percentage of teachers who were unfamiliar with any of the given AI apps was low (4.60%), compared to those who indicated not using any of them in their teaching (54.00%) (Fig. 3).

In terms of the purpose of using AI, the teachers could check all options that were valid for them, which explains why the cumulative percentage exceeded 100%. Seven reasons for using AI were indicated in 89.40% of the responses, and the proportions are given in descending order in Fig. 4. Among them, preparation of teaching materials was the most frequent (25.40%), and grading tests and exams was the least frequent (4.40%). More than half of the responses (59.50%) indicated nonuse of AI, as 5.10% of the teachers selected both options "*I have not used AI in my teaching*." and "*I do not want to use AI in my teaching*."

4.3 Opinions on the usefulness of AI technology

Ten survey items aimed to elicit teachers' opinions on the usefulness of AI for the teaching process, students' learning and development, and ease of working. Four of the items carried negative connotations (22, 23, 24, and 25). In calculating the overall mean score of all ten items, the coding of those four items was reversed, which allowed for the association of higher scores with favorable attitudes and lower scores with unfavorable ones.

As can be seen in Table 3, the teachers' ratings on the usefulness of AI tools for the teaching process, students' learning and development, and ease of working (items 16 through 20, and item 24) regressed towards the middle value of 3 (*somewhat agree*), which pointed towards a moderate reception of the usefulness of AI applications. The items with negative connotations (21, 22, 23, and 25) had mean values above the midpoint and medians at the midpoint (3). The results indicate that the teachers were concerned about the impact of AI technologies on students' cognitive processes and the difficulties these tools provide in fairly evaluating their academic performance. The overall usefulness score fell into a similar range as the single item scores; however, both the mean and median values were a little below the midpoint.

The multiple linear regression analysis revealed two significant associations with more favorable opinions on AI's educational potential (Table 4). The first and strongest relationship was found between the teachers' use of AI in their teaching practice and their opinions on AI's usefulness ($p < 0.001$). The teachers who indicated frequent use of AI held

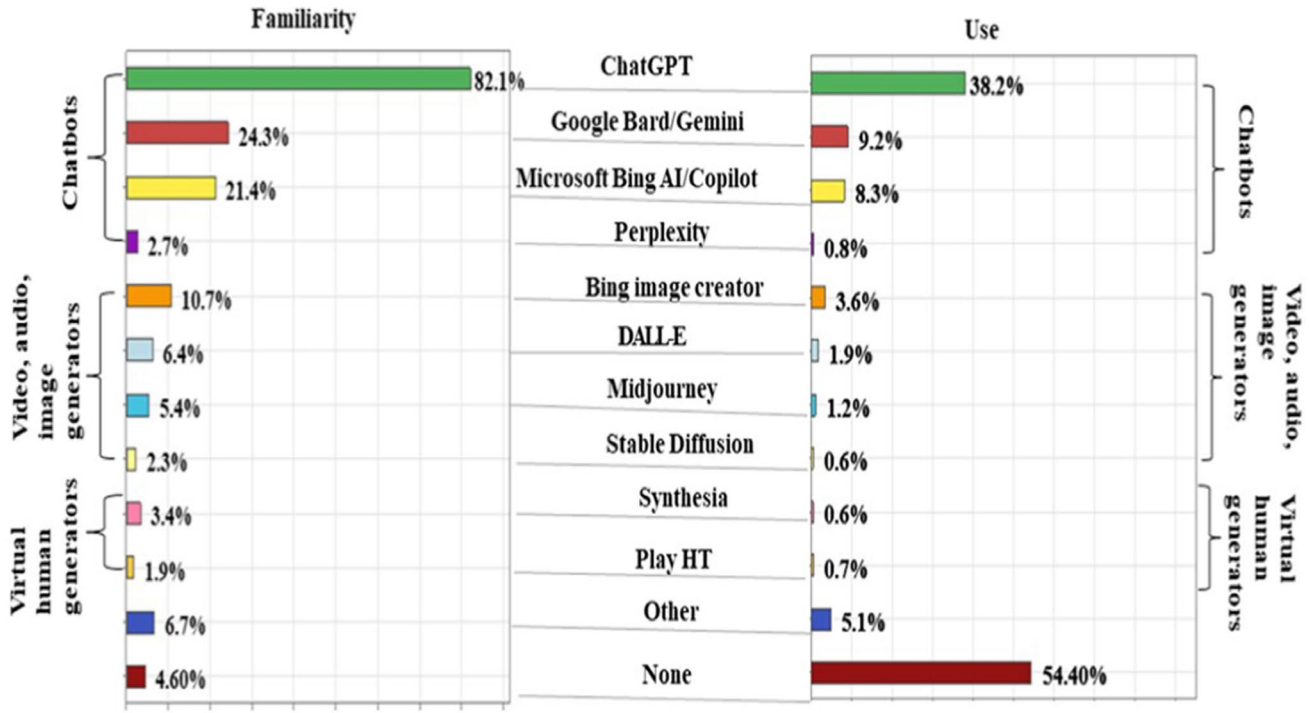

Fig. 3 Familiarity with and use of AI applications

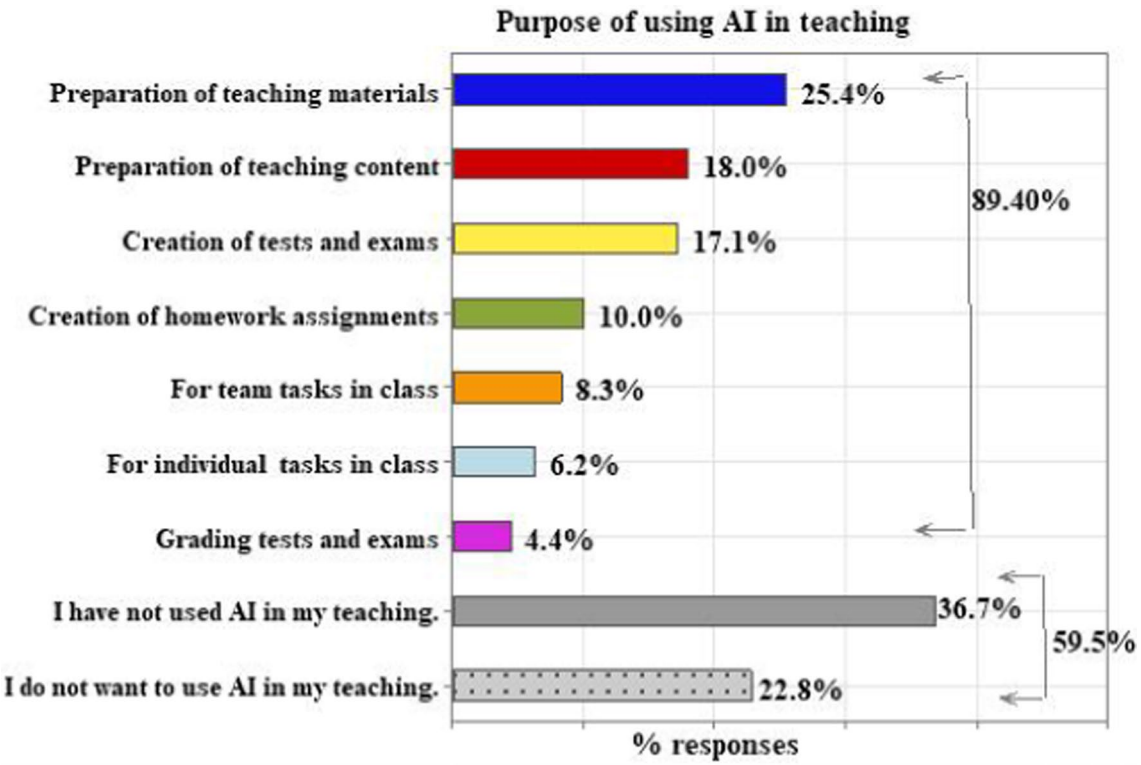

Fig. 4 Purpose for using AI in the teaching practice

Table 3 Opinions on the usefulness of AI

Item	Mean (SD)	Median (IQR)
I:16) AI tools can make the education process more effective	2.66 (1.08)	2 (1)
I:17) AI tools can make the education process more creative	2.93 (1.05)	3 (2)
I:18) AI tools have a positive effect on student learning and development	2.73 (1.01)	3 (1)
I:19) AI tools improve academic achievement (e.g. grades)	2.71 (0.98)	3 (1)
I:20) AI tools increase students' motivation and self-confidence	2.76 (1.00)	3 (1)
I:21)! AI tools negatively impact students' ability to think creatively	3.45 (1.05)	3 (1)
I:22)! AI tools negatively impact students' ability to think analytically	3.45 (1.04)	3 (1)
I:23)! AI tools negatively impact students' ability to think critically	3.40 (1.04)	3 (1)
I:24) AI tools make my work as a teacher easier	2.87 (1.03)	3 (1)
I:25)! The use of AI tools by the students presents challenges for fair assessment	3.05 (1.07)	3 (2)
Total score of all items	2.73 (0.66)	2.80 (0.8)

Measurement scale -1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree, 5 = strongly agree. The exclamation mark (!) indicates statements with negative connotations. We reversed these responses when calculating the total score to associate low scores with negative opinions on AI's overall usefulness and higher scores with positive opinions

more positive views on its usefulness compared to those who never or rarely used AI. The second significant factor was school level, with upper secondary school teachers being less positive in their ratings of AI's usefulness compared to primary and lower secondary school teachers ($p < 0.001$). The remaining factors were removed from the regression equation as they did not show significant associations with AI's usefulness: familiarity with AI ($p = 0.065$), gender ($p = 0.150$), age ($p = 0.476$), subject area ($p = 0.146$), and school location (0.820).

In terms of the challenges faced or perceived by the instructors regarding the use of AI technology for educational purposes, the primary concerns consistently revolved around the fairness of assessment, particularly in relation to plagiarism (70.7%) and cheating (67.9%). Other concerns were expressed on the need for teacher training, which appeared

Table 4 Multiple linear regression results for variables associated with AI usefulness

Predictors	Coefficient	t-value	p-value	VIF
Use of AI	0.310	18.56	< 0.001	1.35
School level (against primary)				
Lower secondary	− 0.008	− 0.20	0.845	1.68
Upper secondary	− 0.143	− 3.50	< 0.001	1.93
Constant	2.43	22.93	< 0.001	

Values below 5 indicate low or lack of multicollinearity [18]

VIF a variance inflation factor

in 40.4% of the responses, and the absence of established guidelines for teachers, indicated in 37.10% of the responses. Some of the responses also mentioned *the lack of established rules for students*, *the lack of computers and/or internet connections*, and *the need to educate students on the appropriate use of AI* (Fig. 5).

Of the challenges identified in Fig. 5, the first two (student plagiarism and student cheating) showed significant differences among the teachers in primary, lower secondary, and upper secondary schools ($p < 0.001$).

The highest proportion of teachers (84.40%, n = 908) who expressed concern about ethical violations were in upper secondary schools, compared to 76.80% (n = 484) in lower secondary schools and 69.40% (n = 379) in primary schools.

4.4 Teachers' views on the need for AI training

The need for teacher training in AI technology and its pedagogical implications was recognized by the majority of the respondents, with a mean score above 3 and a median at the midpoint (somewhat agree). The need for special training in assessment when AI tools are involved received the highest level of agreement, as indicated by both the mean (3.72) and median scores (4.0). The teachers' willingness to participate in teacher training programs also exceeded the midpoint, with a mean of 3.71 and a median of 4. The average of the three items stayed in the same range, with a mean of 3.58 and a median of 3.66 (Table 5).

Four factors showed significant associations with the teachers' inclination to engage in AI training programs. One of them was gender ($p < 0.001$), as female educators held more favorable intentions in comparison to their male colleagues. The educators' employment location was another demographic factor. The teachers working in village schools showed a higher degree of support for AI training compared to those working in urban schools ($p = 0.009$). The need for training

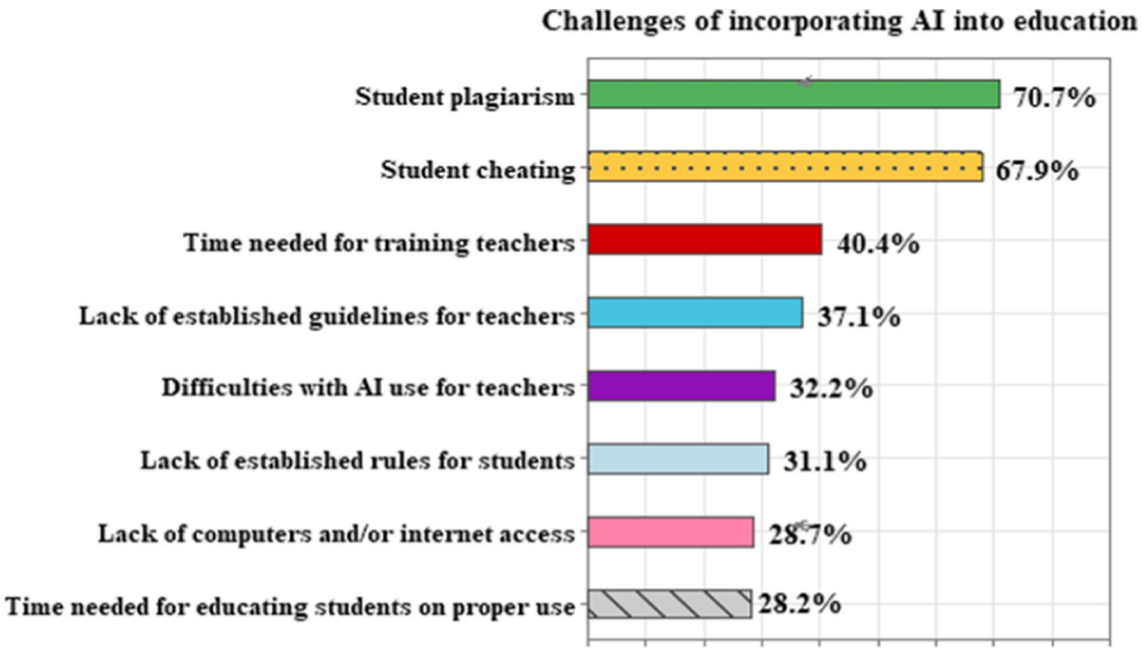

Fig. 5 Challenges experienced or perceived by the teachers regarding the use of AI technology for educational purposes

Table 5 Teachers' views on the need for teacher training in AI

Item	Mean (SD)	Median (IQR)
I:29) AI tools should be studied in teacher education and teacher training programs	3.32 (1.24)	3 (1)
I:30) Teachers need special training in assessment that involves AI tools	3.72 (1.13)	4 (2)
I:31) I am willing to participate in AI teacher education and/or teacher training program	3.71 (1.13)	4 (2)
Total score of all items	3.58 (1.06)	3.66 (1.33)

Measurement scale—1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree, 5 = strongly agree

was also significantly correlated with the subject area. The humanities instructors were less receptive to AI training ($p < 0.001$) than their math, science, and technology colleagues. The arts and music teachers were also associated with a lower interest in AI training ($p = 0.026$). On the other hand, the social science teachers shared nearly the same enthusiasm for AI training as those of mathematics, science, and technology. Additionally, the frequency of AI usage was positively correlated with the inclination for training ($p < 0.001$). The teachers who indicated more frequent usage were more supportive of the need for AI training. The factors that were not significantly associated with the willingness to be trained included age ($p = 0.731$) and school level ($p = 0.097$) (Table 6).

The teachers identified six domains as requiring AI-specific instruction and guidelines in order to assure greater confidence and efficacy in the integration of AI into the education process (Fig. 6).

5 Discussion

The current research was carried out in the first quarter of 2024, a pivotal time that marked a significant advancement in the development of AI technology and a growing momentum in the official discourse and planning around its integration into the educational system in Bulgaria. Until now, the utilization of AI technology has been propelled by the teachers' own motivation without explicit methodological and ethical guidelines. Thus, the findings of the present study provide an insight into the teachers' perspectives on AI technology prior to its formal implementation in the Bulgarian school system. The survey data revealed several factors that influenced teachers' familiarity with, use of, and inclinations toward AI technology, as well as the interplay between them.

Given the recent release of AI apps for general use, our results showed a relatively high percentage (72%) of teachers having some familiarity (38.5% somewhat familiar and 33.80% familiar and very familiar) with AI technology. The percentages are comparable to those reported in a study that examined the perceptions of Estonian K–12 schools on AI [9].

However, the proportion of teachers who reported using AI technology in teaching was lower than the proportion who indicated being familiar, but still above 50%. Familiarity with AI technology was the only significant predictor of AI

Table 6 Multiple regression for the factors significantly associated with the teachers' inclination to engage in AI training

Predictors	Coefficient	t-value	p-value	VIF
Gender (against male)				
Female	0.272	10.96	< 0.001	1.02
School location (against regional town)				
Small town	0.062	0.67	0.500	2.24
Village	0.215	2.62	0.009	2.33
Subject area (against math, sciences and technology)				
Humanities	− 0.237	− 3.98	< 0.001	1.33
Arts and music	− 0.291	− 2.23	0.026	1.10
Physical education and health	− 0.183	− 1.16	0.246	1.09
Social sciences	0.016	0.110	0.916	1.09
Frequency of using AI	0.286	10.96	< 0.001	1.02
Constant	2.869	17.73	< 0.001	

Values below 5 indicate low or lack of multicollinearity [18]

VIF a variance inflation factor

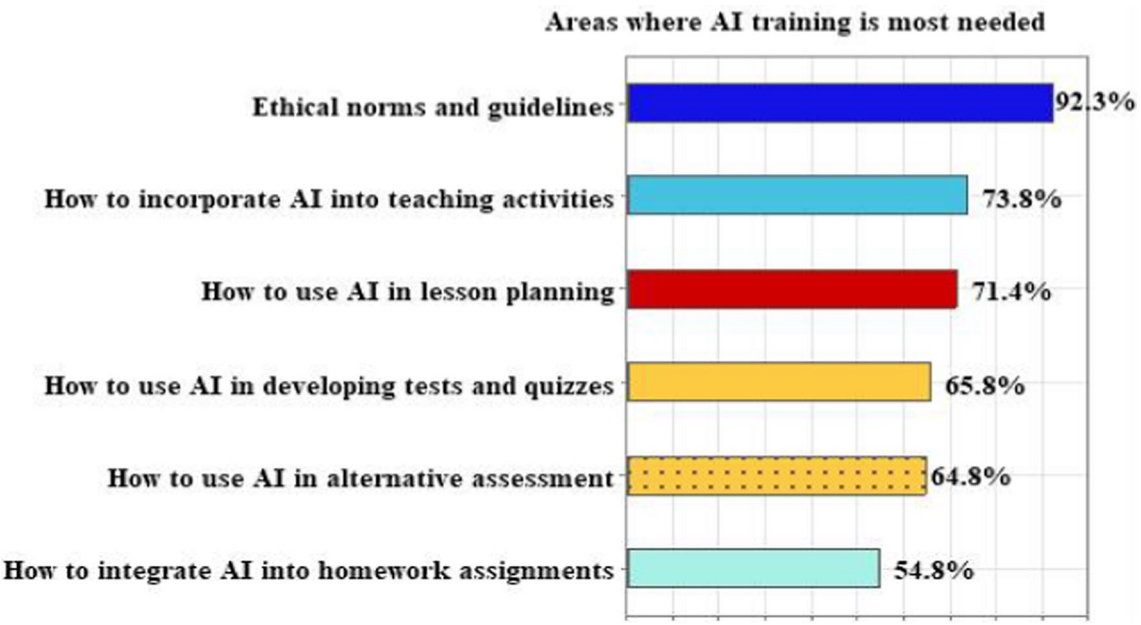

Fig. 6 Areas where the use of AI demands training and guidelines

use, overriding the effect of demographic variables such as age, gender, school level, school location, and subject area. We can indirectly link our findings to the postulation that insufficient or lacking AI literacy may adversely affect teachers' confidence in using AI-based technology [1, 3, 31]. Older studies have drawn similar conclusions about teachers' familiarity with computers and their readiness to integrate them into their instructional practices [40].

On the other hand, several demographic factors were linked with teachers' familiarity with AI technology. Higher levels of familiarity were associated with younger age groups (aged 20 to 29), the subject areas of mathematics, sciences, and technology, as well as male gender. The age-related differences were not surprising in view of the trends reported in other studies regarding generational dissimilarities in attitudes to technology in general and to AI in particular [8, 16, 21, 32, 37]. The teachers aged 20 to 29, who belong to generations Z and Y, have grown up in a technologically advanced society, leading them to naturally gravitate towards technology [8].

Also, it was somewhat expected that mathematics, sciences, and technology teachers would be more familiar with AI technology compared to other subject areas, as these disciplines have inherently been associated with technological literacy and competence [9].

The gender difference was also insightful, given that female teachers make up the majority of school teaching staff not only in the present cohort but also in many other countries [9, 44]. A variety of cognitive and social factors that shape teachers' levels of confidence, risk-taking inclination, anxiety, and other factors could explain the female teachers' lower level of familiarity with AI [44]. Dai et al. found that female teachers were less confident, more self-critical, and more likely to underestimate their preparedness to use technology [10]. The latter claim may also explain why the female teachers in the present study were more inclined to engage in AI training programs compared to their male counterparts. Their higher enthusiasm to receive training could be an expression of a heightened awareness of the gaps in their knowledge and competence to utilize AI effectively. The fact that teachers in village schools showed a higher degree of interest in AI training compared to those in urban schools also suggests a link to a lower level of self-confidence [12].

The teachers' inclination to receive AI training was not one-dimensional and was driven by different perspectives. For example, the mathematics, science, and technology teachers who reported the highest familiarity with AI technology were more receptive to AI training compared to the humanities, arts, and music instructors. In this situation, it is plausible to hypothesize that teachers in technology-intensive domains felt a greater sense of obligation and urgency to enhance their proficiency and understanding of AI, as opposed to teachers in subject areas that rely less on technology. The frequency of AI use was another factor that was associated with a higher propensity for AI training. The teachers who reported a greater frequency of use demonstrated a stronger endorsement of the necessity for AI training. This finding can also be attributed to underlying cognitive processes that start with knowledge (or familiarity), prompt use, reflection on knowledge gaps, and an awareness of the need for more knowledge and/or training [21, 30, 41].

Among the diverse range of available AI apps, current AIED research has predominantly concentrated on ChatGPT, leaving other applications unexplored. The present study widened the existing framework to encompass other popular AI apps, as detailed in the directives from the Bulgarian Ministry of Education. Our results showed that chatbots were the most popular among the respondents and the most frequently used. Among them, ChatGPT ranked first, marked as familiar in 82.10% of the responses and as used in 38.20%. Given that ChatGPT has been the subject of several research studies discussing both the benefits and drawbacks of the app for teaching and student assessment, its popularity among the surveyed teachers was anticipated [2, 6, 20, 23, 24]. Other examples of chatbots that were added by the participants included YouChat, Jasper AI, and Claude.

Much less popular were AI generators of video, audio, and images. They were marked as familiar in 24.8% of the responses and as used in 7.60%. Among them, Bing Image Creator was the most familiar and used. The participants added OpenAI playground under the option 'other', which can produce images based on text prompts. AI virtual human generators were the least popular and the least used. They were marked as familiar in 24.8% of the responses and as used in 7.60%. Among them, Bing Image Creator was the most familiar and used. The participants added OpenAI playground under the option 'other', which can produce images based on text prompts. Overall, it is not possible to make a direct comparison between the present results and previous ones because of a lack of studies on educators' familiarity with and use of AI applications other than ChatGPT.

In the current study, the teachers reported using AI technology to prepare teaching, assessment, and homework materials, design individual and team tasks, and grade students' tests and exams. Among them, preparation of teaching materials was the most frequent (25.40%), and grading tests and exams was the least frequent (4.40%). These results are similar to how Bulgarian university professors used ChatGPT in the research by Kiryakova and Angelova [23].

Overall, the surveyed teachers expressed moderate opinions on the usefulness of AI technology for making the education process more effective and creative, for stimulating student learning, motivation, and self-confidence, and for making their work as educators easier. These results are in line with the overall positive sentiments of Bulgarian university professors in the study by Kiryakova and Angelova [23] and in contrast with the predominantly negative feelings among the Pakistani university instructors in the research conducted by Iqbal et al. [20].

However, there was a full agreement between the current findings and those of the two related studies [20, 23] as far as the negative impact of AI technology is concerned. The educators expressed concern about the negative impact that AI technologies could have on students' cognitive processes, as well as the challenges that their use poses to academic integrity and fair assessment. Moreover, ethical concerns pertaining to plagiarism, cheating, and equitable evaluation in the context of AI technology implementation have been extensively discussed in the existing AIED research [2, 4, 6, 13, 15, 24].

In line with previous studies [1, 3, 11, 21, 30, 41], there was a strong link between the Bulgarian school teachers' use of AI in their teaching practice and their opinions on its usefulness. The teachers who reported regular use of AI had more favorable perspectives in contrast to those who seldom or never employed AI. On the other hand, the teachers in primary and lower secondary schools had more favorable opinions about the utility of AI compared to upper secondary school teachers. On the other hand, the teachers in primary and lower secondary schools had more favorable opinions about the utility of AI compared to upper secondary school teachers. The latter group's heightened concerns (84.40%) over the possibility of older students engaging in unethical utilization of AI technology may account for the difference.

Both Kim and Kim [21] and Yue et al. [41] highlight the need for teacher training in AI technology to enhance instructors' confidence and cultivate more positive attitudes towards using AI for educational objectives. The majority of the respondents in the current study recognized the need for teacher training in AI technology and expressed willingness to participate in teacher training initiatives. The teachers identified specific areas for inclusion in teacher education and preparation programs. Among them, guidelines and training in applying ethical norms ranked first. The teachers were also aware of the need for technical and methodological competence that would enable them to use AI for lesson planning, teaching activities, tests, quizzes, alternative assessment, and homework assignments.

5.1 Limitations

Because of the rapid emergence of new AI applications and the growing domain of AIED, which is striving to keep pace with technological progress, the findings of this research are susceptible to the impact of time. Teachers' knowledge and use of AI applications will develop and grow. Teacher education programs will provide specialized courses in AI technology designed for certain topic areas and targeted age groups of students. Guidelines and regulations will be established and enforced to tackle concerns related to plagiarism, fair evaluation, infringements of human rights, and

other relevant matters. However, the significance of this study lies in its ability to serve as a benchmark for evaluating future advancements in the use and implementation of AI technology in education.

6 Conclusion

At the time when AI technology was starting to make its way into the Bulgarian education system, the participants in the present study reported some unsystematized baseline knowledge and limited experience in using AI technology in their teaching. The teachers held moderate sentiments towards the benefits of AI and shared concerns about its negative impact on academic integrity, objective assessment, and students' critical and creative thinking. The majority of the teachers recognized the need for special training in AI technology and expressed willingness to engage in such educational opportunities. Moreover, familiarity with and use of AI technology appeared to be underlying factors for teachers' favorable inclinations towards its implementation for instructional purposes.

Therefore, the current situation requires preservice and in-service teacher programs to harness the teachers' needs and assist them in acquiring the necessary knowledge and skills that will enable them to effectively integrate AI technology into their teaching. Given the rapid release of new AI apps, it is important for teachers to receive a fundamental understanding of the underlying principles and functions that these apps can perform. Thus, they will be able to critically evaluate new apps and make informed choices about which ones are suitable for their objectives and learner profiles. They should also be prepared to estimate the benefits and downsides of adopting a specific AI-based technology.

Teacher training programs should prepare teachers for the technical, methodological, and ethical aspects of using AI technology. By building their own confidence, teachers would be able to employ AI technology in ways that would engage the students in meaningful and creative tasks. They should also be able to safeguard against wrong use and undesired outcomes. AI training appears to be especially important for in-service teachers of older age groups, provincial schools, and instructors in subjects usually seen as less technically demanding.

Educational institutions and relevant stakeholders should provide guidelines, consultancy, and updates on the new developments in AI technology and its potential implications for teachers and learners. They should organize formal and informal venues where teachers can share their positive and negative experiences, as well as discuss problematic issues and possible solutions. Teachers and stakeholders must maintain continuous communication to tackle the challenges posed by this AI-based society and the current and future student populations, known as 'digital natives' because they acquire technical skills in a manner similar to their native language acquisition [31].

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Data availability The data is not publicly available but can be requested from the corresponding author for a reasonable purpose.

Declarations

Consent for publication Following the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments, the participants were asked to provide their consent for participating in the survey and for using the data in scientific publications. They were assured about the anonymity of their responses.

Competing interests The author declares no potential competing interests with respect to the research, authorship, and/or publication of this article.

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