

STEAM Teachers' Perceptions of Artificial Intelligence in Education: Preliminary Research

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Abstract: Integrating Artificial intelligence into teachers' practices allows them to equip students with the skills, knowledge and mindsets needed to thrive in an ever-changing world, preparing them to be active and innovative citizens in the 21st century. This study aims to understand the perception of a group of STEAM teachers about designing pedagogical experiences using artificial intelligence in their teacher work context. A quantitative approach is used in research. Results show that teachers recognise the importance of integrating AI into their teaching practice. However, they need to improve their know about AI technologies to use it efficiently. Results suggest that teachers recognise AI as a valuable resource for their daily work, however they admit that need training on it.

1 INTRODUCTION

Integrating STEAM approaches and artificial intelligence (AI) in education is a multifaceted task dynamic involving the adoption of new technologies and significant changes in teacher practices and pedagogies (Carvalho et al., 2015). Teachers play a pivotal role in successfully using technology in education (Ortega-Ruipérez & Alcalde, 2023) and generally need more training to use technology effectively (Brandão & Carvalho, 2014; Carvalho et al., 2015; Zhang, 2021). Professional development programs that focus on integrating AI into educational practices have been improve teachers' attitudes towards technology-supported instruction and enhance their skills in using these tools (Ali et al., 2023; Soares et al., 2014). Such training should not be limited to the technical aspects of technology but should also include pedagogical strategies for integrating technology-enhanced learning into lesson plans and curricula (Cruz et al., 2023). Therefore, it is essential to address the professional development needs of teachers (Tapalova & Zhiyenbayeva, 2022; Ayala-Pazmiño, 2023). In response to this need, we created a continuing training course for teachers focusing on technologies to support STEAM

Education. Being an innovative initiative in Portugal and globally, this program explores the integration of electronics, robotics, virtual or augmented reality, and digital games into STEAM education. This article presents just a part of bigger study that is still being developed at a Portuguese University. Therefore, this study aims to understand the perception of a group of STEAM teachers about designing pedagogical experiences using artificial intelligence in their teacher work context.

We divided this paper into five sections. Section 2 presents a brief on AI in an educational context. Section 3 describes the adopted methodology and the procedures for data collection. Section 4 presents the data collected and the main reflections. In section 5, we present the conclusions, limitations of this study and suggestions for future work.

2 ARTIFICIAL INTELLIGENCE IN EDUCATION

Artificial Intelligence has become a transformative force in education, offering a range of applications that promise to revolutionise the way we teach and

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learn (Park et al., 2023; Ayala-Pazmiño, 2023). AIED, often referred to as Artificial Intelligence in Education (AIED), encompasses technologies that can adapt to student's learning needs, providing personalised learning experiences, intelligent tutoring systems, and data-driven insights into the learning process (Mouta et al., 2023; Tapalova & Zhiyenbayeva, 2022).

AI-TPACK, or Technological Pedagogical Content Knowledge with AI, is a theoretical framework that extends the popular TPACK (Technological Pedagogical Content Knowledge) to incorporate AI as an essential teaching practice element. This model acknowledges that AI is rapidly changing the way we learn and teach and that teachers need knowledge and skills that enable them to teach in the present (Zhang, 2021; Ning et al., 2024; Park et al., 2023). The teacher's AI-TPACK concept includes integrating knowledge related to AI technology, specialised knowledge, pedagogical knowledge and the intersection of these three domains (Ning et al., 2023). One of the key benefits of AIED is its ability to create personalised learning paths for students (Ayala-Pazmiño, 2023). By analysing vast amounts of data, AI systems can tailor educational content to individual learning styles, strengths, and weaknesses, allowing students to learn at their own pace and improve their outcomes (Mouta et al., 2023; Tapalova & Zhiyenbayeva, 2022). This personalisation extends to various educational tools and platforms, such as Altitude Learning, Gradescope, and Knewton's Alta, which support self-study and provide immediate, personalised feedback to students (Tapalova & Zhiyenbayeva, 2022). Intelligent tutoring systems are another significant application of AIED. These systems can identify areas where a student is struggling and provide targeted assistance to help them grasp the material. As these systems interact with students, they learn and improve their effectiveness, making the tutoring experience more efficient and relevant (Mouta et al., 2023). AI-driven analytics, such as Learning Analytics (LA) and Educational Data Mining (EDM), are crucial for understanding and optimising learning environments. In this line of ideas, AIED technologies enable educators to construct personalised educational pathways that cater to individual learners' requirements. They can enhance participants' engagement and interest in learning, aid in customising educational content to suit personal needs, expedite the educational process, and stimulate cognitive activity (Tapalova & Zhiyenbayeva, 2022).

Despite these advantages, implementing AIED is not without challenges (Ayala-Pazmiño, 2023). Park

et al. (2023) highlights the significance of providing teachers with the necessary training and resources to integrate AI into their teaching practices effectively. Also, ethical considerations must be addressed, such as privacy, fairness, and the potential impact on students' and teachers' agency. There is also a need for a systematic examination of the values and ethics that justify the use of AI technologies in education (Mouta et al., 2023).

3 METHOD

This study was strongly anchored on the perception of fifteen teachers who, in the 2023/2024 academic year, attended a training course focused on technologies to support STEAM education. This article presents only part of this more extensive study focused on the STEAM approach and the use of AIED. With this text, we present results obtained by us to answer the following question: What are an group of 15 teachers' perceptions about designing pedagogical experiences that use Artificial Intelligence? In this study, a quantitative methodology was chosen using convenience sampling.

Data collection is based on the survey we built and its validity to the teachers who attended our training course. We are constructing the survey based on the research conducted by Tasiopoulou et al. (2020) to measure teachers' conceptual understanding of integrated STEM education. The survey included 17 questions and 12 closed-response items using a Likert-type scale of degree according to 5 points (from 1 = strongly disagree to 5 = strongly agree), allowing teachers to express how much they agreed or disagreed with the statements. In the descriptive analysis, the frequency and mean values on the Likert scale perceived by teachers.

The initial version of the survey was previously subjected to a scientific screening by three experts that suggested at this stage, including adding specific questions. Subsequently, a pilot test was carried out with four teachers of STEAM areas, who constitute part of the population of teachers under study but are not part of the analysed sample. We reformulated the survey with the information collected before sharing it with the 15 teachers. The changes suggested in the pilot test concern replacing some words to facilitate understanding and adding examples of specific AI technologies.

The survey consisted of three sections: (i) Sociodemographic data, (ii) Integrating STEAM approach and (iii) Integrating Artificial Intelligence. In this article, we will focus on the analysis in the

perception about Integrating Artificial Intelligence. In first dimension of the survey, we include a question about their experience in education based on the professional phases outlined by Huberman (1992). Huberman (1992) distinguishes five phases that mark the evolution of the teaching profession: entry into the career (1 to 3 years of experience), stabilisation (4 to 6 years), experimentation or diversification (7 to 25 years), and preparation for retirement (35 to 40 years of experience). Additionally, within this first dimension of the survey, we include a question allowing the teachers to position themselves in digital knowledge according to the European Framework for the Digital Competence of Educators (DigCompEdu) (Redecker & Punie, 2017).

In our survey for the second and third dimensions, we used the results of Tasiopoulou et al. (2020). Therefore, by drawing on the findings of Tasiopoulou et al. (2020), our survey aimed to understand teachers' perspectives regarding integrating AI and the STEAM approach in their classroom practice.

A total of 15 teachers answered the survey. The data was exported by Excel and analysed with the statistical software IBM® SPSS® Statistics for Windows version 25.0 through descriptive statistical techniques such as frequency distributions, graphics, central tendency, and dispersion measures. We designated the information of each teacher in the surveys T_i ($i = 1 \dots 15$).

The survey was implemented using Google Forms and convenience sampling. The survey was made available and posted on Moodle, the official web page of the training course, until November 2023. Teachers were informed that their participation was voluntary, anonymous, and confidential, with no relationship with their school; this way, their opinions were protected by anonymity. The students constituted a convenience sample, selected in a non-probabilistic way, and after being presented with the study's objectives, they voluntarily accepted participation. In this way, all students in this course voluntarily participated by answering the survey. In the constructed validation of the instrument, Cronbach's alpha (α) was employed, which allows for quantifying the questionnaire's reliability on a scale from 0 to 1 (Pestana & Gageiro, 2008).

This work follows a quantitative paradigm with a descriptive exploratory character to understand the perception of a group of STEAM teachers about designing pedagogical experiences using artificial intelligence in their teacher work context. Data analysis was based on the following dimensions that emerged from the literature: (i) conception of AI concept, (ii) AI implementation capability, (iii) AI

technologies in education, (iv) professional development in AI, (v) comfort with AI and (vi) barriers to integrating AIED.

3.1 Participants

The study involved 15 in-service STEAM teachers who attended a training course focused on technologies to support STEAM Education. One teacher teaches technology and programming, seven teach mathematics, two teach Science, and five teach Arts. Two teachers taught in primary school, and thirteen taught in secondary school. Regarding their digital literacy, four teachers fall into the Newcomer category. These respondents know the importance of digital technologies in improving teaching and professional practice. However, they may still need to explore or integrate these technologies extensively into their practice. The majority of respondents (six teachers) fall into the Explorer category, four teachers also fall into the Integrator category and only one teacher falls into the Specialist category, according to Huberman (1992).

4 FINDINGS

Regarding the concept of AI, only 20% agree that have a clear understanding of integrating AI in class and only 14% feel confident in this aspect. These results emphasize the importance of AI-related training and support for educators.

AI is becoming increasingly present in the lives of students and teachers, and this means it is more important than ever for students to develop critical thinking about this technology. Our results suggest that 73% of teachers either strongly disagree or disagree that they understand how to promote critical thinking about AI in their students. This suggests a significant gap in AI literacy and teaching strategies related to AI. Furthermore, 60% of teachers need to understand how AI can be used to differentiate pedagogically. This suggests more awareness or training in leveraging AI for personalized learning experiences. In Table 1, we present the responses of the 15 teachers regarding the AI concept dimension.

Regarding the ability to create a class plan using AI technology, nearly half of the respondents (67%) indicated that they haven't created a class plan using AI technology and 34% believe that it is easier to plan a lesson without AI. Regarding the ability to incorporate AI into their class, more than half of respondents (53%) agreed that they aren't able to incorporate AI into their professional activities with

Table 1: Artificial intelligence concept.

	1	2	3	4	5	\bar{x}	σ
I have a clear understanding of how I can use AI in my professional practice.	3 20%	4 27%	5 33%	2 13%	1 7%	2,6	0,3
I have a clear understanding of how I can use AI in the classroom with students.	5 33%	3 20%	5 33%	1 7%	1 7%	2,3	0,3
I have a clear understanding of how I can promote critical thinking about AI in my students.	5 33%	6 40%	2 13%	2 13%	0 0%	2,1	0,3
I understand how AI can be used to differentiate pedagogically.	4 27%	5 33%	3 20%	1 7%	2 13%	2,5	0,3
I understand how AI can enhance my teaching work.	3 20%	4 27%	3 20%	4 27%	1 7%	2,7	0,3
Alpha de Cronbach: 0.855							

1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree

students. Few respondents (20%) agreed they feel competent to lead a class where students use AI technologies. This indicates these teachers' insecurity regarding their knowledge of using AI with their students.

Most respondents (60%) feel they need to be more competent to use AI-based administrative assistants. Furthermore, when asked if they feel competent to use AI-based assessment systems, most respondents (67%) disagree. Similarly, most respondents (73%) disagree that they can record and personalize student performance assessments, while only 14% feel comfortable doing so. Nearly two-thirds of respondents (67%) agreed that they don't feel able to use collaborative environments that incorporate AI. AI technologies offer tools for creating personalized teaching materials, significantly enhancing individualized learning and improving students' educational experiences. Most respondents (80%) agreed they can't use AI technologies to design personalized teaching materials. Table 2 presents these and other teachers' responses regarding the AI implementation capability dimension.

Table 2: AI Implementation Capability.

	1	2	3	4	5	\bar{x}	σ
I have already created a class using AI technologies.	7 47%	3 20%	2 13%	1 7%	2 13%	2,2	1,5
I can incorporate AI into my professional activity with students.	5 33%	3 20%	4 27%	3 20%	0 0%	2,3	1,2
For me, it is easier to plan a lesson without using AI technologies.	3 20%	2 13%	5 33%	4 27%	1 7%	2,8	1,2
I feel competent to lead a class in which students use AI technologies.	5 33%	5 33%	2 13%	3 20%	0 0%	2,2	1,1
I feel competent to use AI-based administrative assistants.	5 33%	4 27%	3 20%	2 13%	1 7%	2,3	1,3
I feel competent to use AI-based assessment systems to develop tests/exams.	6 40%	4 27%	3 20%	1 7%	1 7%	2,1	1,2
I can use AI to record and personalized assessment of student performance.	6 40%	5 33%	2 13%	1 7%	1 7%	2,1	1,2
I feel able to use collaborative environments.	7 47%	3 20%	3 20%	1 7%	1 7%	2,1	1,3
I can use AI technologies to design personalized teaching materials.	6 40%	6 40%	1 7%	1 7%	1 7%	2,0	1,2
Alpha de Cronbach: 0.852							

1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree

Regarding the availability of resources and materials to support teachers in using AI technologies, about 60% of teachers disagree that there are sufficient resources to help teachers use AI technologies in an educational context. The majority

of teachers (60%) agree that AI technologies can enhance the teaching and learning process. These results seem to indicate that these teachers generally see the potential for AI to improve education.

The question about AI as a pedagogical resource for students has divided teachers' opinions. Nearly 47% of teachers opt for a neutral response, and only 27% agree. About 40% of teachers agree that AI Technologies for Education (AIED) can assist teachers' work, indicating that teachers perceive AI as a supportive tool. Despite this, almost all teachers (87%) assume that they don't know about AI technologies enough for implementing in Education. Table 3, presented below, shows the teachers' responses to the AI Technologies dimension.

Table 3: AI Technologies

	1	2	3	4	5	\bar{x}	σ
There are sufficient resources and materials to support teachers in using AI technologies in an educational context.	4 27%	5 33%	5 33%	0 0%	1 7%	2,3	1,1
AI technologies can be used in Education to enhance the teaching and learning process.	2 13%	1 7%	3 20%	5 33%	4 27%	3,5	1,3
AIED can be a pedagogical resource for students.	2 13%	2 13%	7 47%	3 20%	1 7%	2,9	1,1
AIED can assist the teacher's work.	2 13%	2 13%	5 33%	5 33%	1 7%	3,1	1,2
I have knowledge about AI technologies suitable for implementing in Education.	6 40%	7 47%	1 7%	1 7%	0 0%	1,8	0,9
Alpha de Cronbach: 0.734							

1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree

Table 4 presents the teachers' responses to professional development in the AI dimension. Regarding opportunities for skill development, about 73% of teachers either disagree that current training programs offer them the opportunity to develop skills in integrating AI into education. In line with these results, nearly 80% of teachers either disagree or

strongly disagree that training programs promote AI technologies to support their work as educators. This suggests that teachers perceive that existing training programs aren't useful for supporting teachers' work with AI technologies.

Table 4: Professional development in AI.

	1	2	3	4	5	\bar{x}	σ
Training programs offered me the opportunity to develop skills in the integration of AIED.	1 33%	2 40%	3 13%	4 13%	0 0%	2,1	1,0
Training programs promote the use of AI technologies to support the teacher's work.	5 33%	7 47%	2 13%	1 7%	0 0%	1,9	0,9
Training programs that address the integration of AI technologies in Education are scarce or non-existent.	2 13%	4 27%	4 27%	3 20%	2 13%	2,9	1,3
I feel that I need additional professional training to be able to promote critical thinking around AI in my students.	1 7%	0 0%	2 13%	7 47%	5 33%	4	1,1
I feel that I need additional training to effectively implement AI technologies in my teaching.	1 7%	0 0%	3 20%	6 40%	5 33%	3,9	1,1
Alpha de Cronbach: 0.594							

1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree

Some teachers (33%) agree that training programs addressing the integration of AI technologies in education are limited or non-existent. Furthermore, most teachers (80%) agree that they need additional professional training to promote critical thinking around AI in their students. A substantial proportion of teachers (73%) agree that they need additional training to implement AI technologies effectively in their teaching. The results indicate that teachers believe that need more specialized training to be able to incorporate AI technologies into their teaching practices effectively.

Table 5 presents the teachers' responses in dimension related to comfort with AIED.

Table 5: Comfort with AIED.

	1	2	3	4	5	\bar{x}	σ
I regularly incorporate AI technologies into my classes.	8 53%	5 33%	2 13%	0 0%	0 0%	1,6	0,7
I feel comfortable with the idea of planning educational activities based on AI technologies.	5 33%	3 20%	3 20%	4 27%	0 0%	2,4	1,2
I like to promote a critical approach to the use of AI in my students.	3 20%	4 27%	4 27%	4 2%	0 0%	2,6	1,1
I feel confident planning and incorporating AI technologies into my practice with students.	7 47%	3 20%	4 27%	1 7%	0 0%	1,9	1,0
I am able to develop instruments to assess the progress of my students based on AI technologies.	7 47%	6 40%	1 7%	1 7%	0 0%	1,7	0,9
I feel comfortable with the knowledge I have about the use of AIED.	7 47%	4 27%	4 27%	0 0%	0 0%	1,8	0,9
Alpha de Cronbach: 0.867							

1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree

Observing the average values obtained, the need for training to promote students critical thinking around AI and additional training to effectively implement AI technologies in teaching stands out. The results obtained show that most teachers (86%) do not regularly incorporate AI technologies into their classes. Regarding comfort with planning educational activities based on AI technologies, a significant portion of these teachers (53%) disagree to feel comfortable. Most teachers (67%) feel that they aren't confident in planning and incorporating AI technologies into their practice with students. These results are perhaps because most teachers cannot develop instruments to assess the progress of their students based on AI technologies (87%), and do not feel comfortable with the knowledge they have about the use of AIED (74%).

The data shows that teachers admit to barriers to integrating AIED. A significant portion of teachers (53%) agree that the school environment does not favour the integration of AIED. Furthermore, the lack of skills among teachers in integrating AI is another barrier (67%). Most teachers (60%) agree that the

need for more resources guiding effective AI integration is a barrier. These results suggest that many teachers feel inadequate resources are hindering their AI integration efforts. On table 8, we present teachers responses regarding the AI integration main barriers.

Table 6: Integration AIED main barriers.

	1	2	3	4	5	\bar{x}	σ
The school environment does not favour the integration of AIED.	1 7%	4 27%	2 13%	5 33%	3 20%	3,3	1,3
Teachers' lack of skills in integrating AIED.	2 13%	1 7%	2 13%	6 40%	4 27%	3,6	1,3
Curricular guidelines do not favour the integration of AIED.	2 13%	3 20%	5 33%	3 20%	2 13%	3,0	1,2
The guidance for student assessment does not favour the integration of AI-based personalized assessment systems.	2 13%	2 13%	5 33%	5 33%	1 7%	3,1	1,2
The lack of resources presents an effective integration of AIED by teachers.	1 7%	2 13%	3 20%	6 40%	3 20%	3,5	1,2
Alpha de Cronbach: 0.929							

1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree

Regarding the dimensions of analysis, Cronbach's α value obtained allows us to conclude that the questions have good reliability, and that data is reliable (Pestana & Gageiro, 2008).

5 DISCUSSION

Nowadays, AI serves as the driving catalyst for change, with a strong emphasis on addressing the requirements and preferences of the students (Tapalova & Zhiyenbayeva, 2022). Schools are adapting their classrooms to equip students for an increasingly automated world driven by emerging

technologies, including AI (Park et al., 2023). Concerning conception about AI concept, results suggest a need for more comprehensive AI education and training for teachers, as many of them currently lack a clear understanding of how to integrate AI into their professional practice and promote AI-related critical thinking in their students. Addressing these gaps through professional development could help educators leverage AI effectively in education. We must empower teachers and help them master the use of technology so that they are able to apply the knowledge they learn in their work with students (Zhang, 2021).

Regarding AI implementation capability, data results data suggest that educators have varying levels of confidence and competence in using AI technologies in their professional activities. While some appear to be more confident and skilled, others express uncertainty or hesitation, particularly in areas like using AI for administrative tasks and assessment systems. This indicates a targeted need for professional development and support to enhance educators' AI implementation capabilities.

AI technologies help educators to develop and introduce personalized approaches to master new knowledge and develop professional competencies (Tapalova & Zhiyenbayeva, 2022). Results show that this group of teachers seem to have mixed perceptions of AI technologies in education. While they recognize the potential benefits of AI in enhancing teaching and learning, there is a notable concern about the availability of resources and materials for AI integration. Overall, teachers seem open to the idea of AI as a pedagogical resource and a tool to assist their work, but admit to needing more training to be able embrace AI technologies in their educational practices fully. Park et al. (2023) highlights the importance of providing more supportive ways and practical resources for teachers to integrate AI into their teaching practices effectively.

In relation to professional development in AI, our results suggest that while many educators believe that training programs have provided them with the opportunity to develop AI-related skills and promote AI use, there is still a significant need for additional training, especially in addressing critical thinking about AI and effectively implementing AI technologies in teaching. The incorporation of AI technologies enables the enhancement of education's efficiency and quality while remaining attentive to the student's needs and demands and promoting their critical thinking (Tapalova & Zhiyenbayeva, 2022; Ayala-Pazmiño, 2023).

Teacher development is essential for educational reform and innovation. Teachers' knowledge forms the basis for their teaching activities, directly impacting their teaching methods and students' learning outcomes. In today's era of advancing technology, including computerisation, networking, and AI, teachers must adapt actively to these changes to improve the quality of talent development and promote education's vigorous development (Zhang, 2021). Regarding professional development in AI, teachers perceive a lack of adequate training opportunities and support in AI integration in education. They express a need for more training to develop skills related to AI and promote critical thinking among students. In their study, Park et al. (2023) emphasises the need for a structured AI-integrated lesson that can be adopted for an enrichment program after school, particularly focusing on the development paths of teachers' professionalism in AI-TPACK.

The use of AIED has the potential to enhance teaching and learning experiences (Ayala-Pazmiño, 2023). In relation to comfort with AIED, our results indicate that, teachers generally don't feel comfortable with the regular incorporation of AI technologies into their classes and promoting a critical approach to AI. These group pf teachers perceive several barriers to integrating AIED, including the school environment, the lack of teacher skills, curricular guidelines, guidance for student assessment, and the availability of resources. These barriers reflect challenges that must be addressed to promote effective AI integration in educational settings. According to Zhang (2021), teachers' lack of technical knowledge and skills is the main obstacle to using technology in the classroom

6 CONCLUSION

With this work, we seek to understand the perception of a group of STEAM teachers about designing pedagogical experiences that use AI in their work context. Results show that this teacher group generally has a positive attitude towards AI and its educational potential. However, a notable portion still expresses the need for more training in the area to use AI on teaching work effectively. According to Park et al. (2023), the professional development needs of teachers in the context of AI integration revolves around providing supportive ways, practical resources, and structured AI-integrated lessons to enhance their capabilities in integrating AI into their teaching practices. Empowering educators with AI-

TPACK is crucial for preparing teachers to navigate through this new educational landscape (Zhang, 2021). Similarly, this study focused only on the conception of teachers from the areas of mathematics, science, technology and Art, with the teachers needing an engineering background.

Future research can incorporate quantitative methods applied to more teachers to collect data from a larger sample. Additionally, future research can focus on students' perceptions regarding the topic under discussion. This can also encourage the discussion regarding integrating the different disciplines of STEAM education from the perspective of teachers and students.

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