AI4T
AI FOR TEACHERS

Work Package 3:

Evaluation

Deliverable D3.3

National Evaluation Report

Italy

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ABSTRACT	This report presents the quantitative and qualitative evaluation of the impact of the AI4T professional learning pathway in France. The first parts are dedicated to introducing the intervention – which is the AI4T professional learning pathway, and the experimental design detailing: the recruitment and randomisation procedures, the theoretical framework of the evaluation and the instruments used for data collection. The sample is then described, and elements are provided on data processing, along with verifications regarding the experiment's internal and external validity. The results are then outlined in three parts, first the teachers' results, then the school leaders' and finally the students. A bigger focus is given to teachers as they are the main target of the AI4T project. After detailing their reactions to the professional learning pathway, the report delves into the three main outcomes of the experiment: teachers' knowledge, perceptions and use of AI. Both the initial state and the impact of the intervention are presented for each outcome. Additional analyses on the heterogeneity of the impact of the intervention depending on teachers' engagement in the MOOC, teachers' self-efficacy for integrating technologies into the classroom, and teachers' subject are then outlined. The final part highlights the takeaways from teachers and school leaders which could inform educational policies on AI. It focuses on their needs regarding professional learning, tool development and ethical safeguards.
KEYWORDS	Artificial intelligence, experimentation, evaluation, impact study, professional learning, teachers

Dissemination level		
PU	Public	**X**
PP	Restricted to project partner (including the Commission)	
RE	Restricted to a group defined by the consortium (including the Commission)	
CO	Confidential, only for members of the consortium (including the Commission)	

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Introduction

In recent years, the rapid development of new technologies based on Artificial Intelligence (AI) has prompted a crucial discussion on its implications for education. At the European level, the Digital Education Action Plan 2021-2027 emphasized the necessity of developing students' AI skills and providing ethical guidelines on the topic.

Funded by the European Commission, the Artificial Intelligence For and by Teachers (AI4T) project was a three-year experiment to explore and support the use of AI in education. It consisted in producing, implementing and evaluating professional learning activities with the goal of acculturating teachers to AI. The project was conducted in 5 countries: France, Slovenia, Italy, Ireland and Luxemburg. 17 partners, including education ministries, evaluators and research labs took part in the project, under the coordination of France Education International (FEI).

The AI4T intervention was built around two common online resources: the AI4T MOOC created under the coordination of the Institut national de recherche en sciences et technologies du numérique (Inria) and the textbook "AI for teachers: an open textbook" written under the coordination of the Université de Nantes. Both resources received contributions from the consortium partners. In each country, professional learning pathways, with common objectives but varied formats (online platforms, webinars, face-to-face sessions), were then developed.

Following a pilot phase conducted the previous year in a small sample of schools, the intervention took place during the 2022-2023 school year. The program was aimed at math, science and language teachers with students aged 15 to 17. Out of all the participating schools, half were randomly chosen within each country to engage in the professional learning pathway during the experimentation year. The remaining schools served as a control group and were given access to the resources only after the end of the experimentation.

The findings presented were gathered by administering surveys to teachers, school leaders, and students, as well as conducting interviews with teachers and school leaders. Based on the data collected, this report will address the four evaluation questions formulated at the beginning of the project.

1) *Was the professional learning experience conducive to teachers' learning[1] of AI?*
2) *Was the professional learning experience conducive to changing teachers' perceptions of AI?*
3) *Was the professional learning experience conducive to modifying teachers' use or behavioral intentions[2] of using AI?*
4) *What are some key factors that can account for the impact of the intervention?*

[1] The term learning refers to Guskey's model for evaluating professional development (2013)

[2] The term behavioral intention refers to the TAM (Davis & al., 1989)

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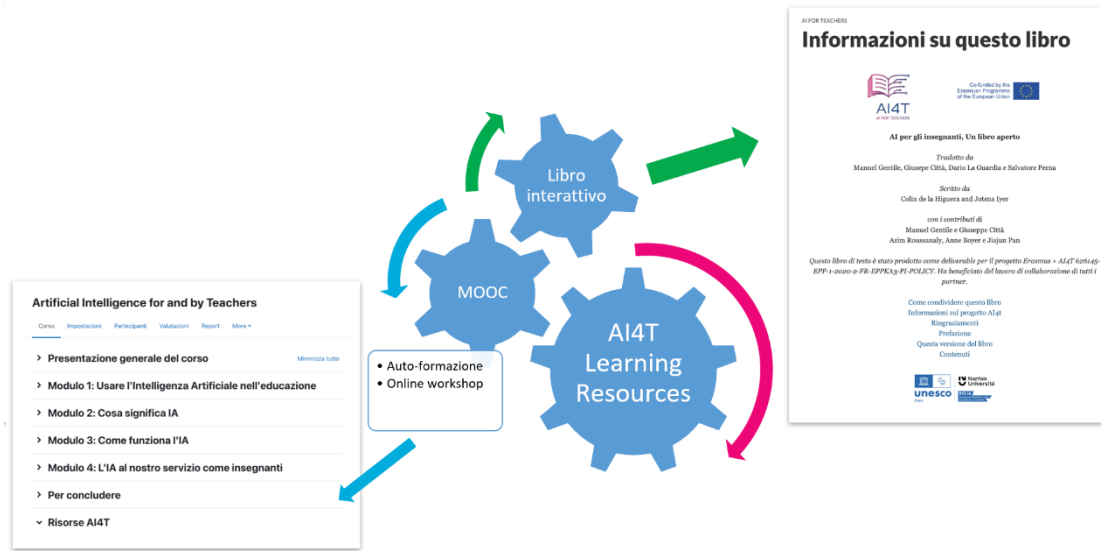
1. Intervention

The AI4T intervention revolved around two common online resources translated for all 5 countries. The first resource was the AI4T MOOC. A textbook entitled "AI for Teachers: An Open Textbook" was also developed by the Université de Nantes as a resource for more experienced users and trainers. Finally, a set of common learning outcomes were established for the professional learning pathways in all countries:

1. Being able to express one's understanding and attitude towards AI and discuss it.
2. Being able to understand the basic principles of AI systems.
3. Being aware of AI educational applications and key considerations when identifying, assessing and selecting an AI for teaching, learning and assessment.
4. Being aware of legal considerations when using AI in an educational setting.
5. Being aware of ethical considerations when using AI in an educational setting.
6. Being aware of generic AI tools and being able to reflect on their impact on education and critically consider the possibilities for AI tools in education.

The large-scale project took place in 2022/2023.



Italian participants accessed the AI4T MOOC on the ITD-CNR platform (https://ai4t.itd.cnr.it) between March and May. CNR-ITD oversaw designing and customizing the national training course, ensuring alignment with the needs and requirements of the local context. During these three months,

a group of CNR-ITD researchers supported the teachers through the forum available within the course. The course accessible through the MOOC was complemented by 5 (online) webinars.
During the first webinar, the AI4T project, the training course and the evaluation protocol were presented to the teachers, with the aim of familiarizing the participants with the context and objectives of the project and socializing among the teachers. During the second meeting, the topic of generative AI and its impact on teaching and learning processes was analyzed. In the third meeting, the discussion focused on the difference between symbolic and sub-symbolic AI, offering an overview of AI-based tools specifically designed for the educational sector. From the fourth meeting, a project work activity began in which teachers were asked to design teaching activities that exploited AI-based technologies. During the last meeting, teachers presented and discussed the teaching practices they had designed, with the aim of sharing experiences and planning future applications of AI in education.

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2. Experimental design

2.1 Recruitment and randomization

The recruitment process was conducted via a public call for applications issued by the Ministry of Education and Merit in January 2023. Prior to this, a notification letter was sent to all schools. To address time constraints related to contractual matters and to prevent any potential risks to the overall project, the Ministry prioritized schools with established experience as innovation centers and those already integrated into the Italian Digital Transition Plan. This approach aimed to ensure geographical diversity, encompassing various types of schools, and facilitate prompt engagement in the project. It also capitalized on the experience of teachers who already possessed insights into digital technology over those who were entirely new to the technology.
Upon reviewing the schools' responses to the call, 91 high schools were selected in alignment with the project criteria. These criteria specifically targeted secondary schools featuring classes with students aged between 15-17 years old. On the basis of the criteria defined in the WP3 protocol the schools were identified and chosen by school type, geographical region and socio-economic background. The final 91 selected schoolscomprised the following distribution: 50% Lyceums, 40% Technical Institutes and 10% Vocational Institutes. As far as geographical distribution is concerned, the distribution over the entire national territory was respected with the following proportions: 47% in the south, 29% in the north and 24% in the center, with particular attention paid to schools located in more disadvantaged areas. A total of 438 teachers were involved, including 262 teachers in STEM subjects, 152 in English language and literature and 24 in other subjects.

The stratification of the schools was carried out by CNR-ITD (Italian partner of WP2), under the supervision of the Ministry education and Merit. The aim was to adhere to the indications provided and shared within WP3 while simultaneously contextualizing and adapting these guidelines to the Italian sample.
. The employed methodology was that of stratified randomization of schools according to the following criteria:

- Region
- Type of schools (academic/vocational)
- The number of volunteer teachers
- STEM and English teachers

Once the strata has been constructed and made as homogeneous as possible, the schools and teachers in each group, they were randomly assigned to the intervention and control groups.

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2.2 Theoretical framework

AI4T started as a pioneer project on AI in education, tackling a relatively unexplored topic. To refine the evaluation questions identified at the beginning of the project, we adopted a theoretical framework drawing from various literature, on AI but also on digital technologies and professional development evaluation. Specifically, we drew upon Guskey's work as a foundational framework (2000). According to Guskey, an effective evaluation of professional development requires the collection and analysis of five critical levels of information: 1) Participants' reactions, 2) Participants' learning, 3) Organization support and change, 4) Participants use of new knowledge and skills, 5) Student learning outcomes.

For each level we created robust indicators adapted from existing scales and tested them during the pilot phase of the project.

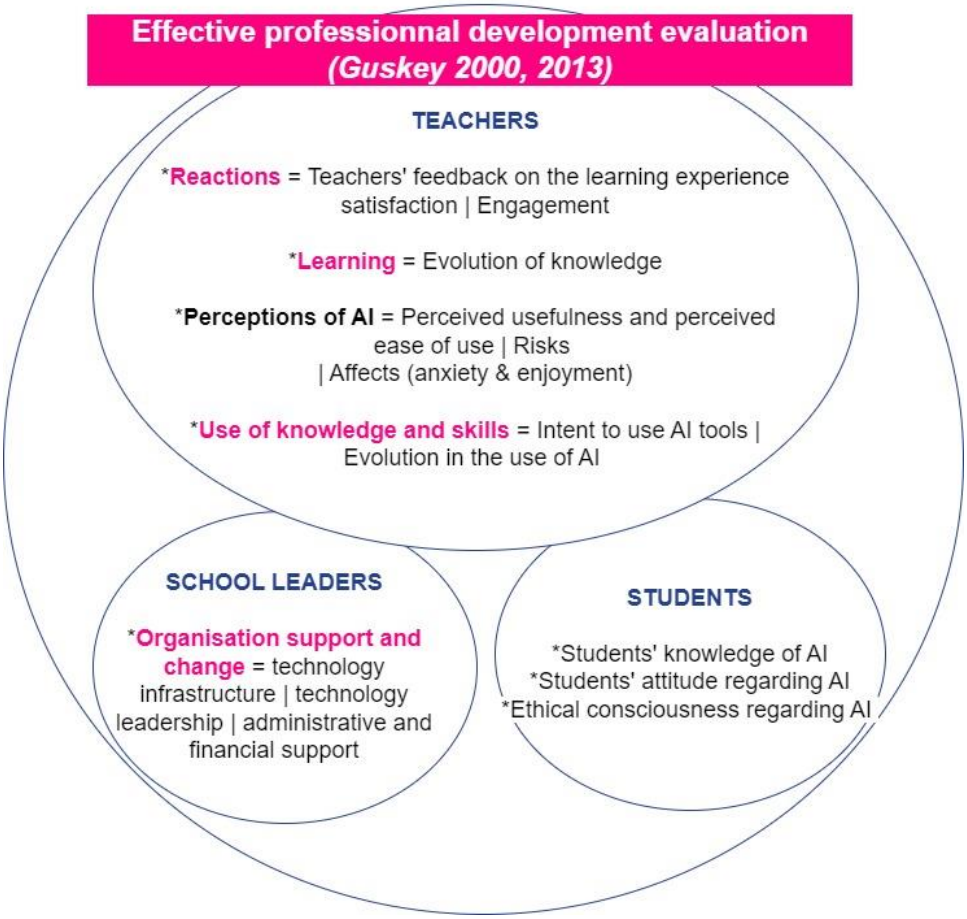

Figure 1: Theoretical framework for the evaluation of the AI4T professional learning pathway

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Participants' reactions were assessed through the measure of participants' engagement in and satisfaction with the professional learning pathway. The engagement scale was adapted from Deng & al. (2020) and the satisfaction scale from Yenneck (2014).

The measure of **participants' learning** was based on the content of the AI4T MOOC. We also consulted experts on AI in education from and outside of the consortium to review the questions and their interpretation. To measure participant's learning, we asked participants to self-assess their knowledge of AI, indicate their level of familiarity with AI technologies, answer questions about how AI works, and identify tools that contain AI.

Data on **organisation support and change** were collected through school leaders. Guskey recommends assessing whether the organization's policies and characteristics are compatible with the implementation of the envisioned change. To address the integration of AI, we assessed the technology infrastructure and technology leadership (Anderson & Dexter, 2005) of the schools. We also assessed the administrative and financial support provided to teachers for their participation in the professional learning pathway.

Given the specific context of the project, which centres on changing teachers' **perceptions of AI** and encouraging the integration of AI tools in classrooms, the measure of **participants use of knowledge and skills** was extensively developed by incorporating to the framework, the Technology Acceptance Model (Davis, 1989), described by Scherer et al. (2019) as follows:

> *In the literature, the question is repeatedly put forward as to what variables determine technology integration in education. Measuring user acceptance of technology is a way of determining the teacher's intentions towards using new technologies in their educational practice. Over the last decades, a series of models have been proposed to describe the mechanism behind and factors affecting technology adoption. [...] Despite the variety of models, the TAM has dominated the research landscape as the most commonly used model to describe use intentions and actual technology use. (abstract)*

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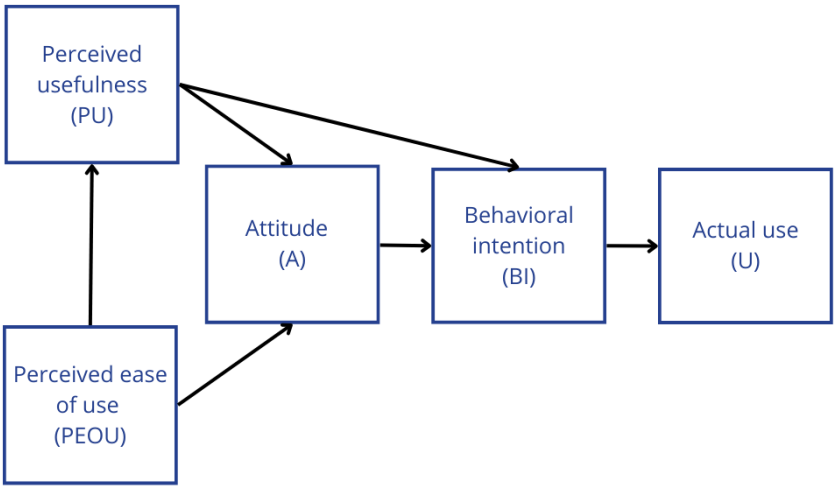

Figure 2: Technology Acceptance Model developed by Davis and al. (1989)

This model identifies two main variables "perceived ease of use" and "perceived utility" that determine behavioral intention to use and use of a technology. We adapted the original scale from Davis & al. (1989) to measure "perceived ease of use of AI". To measure the perceived utility of AI, we created items specific to the teaching profession, which enabled us to gain information on the specific pedagogical functions (identified by André Tricot, Cnesco, 2020) for which teachers perceived AI to be the most useful. In order to counter-balance the positive concept of "perceived utility", we also surveyed participants on "risks" posed by AI, based on elements identified by Schiff (2021) and Remian (2019).

Some versions of the TAM also contain the concept of 'attitude', whose definition and scope often varies (Njiku, 2019). We took a particular interest in one of the subdimensions of attitude which is "affects". Affects regarding AI are prominent in the AI literature (Wang and Wang, 2019, Cave and al., 2019), of interest to the AI4T partners, and can also impact the use of a technology (Février and al., 2011). We therefore measured AI anxiety, by adapting items from the Wang and Wang scale on AI anxiety (2019), and AI enjoyment by generating items based on existing scales on computer enjoyment (Christensen & Knezek, 2009; Noiwan & al., 2005).

Both behavioral intentions to use AI and **use of AI** were measured, in accordance with the TAM. We also characterized the types of use by asking about the frequencies, the tools and the tasks done with the tools. Finally, we measured participants' ethical consciousness when using AI, by using items from a subscale on ethics in the AI literacy scale (Wang & al., 2022).

Due to the characteristics of the AI4T professional learning pathway - objectives, length and content - and the focus on teachers, we did not measure **student** learning outcomes, but instead gathered context information on student's knowledge, attitude and ethical concerns regarding AI. We created an attitude scale towards AI in education based on the conceptualization of attitude by Njiku (2019) and on existing

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scales on attitude towards AI (Suh & Ahn, 2022; Shepman & Rodway, 2020). For the ethical concern scale, we did a literature review to include the main concerns mentioned in the literature on AI in education (Jang & al., 2022; Remian, 2019; Schiff, 2021; Akgun & Greenhow, 2021; European Commission, 2022; Holmes & al., 2021).

2.3 Evaluation instruments

The research design for the impact evaluation, the methodology of which is described below, included a quantitative phase, i.e. the administration of questionnaires to two groups of teachers (intervention T and control C), to the students and to the school headmasters, the teachers, in addition, answered two questionnaires (pre-post). This was followed by a qualitative phase addressed only to the schools that received the training (group T) through individual interviews with the school headmaster and group interviews with the teachers. In Italy, the professional learning process took place from March to May 2023.

For the administration of the questionnaires, the education ministry sent generic links to teachers and school leaders on their email addresses. They were also given individual evaluation numbers, necessary to access the questionnaires. For students, the questionnaire was administered in class under the supervision of a school staff member. Students from one class were all asked to enter the same number which was their teacher's evaluation number.

The teacher questionnaires covered the main outcomes regarding teachers' knowledge, perceptions and use of AI. In the baseline, teachers were also asked to provide information on this background (gender, teaching experience, etc.). In the endline, teachers who had participated in the intervention were also asked questions about their engagement and satisfaction with the intervention. Through the school leader questionnaire, data was collected on the general characteristics and technical infrastructure of the school, administrative and financial support for teachers' professional learning and integration of AI in the school. Finally, students were surveyed on their understanding of AI, attitude towards AI and ethical concerns regarding AI.

Interviews were conducted online with a subset of schools from the intervention group. The interviews took place after the administration of the endline questionnaires to avoid creating a bias between participants who had taken part in the interviews and the others.

The interviews focused on teachers' experience with the professional learning activities and AI tools. They covered the dimensions addressed in the questionnaires to provide a better understanding of the answers given by the participants. Teachers were also asked about their expectations and recommendations regarding AI policies.

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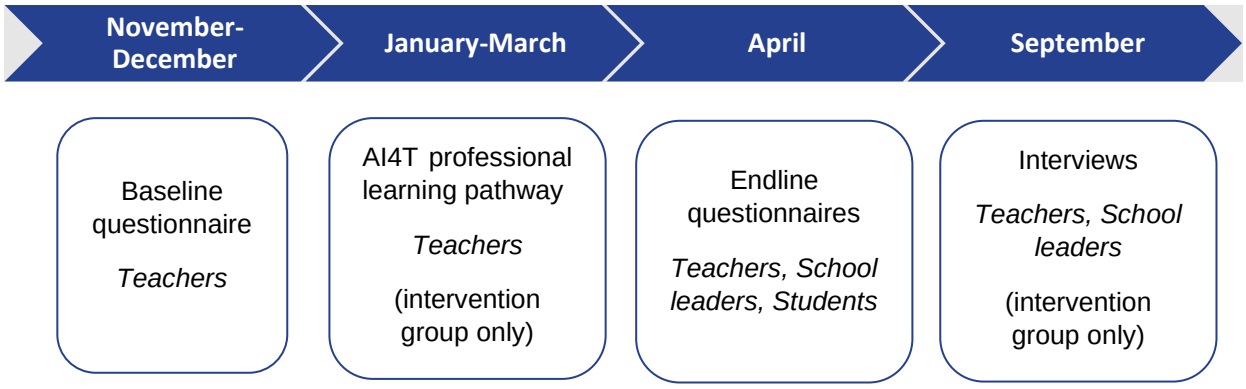

Figure 3: calendar of the evaluation of the AI4T intervention

The learning traces were collected by the Loria. They correspond to the digital traces left by users of the MOOC (i.e. teachers in the intervention group only). These traces were used to assess their level of engagement in the training (e.g. through the number of clicks or consistency in watching video lectures) and to identify types of learners through cluster analysis. A correspondence table matches the IDs of the learning traces to the IDs entered in the survey. This link allowed us to investigate how engagement in the MOOC appeared to modulate the impact of the professional learning activities on teachers. More information about the analysis of learning traces can be found in Deliverable D1.3 "Analysis of traces of use".

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3. Data

3.1 Sample characteristics

- Teachers

In the Italian sample, 193 respondents are female, representing 70,2% of the total; 81 respondents are male (29.4% of the total). 1 respondent, representing 0,4% of the total, preferred not to answer; none defined themselves as 'other'. The sample is therefore predominantly female. The distribution of teachers in terms of years of service is as follows 0 to 9 years for 71 teachers, representing 26,2% of the total; 10 to 19 years for 66 teachers, representing 24,0% of the total. Most of the teachers have been teaching for more than 20 years, i.e. 137 of them, representing 49.8% of the total. Half of the sample have therefore been teaching for a long time and have many years of experience behind them.

In terms of disciplines, language teachers are the most numerous category: they represent 35,6% of the total, with 98 teachers. There are 87 mathematics teachers, representing 31,6% of the total. Science teachers represent 11.0% of the total, with 30 teachers, and computer science teachers represent 13,4% of the total, with 37 teachers. The category 'other' is represented by 23 teachers, or 8,4% of the total. The distribution between categories is fairly even, although there is a slight predominance of mathematics teachers.

As far as the type of school is concerned, the teachers all teach in secondary schools: the largest category, with 155 teachers, or 56,4% of the total, teaches in upper secondary schools; vocational teachers, with 101 teachers, represent 36,7% of the total. Other is indicated by 19 teachers, 6,9%. Most teachers, 191 or 69,4% of the total considered, state that they see pupils 3-4 times a week; 66 teachers or 24% see them 1-2 times; 17 teachers (6,2%) more than 5 times; only 1,0 times (0,4%).

It should be noted that the sample consists of volunteer teachers. We expected that teachers in the AI4T project would have a greater interest in digital technologies. Indeed, they have a high level of self-efficacy for integrating technology in the classroom. 90,9% of the teachers are confident in their ability to use digital technologies effectively for teaching; 236, or 85,9% of the total, say they are confident in assigning and evaluating activities that involve students' use of digital technologies; 199 teachers, or 72,4% of the total, say they are confident in their skills to effectively monitor students' use of digital technologies in the classroom; 222 subjects, or 80,7% of the total, say they know the capabilities of digital technologies well enough to make the best use of them in the classroom; 221 subjects, or 80,4%, say they are confident in selecting appropriate digital technologies for teaching. This is confirmed by the mean and standard deviation (SD) for self-efficacy in using digital technologies for teaching, which has a mean of 5.41 and a SD of 0.50.

- School leaders

A total of 56 headteachers responded, compared to 89 participating institutions. 30 school leaders, or 54,5%, reported having more than 1000 pupils; 20, or 36.4%, between 500 and 999; only 5, or 9,1%,

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less than 499 pupils. Regarding the participation of the school in other studies related to digital tools in the last 5 years, 70,9% of the headteachers, 39 of them, answered that they had already participated in studies on the subject; the remaining 16, i.e. 29,4%, said that they had not. This aspect of the composition of the sample also raises the question of whether there are differences in perception and impact between these two groups of schools. 16 principals, or 29,1% of the total, responded that the school had participated in other AI-related studies in the last 5 years. The majority, i.e. 39 headteachers, 70.9%, stated that this was the first time. The schools that participated in the sample are schools that are very experienced in digital technologies and some even in AI.

- Students

The total number of students who responded to the questionnaire was 1590.

The 'other' category is similar in number to language teachers, with 507 teachers representing 31,9% of the total. The distribution between categories is even, although there is a slight predominance of mathematics teachers. There are 714 female respondents, representing 44,9% of the total, and 831 male respondents, representing 52,3% of the total: 30 respondents, representing 1,9% of the total, prefer not to answer; 15 respondents, representing 0,9% of the total, define themselves as other.

The distribution of students in classes is as follows:

In class X (14-15 year olds) there are 310 students, representing 19,5% of the total; in class XI (15-16 year olds) there are 372 students, representing 23,4% of the total. The majority of students are in grade XII (16-17 years old), i.e. 908 students, or 57,1% of the total. None belong to year XIII (18-19 years old) or any other year. The majority of students are therefore between 16 and 17 years old. The table shows some summary data:

Table 1: characteristics of the sample

Teacher characteristics		
Gender	Female	70,2%
	Bad	29,4%
	Prefers not to say	0,4%
Teaching experience	0-9 years of teaching experience	26,2%
	10-19 years of teaching experience	24%
	20 and more years of teaching experience	49,8%
	Math	31,6

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	Experimental Science	11%
Subject	Foreign language	35,6%
	Computer Science	13,4%
	Other	8,4%
School characteristics		
Type of schools	Academic	56,4%
	Vocational	36,7%
	Other	6,9%
	Lower-secondary	0%
Classes characteristics		
Student year	Year 10	19,5%
	Year 11	23,4%
	Year 12	57,1%

- Qualitative sample

  As far as the qualitative sample is concerned, seven institutions participated in the qualitative phase, 3 of the 10 contacted have not yet indicated their availability. The schools are distributed in the center, north and south of the country and by type of school (3 Lyceums, 1 Omnicomprensivo and 3 Professionals). In total, there are 4 male and 3 female head teachers; 3 of them have a long experience in management and one is newly appointed. The teachers responded in groups of three or four per school: a total of 28 teachers were interviewed, 5 IT teachers, 10 English teachers, 3 science teachers, 10 others. They are 6 male and 22 female. Most of them already have good experience of new technologies, and some even have experience of using artificial intelligence in the classroom.

3.2 Data processing

Data cleaning

As the administration method allowed for multiple responses from a single participant, the first step in the data cleaning process was to remove duplicates, identifiable by the rating numbers entered by participants. If a single participant responded more than once, we kept the most complete response, and if several responses had the same level of completion, we kept the first one. Incomplete responses

were kept if the participant had completed at least the first module of results. The report of the data cleaning process can be found in the appendix (Table 15).

Correspondence was checked between the student's country code and the country entered by the student. A few students entered a country that did not match their evaluation number. In this case the country was changed by the evaluator. In the questionnaires for teachers and school leaders there was no inconsistency between these two variables.

Psychometrics properties of the scales

Before the scales were scored, their psychometric properties were tested. Cronbach's alpha was calculated for all scales as a measure of internal consistency. For each item, we calculated the item-total correlation and the alpha if the item was dropped. Items were dropped from the scale if their correlation with the total was significantly lower than the other items and if their removal improved the alpha. A factor analysis was then carried out for each scale. We used Cattell's scree test to determine the number of factors. Additional items were eliminated when we found cross-loadings on multiple factors.

A summary of the psychometric properties of the scale can be found in the Appendix (Table 16) for teachers and in the Appendix (Table 17) for students.

To calculate the scores, the Likert scales were converted into numbers. The scores for each item were summed and divided by the number of items. Standardization was carried out at country level based on the mean and standard deviation of the control group in the baseline.

Balancing checks & attrition

Before conducting the impact analysis, we checked that randomization had produced two comparable groups in each country. To do this, we ran a student's t-test on teacher characteristics and on the main outcomes measured at baseline. Finding significant differences between the two groups is likely in small samples like this. They do not invalidate the randomization process, but they do reinforce the importance of including control variables in the regression analyses.

The comparability of the two groups also depends on attrition throughout the experiment. A difference in response rates between the two groups could lead to both observable and unobservable differences. Table 2 shows the response rate in each group.

Table 2: response rate for each type of participant

	Control group	Intervention group
Teachers response rate ***(answered both questionnaires)***	60,74%	65,61%
School leaders response rate	32,60%	88,88%

Class response rate	23,54%	31,78%

Compliance

The endline questionnaire asked teachers whether they had access to the AI4T intervention. The results show that the randomization was well respected: teachers who said they had access to the learning resources even though they were in the control group 5.1%, teachers who said they did not have access to the learning resources even though they were in the intervention group 0.7%.

Treatment of qualitative data: Interviews - Thematic/coding process

Data was collected through interviews with school leaders and focus groups with teachers. The result is the corpus of audio transcripts, which were made available to the researchers as a key resource for analysis. A total of 28 teachers participated in the focus groups with an average of 4 participants.

The detailed analysis of the transcripts was the starting point for the coding process. Each dialogue was carefully examined and each significant segment of text was given a label or 'code'. The coding process was carried out using the free software *Taguette* to ensure accuracy and systematicity in the assignment of codes.

From the initial coding analysis, the identified codes underwent a thorough process of revision and adaptation to accurately reflect the themes and sub-themes explored during the interviews and focus groups. The resulting classification covered both focus groups and interviews with managers and provided a clear and systematic view of the themes that emerged in the context of the qualitative analysis. Once the review of themes and tags was complete, a further review and classification of the significant text segments identified in the previous phase was undertaken.

Open-ended questions were also treated as qualitative data. Common analysis grids were defined in consultation with the other evaluation teams.

The grid codes and results can be found in the Appendix (Table 20).

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4. Teacher results

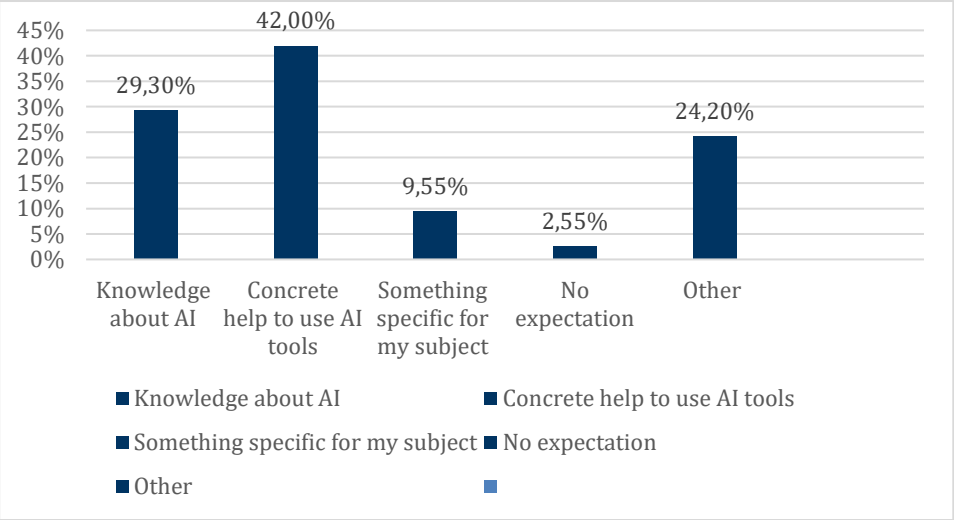
4.1 Teacher's reaction to the training

Expectations

When teachers were asked about their expectations from the training course experience, 42% of them said they wanted concrete help in using AI tools and 29,30% wanted to increase their knowledge of AI. More specifically, the expectations were related to the need to learn how to use AI tools (20,4%), but mainly to get help in using such tools in the classroom (32,5%).

Few participants reported barriers to their participation in the professional AI community.

Figure 4: ***Teachers' expectations toward the professional learning pathway***



Completion and engagement

A very high percentage of teachers participated in the MOOCs (91.1%) and webinars (89,2%), while the percentage of teachers who consulted the texbook (61,8%) was lower, but still positive. There were no comments about the textbook in the interviews, and the data collected from only three respondents to the open questions is insignificant. In terms of their involvement in the training course, the data that seems to stand out the most is the emotional involvement with an average agreement of 5.76, which is overall higher than the cognitive involvement (engagement in learning during the training) with an average of 5.42 and the behavioral involvement (taking notes, reflecting on what has been learnt) with an average of 5.11 ('generally agree'). Social involvement' (sharing and interacting in the course) remains the area of greatest indecision with an average of 4.07 (neither agree nor disagree). From the interviews it emerges as a critical issue that the course was run at the wrong time, as it was the end of the school year and teachers found it difficult for other activities in the school.

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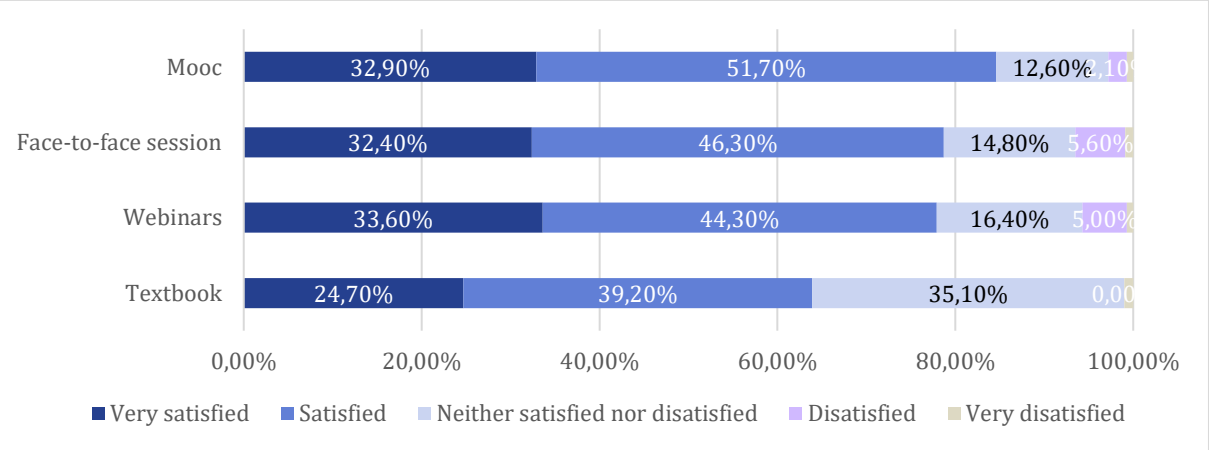
"The time frame was short, maybe spread over a longer period, we would have had more time, maybe to metabolize many things as well, to study them. Everything was very fast."

"So, the format [of the course] was fine, because there is interaction anyway, let's say, it's a light format that you can manage simultaneously with the other workloads we have."

Satisfaction

Satisfaction with the perceived usefulness of the course is on average 5.10 (on a scale of 1 to 7). In particular, teachers are 'satisfied' or 'very satisfied' with the professional development provided by MOOCs (84,6%) and face-to-face sessions (78,7%). Satisfaction with webinars is also high (77,9%), while it is lower for the textbook (63,9%). Several positive aspects emerged from the open-ended responses, which can be attributed to the professionalism of the trainers, the ease of use and the clarity of the experts' presentation.

Figure 5: Teachers' satisfaction with the professional learning pathway



This was also evident from the interviews:

Teacher - interview excerpt: "I also appreciated the opportunity to collaborate with colleagues at national level, a dialogue that was engaging and productive. I was included in a group with colleagues from other regions, and this dialogue is definitely something that needs to be continued and carried on.

Teacher - interview excerpt: "The international meetings were a very interesting aspect, giving us the opportunity to get to know the opinions of our colleagues on a common project. This confrontation contributed greatly to our cultural, personal and professional growth".

On the critical side, teachers highlighted the lack of practical, concrete examples to take back to the classroom with the students and that the course should be extended to other disciplines.

Teacher - interview excerpt: "As a first course it was very good and we would now need a practical application, i.e. a course that guides us in actual experimentation in doing something in the classroom."

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Teacher - interview excerpt: "Now it should be sectoralised, considering this first course as a general smattering module, a basic module should then be sectoralised and reviewed on the rest of the class council. Now it has been dedicated (only) to STEM subjects and language subjects".

Almost all (91.4%) of the teachers stated that the experience changed their perception of AI in education, 96.7% stated that the experience improved their knowledge of AI in education. Teachers (86.2%) indicated that the experience prompted them to use AI more frequently in their work as teachers.

The interviews revealed that the MOOCs (Massive Open Online Course) and the face-to-face sessions (practical online meetings) attracted particular interest because of the possibility to interact with colleagues and engage with experts, discovering new aspects and reflecting on the potential and limitations of AI.
Teacher - interview excerpt: "Participating in discussions with other professionals during the course was extremely stimulating. The exchange of ideas broadened my perspective, offering different angles on how to integrate AI in teaching".

Teacher - interview excerpt: 'there were also international conferences where we participated, where we talked in general terms, about what were the risks, the dangers of limits of obstacles, the world of artificial intelligence was really a great discovery for me'

The appreciation is also verified by 74,3% of the teachers who recommend the course materials to other colleagues and by the fact that most of the participants state that they would like to continue their education in the field of Artificial Intelligence. 95,3% of the teachers are motivated to further develop their knowledge and skills on this topic. This high rate of intention suggests a strong commitment to continuous learning and deepening of skills related to artificial intelligence. Teachers (83,3%) also stated their intention to continue exchanging information with participants in projects on AI in education, indicating a willingness to maintain a link and dialogue with the community of teachers interested in AI, fostering the exchange of experiences and ongoing collaboration.

Most of the teachers appreciated the course especially the webinar part and the interactive sessions that provided to reflect on the potential of using artificial intelligence with students in the classroom. Their expectations were mainly met by the MOOCs, although there was a lack of a more practical part that could provide concrete examples that could be used in the classroom. Most of the teachers stated that they were interested in learning more about artificial intelligence and developing skills in this area, both technical and educational

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Initial knowledge

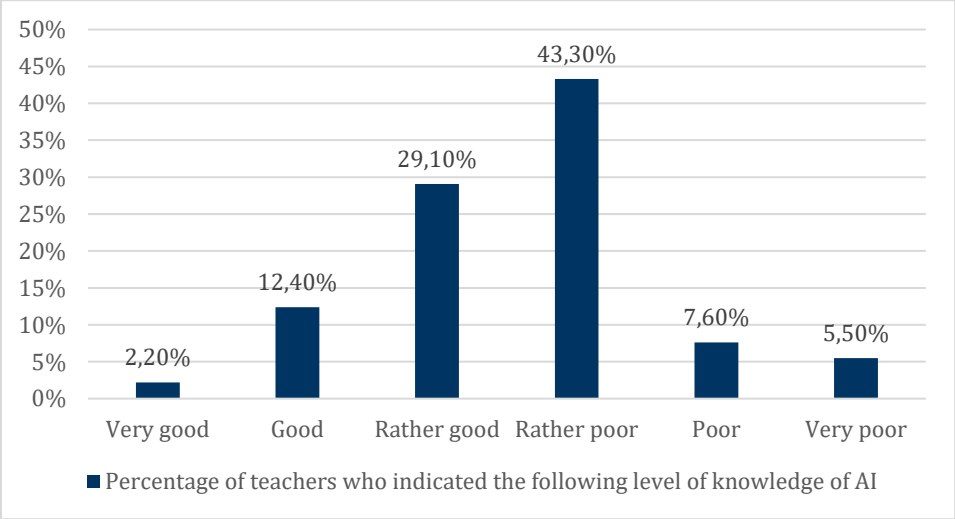
A good part of teachers assessed their knowledge prior to the training as "rather poor" (43,3%), as also reflected in the interviews conducted with teachers:

Teacher - interview excerpt: "I was not that aware. I had heard about GPT chat a bit by chance, conversing with friends, but not particularly before the course. Even on image creation, I had absolutely no idea how powerful this software could be".

Teacher - interview excerpt: 'So, I thought, I tell the truth and I say this without false modesty, that I was one of the few keepers of clarity, of ideas about artificial intelligence, instead I realised that there is a great variety of tools unknown to me, a great variety of applications.

Teacher - interview excerpt: 'I learnt that I know very little about this. But there is really a curiosity to go deeper into the tools, I mean I am starting to approach it but I realise, that it is not such a trivial thing though".

Figure 6: Teacher's initial level of knowledge of AI



In the first questionnaire, the level of familiarity with AI was low, with an average of 2.1 (scale 1 to 5), but a fairly high average of 4.5 claimed to know how AI software works (scale 1 to 6). Most teachers (82.9%) believe that AI tries to imitate human cognitive functions, about half of them (50,91) claim to be able to give an example of artificial intelligence, although in the open-ended questions the software mentioned by the teachers are not all associated with AI, e.g: Geogebra. Many teachers (78,5%) believe that a single AI product can perform many different tasks in a wide range of areas, demonstrating a good understanding of the versatility of artificial intelligence. The vast majority (93,8%) state that AI can be trained using data sets, but a significant percentage (42,9%) believe that AI can be racially or sexually biased, indicating concern about the potential ethical implications of AI. Below are some quotes from the results:

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Teacher - interview excerpt: 'The accuracy of machine learning models is a key concern. If models are not well adapted to the specific educational context, they may lead to incorrect assessments or distorted teaching. Therefore, ensuring the accuracy and adaptability of models is critical to the success of any AI implementation in schools.

Teacher - interview excerpt: 'artificial intelligence works with big data, handling huge amounts of information. As illustrated, this processing can lead to specific results, such as percentages or numbers, especially when involving neural networks'.

Impact

The AI4T professional learning pathway had a significant impact on several indicators used to measure teachers' learning. The effect was particularly strong on their familiarity with AI technologies: +91% of a standard deviation. We also measured a strong effect on teachers' confidence in recognising AI in AI tools: +79% of a standard deviation, and on their self-assessment of their knowledge of AI: +54% of a standard deviation; knowledge of how AI works: +54% of a standard deviation; only the identification of AI in tools is not significant.

The model also highlights the significant role of gender, teaching experience, self-efficacy in technology integration and specific interventions on different aspects of AI knowledge.

Table 3

	Self-assessment of knowledge of AI	Knowledge of how AI works	Familiarity with AI technologies	Identification of AI in tools that are mainly based on AI	Identification of AI in tools that are not mainly based on AI
Randomization	*-0.052*	0.145	-0.024	-0.069	0.013
	(0.101)	(0.113)	(0.114)	(0.120)	(0.124)
Time	*-0.015*	0.141	0.154	0.349***	0.120
	(0.101)	(0.112)	(0.113)	(0.119)	(0.123)
Gender (1=male)	*0.037*	0.392***	0.074	0.084	-0.295***
	(0.085)	(0.094)	(0.095)	(0.100)	(0.103)
Years of teaching experience	*-0.012****	-0.015***	-0.016***	-0.015***	0.007
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)

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Subject = language	*-0.117*	-0.022	-0.273***	0.011	0.349***
	(0.093)	(0.104)	(0.104)	(0.110)	(0.114)
Subject = mathematics	*0.068*	-0.107	0.012	0.086	0.014
	(0.094)	(0.105)	(0.106)	(0.112)	(0.115)
Type of school = Other type of school	*-0.158*	0.091	-0.213	-0.057	-0.107
	(0.148)	(0.165)	(0.166)	(0.175)	(0.180)
Type of school = vocational	*-0.091*	0.037	-0.093	0.028	0.020
	(0.080)	(0.090)	(0.090)	(0.095)	(0.098)
Self-efficacy for integrating technology into the classroom	*0.408****	0.039	0.323***	0.085*	-0.068
	(0.038)	(0.043)	(0.043)	(0.045)	(0.047)
Intervention	*0.540****	0.380**	0.918***	0.791***	0.269
	(0.139)	(0.155)	(0.155)	(0.164)	(0.169)
Constant	*-1.913****	0.005	-1.296***	-0.226	0.154
	(0.253)	(0.282)	(0.283)	(0.300)	(0.309)
Observations	*550*	550	550	550	550
R2	*0.279*	0.162	0.327	0.220	0.102
Adjusted R2	*0.266*	0.146	0.314	0.206	0.086

Training on AI had a strongly positive impact on all variables, the time factor was significant for the identification of tools that are mainly based on AI and for males with respect to knowledge of AI. Self-efficacy for integration of technology in the classroom is positively associated with the variables on self-evaluation and familiarity with the use of AI technologies. The teachers are aware of the ethical implications and demonstrate, albeit moderately, concern about the possible ethical implications of artificial intelligence.

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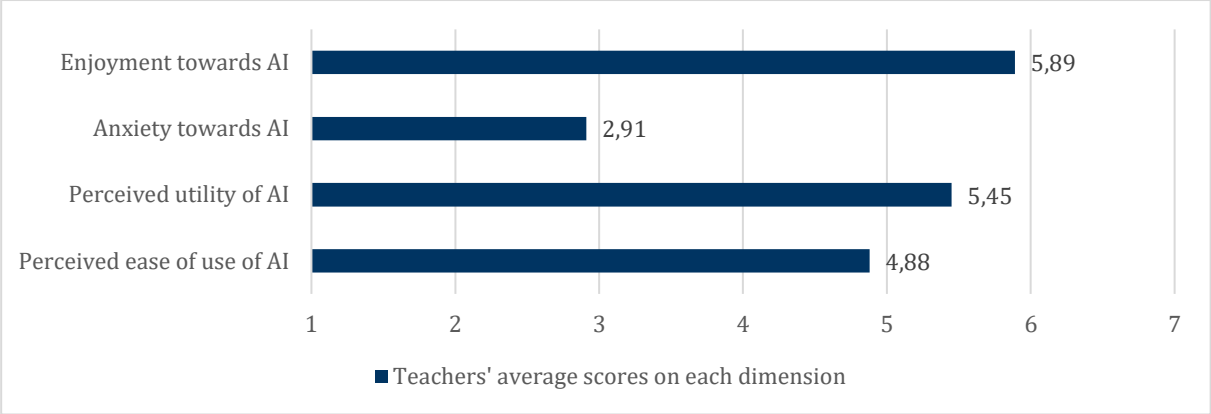
4.3 Teachers' perceptions

Initial perceptions of AI

Prior to training, there is a fairly high average (4.8) for teachers' perceptions of the ease of use of AI tools. As for the emotions felt towards AI, most of them are attracted (61,04%) and 41,9% of the teachers associate AI with emotions of pleasure. There is also a high average for enjoyment (5.8) and most of them said that using AI tools is stimulating (94,5%), followed by "I would like to use AI tools (93,4%)". On the other hand, a minority of them were afraid, with an average score of 2.9, there is also a certain fear of using them, mainly due to the fear of making mistakes (25,1%) and of making mistakes in class with students (27,3%). As far as the usefulness of AI in their work as teachers is concerned, they see it mainly in the support of administrative tasks (90,2%), in the possibility of creating teaching content (90,5%) and in monitoring students' activities (84,0%).

Figure 7: Teachers' initial perceptions of AI



These aspects also emerge from interviews with teachers:

Teacher - interview excerpt: "The fear, in quotes, that I have is that it may create not only benefits, but also harms in the preparation of the student".

Teacher - interview excerpt: "Artificial intelligences serve to correct our mistakes as teachers. For example, a historical analysis of my assignments, the questions I ask, and the errors can make me realize if there are recurring errors on the same topic. Perhaps I expose that topic incorrectly or treat it poorly. I realize that this is a strong thing because for some of us it is very difficult to get off the desk."

Teacher - interview excerpt: "Currently, I use automatic correction tools to assess students' performance in assignments, trying to save time in manual correction. The main goal is to improve the efficiency of assessment, allowing me to focus more on direct interaction with students."

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Impact

We observed significant effect of the intervention on teachers' perceptions of AI, +44% of a standard deviation. There is no significant effect of the intervention on teachers' emotions associated with use of AI.

The model also highlights how high self-efficacy in technology integration has a very positive impact on perceived ease of using AI, associated enjoyment, and perceived usefulness of AI for education, but reduces anxiety associated with using and learning AI.

Table 4

	Perceived ease of use of AI	Anxiety associated with use of AI and learning about AI	Enjoyment associated with use of AI and learning about AI	Perceived usefulness of AI for education
Randomization	-0.048	-0.054	-0.054	0.016
	(0.107)	(0.110)	(0.124)	(0.119)
Time	-0.082	0.071	-0.314**	-0.184
	(0.107)	(0.109)	(0.123)	(0.118)
Gender (1=male)	-0.174*	-0.301***	-0.114	-0.265***
	(0.090)	(0.092)	(0.104)	(0.099)
Years of teaching experience	-0.015***	0.0004	-0.011**	-0.006
	(0.004)	(0.004)	(0.004)	(0.004)
Subject = language	-0.225**	0.093	-0.382***	0.041
	(0.098)	(0.101)	(0.114)	(0.109)
Subject = mathematics	0.070	-0.241**	-0.211*	-0.013
	(0.100)	(0.103)	(0.115)	(0.111)
Type of school = Other type of school	-0.297*	-0.022	-0.184	-0.091
	(0.157)	(0.161)	(0.181)	(0.173)

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Type of school = vocational	-0.015	-0.038	-0.107	-0.037
	(0.085)	(0.087)	(0.098)	(0.094)
Self-efficacy for integrating technology into the classroom	0.534***	-0.287***	0.425***	0.283***
	(0.040)	(0.041)	(0.047)	(0.045)
Intervention	0.440***	-0.102	0.183	0.156
	(0.147)	(0.151)	(0.170)	(0.163)
Constant	-2.436***	1.660***	-1.782***	-1.332***
	(0.268)	(0.275)	(0.309)	(0.296)
Observations	550	550	550	550
R2	0.329	0.164	0.213	0.089
Adjusted R2	0.316	0.148	0.199	0.072

The same thing also emerges from the interviews reveal a significantly positive influence on the perceived simplicity of utilizing AI, the enjoyment linked to it, and the perceived usefulness of AI in education. Simultaneously, it alleviates anxiety related to the utilization and learning of AI:

Teacher - interview excerpt: "I have noticed that there is a kind of fear in the end of wanting to exploit artificial intelligence, because it is seen as something potentially harmful. This is not the case,"

Teacher - interview excerpt: "artificial intelligence can be of great support to us, especially with regard to two aspects often neglected in English teaching: listening and speaking."

Training regarding ease of use of AI has had a positive impact . The strong self-efficacy of teachers, is significantly associated with all the variables related to ease of use, enjoyment and usefulness, except that anxiety. AI tolls can support in carrying out administrative tasks and in the possibility of creating content teaching and monitoring student activities.

4.4 Teacher's intention to use AI & use of AI

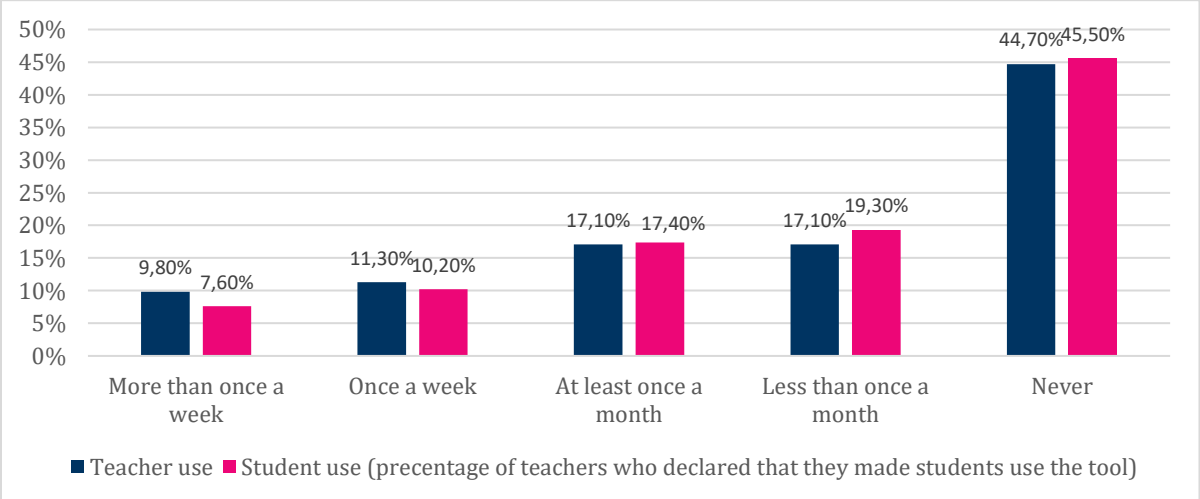
Initial use & intention

At the start of the experiment, 44,7% said they had never used 'AI tools designed for teaching' and 34.5% said they had never used 'generic AI tools for teaching' during the year. However, it should be noted that a significant percentage of teachers use these tools less than once a month: 17,1% for 'AI tools designed for teaching' and 20,7% for 'generic AI tools for teaching'.

This trend is also reflected in teachers' requests to their students to use such tools in the classroom: 45.5% of teachers never ask their students to use 'AI tools designed for education', while 34.2% never ask them to use 'generic AI tools for teaching'. In contrast, 19,3% of teachers ask students to use 'AI tools designed for education' at least once a month, while the same 19,3% ask students to use 'generic AI tools for teaching' with the same frequency. The data suggests that teachers are confident in their use of AI-related technologies and tools.

Teachers were asked to indicate whether they had used specific AI tools for mathematics and English during the school year. Mathematics teachers reported that the software most used by teachers (19,3%) and students (25%) was Fotomatica. English teachers used automatic translators such as deepl, linguee, google Translate, etc. (teachers 59,6% and students 52,1%), Duolingo (teachers 11.7% and students 17,0%) and 24.5% of teachers used intelligent personal assistants (Alexa, Siri, Cortana, etc.). In addition, 65% of them used these tools to create and share presentations (lessons, exercises, assignments, etc.). In the next five years, 95,3% of teachers intend to use artificial intelligence tools and 97.1% intend to use artificial intelligence tools in the classroom. Regarding the ethical implications of AI, the average score of 5.44 (on a scale of 1 to 7) is quite high, with 78,9% of teachers "generally agree", "agree", "strongly agree" that they have a good understanding of the ethical issues involved in the use of AI tools and that they respect their ethical principles (79,9%).

Figure 8: Teacher's declarations on whether they used or asked their students to use educational AI tools this year



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Impact

The AI4T professional learning pathway had a significant impact on several indicators used to measure use of AI. The effect was stronger on the use of AI in the classroom: **+41% of a standard deviation.** We also measured an effect on teachers' ethical consciousness, **+31% of a standard deviation**, an on intention to use AI, + 27 of a standard deviation.

The model shows how variables such as time, gender, teaching experience, subject taught, self-efficacy in using technology, and training interventions can influence teachers' use of AI. Self-efficacy in technology integration and training interventions appear to be key factors in increasing the use and awareness of AI.

Table 5

	Use of AI	Frequent use of AI	Ethical consciousness when using AI	Intention to use AI
Randomization	0.037	0.100	-0.113	0.075
	(0.106)	(0.131)	(0.136)	(0.118)
Time	0.233**	0.082	0.047	-0.084
	(0.105)	(0.130)	(0.131)	(0.117)
Gender (1=male)	-0.132	-0.122	-0.120	0.059
	(0.088)	(0.109)	(0.109)	(0.098)
Years of teaching experience	-0.010***	-0.006	0.001	-0.007*
	(0.004)	(0.005)	(0.005)	(0.004)
Subject = language	0.242**	0.382***	0.163	-0.134
	(0.097)	(0.120)	(0.116)	(0.108)
Subject = mathematics	-0.184*	-0.216*	0.108	-0.293***
	(0.098)	(0.122)	(0.122)	(0.110)
Type of school = Other type of school	0.008	0.060	-0.235	-0.194
	(0.154)	(0.191)	(0.187)	(0.172)

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Type of school = vocational	-0.025	-0.060	0.019	-0.098
	(0.084)	(0.104)	(0.101)	(0.093)
Self-efficacy for integrating technology into the classroom	0.127***	0.143***	0.271***	0.276***
	(0.040)	(0.049)	(0.049)	(0.044)
Intervention	0.417***	0.280	0.314*	0.269*
	(0.145)	(0.179)	(0.177)	(0.161)
Constant	-0.480*	-0.686**	-1.560***	-1.186***
	(0.264)	(0.326)	(0.322)	(0.294)
Observations	550	550	450	550
R2	0.161	0.097	0.087	0.134
Adjusted R2	0.146	0.081	0.066	0.118

As indicated, the AI4T professional learning path has had a significant impact on several indicators used to measure the use of AI. From the testimonies, a greater propensity to use AI in the classroom emerges, also underlined by positive reactions from the students. In general, it seems that the course has opened the doors to AI-supported teaching:

Teacher - interview excerpt: "However, I definitely see the future of the school as a combination of these tools (technology and AI) and aspects of the traditional classroom. A balance has to be found, managing to agree on everything".

Teacher - interview excerpt: "It will be a pleasure to implement what I have learnt in my lessons and to involve the children in this exciting journey."

Teacher - interview excerpt: "I have the intention of proposing something to the three-year old, focusing on textual analysis to make literature more interesting for the students."

The intervention had an impact on the of AI. The time of administration was found to be a significant factor for the use of AI even after training. English language teachers in general use and frequently use AI tools (especially automatic translators and support for written and spoken learning), mathematics teachers would be willing to use them. The self-efficacy factor is positively related to all variables on the use of AI

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Engagement in the MOOC

The Intervention Engagement had a significant impact on several indicators used to measure knowledge of AI, both for teachers with lower and higher level of engagement in the MOOC. The effect was particularly strong on their familiarity with AI **technologies: +88% of teachers with higher level of engagement in the MOOC and +94% of teachers with lower level of engagement in the MOOC**. We also measured a strong effect on teachers' confidence in the identification of AI in tools: **+76% of teachers with higher level of engagement in the MOOC and +81% of teachers with lower level of engagement in the MOOC**, and in their self-assessment of knowledge of AI. However, the effects on identification of AI in tools that are not mainly based on AI were non-significant.

Table 6

	Self-assessment of knowledge of AI	Knowledge of how AI works	Familiarity with AI technologies	Identification of AI in tools that are mainly based on AI	Identification of AI in tools that are not mainly based on AI
Treatment	-0.046	0.141	-0.024	-0.074	0.009
	(0.102)	(0.114)	(0.114)	(0.121)	(0.124)
Time	-0.015	0.141	0.154	0.349***	0.120
	(0.101)	(0.113)	(0.113)	(0.119)	(0.123)
Gender (1=male)	0.037	0.397***	0.075	0.095	-0.284***
	(0.085)	(0.095)	(0.095)	(0.101)	(0.104)
Years of teaching experience	-0.011***	-0.015***	-0.016***	-0.015***	0.006
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Subject = language	-0.125	-0.023	-0.276***	0.004	0.349***
	(0.093)	(0.104)	(0.105)	(0.111)	(0.114)
Subject = mathematics	0.072	-0.118	0.010	0.064	-0.009
	(0.095)	(0.106)	(0.107)	(0.113)	(0.116)
Type of school = other type of school	-0.154	0.088	-0.212	-0.062	-0.114
	(0.148)	(0.165)	(0.166)	(0.175)	(0.180)
Type of school = vocational	-0.090	0.029	-0.095	0.011	0.004
	(0.081)	(0.091)	(0.091)	(0.096)	(0.099)
	0.409***	0.036	0.322***	0.078*	-0.076

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Self-efficacy for integrating technology into the classroom	(0.038)	(0.043)	(0.043)	(0.046)	(0.047)
Intervention for teachers with higher level of engagement in the MOOC	0.450***	0.394**	0.887***	0.762***	0.308
	(0.155)	(0.173)	(0.174)	(0.184)	(0.189)
Intervention for teachers with lower level of engagement in the MOOC	0.624***	0.367**	0.948***	0.818***	0.211
	(0.155)	(0.173)	(0.174)	(0.184)	(0.189)
Constant	-1.931***	0.041	-1.292***	-0.161	0.229
	(0.256)	(0.286)	(0.287)	(0.303)	(0.312)
Observations	548	548	548	548	548
R2	0.282	0.163	0.326	0.220	0.102
Adjusted R2	0.267	0.145	0.312	0.204	0.084

Regarding the heterogeneity of the effects, it is interesting to see how the interviews show a greater awareness of the presence of AI even in apps and software that are routinely used:

Teacher - interview excerpt: 'We already have practical examples, such as Siri and Google's voice assistants, which we commonly use, for example, to make car calls. Voice recognition and other artificial intelligence features are now within everyone's reach, and the common man knows how to use them without being alarmed."

Teacher - interview excerpt: "And then we are now using it everywhere, in all our daily activities. Artificial intelligence is involved in millions of things, just look, even on Facebook, at all the advertisements that are personalized according to our interests. Almost all of them are run by artificial intelligence. We are submerged, immersed in something bigger than ourselves."

We observed significant effect of the intervention engagement on teachers' perceptions of AI: +**46% of teachers with higher level of engagement in the MOOC and +40% of a teachers with lower level of engagement in the MOOC.** There is **no significant effect of the intervention on teachers' emotions associated with use of AI:** Anxiety towards learning about and using AI has decreased, while enjoyment has increased.

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Table 7

	Perceived ease of use of AI	Anxiety associated with use of AI and learning about AI	Enjoyment associated with use of AI and learning about AI	Perceived usefulness of AI for education
Treatment	-0.046	-0.048	-0.060	0.007
	(0.108)	(0.111)	(0.124)	(0.119)
Time	-0.082	0.071	-0.314**	-0.184
	(0.107)	(0.110)	(0.123)	(0.118)
Gender (1=male)	-0.175*	-0.310***	-0.099	-0.261***
	(0.090)	(0.092)	(0.104)	(0.100)
Years of teaching experience	-0.015***	0.001	-0.011**	-0.007*
	(0.004)	(0.004)	(0.004)	(0.004)
Subject = language	-0.223**	0.099	-0.399***	0.047
	(0.099)	(0.101)	(0.114)	(0.109)
Subject = mathematics	0.070	-0.223**	-0.241**	-0.023
	(0.101)	(0.104)	(0.116)	(0.112)
Type of school = other type of school	-0.298*	-0.018	-0.188	-0.096
	(0.157)	(0.161)	(0.181)	(0.173)
Type of school = vocational	-0.014	-0.024	-0.131	-0.042
	(0.086)	(0.088)	(0.099)	(0.095)
Self-efficacy for integrating technology into the classroom	0.534***	-0.280***	0.414***	0.280***
	(0.041)	(0.042)	(0.047)	(0.045)
Intervention for teachers with higher level of engagement in the MOOC	0.463***	-0.075	0.071	0.245
	(0.164)	(0.168)	(0.189)	(0.182)
Intervention for teachers with lower level of engagement in the MOOC	0.406**	-0.133	0.297	0.078
	(0.164)	(0.168)	(0.189)	(0.182)

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Constant	-2.437***	1.605***	-1.699***	-1.293***
	(0.272)	(0.278)	(0.313)	(0.300)
Observations	548	548	548	548
R2	0.328	0.161	0.215	0.090
Adjusted R2	0.314	0.144	0.199	0.071

These elements also emerge from the interviews conducted with teachers who appear favorable and even enthusiastic in some cases in using AI in the classroom.

Teacher - interview excerpt: "Maybe I am a little too enthusiastic, I would like to be a little less enthusiastic, but I definitely am."

Teacher - interview excerpt: "in personal and scholastic terms, I have experienced a considerable advantage using artificial intelligence".

The AI4T Intervention Engagement had a significant impact on use of AI on teachers with **higher level of engagement in** the MOOC, of +45% of a standard deviation and +35% for a teachers with lower level of engagement in the MOOC**.** For **teachers** with **higher level of engagement** there are **no significant effect of the intervention engagement on** teachers' Ethical consciousness and on intention to use AI; teachers with lower level of engagement in the MOOC there are **no significant effect of the intervention engagement on frequent use of AI.**

Table 8

	Use of AI	Frequent use of AI	Ethical consciousness when using AI	Intention to use AI
Treatment	0.044	0.102	-0.112	0.073
	(0.106)	(0.131)	(0.137)	(0.118)
Time	0.233**	0.082	0.047	-0.084
	(0.105)	(0.130)	(0.131)	(0.117)

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Gender (1=male)	-0.138	-0.132	-0.119	0.071
	(0.089)	(0.110)	(0.109)	(0.099)
Years of teaching experience	-0.010***	-0.006	0.001	-0.007*
	(0.004)	(0.005)	(0.005)	(0.004)
Subject = language	0.249**	0.393***	0.161	-0.148
	(0.097)	(0.120)	(0.117)	(0.108)
Subject = mathematics	-0.173*	-0.196	0.109	-0.316***
	(0.099)	(0.123)	(0.123)	(0.111)
Type of school = other type of school	0.009	0.062	-0.235	-0.197
	(0.154)	(0.191)	(0.187)	(0.172)
Type of school = vocational	-0.016	-0.044	0.019	-0.117
	(0.085)	(0.105)	(0.102)	(0.094)
Self-efficacy for integrating technology into the classroom	0.131***	0.150***	0.272***	0.268***
	(0.040)	(0.050)	(0.049)	(0.045)
Intervention for teachers with higher level of engagement in the MOOC	0.458***	0.359*	0.294	0.166
	(0.162)	(0.200)	(0.194)	(0.180)

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Intervention for teachers with lower level of engagement in the MOOC	0.353**	0.206	0.337*	0.366**
	(0.162)	(0.200)	(0.195)	(0.180)
Constant	-0.511*	-0.740**	-1.564***	-1.123***
	(0.267)	(0.330)	(0.325)	(0.297)
Observations	548	548	449	548
R2	0.160	0.098	0.086	0.137
Adjusted R2	0.143	0.080	0.063	0.119

From the interviews it emerges that those who attended the course appreciated the practical examples for using AI in the classroom:

Teacher - interview excerpt: "It has equipped me with practical skills that I can apply directly in my teaching and opened up new possibilities for involving students in projects and activities related to artificial intelligence. Its usefulness is reflected concretely in my lessons."

Teacher - interview excerpt: "within my discipline it has, as it were, fostered a more precise reflection on how to use just practically certain APPs in the study of the English language, in then introducing them to the children."

Subject

The Intervention had a significant impact on several indicators used to measure knowledge of AI, for both language and mathematics teachers. The effect was particularly strong on their familiarity with AI **technologies: +107% of** a standard deviation for language teacher and + 86% mathematics teachers.

Table 9

	Self-assessment of knowledge of AI	*Knowledge of how AI works*	*Familiarity with AI technologies*	*Identification of AI in tools that are mainly based on AI*	*Identification of AI in tools that are not mainly based on AI*
Randomization	*-0.053*	*0.132*	*-0.034*	*-0.084*	*-0.010*
	(0.102)	*(0.113)*	*(0.114)*	*(0.120)*	*(0.124)*
Time	*-0.015*	*0.141*	*0.154*	*0.349****	*0.120*
	(0.101)	*(0.112)*	*(0.113)*	*(0.119)*	*(0.123)*
Gender (1=male)	*0.040*	*0.396****	*0.074*	*0.083*	*-0.290****
	(0.085)	*(0.094)*	*(0.095)*	*(0.100)*	*(0.103)*
Years of teaching experience	*-0.012****	*-0.015****	*-0.016****	*-0.015****	*0.006*
	(0.004)	*(0.004)*	*(0.004)*	*(0.004)*	*(0.004)*
Subject = language	*-0.125*	*-0.102*	*-0.331****	*-0.082*	*0.208*
	(0.105)	*(0.117)*	*(0.118)*	*(0.124)*	*(0.128)*
Subject = mathematics	*0.028*	*-0.187*	*0.001*	*0.085*	*-0.074*
	(0.109)	*(0.121)*	*(0.122)*	*(0.129)*	*(0.133)*
Type of school = other type of school	*-0.160*	*0.096*	*-0.205*	*-0.043*	*-0.092*
	(0.148)	*(0.165)*	*(0.166)*	*(0.175)*	*(0.180)*
Type of school = vocational	*-0.092*	*0.040*	*-0.088*	*0.036*	*0.028*
	(0.081)	*(0.090)*	*(0.090)*	*(0.095)*	*(0.098)*
Self-efficacy for integrating technology into the classroom	*0.409****	*0.040*	*0.323****	*0.085**	*-0.068*
	(0.038)	*(0.043)*	*(0.043)*	*(0.045)*	*(0.046)*

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Intervention for teachers of other subjects	*0.493****	*0.212*	*0.840****	*0.682****	*0.020*
	(0.169)	*(0.188)*	*(0.189)*	*(0.199)*	*(0.205)*
Intervention for language teachers	*0.511****	*0.507***	*1.072****	*1.055****	*0.562***
	(0.183)	*(0.203)*	*(0.204)*	*(0.216)*	*(0.222)*
Intervention for math teachers	*0.640****	*0.491***	*0.867****	*0.667****	*0.320*
	(0.187)	*(0.208)*	*(0.209)*	*(0.221)*	*(0.227)*
Constant	*-1.899****	*0.067*	*-1.263****	*-0.178*	*0.249*
	(0.255)	*(0.284)*	*(0.286)*	*(0.302)*	*(0.311)*
Observations	*550*	*550*	*550*	*550*	*550*
R2	*0.280*	*0.166*	*0.329*	*0.225*	*0.112*
Adjusted R2	*0.264*	*0.147*	*0.314*	*0.208*	*0.092*

We observed significant effect of the intervention on teachers' perceived ease of use of AI on math teacher **+48% of a standard deviation.** There is **no significant effect of the intervention on teachers' emotions associated with use of AI:** Anxiety towards learning about and using AI has decreased, while enjoyment has increased. We observed no significant effect of the intervention on perceived usefulness of AI for education.

Table 10

	Perceived ease of use of AI	*Anxiety associated with use of AI and learning about AI*	*Enjoyment associated with use of AI and learning about AI*	*Perceived usefulness of AI for education*
Randomization	*-0.042*	*-0.055*	*-0.061*	*0.007*
	(0.108)	*(0.111)*	*(0.125)*	*(0.119)*
Time	*-0.082*	*0.071*	*-0.314***	*-0.184*
	(0.107)	*(0.110)*	*(0.123)*	*(0.118)*

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Gender (1=male)	*-0.173**	*-0.302****	*-0.115*	*-0.258****
	(0.090)	*(0.092)*	*(0.104)*	*(0.099)*
Years of teaching experience	*-0.015****	*0.0004*	*-0.011***	*-0.006*
	(0.004)	*(0.004)*	*(0.004)*	*(0.004)*
Subject = language	*-0.190**	*0.087*	*-0.422****	*-0.015*
	(0.111)	*(0.114)*	*(0.129)*	*(0.123)*
Subject = mathematics	*0.072*	*-0.233***	*-0.210*	*-0.121*
	(0.115)	*(0.118)*	*(0.133)*	*(0.127)*
Type of school = other type of school	*-0.303**	*-0.020*	*-0.178*	*-0.092*
	(0.157)	*(0.161)*	*(0.181)*	*(0.173)*
Type of school = vocational	*-0.018*	*-0.037*	*-0.104*	*-0.038*
	(0.085)	*(0.088)*	*(0.099)*	*(0.094)*
Self-efficacy for integrating technology into the classroom	*0.534****	*-0.287****	*0.425****	*0.284****
	(0.040)	*(0.042)*	*(0.047)*	*(0.045)*
Intervention for teachers of other subjects	*0.485****	*-0.102*	*0.138*	*-0.011*
	(0.179)	*(0.183)*	*(0.206)*	*(0.197)*
Intervention for language teachers	*0.342**	*-0.075*	*0.298*	*0.179*
	(0.193)	*(0.198)*	*(0.223)*	*(0.214)*
Intervention for math teachers	*0.481***	*-0.132*	*0.127*	*0.376**
	(0.198)	*(0.203)*	*(0.229)*	*(0.219)*
Constant	*-2.455****	*1.661****	*-1.762****	*-1.275****
	(0.271)	*(0.278)*	*(0.313)*	*(0.299)*
Observations	*550*	*550*	*550*	*550*
R2	*0.330*	*0.164*	*0.214*	*0.094*
Adjusted R2	*0.315*	*0.145*	*0.197*	*0.074*

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The AI4T Intervention had a significant impact on indicators used to measure use Ai. Between language and math teacher. The Intervention for math teachers had a strong effect on the use of AI in classroom: **+77% of a standard deviation;** The Intervention for language teachers had not a **significant effect**.

Table 11

	Use of AI	*Frequent use of AI*	*Ethical consciousness when using AI*	*Intention to use AI*
Randomization	*0.035*	*0.099*	*-0.118*	*0.065*
	(0.106)	*(0.131)*	*(0.137)*	*(0.118)*
Time	*0.233***	*0.082*	*0.047*	*-0.084*
	(0.105)	*(0.130)*	*(0.131)*	*(0.117)*
Gender (1=male)	*-0.122*	*-0.118*	*-0.122*	*0.062*
	(0.088)	*(0.109)*	*(0.109)*	*(0.099)*
Years of teaching experience	*-0.010****	*-0.006*	*0.0004*	*-0.007**
	(0.004)	*(0.005)*	*(0.005)*	*(0.004)*
Subject = language	*0.233***	*0.379****	*0.145*	*-0.195*
	(0.109)	*(0.136)*	*(0.135)*	*(0.122)*
Subject = mathematics	*-0.320****	*-0.277***	*0.132*	*-0.343****
	(0.113)	*(0.141)*	*(0.147)*	*(0.127)*
Type of school = other type of school	*-0.003*	*0.055*	*-0.232*	*-0.189*
	(0.154)	*(0.191)*	*(0.187)*	*(0.172)*
Type of school = vocational	*-0.032*	*-0.063*	*0.023*	*-0.096*
	(0.084)	*(0.104)*	*(0.102)*	*(0.094)*
Self-efficacy for integrating technology into the classroom	*0.127****	*0.143****	*0.271****	*0.276****
	(0.040)	*(0.049)*	*(0.049)*	*(0.044)*
	0.280	*0.218*	*0.313*	*0.150*

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Intervention for teachers of other subjects	*(0.175)*	*(0.217)*	*(0.210)*	*(0.196)*
Intervention for language teachers	*0.271*	*0.212*	*0.380**	*0.381**
	(0.189)	*(0.235)*	*(0.228)*	*(0.212)*
Intervention for math teachers	*0.775****	*0.443**	*0.246*	*0.322*
	(0.194)	*(0.241)*	*(0.235)*	*(0.217)*
Constant	*-0.441**	*-0.668***	*-1.555****	*-1.142****
	(0.265)	*(0.329)*	*(0.326)*	*(0.297)*
Observations	*550*	*550*	*450*	*550*
R2	*0.173*	*0.099*	*0.087*	*0.136*
Adjusted R2	*0.155*	*0.079*	*0.062*	*0.117*

elf-efficacy teaching with digital technologies.

Teachers' IT skills had a significant effect on several indicators used to measure teachers' learning. For both teachers with high and low self-efficacy for technology integration, the effect was strong for their familiarity with AI technologies: **+89% of a standard deviation for teachers with high self-efficacy and +94% of a standard deviation for teachers with low self-efficacy.** For no teacher there were significant effects on the identification of AI in tools that are not mainly based on AI.

Table 12

	Self-assessment of knowledge of AI	*Knowledge of how AI works*	*Familiarity with AI technologies*	*Identification of AI in tools that are mainly based on AI*	*Identification of AI in tools that are not mainly based on AI*
Randomization	*-0.052*	*0.145*	*-0.024*	*-0.069*	*0.013*
	(0.102)	*(0.113)*	*(0.114)*	*(0.120)*	*(0.124)*
Time	*-0.015*	*0.141*	*0.154*	*0.349****	*0.120*

	(0.101)	*(0.112)*	*(0.113)*	*(0.119)*	*(0.123)*
Gender (1=male)	*0.039*	*0.387****	*0.076*	*0.080*	*-0.296****
	(0.085)	*(0.095)*	*(0.095)*	*(0.101)*	*(0.104)*
Years of teaching experience	*-0.012****	*-0.015****	*-0.016****	*-0.015****	*0.007*
	(0.004)	*(0.004)*	*(0.004)*	*(0.004)*	*(0.004)*
Subject = language	*-0.118*	*-0.020*	*-0.274****	*0.012*	*0.350****
	(0.093)	*(0.104)*	*(0.104)*	*(0.110)*	*(0.114)*
Subject = mathematics	*0.066*	*-0.101*	*0.010*	*0.091*	*0.016*
	(0.095)	*(0.105)*	*(0.106)*	*(0.112)*	*(0.116)*
Type of school = other type of school	*-0.160*	*0.095*	*-0.214*	*-0.053*	*-0.105*
	(0.148)	*(0.165)*	*(0.166)*	*(0.175)*	*(0.181)*
Type of school = vocational	*-0.092*	*0.040*	*-0.094*	*0.031*	*0.021*
	(0.080)	*(0.090)*	*(0.090)*	*(0.095)*	*(0.098)*
Self-efficacy for integrating technology into the classroom	*0.414****	*0.027*	*0.327****	*0.074*	*-0.071*
	(0.041)	*(0.045)*	*(0.045)*	*(0.048)*	*(0.049)*
Intervention for teachers with high self-efficacy integrating technology	*0.516****	*0.440****	*0.897****	*0.846****	*0.285*
	(0.153)	*(0.170)*	*(0.171)*	*(0.181)*	*(0.186)*
Intervention for teachers with low self-efficacy integrating technology	*0.573****	*0.300**	*0.945****	*0.718****	*0.249*
	(0.163)	*(0.181)*	*(0.182)*	*(0.193)*	*(0.199)*
Constant	*-1.940****	*0.071*	*-1.319****	*-0.165*	*0.171*
	(0.262)	*(0.293)*	*(0.294)*	*(0.311)*	*(0.321)*

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Observations	*550*	*550*	*550*	*550*	*550*
R2	*0.279*	*0.163*	*0.327*	*0.221*	*0.103*
Adjusted R2	*0.265*	*0.146*	*0.313*	*0.205*	*0.084*

The teachers' IT skills had a on teachers' perceptions of AI do not have an impact considered statistically significant for the parameters it presents (i.e., more than 5%)**.** There are **not significant effects of the intervention on teachers' emotions associated with use of AI for both teachers.**

Table 13

	Perceived ease of use of AI	*Anxiety associated with use of AI and learning about AI*	*Enjoyment associated with use of AI and learning about AI*	*Perceived usefulness of AI for education*
Randomization	*-0.006*	*0.051*	*0.018*	*-0.265**
	(0.153)	*(0.149)*	*(0.159)*	*(0.153)*
Time	*0.300**	*0.308***	*-0.353***	*-0.364***
	(0.153)	*(0.149)*	*(0.159)*	*(0.153)*
Gender (1=male)	*0.255***	*-0.100*	*-0.066*	*-0.004*
	(0.125)	*(0.121)*	*(0.129)*	*(0.124)*
Years of teaching experience	*-0.025****	*0.013***	*-0.010*	*-0.003*
	(0.006)	*(0.006)*	*(0.007)*	*(0.006)*
Subject = language	*0.419*	*0.379*	*0.376*	*0.312*
	(0.276)	*(0.268)*	*(0.286)*	*(0.275)*
Subject = mathematics	*0.398*	*0.081*	*0.183*	*0.087*
	(0.272)	*(0.265)*	*(0.282)*	*(0.271)*
Type of school = lower-secondary	*-0.118*	*0.041*	*0.130*	*-0.026*
	(0.154)	*(0.150)*	*(0.160)*	*(0.154)*
	-0.001	*-0.082*	*0.300*	*0.132*

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Type of school = other type of school	*(0.192)*	*(0.187)*	*(0.199)*	*(0.192)*
Type of school = vocational	*-0.029*	*0.323**	*0.245*	*-0.081*
	(0.198)	*(0.193)*	*(0.206)*	*(0.198)*
Self-efficacy for integrating technology into the classroom	*0.447****	*-0.348****	*0.352****	*0.322****
	(0.065)	*(0.063)*	*(0.067)*	*(0.065)*
IPS	*-0.002*	*0.007**	*-0.004*	*-0.014****
	(0.004)	*(0.004)*	*(0.004)*	*(0.004)*
Intervention for teachers with high self-efficacy integrating technology	*-0.087*	*-0.131*	*-0.167*	*-0.060*
	(0.240)	*(0.234)*	*(0.249)*	*(0.239)*
Intervention for teachers with low self-efficacy integrating technology	*-0.444**	*-0.256*	*0.006*	*0.464**
	(0.253)	*(0.246)*	*(0.262)*	*(0.253)*
Constant	*-2.212****	*0.728*	*-1.701***	*-0.380*
	(0.685)	*(0.668)*	*(0.711)*	*(0.684)*
Observations	*352*	*352*	*352*	*352*
R2	*0.243*	*0.171*	*0.160*	*0.164*
Adjusted R2	*0.214*	*0.139*	*0.127*	*0.131*

The interviews reveal the teachers' openness towards AI. Their attitude is positive and proactive regarding the hypothesis of using AI more widely with students:

Teacher - interview excerpt: "If students are using Chat GPT, it is a resource available to us. So instead of resisting change, let's try to make the best of it and use the available tools as correctly as possible."

Teacher - interview excerpt: "At the moment, I think I can use tools that allow the creation of images, videos and GPT chat to generate links. It could be useful, for example, to give a scientific topic, collaborate with a literature colleague and use ChatGPT to stimulate reflection or creation, thus motivating the reworking and presentation of the topic"

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Teachers' skills had a significant impact on both teachers with high self-efficacy integrating technology and low self-efficacy integrating technology, for the use of AI: **+39% of a standard deviation for teachers with high self-efficacy and +45% of a standard deviation for teachers with low self-efficacy.** For no teacher there were significant effects on the frequent use of AI, on the intention to use AI and on Ethical consciousness.

Table 14

	Use of AI	Frequent use of AI	Ethical consciousness when using AI	Intention to use AI
Randomization	0.037	0.100	-0.114	0.075
	(0.106)	(0.131)	(0.136)	(0.118)
Time	0.233**	0.082	0.046	-0.084
	(0.105)	(0.130)	(0.131)	(0.117)
Gender (1=male)	-0.130	-0.125	-0.118	0.059
	(0.089)	(0.110)	(0.109)	(0.099)
Years of teaching experience	-0.010***	-0.006	0.001	-0.007*
	(0.004)	(0.005)	(0.005)	(0.004)
Subject = language	0.241**	0.383***	0.162	-0.134
	(0.097)	(0.120)	(0.116)	(0.108)
Subject = mathematics	-0.187*	-0.213*	0.104	-0.293***
	(0.099)	(0.122)	(0.123)	(0.110)
Type of school = other type of school	0.006	0.062	-0.239	-0.194
	(0.154)	(0.191)	(0.187)	(0.172)
Type of school = vocational	-0.027	-0.059	0.017	-0.098
	(0.084)	(0.104)	(0.101)	(0.094)
Self-efficacy for integrating technology into the classroom	0.132***	0.136***	0.279***	0.276***
	(0.042)	(0.052)	(0.052)	(0.047)
Intervention for teachers with high self-efficacy integrating technology	0.390**	0.311	0.287	0.272
	(0.159)	(0.197)	(0.190)	(0.177)
Intervention for teachers with low self-efficacy integrating technology	0.453***	0.238	0.356*	0.265

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	(0.170)	(0.210)	(0.207)	(0.189)
Constant	-0.510*	-0.651*	-1.598***	-1.183***
	(0.274)	(0.339)	(0.336)	(0.305)
Observations	550	550	450	550
R2	0.162	0.098	0.087	0.134
Adjusted R2	0.144	0.079	0.064	0.117

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5. School leaders results

5.1 Infrastructure of the schools

School leaders generally reported a fairly good level of ICT equipment; in 81,9 % of schools, there are fewer than 10 students per ICT device, and 94,4 % of classrooms are equipped with a multimedia projector or smartboard. In most schools (66,7%), almost all teachers have an ICT device to use in the classroom.

> School Leader – interview excerpt - *School Leader - interview - Over the past three years, the school has equipped itself with a lot of equipment to improve learning in the area of students' digital skills. Through a call for innovative laboratories, materials for developing experiences with Augmented Reality and Virtual Reality were purchased.*

5.2 Support for professional learning

Almost all of the responding school leaders, 97,6%, indicate that they have provided information to teachers about the AI4T project.

In reference to the training received under the AI4T project, 74,6 % of School leader indicate that teachers had access to the training while 21,8 % report that they did not participate. Regarding classroom substitution for teachers when the AI4T training took place during their teaching hours most School leader, 80,5%, indicate that the training was never conducted during teachers' teaching hours. 9,8 % of them indicate that they replaced them entirely and 2,4 % partially.

Almost all school leaders 92,7% indicated that teachers did not encounter any problems in taking the AI4T project training such that they had to intervene 7,3% of school leaders had to intervene.

A large proportion of school principals (82,9%) indicate that they have talked to teachers about their satisfaction with the training, 17,1% of them indicate that there was no discussion about this.

> School Leader - interview excerpt - *The teachers told me that they were very satisfied, they particularly appreciated the quality of the materials proposed.*

> School Leader - interview excerpt - *The teachers found AI4T a very interesting and formative experience, from the exchanges I had with them on the subject of AI I found them, so to speak, very well prepared on the subject, thanks perhaps also to the very simple use of the artificial intelligence platform, so I found them very, very well prepared. They really appreciated this kind of course.*

> School Leader - interview excerpt- *I would like to report that the training was so effective that the teachers reported to the class councils, during the school term, on the results of the work carried out as a result of the training.*

> School Leader - interview excerpt - *From the impressions I gathered, the learning pathway undertaken in AI4T was positive. It seems to me that there were no absences during the training and the impressions were very positive, i.e. everyone told me that the course was very interesting. They received not only theoretical training, but also very practical guidance on how to eventually use artificial intelligence for educational purposes.*

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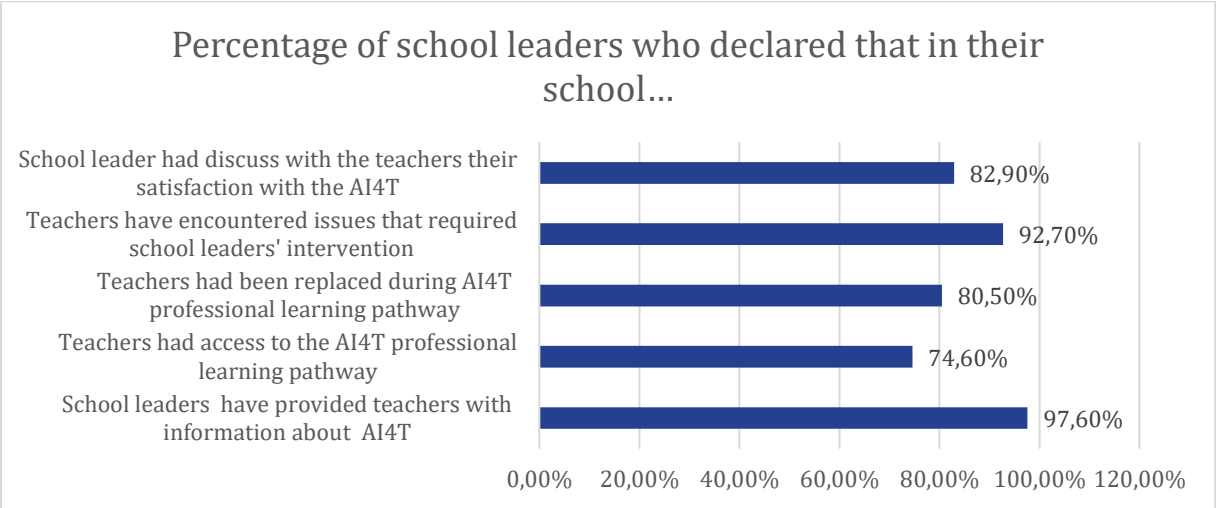
Figure 9: Support for professional learning



5.3 AI leadership

School leaders' knowledge and use of AI

Most school leaders (65,5 %t) seem to have a good knowledge of AI, 41,9 %t of them indicating a fairly good knowledge while 23,6% of School leader indicate that their knowledge of AI is good and very good.

50.9 percent of school leaders indicate that they are familiar with AI tools for teaching and learning.

> School Leader - interview excerpt - *In addition to the well-known GPT chat, from Openai.com, I am using artificial intelligence for images and, therefore, many images that we use for educational purposes, which we then print and apply within learning environments, are generated by AI.*

> School Leader - interview excerpt - *I do not have an in-depth knowledge about AI, I have done some reading on the subject partly because of the profession I work in. From these, it is clear to me that AI in the school field is very versatile and can be applied through automated tools for assessment, customisation of teaching materials with an obvious focus on inclusion and personalisation of the curriculum through ad hoc suggestions, a form of automated tutoring to keep students' attention and positively affect their performance, prediction and use of indicators to prevent school drop-out.*

> School Leader - interview excerpt - *It is clear that, in the short term, the use of these tools by students could influence teachers' teaching methodologies. Consequently, teachers need to find ways to integrate artificial intelligence into their daily teaching practices and understand that it is essential to review their methodologies, adopting more radical innovation. We are moving towards a type of incremental learning, a constructivist approach to teaching that, for those who follow a more traditional approach, would represent a significant innovation*.

School policy for AI integration

Most school leaders believe that integrating AI in their school is a priority, 63,7%. 25,5% of school leaders believe it is a priority for most teachers but 49,1% believe it is a priority for a minority of teachers.

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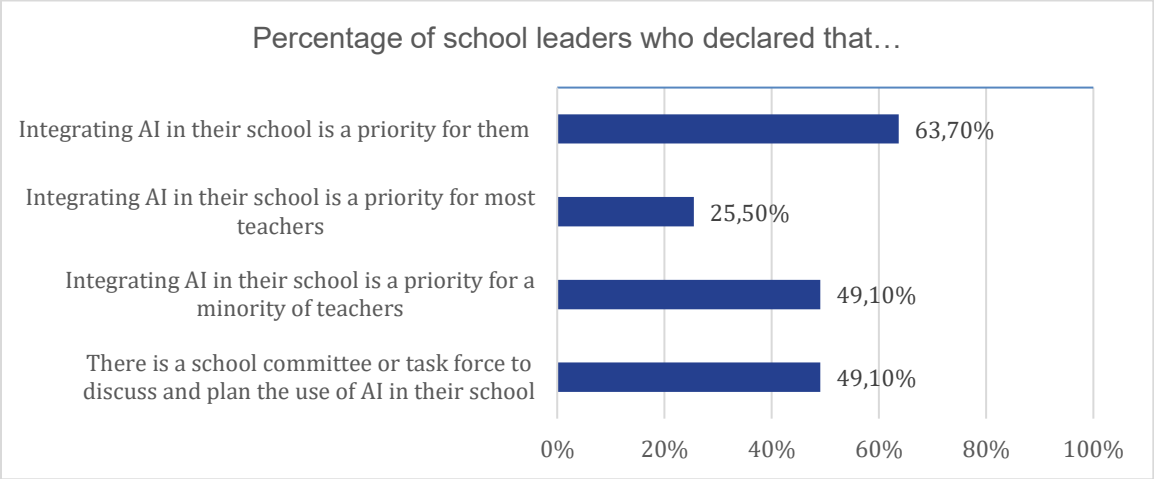
Most school leaders said that teachers have access to AI tools (52,7%). In addition, most school leaders (61,8%) have spent 3 or more days managing AI in their school. Ethical issues are important when it comes to adopting AI in school, 72,8% of school leaders say that ethical issues play a medium or important role.

> School Leader - interview excerpt - *Artificial Intelligence confronts us with problems of great importance, because if we had difficulties with the use of Google, we will have even more difficulties with the use of artificial intelligence tools. Look, I aim to study the subject and I believe it is a subject that also needs to be addressed with staff. I am lucky and I am surrounded by competent people who know even more about it than I do and who will be able to study it with me, because this is something new.*

Figure 10: School policy for AI integration



School leaders who participated in the survey have a good understanding of AI and that schools in the sample generally have good technical infrastructure. Access to equipment does not appear to be a significant barrier to AI use. Most school leaders encouraged teachers to participate in the AI4T trial and provided the necessary information.

Unfortunately, there do not appear to be internal school dynamics to encourage the use of AI. Most school leaders did not feel that integrating AI into the school was a priority. Most school leaders stated that teachers have access to AI tools. Ethical issues are important when it comes to adopting AI in school.

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6. Students results

6.1. Student knowledge of AI

58% of students stated that they know 'pretty much' or 'definitively' what AI is and 36,7% confirmed that they know 'a little'. Most students are aware of the use of AI driven technology in image-recognition software (88,7%), automatic translators (76,5%), or search engines (66,5%).

6.2. Student attitude towards AI

The results of the survey, indicates a strong admiration for AI's capabilities, with 91,8% of participants reporting positive impressions about AI's potential. A considerable proportion of students, approximately 73%, exhibit enthusiasm towards AI advancements, reflecting an optimistic outlook on the role of AI in future. 83,6% of respondents expressing interest in exploring new AI applications for educational purposes and a significant 71,1% of students express the interest for a greater integration of AI in classroom settings. 63,8% of students anticipate actively using AI for their learning and 71,9% of respondents see AI driven technology as a beneficial tool for educational purposes. 65,4% of students see AI as a catalyst for personalized teaching. The students' answers show also concern, with 35,2% of students apprehensive about AI potentially dehumanizing the educational experience, but negative sentiments towards AI are more uncommon, with only 10,5% of students expressing an instinctive dislike for the technology.

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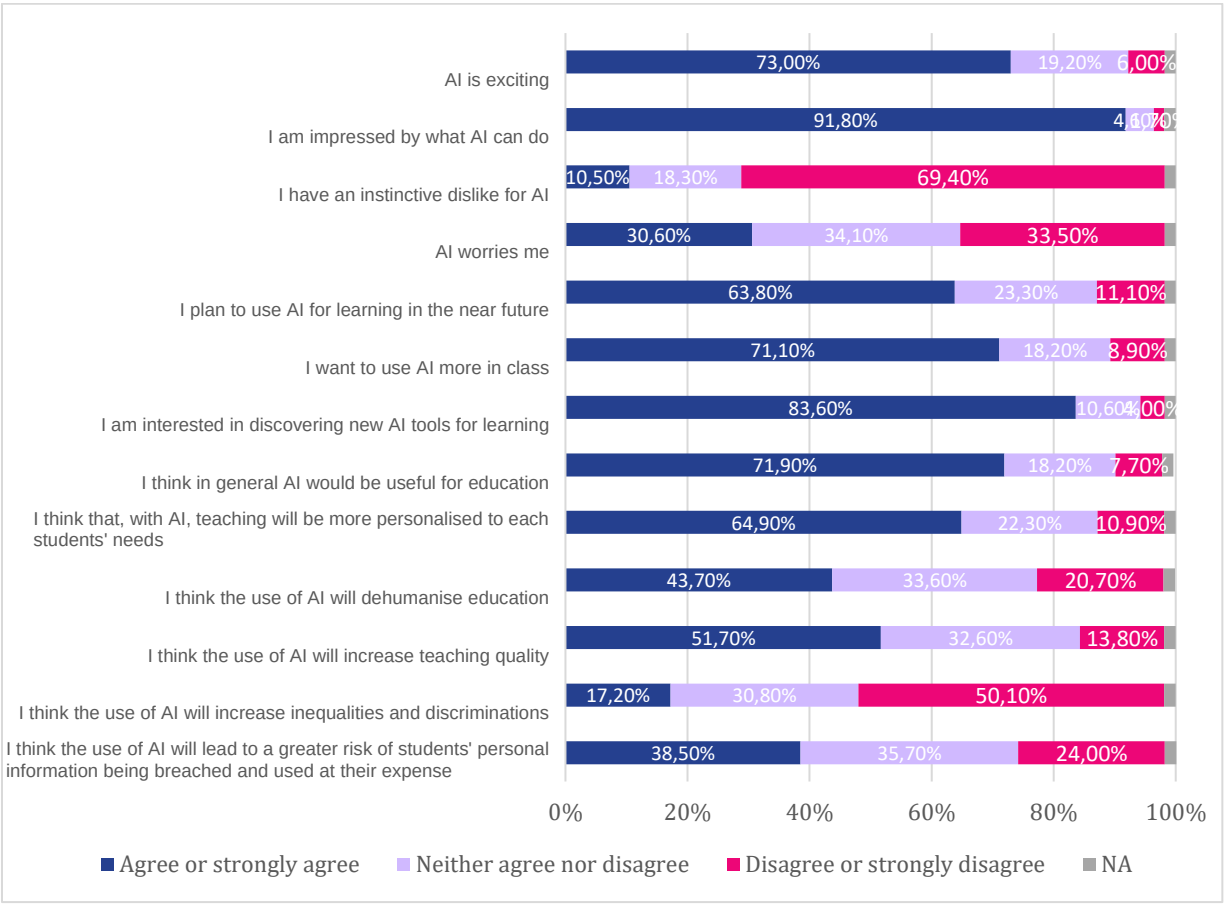
Figure 11: Students' attitude towards AI



6.3. Student ethical awareness and worries regarding AI

Most students have heard of debates regarding potential privacy violations due to data collection by AI tools (78,2%) a potential use of AI for illegitimate intents (74,3%). The results of the students' answers show the high level of awareness among students regarding potential privacy concerns associated with data collection by AI tools. 78,2% of respondents are cognizant of this issue, indicating a widespread understanding of privacy as a critical ethical consideration in the context of AI. Close to this level of recognition is the awareness of AI's potential misuse for illegitimate purposes, with 74,3% of students acknowledging this concern. Regarding the responsibility associated with decisions made by AI, the survey shows that 57,9% of students are aware of this debate, and 40,6% of students are aware of the debate about AI's potential to perpetuate discrimination. The potential loss of privacy due to AI-driven data collection concerns a substantial 33,3% of students, with an additional 37,4% being very concerned. This strong concern reflects the prevalent apprehensions regarding privacy in the era of digital data and AI. Only 11,6% of students state that, in their opinion, AI operates with transparency and 41,7% mostly agrees with this sentiment. This indicates a general, though not unanimous, confidence in the transparency of AI systems. The results of the survey also reflect a common understanding of the challenges in attributing responsibility in AI-driven contexts. For example, the complexity of assigning responsibility for AI's decisions is

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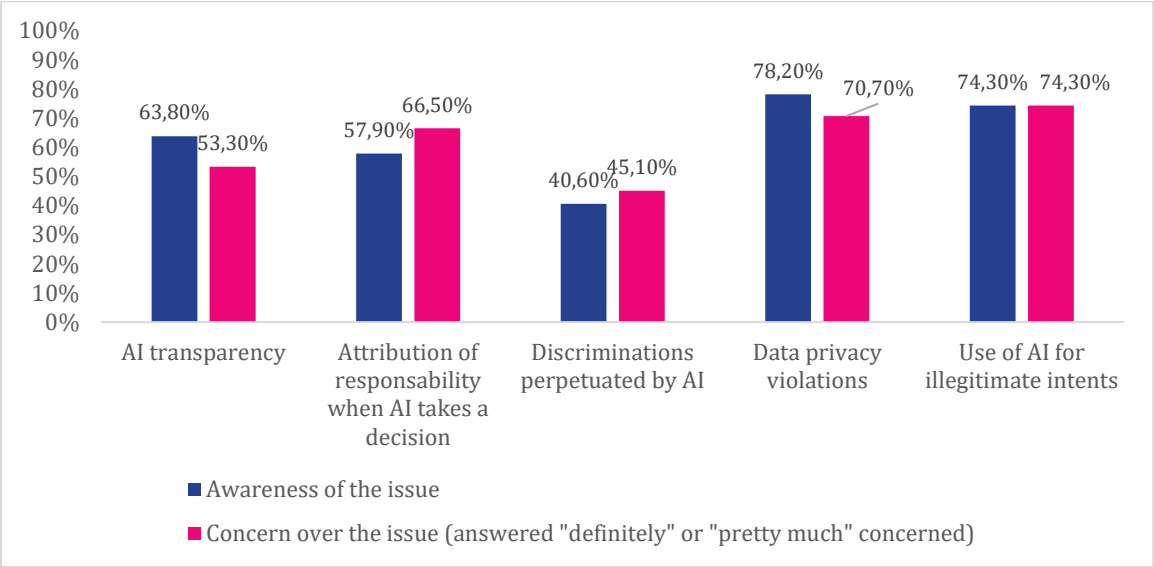
acknowledged by 65,5% strongly agree or agree to find it a complex issue, while the potential discrimination perpetuated by AI tools, 45,1% of students acknowledge it as a problem.

Figure 12: Students' awareness and concern regarding ethical issues associated with AI



6.4 Students' use of AI

About 36,4% of respondents indicated using general-purpose AI tools like search engines and automatic translators more than once a week and only 7,9% of students say that they never used generic AI tools. In contrast, the use of educational AI tools, such as Photomath, Duolingo for Schools, and Grammarly, showed a diverse range of engagement levels. While 16,2% of students used these tools more than once a week, a slightly higher percentage of 18,3% engaged with them once a week. The most frequent usage, reported by 23.1% of students, was at least once a month. However, 23,8% of students did not use these educational AI tools at all during the school year, indicating a potential gap in the adoption of AI for specifically educational purposes.In the context of mathematics education, search engines were the most utilized AI tools, with 30,1% of students reporting their use. However, discipline-specific tools like Photomath also saw significant usage, with 12,5% of students using them. Similarly, in language education, search engines were highly used, with 28,8% of students utilizing them. Automatic translators were also popular, used by 17,6% of students, indicating their role in facilitating language learning and comprehension.

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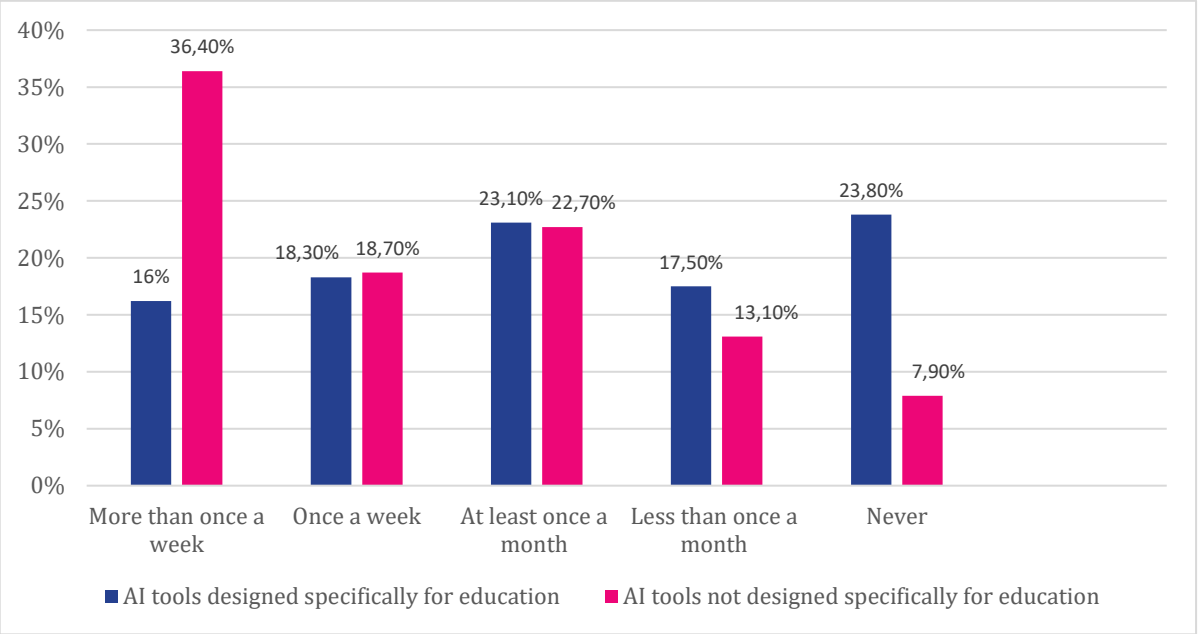
Figure 13: Students' declarations regarding the use of AI tools



Students show a generally positive attitude among students towards AI. A significant majority are impressed by AI's capabilities and are excited about its potential applications. This enthusiasm is coupled with the interest in exploring new AI tools for learning. A considerable number of students express a desire to see more AI integration in classroom settings, reflecting a belief in the potential of AI to enrich their learning experience. In terms of ethical awareness, the survey shows that most students are aware of potential privacy concerns and the misuse of AI for illegitimate purposes, highlighting a critical understanding of the ethical implications associated with AI technologies. However, there is less awareness regarding issues like AI transparency, discrimination perpetuation by AI, and the assignment of responsibility in AI-driven decisions. The utilization of AI tools presents a varied picture. Students report frequent use of general-purpose AI tools, such as search engines and automatic translators, suggesting that AI is deeply integrated into their everyday information-seeking and language processing activities. However, the usage of specialized educational AI tools is more diverse, with a significant portion of students not using them at all.

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7. Takeaways from teachers and school leaders

7.1 On professional learning about AI

Teachers' questionnaires highlight the importance of up-to-date training on AI tools for their own professional development, and the need for greater support from the head teacher and involvement of the whole school community to increase the uptake of AI in schools.

Teacher - interview excerpt: *'Our task is always to educate and obviously to do this we ourselves must be trained. So, the big obstacle is teacher training".*

Teacher - interview excerpt: *'We think that artificial intelligence should be addressed in schools in a more transversal way, let's say not only with language and IT teachers, obviously, so we are trying to involve all teachers'*

In the qualitative analyses, the teachers state that the role of the teacher is fundamental in the use of AI didactic tools precisely in order to direct learning towards specific educational objectives.

Teacher - interview excerpt: *"It is crucial that children do not completely dedicate themselves to artificial intelligence. They must understand that their role must be active, not just taking data or information, but actively participating."*

Teacher - interview excerpt: *'A competent teacher must understand that it is not the copying that harms the student, but rather his use of the instrument'.*

Teacher - interview excerpt: *'I see the future of school as a combination of these tools (technologies and AI) and aspects of traditional lessons. It is necessary to find a balance, managing to agree on everything'.*

As for the training course in general, it was appreciated by the teachers and perceived as effective, as it increased their knowledge, familiarity with the AI tools and awareness, although most of them acknowledged that the time devoted to the training was too short for them to have gained more confidence in using the AI tools.

Teacher - interview excerpt: *"Before participating, I have to be honest, artificial intelligence was a topic I had personally explored, but I had never considered applying it in an educational context."*

Teacher - interview excerpt: *'The discussion with colleagues was very stimulating. I come from a specific scholastic and geographical context and comparing myself with colleagues from different parts of Italy, teachers in different schools, was enlightening.*

Teacher - interview excerpt: *"Even in my case, a world opened up, and I have to be honest, there was a lot of mistrust on my part."*

Teacher - interview excerpt: *'The period was short, perhaps spread over a longer period, we would have had more time, perhaps to metabolize many things, to study them. Everything was very fast'.*

One aspect that was identified as important in the training was the provision of practical examples of use that would help teachers to contextualize them in their own classrooms.

Teacher - interview excerpt: *'The course was extremely useful. It has equipped me with practical skills that I can apply directly in my teaching and has opened new possibilities for engaging students in AI-related projects and activities. Its usefulness is concretely reflected in my lessons."*

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> Teacher - interview excerpt: *"If not if I hadn't taken the course. I would probably never have done those examples that were elementary with the students".*

The interviews also revealed the added value of comparison at both national and international level.

> Teacher - interview excerpt: *'The international meetings represented a very interesting aspect, offering us the opportunity to know the opinions of our colleagues on a common project. This comparison contributed significantly to our cultural, personal and professional growth'.*

> Teacher - interview excerpt: *'Participating in discussions with other professionals during the course was extremely stimulating. The exchange of ideas broadened my perspective, offering different angles on how to integrate AI into teaching".*

> Teacher - interview excerpt: *'After the international meeting I changed my mind. It will definitely be part of my future teaching style. So yes, it was very constructive for me."*

School leaders consider AI training to be a priority, although half of them from schools that had taken the course stated that they had not disseminated the project within their school, so more liaison with the organisational/school level would be necessary.

> School Leader - interview excerpt: *'In my opinion, at this moment, we must not stop talking about this thing; therefore, we must do continuous, and I mean immediate training even within individual communities. For example, within the month of September I will do a small self-training section, managed by the teachers and if they like me too, precisely because it is important that we compare ourselves, that we talk about this thing, and that all of them come out difficulties.*

> School Leader - interview excerpt: *'I personally believe that even our digital team is currently not, so to speak, trained and prepared on the topic. On the topic of artificial intelligence dedicated to teaching, therefore first we must train the digital team".*

> School Leader - interview excerpt: *"I believe that training must be given priority, without which it is not possible to envisage the use of AI tools. I also believe that training must be supported by adequate motivation: the implications and advantages must be clear and evident, but also, the dangers inherent in the use of AI tools.*

> School Leader - interview excerpt: *'It would be essential to integrate training courses for teachers. We felt the need to create a network between schools, not only with a single institution that decides to undertake a path, but by looking for experts and feeling part of a larger project.*

Regression models designed to measure the impact on teachers' knowledge of AI show in particular the significant role of gender, teaching experience, and the perception of self-efficacy in technology integration: the dimension of efficacy with respect to the use of new technologies is an aspect to be kept strongly in mind when developing training interventions on the subject.

> Teacher - interview excerpt: *'Understand what artificial intelligence can do, how it can help, how it can be a support, but it cannot and must not replace. This is a premise. And then we are now using it everywhere, in all our daily activities. Artificial intelligence is involved in millions of things, just look, even on Facebook, at all the advertisements personalized based on our interests. Almost all of them are operated by artificial intelligence. We are submerged, immersed in something bigger than us. "*

> Teacher - interview excerpt: *"I would really like to explore all possible apps that can be used, also for programming, for example to personalize teaching in a more individual way."*

> Teacher - interview excerpt: *'My involvement in learning about artificial intelligence has significantly influenced my perception in a positive way. Before the course, my interest was already high, but the*

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training deepened my understanding of the applications and ethical implications of AI, generating even stronger interest".

7.2 On AI tools

Many teachers have great confidence in AI tools to support classroom activities, particularly in terms of personalized teaching; this last aspect was also noted by students, who recognized how AI tools could help them with their homework. The questionnaires revealed a strong link between the perception of competence in AI, knowledge and ease of use of AI, which can also be attributed to the strong link between these perceptions and the perception of the use of technology in general. The selected schools were indeed equipped with excellent technological infrastructures, an aspect also recognized by the DS. Teachers were particularly interested in the use of Chat GPT, which was made available free of charge during the period of the survey and the training course. In fact, some of the teachers interviewed talked about their educational use of CGPT, even when asked by students.

> Teacher - interview excerpt: *"Our kids are quite confident in the use of technologies; therefore, they know how to use GPT chat very well, it is the problem that I have encountered, it is the unbridled use of this, in the sense that they choose the easiest way, that is, they copy from there everything they can copy without perhaps realizing that what they are doing; so maybe we find ourselves with homework done with topics that have not yet been explained in class, but they are already ahead but have no knowledge of that particular topic. "*
>
> Teacher - interview excerpt: *'I had to prepare a class test with 20 questions, and I asked GPT chat to help me. I said, "Make me a test for high school students with 20 questions, each with four answers of which only one is correct. GPT chat did the job for me. As opposed to taking five days, it only took me 5 minutes. "*
>
> Teacher - interview excerpt: *'Besides GPT chat, there are other image creation programmes, for example, related to the language. They must write the image they want in English anyway and then you can see what comes out, so they have to use an adequate grammatical structure, otherwise you can't understand what they want".*
>
> Teacher - interview excerpt: *'I proposed that they use an AI-based tool to create mini videos and convey the concept. They were enthusiastic and curious about this different application, showing that they did not know many other proposals that could be used during classroom activities".*
>
> Teacher - interview excerpt: *'During the last days of school, I involved three students from the institute's band in creating music using artificial intelligence tools. They directed the activity using a digital board, involving the whole class in choosing and evaluating the music created. This is just an example of how varied the tools that can be used in this field are".*

From the regression models aimed at measuring the impact on the use of AI tools, it emerges that language teachers seem to perceive greater difficulty and less pleasure in using AI compared to their colleagues in STEM subjects; furthermore in this case a high self-efficacy in the integration of technology in the classroom has a very positive impact on the perceived ease of using AI and on the associated pleasure and on the perceived usefulness of AI for education, while reducing the anxiety associated

with using and learning AI. Also in this case, therefore, it is a priority to invest in terms of self-efficacy and competence compared to the use of new technologies in the classroom.

Asked also what they considered to be superpowers that could help in the work of teachers, the teachers replied: in correcting homework (11,63%), helping to motivate students (17,33%) and better understanding their thinking (17,57%). A final interesting aspect concerns the role of the teacher in the AI era: few (9,8%) say that the teaching profession will be devalued or that teachers will be overwhelmed by AI (20,7%), while most (47,6%) say that teachers will have more time to focus on student learning.

> Teacher - interview excerpt: *"I am optimistic, I have a positive attitude, I don't see any critical issues, otherwise the use and non-regulation of artificial intelligence and this, let's say, is a critical human problem and not linked to research, because as I was saying, I am very much in favour of to the research approach."*
>
> Teacher - interview excerpt: *'We already have practical examples, such as Siri and Google's voice assistants, which we commonly use, for example, to make calls in the car. Voice recognition and other artificial intelligence features are now within everyone's reach, and the common man knows how to use them without alarm. Regarding the change in jobs, it is true that some professions will undergo transformations, but this is a normal process that we have also experienced in the past. There are jobs that didn't exist 200 years ago and vice versa. Ultimately, I see no reason to worry, and artificial intelligence doesn't scare me either.*
>
> Teacher - interview excerpt: Teacher - interview excerpt: 'I definitely see the future of school as a combination of these tools (technologies and AI) and aspects of traditional lessons. It is necessary to find a balance, managing to agree on everything".

7.3 On Ethics

Awareness of the ethical dimension in the use of AI tools is very much present among both lecturers and DSs, especially regarding the risk of large amounts of data being collected by private companies and corporations for uses that are not strictly educational.

> Teacher - interview excerpt: *'One of the biggest risks is certainly linked to the privacy of student data. It is vital to ensure that personal information is handled securely and that there is full transparency into how it is used. This aspect should be at the center of any implementation of AI-based technologies in schools'.*
>
> Teacher - interview excerpt: *'It is necessary for authorities to develop regulations to ensure safe and informed use of this powerful technology, as otherwise it could pose both positive and negative risks, especially considering the constant evolution of tools such as these.*
>
> School Leader - interview excerpt: *'AI requires a lot of data, so the dangers inherent in the privacy, storage, sharing and governance of the mentioned data are evident, there are also profiles of responsibility, with respect to margins of error that must be defined. Furthermore, although AI tools stimulate students' critical thinking and creativity, they risk, if not adequately used and dosed, decreasing the importance of direct teaching by teachers and direct learning by students who could become "addicted" to the 'AI.*
>
> School Leader - interview excerpt: *'From an ethical point of view, we still need to raise awareness, that is, the users of artificial intelligence are not very clear about the moral weight of the use of artificial intelligence, because, as always, we are rather dazzled using the medium, therefore of the technology. But side effects or simple medium- and long-term effects are not of interest to most people. So, I would recommend keeping your attention high, using, and looking for tools to keep this attention high.*

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This aspect is instrumental in the anxiety that many teachers show about AI. While a large proportion of teachers and school leaders are also concerned that AI may pose a problem about racial or sexual prejudice, students are not optimistic and do not see the risk of dehumanization of education or the risk of increased inequality.

> Teacher - interview excerpt: *'The accuracy of machine learning models is a key concern. If the models are not well adapted to the specific educational context, they could lead to incorrect assessments or biased teaching.*
>
> School Leader - interview excerpt: *"These algorithms may or may not be influenced and therefore misdirected or misled towards attitudes, solutions, proposals, responses that may be detrimental to the equal dignity of men and women and sexual tendencies, etc.. So it is definitely a very serious problem and what interests me now is, I repeat, the personalization of learning as the first element."*

Appendices

Table 15: monitoring of the data cleaning process in Italy

	Teacher baseline	Teacher endline	School leader	Pupils
Number of answers (non-empty)	435	435	91	1589
Number of answers without duplicates	435	435	91	1589
Number of answers who completed at least the first module of outcomes	275	275	55	1589
Number of answers who completed both questionnaires	275	275	x	x

Table 16: summary of the psychometric properties of the scales for the teacher questionnaire

Name of the scale	Psychometric properties
Context	
Self-efficacy for integrating technology into the classroom	The scale includes 5 items. The cronbach alpha is 0.93. The item-total correlations (Kendall's tau) are comprised between 0.76 and 0.78. There is one underlying factor that explains 72% of the variance. The factor loadings for each item are comprised between 0.84-0.86.
Reactions to the professional learning pathway	
Learner engagement	The scale includes 11 items. he cronbach alpha is 0.86. The item-total correlations (Kendall's tau) are comprised between 0.41 and 0.55. There are four underlying factors. The first one explains 21% of the variance. On the first factor, the factor loadings for each item are comprised between 0.66-0.94. The second factor explains 18% of the variance. On the second factor, the factor loadings for each item are comprised between 0.69-0.79. The third factor explains 16% of the variance. On the third factor, the factor loadings for each item are comprised between 0.57-0.84. The fourth factor explains 14% of the variance. On the fourth factor, the factor loadings for each item are comprised between 0.69-0.94.
Satisfaction with the utility of the Professional learning pathway	The scale includes 3 items. The cronbach alpha is 0.92. The item-total correlations (Kendall's tau) are comprised between 0.82 and 0.87. There is one underlying factor that explains 79% of the variance. The factor loadings for each item are comprised between 0.85-0.94.
Participants' learning	

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Knowledge of how AI works	The scale includes 5 items. The cronbach alpha is 0.68. The item-total correlations (Kendall's tau) are comprised between 0.48 and 0.61. There is one underlying factor that explains 33% of the variance. The factor loadings for each item are comprised between 0.42-0.75.
Familiarity with AI technologies	The scale includes 5 items. The cronbach alpha is 0.87. The item-total correlations (Kendall's tau) are comprised between 0.65 and 0.72. There is one underlying factor that explains 58% of the variance. The factor loadings for each item are comprised between 0.70-0.82.
Ability to identify AI tools	The scale includes 8 items. The cronbach alpha is 0.77. The item-total correlations (Kendall's tau) are comprised between 0.31 and 0.59. There are two underlying factors. The first factor explains 31% of the variance. On the first factor, the factor loadings for each item are comprised between 0.67 and 0.89. The second factor explains 21% of the variance. On the second factor, the factor loadings for each item are comprised between 0.49 and 0.72.
Perceptions of AI	
Perceived ease of use of AI	The scale includes 4 items. The cronbach alpha is 0.91. The item-total correlations (Kendall's tau) are comprised between 0.73 and 0.81. There is one underlying factor that explains 72% of the variance. The factor loadings for each item are comprised between 0.77-0.88.
Anxiety associated with use of AI and learning about AI	The scale includes 3 items. The cronbach alpha is 0.90. The item-total correlations (Kendall's tau) are comprised between 0.74 and 0.83. There is one underlying factor that explains 69% of the variance. The factor loadings for each item are comprised between 0.73-0.91.
Enjoyment associated with use of AI and learning about AI	The scale includes 4 items. The cronbach alpha is 0.90. The item-total correlations (Kendall's tau) are comprised between 0.79 and 0.85. There is one underlying factor. The factor loadings for each item are comprised between 0.74-0.96.
Perceived usefulness of AI for education	The scale includes 10 items. The cronbach alpha is 0.88. The item-total correlations (Kendall's tau) are comprised between 0.86 and 0.87. There is one underlying factor that explains 45% of the variance. The factor loadings for each item are comprised between 0.57-0.73.
Use of AI	
Use of AI	The scale includes 4 items. The cronbach alpha is 0.9. The item-total correlations (Kendall's tau) are comprised between 0.79 and 0.82. There is one underlying factor that explains 69% of the variance. The factor loadings for each item are comprised between 0.77-0.88.
Frequent use of AI	The scale includes 4 items. The cronbach alpha is 0.84. The item-total correlations (Kendall's tau) are comprised between 0.69 and 0.82. There is

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	one underlying factor that explains 58% of the variance. The factor loadings for each item are comprised between 0.75-0.83.
Ethical consciousness when using AI	The scale includes 3 items. The cronbach alpha is 0.75. The item-total correlations (Kendall's tau) are comprised between 0.70 and 0.76. There is one underlying factor that explains 56% of the variance. The factor loadings for each item are comprised between 0.53-0.94.
Intention to use AI	The scale includes 3 items. The cronbach alpha is 0.88. The item-total correlations (Kendall's tau) are comprised between 0.82 and 0.86. There is one underlying factor that explains 74% of the variance. The factor loadings for each item are comprised between 0.69-0.95.

Table 17: summary of the psychometric properties of the scales for the student questionnaire

Name of the scales	Psychometric properties
Attitude towards AI in education	The scale includes 8 items. The cronbach alpha is 0.82. The item-total correlations (Kendall's tau) are comprised between 0.31 and 0.60. There are two underlying factors. The first factor explains 31% of the variance. On the first factor, the factor loadings for each item are comprised between 0.53 and 0.77. The second factor explains 12% of the variance. On the second fator, the factor loadings for each item are comprised between 0.53 and 0.64.
Concern about ethical issues raised by AI in education	The scale includes 5 items. The cronbach alpha is 0.82. The item-total correlations are comprised between 0.58 and 0.68. There is one underlying factor that explains 48% of the variance. The factor loadings are comprised between 0.61 and 0.75.

Table 18: comparisons of control variables in the intervention and control group (remove data)

Control variable	Control group	Intervention group	p-value
Gender ***(Percentage of men)***	28.46	30.34	0.73
Teaching experience ***(Average number of years of teaching experience)***	20.1	17.2	0.017**
Class size	20.41	20.91	0.33

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(Number of students in the class participating in the experiment)			
Student academic difficulties ***(Percentage of students with academic difficulties in the class)***	24.67	29.14	0.039**

Table 19: comparisons of the means in the main outcomes at the beginning of the experiment

Outcome	Control group	Intervention group	p-value
Knowledge			
Self-assessment of knowledge of AI	-0.011	0.519	**2.53E-07****
Knowledge of how AI works	0.145	0.745	**5.69E-08****
Familiarity with AI technologies	0.156	1.111	**5.19E-14****
Identification of AI in tools that are mainly based on AI	0.349	1.118	**1.83E-10****
Identification of AI in tools that are not mainly based on AI	0.121	0.326	0.118
Perceptions			
Perceived ease of use	-0.078	0.384	**0.0005****
Anxiety associated with used of AI and learning about AI	0.068	-0.130	0.082
Enjoyment associated with use of AI and learning about AI	-0.312	-0.115	0.163
Perceived usefulness of AI for education	-0.188	-0.003	0.129

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Use of AI	0.233	0.696	**2.73E-07****
Frequent use of AI	0.082	0.445	**0.008****
Ethical consciousness when using AI	0.046	0.206	0.192
Intention to use AI	-0.086	0.282	**0.003****

table 20: theme grid and qualitative analysis results

Index of themes and tags identified for the focus with teachers	
Themes	**Subthemes/tags**
1. Experience of learning professional	1.1 Learning experience - Elements of greatest interest (knowledge of artificial intelligence, involvement, exchange of ideas) 1.2 Learning experience - Critical issues and areas for improvement (unclear learning intentions, lack of class relevance, few disciplinary examples, greater support in practice, timing) 1.3 Learning experience - MOOCs (Highlights, learning artificial intelligence, information contained) 1.4 Learning experience - Online sessions (Clarifications, exchange of ideas, peer comparison, international comparison). 1.5 Learning experience - General comments on the design of AI4T (Synergy between components, benefits of involving multiple subjects, benefits of the online approach)
2. Impact of professional learning experience on AI knowledge	2.1 Impact - professional effects (reflection on pedagogy, change in teaching, discussions with colleagues, reflection on the role of the teacher, reflection on the importance of students' critical thinking) 2.2 Impact - personal effects of participation (AI awareness, AI ubiquity, increased interest in AI) 2.3 Impact - AI governance and infrastructure (school level, school infrastructure, government level)

	2.4 Impact - awareness of negative effects of AI (data protection, failure to address data protection concerns, AI overload) 2.5 Impact - need for training for all teachers: awareness of the importance of professional adaptation
3. Use of the apps	3.1Using other apps 3.2 Using Duolingo 3.3 Usage: chatgpt 3.4 Use grammatically
4. **Perception of the Ai**	4.1 Positive perceptions of the students on AI (interest, confidence in the teaching potential...) 4.2 Negative perceptions of the trainees on AI (fears/distrust/disinterest) 4.3 Pupils' negative perceptions/disinterest in AI 4.4 Pupils' positive perceptions/interest in AI

Theme 1: Professional learning experience

Faculty spoke about the professional learning experience. The 128 comments were divided into five sub-themes:

Themes	**Occurrence total**	**Subthemes/tags**	**Single tag occurrence**
1. **Professional learning** experience	**128**	1.1- Elements of greatest interest (knowledge of artificial intelligence, involvement, exchange of ideas)	51
		1.2 Critical issues and areas for improvement (unclear learning intentions, lack of class relevance, few disciplinary examples, greater support in practice, timing)	39
		1.3 MOOCs (Highlights, AI learning, information contained)	23
		1.4 Online sessions (Clarifications, exchange of ideas, comparison between peers, international comparison)	15

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		1.5 Esp_ appr - General comments on the design of AI4T (Synergy between components, benefits of involving multiple subjects, benefits of the online approach)	14

Themes	**Occurrence total**	**Subthemes/tags**	**Single tag occurrence**
2. Impact of professional learning experience on AI knowledge	180	2.1 Professional effects (reflection on pedagogy, change in teaching, discussions with colleagues, reflection on the role of the teacher, reflection on the importance of students' critical thinking)	67
		2.2 Personal effects of participation (AI awareness, AI ubiquity, increased interest in AI)	21
		2.3 AI governance and infrastructure (school level, school infrastructure, government level)	14
		2.4 Awareness of negative effects of AI (data protection, failure to address data protection concerns, AI overload)	30
		2.5 Training need for all teachers: awareness of the importance of professional adaptation	8

Thema 3: Using apps

Themes	**Occurrence total**	**Subthemes/tags**	**Single tag occurrence**
3. Use of the apps	62	3.1Using other apps	24
		3.2 Using Duolingo	6
		3.3 Usage: Chatgpt	30
		3.4 Use grammatically	2

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Theme 4: Perception of Ai

Themes	Occurrence total	Subthemes/tags	Single tag occurrence
4. Perception of the Ai	61	4.1 Positive perceptions of the students on AI (interest, confidence in the teaching potential...)	24
		4.2 Negative perceptions of the trainees on AI (fears/distrust/disinterest)	14
		4.3 Pupils' negative perceptions/disinterest in AI	2
		4.4 Pupils' positive perceptions/interest in AI	21

Index of themes and tags identified for interviews with School Leaders	
Themes	**Subthemes/tags**
1. Teachers' professional learning experience	1.1 Learning experience - Elements of greatest interest and satisfaction (knowledge of artificial intelligence, involvement, exchange of ideas, operational dimension, disciplinary examples) 1.2 Learning experience - Critical issues, areas for improvement and suggestions (lack of relevance for the class, few disciplinary examples, greater support in practice, times, dropouts, any difficulties encountered, any suggestions) 1.3 Learning experience - support and encouragement to participate in the course
2. Knowledge of AI	2.1 Knowledge and use of AI - Examples of known and used artificial intelligence tools for teachers and school leaders 2.2 Knowledge and use of AI - Participation in professional training courses on AI in the educational field and/or experiences of conferences/events on the topic

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3. AI integration in schools	3.1 AI integration in schools: use in schools and expectations regarding AI (What tools, Objectives, Collaboration, Barriers) 3.2 AI integration in the school: impact on the use, greater or different, of AI since the school joined the project, both for teachers and DS (pedagogical reflection, change in teaching...) 3.3 AI integration in schools: impact on governance and ethical aspects at government level, at school level (adopted data policy, selection of school artificial intelligence tools, communication with school staff, students, parents) 3.4 AI integration in schools: impact on the need for training for all teachers and managers (awareness of the importance of professional adaptation)
4. Perception of the Ai	4.1 Positive perceptions of DS on AI (interest, confidence in the teaching potential...) 4.2 DS's negative perceptions of AI (fears/mistrust/disinterest) 4.3 Teachers' positive perceptions of AI (interest, confidence in the teaching potential...) 4.4 Teachers' negative perceptions of AI (fears/distrust/disinterest)

Index of themes and tags identified for interviews with school leaders

Themes	Total occurrence	Subthemes/tags	Single tag occurrence
1. Teachers' professional learning experience	14	1.1 Learning experience - Elements of greatest interest and satisfaction (knowledge of artificial intelligence, involvement, exchange of ideas, operational dimension, disciplinary examples)	5

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		1.2 Learning experience - Critical issues, areas for improvement and suggestions (lack of relevance for the class, few disciplinary examples, greater support in practice, times, dropouts, any difficulties encountered, any suggestions)	5
		1.3 Learning experience - support and encouragement to participate in the course	4
2) Knowledge of AI	24	2.1 Knowledge and use of AI - Examples of known and used artificial intelligence tools for teachers and school leaders	12
		2.2 Knowledge and use of AI - Participation in professional training courses on AI in the educational field and/or experiences of conferences/events on the topic	12
3) AI integration in the school	47	3.1 AI integration in schools: use in schools and expectations regarding AI (What tools, Objectives, Collaboration, Barriers)	17
		3.2 AI integration in the school: impact on the use, greater or different, of AI since the school joined the project, both for teachers and DS (pedagogical reflection, change in teaching...)	8
		3.3 AI integration in schools: impact on governance and ethical aspects at government level, at school level (adopted data policy, selection of school artificial intelligence tools, communication with school staff, students, parents)	15
		3.4 AI integration in schools: impact on the need for training for all teachers and managers (awareness of the importance of professional adaptation)	6

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4. Perception of AI	20	4.1 Positive perceptions of DS on AI (interest, confidence in the teaching potential...)	17
		4.2 DS's negative perceptions of AI (fears/mistrust/disinterest)	2
		4.3 Teachers' positive perceptions of AI (interest, confidence in the teaching potential...)	0
		4.4 Teachers' negative perceptions of AI (fears/distrust/disinterest)	1

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References

Akgun, S., & Greenhow, C. (2021). Artificial intelligence in education: Addressing ethical challenges in K-12 settings. *AI and Ethics*, 1-10.

Anderson, R. E., & Dexter, S. (2005). School Technology Leadership: An Empirical Investigation of Prevalence and Effect. *Educational Administration Quarterly*, *41*(1), 49-82. https://doi.org/10.1177/0013161X04269517

Badia, Antoni, Julio Meneses, Carles Sigalés, et Sergi Fàbregues. « Factors Affecting School Teachers' Perceptions of the Instructional Benefits of Digital Technology ». *Procedia - Social and Behavioral Sciences* 141 (août 2014): 357-62. https://doi.org/10.1016/j.sbspro.2014.05.063.

Banerjee, A. V., & Duflo, E. (2017). An introduction to the "Handbook of Field Experiments." *Handbook of economic field experiments*, *1*, 1-24.

Casper, Wm, Bryan Edwards, Craig Wallace, Ronald Landis, et Dustin Fife. « Selecting response anchors with equal intervals for summated rating scales ». *Journal of Applied Psychology* 105 (15 août 2019). https://doi.org/10.1037/apl0000444.

Cave, S., Coughlan, K., & Dihal, K. (2019). *'Scary Robots': Examining public responses to AI*. https://doi.org/10.17863/CAM.35741

Céci, Jean-François. « Analyse des pratiques numériques des enseignants, du collège à l'université, au prisme du genre ». *IJARTech (International Journal of Applied Research and Technology)*, Articles JIP2018, 1 (janvier 2019). https://hal.archives-ouvertes.fr/hal-01994895.

Christensen, R. W., & Knezek, G. A. (2009). Construct validity for the teachers' attitudes toward computers questionnaire. *Journal of computing in Teacher Education*, *25*(4), 143-155.

Commission Européenne. (2022). *Plan d'action en matière d'éducation numérique (2021-2027)*. https://education.ec.europa.eu/fr/focus-topics/digital-education/action-plan

Davis, F., Bagozzi, R., & Warshaw, P. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, *35*, 982-1003. https://doi.org/10.1287/mnsc.35.8.982

Deng, R., Benckendorff, P., & Gannaway, D. (2020a). Learner engagement in MOOCs: Scale development and validation. *British Journal of Educational Technology*, *51*(1), 245-262. https://doi.org/10.1111/bjet.12810

Deng, R., Benckendorff, P., & Gannaway, D. (2020b). Linking learner factors, teaching context, and engagement patterns with MOOC learning outcomes. *Journal of Computer Assisted Learning*, *36*(5), 688-708. https://doi.org/10.1111/jcal.12437

European Commission, Directorate-General for Education, Youth. *Final Report of the Commission Expert Group on Artificial Intelligence and Data in Education and Training: A Executive Summary*. LU: Publications Office of the European Union, 2022. https://data.europa.eu/doi/10.2766/65087.

« A Definition of AI: Main Capabilities and Scientific Disciplines ». European Commission, High-Level Expert Group on Artificial Intelligenc, 2019. https://digital-strategy.ec.europa.eu/en/library/definition-artificial-intelligence-main-capabilities-and-scientific-disciplines.

Ertmer, Peggy A., Anne T. Ottenbreit-Leftwich, Olgun Sadik, Emine Sendurur, et Polat Sendurur. « Teacher Beliefs and Technology Integration Practices: A Critical Relationship ». *Computers & Education* 59, nº 2 (1 septembre 2012): 423-35. https://doi.org/10.1016/j.compedu.2012.02.001.

Fengchun, Miao, Wayne Holmes, Huang Ronghuai, et Zhang Hui. « AI and education: guidance for policy-makers ». UNESCO, 2021. https://unesdoc.unesco.org/ark:/48223/pf0000376709.

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Février, F., Gauducheau, N., Jamet, É., Rouxel, G., & Salembier, P. (2011). The study of affects in human-computer interactions: Theories, methods and benefits. *Le travail humain*, *74*(2), 183-201.

Guskey, T. R. (2000). *Evaluating professional development*. Corwin press.

Jang, Y., Choi, S., & Kim, H. (2022). *Development and validation of an instrument to measure undergraduate students' attitudes toward the ethics of artificial intelligence (AT-EAI) and analysis of its difference by gender and experience of AI education*. https://link.springer.com/article/10.1007/s10639-022-11086-5

Njiku, J., Maniraho, J. F., & Mutarutinya, V. (2019). Understanding teachers' attitude towards computer technology integration in education: A review of literature. *Education and Information Technologies*, *24*(5), 3041-3052. https://doi.org/10.1007/s10639-019-09917-z

Noiwan, J., Piyawat, T., & Norcio, A. F. (2005). *Computer Attitude and Computer Self-Efficacy: A Case Study of Thai Undergraduate Students*. 11.

Perrotta, Carlo. « Do School-Level Factors Influence the Educational Benefits of Digital Technology? A Critical Analysis of Teachers' Perceptions: The Educational Benefits of Digital Technology Use ». *British Journal of Educational Technology* 44, nº 2 (mars 2013): 314-27. https://doi.org/10.1111/j.1467-8535.2012.01304.x.

Poyet, Françoise. « Perception de l'utilité et usages pédagogiques d'environnements numériques de travail par des enseignants du second degré ». *Sciences et Technologies de l'Information et de la Communication pour l'Éducation et la Formation* 22, nº 1 (2015): 45-64. https://doi.org/10.3406/stice.2015.1686.

Remian, D. (2019). Augmenting Education: Ethical Considerations for Incorporating Artificial Intelligence in Education. *Instructional Design Capstones Collection*. https://scholarworks.umb.edu/instruction_capstone/52

Samoili, Sofia, COBO Montserrat Lopez, Blagoj Delipetrev, Fernando Martinez-Plumed, GUTIERREZ Emilia Gomez, et PRATO Giuditta De. « AI Watch. Defining Artificial Intelligence 2.0 », 29 octobre 2021. https://doi.org/10.2760/019901.

Schepman, A., & Rodway, P. (2020). Initial validation of the general attitudes towards Artificial Intelligence Scale. *Computers in Human Behavior Reports*, *1*, 100014. https://doi.org/10.1016/j.chbr.2020.100014

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. *Computers & Education*, *128*, 13-35.

Schiff, D. (2021). Out of the laboratory and into the classroom: The future of artificial intelligence in education. *AI & SOCIETY*, *36*(1), 331-348. https://doi.org/10.1007/s00146-020-01033-8

Shattuck, G. (2009). Understanding School Leaders' Role in Teachers' Adoption of Technology Integration Classroom Practices. *Educational Media and Technology Yearbook*, 7-28.

Suh, W., & Ahn, S. (2022). Development and Validation of a Scale Measuring Student Attitudes Toward Artificial Intelligence. *SAGE Open*, *12*, 215824402211004. https://doi.org/10.1177/21582440221100463

Tricot, A. (2020). [Report] Quelles fonctions pédagogiques bénéficient des apports du numérique. Numérique et apprentissages scolaires. https://ecogestion-caen.second-degre.ac-normandie.fr/IMG/pdf/201015_cnesco_tricot_numerique_fonctions_pedagogiques-1.pdf

Wang, B., Rau, P.-L. P., & Yuan, T. (2022). Measuring user competence in using artificial intelligence: Validity and reliability of artificial intelligence literacy scale. *Behaviour & Information Technolog*. https://www.tandfonline.com/doi/abs/10.1080/0144929X.2022.2072768?journalCode=tbit20

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Wang, Y.-Y., & Wang, Y.-S. (2019). Development and validation of an artificial intelligence anxiety scale: An initial application in predicting motivated learning behavior. *Interactive Learning Environments*, *0*(0), 1-16. https://doi.org/10.1080/10494820.2019.1674887

Yennek, N. (2014). Contribution de l'intérêt situationnel à une reconsidération de la satisfaction dans la formation pour adultes [Thesis, Theses.fr]. In *Theses.fr*. https://www.theses.fr/2014PA100122