AI4T
AI FOR TEACHERS

Work Package 3:

Evaluation

Deliverable D3.3

National Evaluation Report

Slovenia

Co-funded by the
Erasmus+ Programme
of the European Union

AI4T
AI FOR TEACHERS

Project Title:	Artificial Intelligence for and by Teachers
Project Acronym:	AI4T
Project Number	626154
Grant Agreement Number	626154-EPP-1-2020-2-FR-EPPKA3-PI-POLICY
Deliverable number	D3.3
Work Package	3 Evaluation
Work Package Leader	Centre national d'étude des systèmes scolaires – Conservatoire national des arts et métiers (Cnesco-Cnam)
Work Package Partners	Dublin City University (DCU), Istituto Nazionale di Documentazione, per l'Innovazione e la Ricerca educativa (INDIRE), Pedagoški inštitut, Université du Luxembourg
Dissemination level	Public
Delivery date	2023-12
Status	Final
Version	4
Author(s)	Simona Bezjak, Plamen Vladkov Mirazchiyski
List of contributor(s)	Deirdre Butler, Pedro Cardoso-Leite, Jean-François Chesné, Christiane Kirsch, Aude Labetoulle, Paola Nencioni, Jessica Niewint, Aurélie Paris, Lina Rivera, Francesca Rossi, Francesca Storai, Sara Mori
Deliverable Manager	Cnesco-Cnam, France Education International

Co-funded by the Erasmus+ Programme of the European Union

ABSTRACT	This report presents the quantitative and qualitative evaluation of the impact of the AI4T professional learning pathway in Slovenia. 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' results and finally the students' results. 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 the 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 are then outlined depending on teachers' engagement in the MOOC, teachers' self-efficacy for integrating technologies into the classroom, and teachers' subject. 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)	

Co-funded by the
Erasmus+ Programme
of the European Union

AI4T
AI FOR TEACHERS

Table of Contents

Co-funded by the
Erasmus+ Programme
of the European Union

Co-funded by the
Erasmus+ Programme
of the European Union

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 for teachers developed for the project: 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 learning objectives but varied formats (online platforms, webinars, face-to-face sessions), were then developed.

Following a pilot phase conducted in 2021-2022 in a small sample of schools, the intervention took place during the 2022-2023 school year. The programme was aimed at maths, science and language teachers with students aged 15 to 17. In Slovenia, the programme targeted teachers of foreign language (English) and mathematics. Out of all the participating schools, half were randomly chosen within each country so that the teachers would engage in the professional learning pathway during the experimentation year. The teachers in the remaining schools served as a control group and were given access to the resources only after the end of the experimentation. The AI4T professional learning pathway was designed for teachers only (school leaders and students had no educational experience in the pathway).

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 behavioural 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 behavioural intention refers to the TAM (Davis et al., 1989).

Co-funded by the Erasmus+ Programme of the European Union

1. Intervention

The AI4T intervention revolved around two common online resources translated for all 5 countries. The first resource was the AI4T Mooc. The second resource was a textbook entitled *AI for Teachers: An Open Textbook.* Finally, a set of common learning outcomes was 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.

In Slovenia, the professional learning pathway took place from the 17th of February until the 20th of March 2023 (24 hours of 45 minutes) and followed an online format. It started with the online training (Mooc and textbook on the Moodle platform – ARNES e-classroom). The online training was complemented by three webinars (online) presenting two AI tools, InstaText (Dr. Matej Guid, University of Ljubljana) and Orange (Dr. Janez Demšar, University of Ljubljana), and the AI4T textbook (Dr. Colin de la Higuera, University of Nantes). It also included the completion of baseline and endline questionnaires for teachers. The introductory and closing meetings were accompanying activities.

Figure 1: The AI4T professional learning pathway in Slovenia

Co-funded by the Erasmus+ Programme of the European Union

Teachers from Slovenia who participated in the intervention group had access to the AI4T online training from the 17th of February until the 20th of March 2023. The Slovenian AI4T e-classroom was coordinated by representatives of the Ministry of Education and the University of Maribor. The professional learning for the control group of teachers (opening of the e-classroom and access to webinars) took place from the 29th of May until the 7th of July 2023.

Co-funded by the
Erasmus+ Programme
of the European Union

2. Experimental design

2.1. Recruitment and randomization

Between May and December 2022, the Slovenian Ministry of Education recruited 269 volunteer teachers from 76 schools (post-secondary level). This number of teachers corresponds to approximately 4.3% of all teachers teaching at the post-secondary level in Slovenia[3]. The teachers recruited included 121 maths teachers, 97 english teachers and 51 teachers of other subjects.

The sample is not assumed to be representative of the general population of teachers in Slovenia, although the sample of volunteer schools represented a significant proportion (approximately 50%) of the total number of post-secondary schools in Slovenia[4]. The participating schools are located in both cohesion regions of Slovenia (Eastern Slovenia and Western Slovenia). All types of secondary schools were included, namely 29 general post-secondary schools and 47 vocational and technical post-secondary schools or schools with mixed programmes.

An evaluation project partner in Slovenia (The Educational Research Institute) randomised the sample into two groups: an intervention group and a control group. The intervention group received access to the AI4T professional learning pathway during the experimentation phase of the project (February and March 2023), while the control group was granted access to the online learning resources only after the end of the experimentation phase (from May to July 2023). The randomization took place before the administration of the baseline questionnaire for teachers. Participants were randomised at the school level. Following the recommendations of Banerjee & Duflo (2017), the chosen method for the randomization was stratification. The strata with 4 schools were created. When the number of schools could not be divided by 4, strata of 3 or 2 schools was formed. To determine homogeneity within strata, the stratification criteria were classified according to the order of their importance. The stratification criteria were used to create strata within each sub-sample to ensure that the schools in each stratum were as similar as possible. The Ministry of Education has collected and provided the data used for the schools according to the following stratification criteria:

- cohesion region,
- type of school,
- number of volunteer teachers in the school.

Numbers were then randomly generated to select the strata of schools that were placed in the intervention group, applying the three stratification variables from above. The intervention group comprised 40 schools (20 from Eastern Slovenia and 20 from Western Slovenia) and 148 teachers (71 from Eastern Slovenia and 76 from Western Slovenia). Regarding school type, 17 general education and 23 vocational, technical and mixed schools were classified in the intervention group.

For the qualitative evaluation (interviews with teachers and school leaders), a subset of schools within the intervention group was selected. Participation in the interviews was voluntary. The call for interviews was sent to schools by the Ministry of Education. Teachers and school leaders applied directly to the Educational Research Institute to be interviewed.

[3] Statistical Office of the Republic of Slovenia (2022/23 school year).

[4] According to the Statistical Office of the Republic of Slovenia, in the 2022/23 school year post-secondary education in Slovenia was provided by 143 public schools with units, 6 private institutions and 6 institutions for students with special needs.

Co-funded by the
Erasmus+ Programme
of the European Union

2.2. Theoretical framework

The AI4T project focused on AI in education, tackling an ongoing and 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, on digital technologies and evaluation of teacher professional development. Specifically, the work of Guskey (2000) was used as a basic framework. According to Guskey (2000), an effective evaluation of professional development involves the collection and analysis of five critical levels of information: 1) participants' reactions, 2) participants' learning, 3) organisational support and change, 4) participants' use of new knowledge and skills, 5) students' learning outcomes. According to the development of the AI4T project, the evaluation covered only the first four elements identified by Guskey.

For each level, the evaluation team created robust indicators adapted from existing scales and tested them during the project's pilot phase. Scales were based on the Likert format and generally had 7 answer options for teachers and school leaders and 5 for students. The response anchors were chosen following the recommendations of Casper *et al*. (2019) to ensure equal intervals between each anchor.

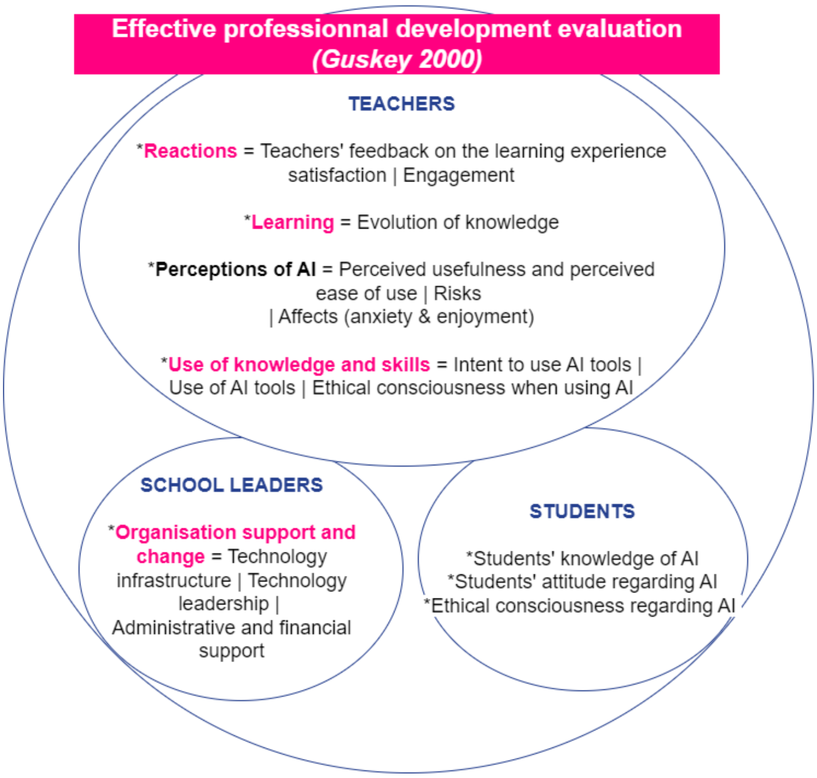

Figure 2: The theoretical framework for the evaluation of the AI4T professional learning pathway

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 *et al.* (2020). The level of engagement in the professional learning pathway was measured through the behavioural, cognitive, social and emotional connections that the participants made with the course content, the instructors and the other learners. While the behavioural engagement corresponds to learners'

Co-funded by the
Erasmus+ Programme
of the European Union

observable actions, such as taking notes, cognitive engagement corresponds to participants' mental investment in the learning process. Social engagement refers to both learner-instructor and learner-learner interactions, while emotional engagement centres on emotional connections with the professional learning pathway (enjoyment, interest, etc.). The satisfaction scale was adapted from Yenneck (2014). Yenneck identified key dimensions of satisfaction, such as the satisfaction with the utility of the course, which has an impact on learning benefits and changes of practice. For both scales, participants were presented with statements and had to answer on a Likert scale from strongly disagree to strongly agree. The answers were then converted into scores from 1 to 7.

The measure of **participants' learning** was based on the content of the AI4T Mooc and additional reports on AI (European Commission, 2019; Samoili *et al.*, 2020; Fengchun *et al.*, 2021). Experts on AI in education from and outside of the consortium were consulted to review the questions and their interpretation. To measure participants' learning, we asked participants to self-assess their knowledge of AI, indicate their level of familiarity with AI technologies, answer true/false questions about how AI works, and identify tools that contain AI. We also asked them through open questions, to give a definition of AI and to name an AI tool that could be used for educational purposes.

Data on **organization support and change** were collected through school leaders. Guskey (2000) recommends assessing whether the organization's policies and characteristics are compatible with the implementation of the envisioned change. To address the integration of AI, the evaluation team assessed the technology infrastructure and technology leadership of the schools. Access to technological equipment is sometimes described as the first-order barrier to technology integration, compared to the second-order barrier of teachers' beliefs (Ertmer *et al.*, 2012). It is a prerequisite for integrating technology into teaching practices. The second dimension measured, technology leadership, was developed by Anderson and Dexter (2005). In their model of technology leadership, Anderson and Dexter (2005) point at several indicators, such as school leaders' own use of technology. They stress that school leaders should model using the technology to encourage adoption. Their indicators also include the number of days school leaders have spent on planning, maintaining and administering the technology and the presence of an ethics policy within the school for the use of the technology. We used these indicators to assess whether the school context was favourable to AI integration. Because Shattuck (2009) emphasises the importance of school leaders in upholding a vision for integrating technology that aligns with teachers' vision, we also included that element in our measures. Finally, we 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 into the framework the Technology Acceptance Model (TAM) (Davis, 1989), described by Scherer *et al.* (2019, p. 4) 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 toward 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.*

Co-funded by the
Erasmus+ Programme
of the European Union

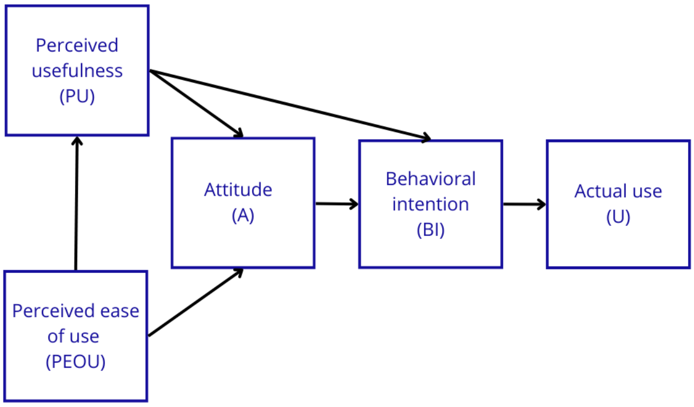

Figure 3: Technology Acceptance Model developed by Davis et al. (1989)

This model identifies two main variables, "perceived ease of use" and "perceived utility", that determine behavioural intention to use and the use of a technology. The evaluation team adapted the original scale from Davis *et 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, that 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 *et al.,* 2019), of interest to the AI4T partners, and can also impact the use of a technology (Février *et 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 *et al.*, 2005).

Both **behavioural 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 *et 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 only gathered endline context information on student's knowledge, attitude and ethical concerns regarding AI. In other words, there was no measurement of impact or change in student learning outcomes before and after the intervention.

We created an attitude scale towards AI in education based on the conceptualization of attitude by Njiku *et al.* (2019) and on existing 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 *et al.*, 2022; Remian, 2019; Schiff, 2021; Akgun & Greenhow, 2021; European Commission, 2022; Holmes *et al.*, 2021).

Co-funded by the
Erasmus+ Programme
of the European Union

2.3. Evaluation instruments

The evaluation of the AI4T intervention is both quantitative and qualitative. Data was collected through questionnaires and interviews. All evaluation instruments were designed as part of the activities of the evaluation work package. After the instruments were translated into Slovenian, they were submitted to the *Ethics Committee of the Educational Research Institute (KEPI)*, which validated their ethical compliance.

Online questionnaires were administered to teachers, school leaders and students. Teachers were asked to answer the same questionnaire twice, at the beginning and at the end of the intervention, while school leaders and students were only surveyed at the end.

For the administration of the questionnaires, the Slovenian Ministry of Education sent generic hyperlinks to the online survey system and identification codes to school coordinators (one of the participating teachers from each school). The school coordinators then ensured that teachers, school leaders and students within their respective schools completed the questionnaires. During the anonymisation process, individual identification codes were issued by the Educational Research Institute to allow access to the questionnaires for participating teachers and school leaders. During the endline data collection, students completed the questionnaire at the school (on a computer or smartphone). Students from one class were given access to the questionnaire using their teacher's identification code (the same code for all students in the class).

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 their 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, during the endline data collection, students were surveyed on their understanding of AI, attitude towards AI and ethical concerns regarding AI.

Interviews were conducted online with teachers and school leaders 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.

2.4. Data collection process

Data collection for the main survey started in Slovenia in December 2022 with a baseline questionnaire for all teachers (intervention and control group). An endline questionnaire for all teachers was conducted after the AI4T professional learning pathway in April 2023. After the endline questionnaire for teachers was administered, school leaders and students started completing their questionnaires (in April and May 2023).

Co-funded by the
Erasmus+ Programme
of the European Union

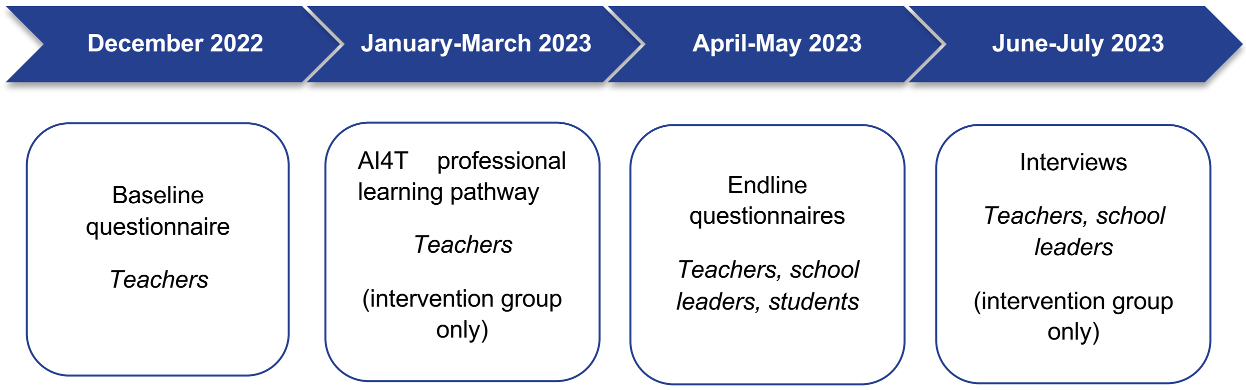

Figure 4: Calendar of the evaluation of the AI4T intervention in Slovenia

All interviews with teachers and school leaders from the intervention group in Slovenia were conducted online by two researchers from the Educational Research Institute. To ensure consistency and reduce bias in the interview process, one interviewer participated in all interviews and in some interviews both interviewers were present. The interviews were conducted according to pre-designed interview grids for teachers and school leaders. All interviews were conducted individually (one teacher or school leader at a time). All the interviews were recorded and later transcribed with the NVivo transcription tool. All machine transcripts were manually reviewed and corrected where necessary.

A total of 24 interviews were conducted with 18 teachers and 6 school leaders. Participants from 13 (32.5%) of the intervention schools were interviewed. The number of teachers interviewed per school varied from 1 to 4. In relation to the total intervention group sample, 12.2% of teachers and 15% of school leaders were interviewed.

Table 1: Response rates for questionnaires in Slovenia

	Number of participants	Number responded	Response rate
Teachers	269	257	95.5%
School leaders	76	75	98.7%
Students	6.280	4.690	74.7%

The response rate of 95.5% among teachers who completed both the baseline questionnaire and the endline questionnaire indicates a high level of engagement and willingness to participate in the evaluation. This is noteworthy as it suggests that most participating teachers found value in the evaluation process and were motivated to contribute their insights. It should also be noted that the completion of the teacher questionnaires was identified as one of the activities in the AI4T professional learning pathway.Teachers who completed the whole pathway were awarded professional development points by the Ministry of Education.

The 98.7% response rate from school leaders is exceptional and indicates almost complete participation from this group. The high response rate from school leaders reflects a strong commitment and engagement at the leadership level.

Co-funded by the
Erasmus+ Programme
of the European Union

Students were not directly involved in the project activities. In Slovenia, participating teachers were asked to select one reference class they were teaching in the ongoing school year. In the baseline questionnaire, they were asked to report the number of students in these reference classes. The total number of students, according to the information provided by teachers, is 6.280. However, it's important to note that the response rate indicates the proportion of students in these classes who chose to participate. There is no data on specific reasons (e.g. absence) or characteristics of the non-responding students that might affect the generalisability of the results. A total of 233 teachers (90.7% of all teachers who completed the baseline and endline questionnaires) engaged their reference classes to complete the student questionnaire. The questionnaire was completed by 4.690 students, corresponding to about 6% of the post-secondary student population in Slovenia[5].

[5] According to the Statistical Office of the Republic of Slovenia, 77.462 students were enrolled in post-secondary education at the beginning of the 2022/23 school year.

Co-funded by the
Erasmus+ Programme
of the European Union

3. Data

3.1. Sample characteristics

Most teachers in the Slovenian sample were female (79.0%), which is higher than the national average (67.2%) in the 2022/23 school year[6]. Participating teachers were relatively experienced, with 16.8 years of average teaching experience. 44.36% of the sample comprised of maths teachers and 35.8% foreign language teachers.

36.2% of the schools where the sampled teachers work are academic (general) secondary schools, 43.6% are vocational schools and 20.2% are mixed schools with both programmes (general and VET). The data about the type of sampled schools are similar to the real data concerning the number of students enrolled in each programme in the 2022/23 school year. A total of 35.52% of students attended general education and 64.48% were enrolled in various VET programmes[7]. The size of the schools (average number of students) was calculated on the school leader database.

A total of 69.6% of the students who completed the questionnaire were enrolled in the 1st and 2nd year of post-secondary education. This means that they were typically between 14 and 16 years old. More students identified themselves as female (51.7%) than male (40.9%). Therefore, there are slightly more female students and slightly fewer male students in our sample than in the general population of post-secondary students in Slovenia (there were 48.80% female students and 51.20% female students in the 2022/23 school year)[8].

Table 2: Characteristics of the sample: questionnaires

Teacher characteristics		
Gender	Female	79.0%
	Male	19.8%
	Prefers not to say / Other	1.2%
Teaching experience	Average number of years of teaching experience	16.8
Subject taught	Maths	44.36%
	Foreign language	35.8%
	Computer science	3.89%
	Other	15.95%
School characteristics		
School size	Average number of students	556
Type of schools	Academic	36.2%
	Vocational	43.6%
	Mixed	20.2%
Classes characteristics		
Student year	1st year (Year 10)	33.8%

6 Statistical Office of the Republic of Slovenia.
7 Statistical Office of the Republic of Slovenia.
8 Statistical Office of the Republic of Slovenia.

Co-funded by the Erasmus+ Programme of the European Union

	2nd year (Year 11)	35.8%
	3rd year (Year 12)	24.5%
	4th year	5.5%
	NA	0.4%
Gender	Female	51.7%
	Male	40.9%
	Prefers not to say / Other	7.4%
Class size	Average number of students in the class	24.4
Proportion of students with academic difficulties	Average proportion of students with academic difficulties in the class	15.9%

Given that the sample consisted of volunteer teachers involved in an AI4T project, it is reasonable to expect that participating teachers have a high level of interest in AI. Furthermore, 80% of the school leaders in Slovenia reported that their school had participated in other projects related to digital technology in the last 5 years, and 17.3% that their school had participated in other AI-related projects in the last 5 years.

Table 3: Characteristics of the sample: interviews

Teacher characteristics		
Gender	Female	83.3%
	Male	16.7%
Teaching experience	Average number of years of teaching experience	21.5
Subject taught	Maths	50.0%
	Foreign language	44.4%
	Other	5.6%
School characteristics		
School size	Average number of students	513
Type of schools	Academic	50.0%
	Vocational	38.9%
	Mixed	11.1%
Engagement with AI		
AI experience before AI4T project	Extensive experience	16.7%
	Moderate experience	27.8%
	Basic experience	33.3%
	Limited or no experience	22.2%
Attitude towards AI	Positive	77.8%
	Neutral	5.5%
	Sceptical/critical	16.7%

Co-funded by the
Erasmus+ Programme
of the European Union

A total of 24 interviews were conducted with 18 teachers (9 mathematics teachers, 8 foreign language teachers and 1 physics teacher) and 6 school leaders from the intervention group. The characteristics of the interview sample are slightly different from those of the questionnaire sample, as teachers and school leaders voluntarily participated according to their individual preferences. The interview sample generally consisted of teachers with more teaching experience, a higher percentage of female teachers, a higher percentage of maths and foreign language teachers, and a higher percentage of teachers from academic schools than the questionnaire sample.

Given the voluntary nature of the sample, teachers' commitment to AI was calculated based on interview data, which showed that generally, voluntary teachers had positive attitudes towards AI, while in terms of previous experience with AI, less than half of the teachers reported having extensive or moderate experience (44.5%) and just over half reported having only basic or no experience of AI (55.5%).

3.2. Data processing

Data cleaning

Due to the administration method that allowed for multiple responses coming from a singular participant, the first step of the data cleaning process was to remove duplicates, identifiable thanks to the unique identification numbers entered by participants. When a single participant answered several times, we kept the most complete answer and if several answers had the same level of completion, we kept only the first one. Incomplete answers were kept as long as the participant had completed at least the first module of outcomes. The reporting of the data cleaning process can be found in the Appendix A: monitoring of the data cleaning process in Slovenia

The correspondence between participants' unique identification numbers, which were specific to the country, and the country entered by participants was checked. A few students indicated a country that was not coherent with their unique identification number. In this case, the country was modified by the evaluator. In the teacher and school leader questionnaires, there was no incoherence between these two variables.

Psychometrics properties of the scales

Before calculating the scale scores, their psychometric properties were tested. The Cronbach alpha coefficient of reliability was calculated on all scales as a measure of the internal consistency. For each item, the evaluation team calculated the item-total correlation and the *alpha if item is dropped*. Items were eliminated from the scale when their correlation with the total was significantly lower than the other items and when their removal improved the reliability. A factor analysis was then conducted for each scale. We used Cattell's scree test to identify the number of factors. Additional items were eliminated when we identified cross-loadings on several factors. A summary of the psychometric properties of the scale can be found in the Appendix B.

To calculate the scores, the Likert scales were converted into their numerical representation. Standardization was operated at the country level based on the mean and standard deviation of the control group in the baseline.

Co-funded by the
Erasmus+ Programme
of the European Union

Balancing checks & attrition

Before conducting the impact analysis, we checked that the randomisation had produced two comparable groups. To do this, we performed a student t-test on teacher characteristics and on the main outcomes measured at the beginning of the intervention (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 regression analyses.

There were statistically significant differences for only two control variables – in the gender composition of the control in intervention groups (with the control group had a higher percentage of men) and teaching experience (the intervention group had more teaching experience on average compared to the control group). There was a small difference in the size of the participating reference classes and no significant statistical difference in the percentage of students with academic difficulties in the class taught by teachers.

A comparison of the mean scores for various outcomes showed that there were very few differences between the control and intervention groups in terms of their knowledge, perceptions and use of AI. These differences were mostly small and not statistically significant, with p-values generally above the conventional threshold of 0.05 for statistical significance. The notable exception is the slightly better knowledge of how AI works in the intervention group, but even this is only at the margin of significance. That is, both groups started with essentially the same self-assessed level of knowledge, reported familiarity with AI technologies, and ability to identify AI in various tools. Both groups had similar perceptions of the ease of use of AI, similar levels of enjoyment of AI, and both groups perceived AI as similarly useful for education. There was no significant difference in the use of AI at baseline. On the other hand, the intervention group started with a slightly lower ethical awareness score, a slightly higher intention to use AI, a slightly more negative score in terms of anxiety about using AI and learning about AI, but again these differences are not statistically significant. For the complete results of these analyses, see the Appendix C: comparisons of control variables and outcomes at the initial stage between the control group and the intervention group.

The comparability of the two groups is also dependent on the attrition throughout the experiment. A difference in response rates between the two groups could lead to both observable and unobservable differences. Table 4 presents the response rates for different types of participants (teachers, school leaders, and classes) in both the control group and the intervention group.

Table 4: Response rate for each type of participant

	Control group	Intervention group
Teachers' response rate ***(answered both questionnaires)***	99.2%	92.6%
School leaders' response rate	97.2%	100.0%
Classes' response rate	90.0%	84.5%

The response rate among teachers is higher in the control group than in the intervention group. While the school leaders' response rate is perfect in the intervention group, it is lower but still high in the control group. The response rate among classes is higher in the control group. Overall, the differences in attrition between the two groups of teachers and classes, are noteworthy. While high response rates in both groups are generally desirable to ensure comparability and reduce bias, the lower rates in the intervention group (for teachers and classes) suggest potential issues with attrition bias. This could mean that those who

Co-funded by the
Erasmus+ Programme
of the European Union

responded in the intervention group might differ systematically from those who did not, potentially affecting the validity of comparisons between the two groups.

Compliance

In the endline questionnaire, teachers were asked whether they had received access to the AI4T professional learning pathway. The results show that generally, the randomization was well-respected. However, 7.4% of teachers reported that they had access to the training even though they were in the control group and 0.8% reported that they had no access even though they were in the intervention group.

We do not know the reasons for the reporting of teachers in the control group. It is likely that the problem was either the clarity of the questionnaire question or their understanding of what was included in the training (there was an introductory meeting for all teachers, including the control group, before the e-classroom with the Mooc and textbook was opened for the intervention group).

Further details are provided on their effective engagement in the professional learning pathway in the section Completion and engagement.

Processing of qualitative data

At the project level, the same interview grid was developed and used in all participating countries. In Slovenia, the interview grid was translated into Slovenian and used for the interviews. The interviews were conducted in the Slovenian language. They were recorded (with the consent of the interviewees) and transcribed. They were then analysed using the NVivo 12 tool. The data collected through the interviews were used to complement the data collected through the questionnaires.

Open-ended questions in questionnaires were also treated as qualitative data. A common analysis grid (coding book) was defined at the project level.

4. Teacher results

4.1. Teacher's reaction to the training

Expectations

In the endline questionnaire (after the professional learning pathway), teachers in the intervention group were asked to share their expectations of the AI4T professional learning pathway through an open-ended question. **63.0%** of teachers said they expected to receive **concrete support in using AI tools**, and **41.6%** said they expected to **learn more about AI**.

When asked whether their expectations had been met, **12.3%** of teachers replied “completely”, **55.8%** “for the most part”, **26%** “a little” and **1.3%** “not at all”.

The data from the interviews confirm the information from the endline questionnaire that teachers in Slovenia expected more "examples of use" of AI in education and more examples of AI tools that could be "directly used in the classroom". In particular, the interviews showed that teachers would like to see more real-life examples of AI in education during the training, including insights into the challenges they might face when implementing AI in real classrooms, and discussions about overcoming barriers and practical solutions to common implementation problems. Another aspect that teachers would like to see more of during the training is concrete pedagogical strategies on how to practically apply AI concepts and/or tools in the classroom, in their teaching and assessment methods, lesson planning and student engagement.

Completion and engagement

Most teachers have engaged with all four parts of the professional learning pathway. **86.4%** of teachers reported that they had partially or fully completed the MOOC, **81.8%** that they had completed the interactive textbook, **90.3%** that they had completed at least 2 webinars and **92.2%** that they had regularly attended online meetings.

Only a few teachers reported obstacles to their participation in the professional learning pathway in the questionnaire: 3.2% reported a lack of technical equipment, 4.5% a lack of space to work with the online materials, 3.9% bugs in the online materials and 3.2% a lack of support from the school administration. The most significant barrier reported by teachers in the interviews was the lack of time to engage with the professional learning pathway. In this respect, many teachers said they liked that the entire pathway was organised as an online activity. By saving time on travel, they had more time to engage in the training. However, it is also important to note that most of the teachers interviewed explained that they were not very comfortable with the online-only format, as they felt that a blended format (online and face-to-face) would have increased their engagement and take-aways from the training.

The mean score of **5.44** for the emotional engagement of participating teachers indicates a high level of **emotional** connection to the learning experience. The relatively low standard deviation (SD of 1.10) indicates a consistent emotional engagement across participants The mean score of **5.14** for **cognitive** engagement reflects a relatively high level of mental investment by participants. This suggests a strong commitment to understanding the course content. The mean score of **4.34** for **behavioural** engagement indicates a moderate level of observable actions by participants, with notable variability (SD of 1.66) between participants (some may show more active behavioural engagement than others). The lowest mean score of **3.48** for **social** engagement indicates a moderate level of engagement in discussions and sharing

Co-funded by the
Erasmus+ Programme
of the European Union

learning materials with other training participants and suggests the need for targeted interventions to foster a more connected learning community.

Satisfaction

Teachers were asked whether they agreed with statements about the utility of the AI4T professional learning pathway for their work. The mean score of **4.75** (SD of 1.25) on the 7-point Likert scale, which falls between **"neither agree nor disagree"** and **"generally agree"**, indicates a positive but moderate satisfaction with the AI4T professional learning pathway. It suggests that, on average, teachers found it to be beneficial in terms of their work efficiency, practical value for their work, and professional skill enhancement, but this satisfaction is not overwhelmingly strong.

This is consistent with the specific statements where a significant percentage of teachers reported positive agreement, particularly in relation to the **responsiveness of the pedagogical team** (81.2%), the **relevance of the content** (76.6%) and the opportunity for active participation (66.9%). In addition, a significant percentage of teachers agreed positively with the practical value of the professional learning experience for their work (53.2%) and its appropriateness for the subject they teach (37.7%). While there is room for improvement (more practical training applicable to the teachers' day-to-day work responsibilities), the mean score straddling between neutrality and agreement, subtly indicates that teachers generally perceive the AI4T professional learning pathway as beneficial.

In this context, it is worth emphasising that **almost half of the teachers (46.8%) did not find the AI4T professional learning experience had great practical value for their work**. This result can be attributed to the fact that a significant proportion of teachers expected more practical activities that were directly applicable to their work. The focus on practical, hands-on activities was a predominant expectation, and the current training may not have fully met these expectations, leading to a less favourable perception of its usefulness for their specific professional needs. This finding highlights the importance of tailoring training content to teachers' expectations to increase their satisfaction.

When asked about specific parts of the professional learning pathway, most teachers were satisfied or very satisfied with each of the four components of the professional learning pathway, with satisfaction levels ranging from 63.6% to 68.2%. While there may be slight variations in satisfaction levels, the overall positive and relatively consistent satisfaction levels across the MOOC, textbook, webinars, and online meetings suggest a well-received training programme and successful design and implementation of different components within the pathway. Teachers' most frequent praise for the MOOC was that it was well structured. However, for the pathway as a whole, they most frequently emphasised its instructional value.

The interviews showed similar results. 14 out of 18 (77.8%) of the teachers interviewed were satisfied with the professional learning pathway. 4 teachers were neutral or highlighted both positive and negative aspects. Almost all teachers emphasised that they had gained much knowledge from the training and that their commitment had been worthwhile, even though **they would have liked to have seen more practical content**. The interviews also showed that most teachers perceived the professional learning pathway as a whole. They did not see it as consisting of four components, so they tended to evaluate it as a whole.

Below are some quotes from interviewed teachers on the AI4T professional learning pathway:

> *"The expectations were perhaps a little different from what was actually offered to us. But […] looking at it now from a distance, I would say that I am very happy to have been involved, and I am also very happy with the material we received. Maybe at the beginning, I was expecting more*

Co-funded by the
Erasmus+ Programme
of the European Union

concrete examples of good practice that I could use in teaching English, but I did not get that." (Language teacher)

"I expected more. I expected more concrete situations from the classroom. How to apply this in a concrete situation. Not so much the theoretical part, although I know we need to know that too. But I would have liked to have been told in the second year, when dealing with vectors, we can do this and that with the help of AI. Something like this, for example. And that's what I missed." (Maths teacher)

"When I talked to the teachers in our school, our expectation was that there would be a more concrete presentation of a tool to be tested later in the classroom. But in fact, there were just some lectures. … Our expectation was that maybe we would get a new app, a new tool that we would present in the classroom, work with it and then write up what the experience was like. But it was very broad, and you could use any tool, so you chose one that you already knew." (Math teacher)

"It took me a long time to do it. That could be a minus, but on the other hand, it's a plus because I learned a lot of new things. I really learned a lot. […] In general, it was all very good. Maybe a little bit more of practical examples." (Maths teacher)

"It was good. I have to say that this training was very professional and very well done. If I had to rate it, I would really give it 5 out of 5. I have attended others, I will not name them, and this was actually my favourite." (Physics teacher)

In summary, the AI4T professional learning pathway for teachers was modestly positively received. Initially, teachers had high expectations, mainly for concrete support in using AI tools and gaining a deeper understanding of AI. While the majority felt that the training largely met their expectations, a significant proportion wanted more practical, classroom-applicable content. While the online format was praised for its convenience, some teachers suggested a blended approach. Despite high levels of emotional and cognitive engagement, social engagement was lower, highlighting an opportunity to foster more interactive learning communities. Overall, according to the perception of teachers, the AI4T professional learning was successful in increasing AI knowledge among teachers, but future training could benefit from a stronger focus on practical applications in the classroom to better align with teachers' needs.

4.2. Teachers' learning

Knowledge of AI

In the baseline and endline questionnaires, teachers from the intervention and control groups answered questions about their knowledge and understanding of AI. Teachers' self-assessed initial knowledge (before the start of the learning pathway for the intervention group) was characterised by a medium level of knowledge with **72.8%** of teachers choosing the answer options "rather poor" or "rather good". A total of 13.2% of teachers rated their knowledge as "good" and 1.2 % as "very good". A comparison of teachers' responses in the baseline and endline questionnaires showed that **teachers' self-assessed knowledge of AI was higher in April 2023 than in December 2022**, as the percentage of teachers who

Co-funded by the
Erasmus+ Programme
of the European Union

rated their knowledge as “very good”, “good” and “rather good” increased. At the same time, the percentage of teachers who rated their knowledge as “rather poor”, “poor” and “very poor” had decreased.

In interpreting these findings (Figure 5), it is important to note that the reported increase in perception of own knowledge cannot be attributed only as a result of the potential quality, effectiveness and relevance of the AI4T professional learning pathway. The data also included the control group that had not yet participated in professional learning at the time of the endline questionnaire.

However, a number of other factors that are likely to have had an overall positive impact on teachers' self-perceived knowledge of AI should also be considered. Particularly the evolution of the AI landscape, as a large amount of AI-related information may have emerged in between the baseline and endline questionnaires. Teachers in the intervention and control groups had many other opportunities to stay informed of the latest developments, which may have contributed to a better perception of their knowledge.

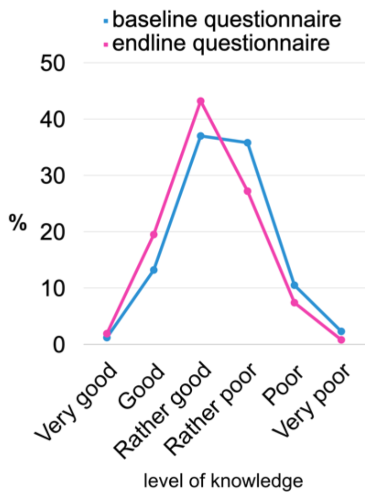

Figure 5: Self-perception of teacher knowledge of AI before and after the training

In both questionnaires, teachers were also asked about their familiarity with various AI technologies and tools. In December 2022, teachers reported a relatively low level of familiarity with technologies such as “machine learning” and “neural networks”, with an average score of **2.14** (on a scale of 1 to 5). Similarly, it appeared that many teachers were unfamiliar with AI tools, as **40.1%** of the participating teachers were unable to name at least one AI tool, and only **20.6%** were able to name a tool that had been identified as AI. **Four months later, teachers reported a higher level of familiarity with AI technologies**, with an average score of **2.59**, and a total of **68.1%** of teachers were able to name an AI tool, and only **10.5%** of teachers were unable to name at least one AI tool.

In responses to an open-ended question asking teachers to describe AI**,** the endline data suggests an overall **positive trend in deepening teachers’ knowledge and understanding of AI concepts**. In the baseline questionnaire, **41.6%** of teachers associated AI with some type of software, revealing a common understanding among teachers that AI involves computer-based programs or applications. The percentage remains relatively stable in the endline questionnaire, with a slight decrease to **39.4%**. At baseline, **17.1%** of teachers associated AI with imitating human intelligence, a percentage that increased significantly to **33.2%** in the endline questionnaire, indicating a significant improvement in recognition of AI's ability to mimic human cognitive functions. There was a notable improvement in the perception of AI's ability to learn, with the percentage increasing from **23.3%** (baseline) to **33.2%** (endline), indicating an increased understanding that AI systems can adapt and improve over time by learning from data and experience. Similarly, the understanding that AI is designed to achieve specific goals increased from **13.6%** (baseline) to **21.7%** (endline), indicating an increased awareness that AI technologies are often developed with specific purposes or goals. While there was a decrease in the mention of the AI's ability of data collection from **9.7%** (baseline) to **7.8%** (endline), there was an increase in recognition of the AI's ability of data processing from **14.4%** (baseline) to **19.7%** (endline). Perceptions of the AI's ability to make decisions decreased slightly from **16.7%** (baseline) to **13.3%** (endline).

Co-funded by the
Erasmus+ Programme
of the European Union

Most interviewed teachers from the intervention group had the perception that the training had increased their knowledge of AI and that they think the most significant impact of the training was on their knowledge. Interviewed teachers felt they had made **more progress in their theoretical knowledge than in their practical knowledge of AI**. It is important to add that two (11%) of the teachers interviewed said they had learnt nothing or almost nothing in the training. These teachers self-reported a very high level of knowledge about AI and would have liked a more advanced AI learning experience.

Below are some quotes from interviewed teachers on the AI4T professional learning pathway:

> *"Overall, we have got a slightly broader insight into what AI could be. Before, we all had our own ideas." (Maths teacher)*
>
> *"I learned a lot. What AI is, how it works, how to use it. I've also had a glimpse of the future – where education is going." (Maths teacher)*
>
> *"My personal experience has been extremely positive. I have to say that I have gained a lot, I have learnt a lot, I have become familiar with things. […] From an educational point of view, I would say that the training has offered me a lot." (Language teacher)*
>
> *"It is a little clearer to me what is going on. A little more than before. I have gained knowledge from this seminar and from media." (Maths teacher)*
>
> *"I congratulate the Ministry for recognising that the future is now, not in the future, but already happening. What and why, even they did not know. And there were also examples that were already very, how shall I say, outdated forms of artificial intelligence. Today's artificial intelligence is much more advanced." (Language teacher)*

Impact

The impact of the intervention on the teacher's knowledge of AI are presented in Table 5 below. Five models on teacher knowledge of AI were tested with each of the following as a dependent variable in each separate model:

- 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

In each model the following independent variables were used:

- Randomization (0 - control, 1 - experimental group)
- Time (0 - baseline, 1 - endline)
- Gender (0 - female, 1 - male)
- Years of teaching experience
- Subject (language)

Co-funded by the
Erasmus+ Programme
of the European Union

- Subject (mathematics)
- Type of school (other type of school)
- Type of school (vocational)
- Self-efficacy for integrating technology into the classroom

The results show that randomization (control vs. experimental group) has no significant effect on any of the knowledge variables. Most of the coefficients are close to zero. The only coefficient which is positive and stronger for the randomization is for the familiarity with AI technologies (*b* = 0.173) but is also insignificant. The coefficients for the knowledge of how AI works, identification of AI tools that are mainly based on AI, and the identification of AI tools that are not mainly based on AI are negative but very weak (-0.094, -0.076 and -0.019, respectively). The time the questionnaire was administrated shows that **the effect is significant for the endline questionnaire for knowledge of how AI works** (*b* = 0.260) and **identification of AI tools** that are mainly based on AI (*b* = 0.276) while insignificant for the other three scales. **For gender, the coefficient is strong, negative and statistically significant for male respondents** (*b* = -0.352). For gender, no significant results were found for any of the other knowledge scales where the coefficients were also very low, close to zero. The **coefficients for years of teaching experience are statistically significant but negative**, meaning that the effect of years of teaching experience is lower for the teachers with more teaching experience (i.e. older teachers) for all knowledge scales (*b* = -0.012, *b* = -0.009, *b* = 0.012 and *b* = 0.010), except for the identification of AI in tools that are not mainly based on AI where the coefficient is very close to zero (*b* = 0.001) and insignificant. It has to be noted that, although significant, the rest of the coefficients are also very weak.

Foreign language as a subject taught by teachers had strong, positive and significant effects on identifying AI tools, either that are, or are not, mainly based on AI (*b* = 0.283, and *b* = 0.299 respectively). On the contrary, the effects of Mathematics as a subject teachers teach had strong and significant effects on the self-assessment of knowledge of AI and knowledge of how AI works scales. However, while for the first scale, the effect is positive (b = 0.201, mathematics teachers have better self-assessment of AI knowledge), for the second one, the effect is negative (b = -0.219, mathematics teachers have less knowledge of how AI works). The type of school (other) has no significant impact on the results. The type of school (vocational) has a negative significant effect on the self-assessment of knowledge of AI (*b* = -0.148), knowledge of how AI works (*b* = -0.192) and identification of AI in tools that are mainly based on AI (*b* = -0.216). That is, the Slovenian **teachers from vocational schools have lower self-assessment knowledge, knowledge of how AI works and improper identification of AI** in tools that are mainly based on AI. For the other two scales, the effect of school type (vocational) is insignificant.

The self-efficacy for integrating technology into the classroom is positively and significantly related to the teacher's self-assessment of AI knowledge (*b* = 0.321), knowledge of how AI works (*b* = 0.083) and familiarity with AI technologies (*b* = 0.213). The self-efficacy for integrating technology into the classrooms has a weak and insignificant relationship with the other two variables on the identification of AI tools (mainly based or not based on AI).

The intervention effects for all five knowledge scales are strong and significant ($p < 0.001$) with all of the impacts from the intervention being positive, meaning that the results were significantly higher for the intervention groups in the endline questionnaire compared to the baseline questionnaire. The explained variances from the models are 25% for the self-assessment of knowledge of AI, 8.7% for the knowledge of how AI works, 19.7% for the familiarity with AI technologies, 16.5% for the identification of AI in tools that are mainly based on AI, and 14.6% for the identification of AI in tools that are not mainly based on AI. The highest amount of explained variance is for the self-assessment of knowledge of AI.

Co-funded by the
Erasmus+ Programme
of the European Union

Table 5. Impact of the intervention on the teacher's knowledge of AI

	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	0.076	-0.094	0.173	-0.076	-0.019
	(0.101)	(0.143)	(0.116)	(0.127)	(0.128)
Time	0.000	0.260*	0.184	0.276**	0.078
	(0.101)	(0.144)	(0.117)	(0.128)	(0.129)
Gender (1=male)	0.043	0.035	0.050	0.055	-0.352***
	(0.093)	(0.132)	(0.108)	(0.118)	(0.119)
Years of teaching experience	-0.012***	-0.009*	-0.012***	-0.010**	0.001
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
Subject = language	0.128	-0.176	0.008	0.283**	0.299**
	(0.100)	(0.142)	(0.115)	(0.126)	(0.127)
Subject = mathematics	0.201**	-0.219*	0.003	-0.052	-0.013
	(0.093)	(0.133)	(0.108)	(0.118)	(0.119)
Type of school = other type of school	-0.149	0.009	0.159	-0.129	-0.106
	(0.098)	(0.140)	(0.114)	(0.125)	(0.125)
Type of school = vocational	-0.148*	-0.192*	-0.075	-0.216**	0.143
	(0.080)	(0.113)	(0.092)	(0.101)	(0.102)
Self-efficacy for integrating technology into the classroom	0.321***	0.083*	0.213***	0.033	-0.048
	(0.034)	(0.048)	(0.039)	(0.043)	(0.043)
Intervention	0.471***	0.445**	0.612***	0.700***	0.597***
	(0.139)	(0.197)	(0.160)	(0.176)	(0.177)
Constant	-1.606***	-0.087	-1.001***	0.018	0.231
	(0.239)	(0.339)	(0.276)	(0.303)	(0.304)
Observations	514	514	514	514	514
R2	0.250	0.083	0.197	0.165	0.146
Adjusted R2	0.235	0.064	0.181	0.148	0.129

Co-funded by the Erasmus+ Programme of the European Union

In summary, years of teaching experience and vocational type of schools have the strongest effect on the knowledge scales. In both cases, the effect is negative, i.e. older teachers tend to have less knowledge and vocational school teachers tend to have less knowledge. These variables are followed by the self-efficacy for integrating technology into the classroom where higher levels of self-efficacy are related to higher self-assessment, knowledge of how AI works, and familiarity with AI technology, but not with identification of technology. Language teachers are better at the identification of AI technology while mathematics teachers are not. The results in the endline administration show mostly positive effects on knowledge from the intervention.

4.3. Teachers' perceptions

Perceptions of AI

The results show an overall **positive trend in teachers' attitudes towards integrating AI in education**. While there is a slight decrease in the percentage of agreement from baseline to endline for statements such as finding the challenge of learning about AI exciting, enjoying using AI tools, and finding AI tools stimulating, most teachers still express positive attitudes. In particular, the AI enjoyment scale, where 7 is the highest score, remains consistently high in baseline (**5.43**) and endline (**5.35**). Despite declining enthusiasm for conducting lessons with students using AI tools, the data indicate a generally optimistic outlook among teachers, highlighting their openness to the challenges and opportunities presented by AI in education.

In contrast, teachers' concerns and worries about integrating AI into their work are low, although the **overall anxiety modestly increased** from baseline to endline from **2.80** to **2.95** on the same scale. There is a notable increase in the percentage of teachers expressing anxiety about learning to use AI tools (from **11.7%** to **21.4%**) and using AI tools (from **11.3%** to **17.9%**). At the same time, there is a slight increase in fears of making mistakes when using AI tools (from **26.8%** to **30.7%**) and conducting class sessions with students using AI tools (from **8.6%** to **11.3%**), while concerns about AI tools malfunctioning show a slight decrease (from **19.5%** to **16.3%**). The recognition and addressing of these concerns in future professional learning initiatives will be critical to building teacher confidence in the integration of AI.

Teachers' growing concerns in the endline questionnaire (after the intervention group engaged in professional learning and deepened their knowledge of AI) were particularly evident in their responses to the open-ended question asking them to indicate their emotions about AI. Between the baseline and endline questionnaires, the responses categorised as **apprehension about AI (fear, worry or mistrust) increased from 25.3% to 40.2%.** We do not know the actual reason for this, as only a small number of teachers explained why the use of AI (by them or by their students) makes or would make them anxious. Of those who did explain, most wrote that their anxiety was caused by teachers not mastering AI tools enough and ethical concerns about using AI in class. The evaluation suggests, however, that the reasons for anxiety are unlikely to be significantly related to their worries about the future of the teaching profession. The percentage of teachers who think the increased use of AI in schools will devalue the teaching profession has only increased from 14.8% (baseline) to 16.8% (endline). In addition, the percentage of teachers who believe that AI will gradually replace teachers has decreased from 9.3% (baseline) to 7.4% (endline).

Co-funded by the
Erasmus+ Programme
of the European Union

The increase in anxiety highlights the complex emotional landscape that teachers are navigating in the context of AI integration. The analysis of the interviews revealed that for many teachers, the apprehension related to the use of AI is linked to their worries about the **educational implications of AI**, the **lack of pedagogical strategies for effectively integrating AI into education**, and concerns about how AI tools might affect their teaching methods, assessment, and student cheating.

On the other hand, the perceived utility of AI to support teachers in their professional work is notably high, with **90.2%** (baseline) and **86.8%** (endline) of teachers indicating that they generally **agree that AI would be useful in their work**. The activities that teachers think AI could most help them with include administrative tasks (91.4% in baseline, 91.0% in endline), creating educational materials (85.2% in baseline, 87.1% in endline), correcting exercises, homework and tests (85.6% in baseline, 79.7% in endline), monitoring students (87.9% in baseline, 84.4% in endline), identifying areas to improve their teaching (81.3% in baseline and endline), encouraging student collaboration (80.5% in baseline, 71.9 % in endline), motivating and engaging students (77.0% in baseline, 70.7% in endline).

On average, teachers in Slovenia feel moderately to highly comfortable and confident in using AI. On a scale ranging from 1 (indicating low ease of use) to 7 (indicating high ease of use), teachers in Slovenia have a **medium to high perceived ease of use of AI** with an average score of **4.63** in baseline and **4.81** in endline. This means they believe that learning how to use AI tools, using them, becoming proficient in their use and getting them to perform the desired tasks are relatively straightforward tasks.

Impact

The impact on teacher perception used four dependent variables in separate models:

- 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

The independent variables in each model are as follows:

- Randomization (0 - control, 1 - experimental group)
- Time (0 - baseline, 1 - endline)
- Gender (0 - female, 1 - male)
- Years of teaching experience
- Subject (language)
- Subject (mathematics)
- Type of school (other type of school)
- Type of school (vocational)
- Self-efficacy for integrating technology into the classroom

The results are presented in Table 6, which shows the impact of the intervention on the teachers' perception of AI. The randomization had no significant effects on teacher perceptions for all four dependent variables

Co-funded by the Erasmus+ Programme of the European Union

and the estimates were very close to zero, except for the perceived usefulness of AI (*b* = -0.171), but this result is insignificant as well. The time of administration (baseline vs. endline) also had an insignificant effect on all dependent variables, except for the perceived usefulness of administration where the effect is strong (*b* = -0.438) and significant ($p < 0.001$). That is, **in the endline, Slovenian teachers tend to find AI as less useful, compared to the baseline.**

Teacher gender has significant negative effects on two of the perceptions of AI variables – enjoyment associated with the use of AI (*b* = -0.303) and perceived usefulness of AI for education (*b* = -0.224). That is, **male teachers tend to enjoy using AI tools less and tend to find them less useful**. Years of teaching experience have a negative effect on perceived ease of use (*b* = -0.018, $p < 0.001$), i.e. **older teachers find using AI tools more difficult**. At the same time, **older teachers tend to have more anxiety associated with the use of AI** (*b* = 0.08, $p < 0.05$). It is worth noting, however, that in both cases, the coefficients are very weak and close to zero.

There are no significant effects on the perception variables exerted by the language as a teaching subject. Concerning mathematics as a subject teachers teach, the effect is negative for enjoyment associated with the use of AI and learning AI (*b* = -0.244, $p < 0.01$) and perceived usefulness of AI in education (*b* = -0.221, $p < 0.05$), i.e. **mathematics teachers tend to find use of AI tools less enjoyable and less useful for education purposes**.

The type of school is not significantly associated to any of the AI perception variables. The self-efficacy for integrating technology into the classroom is strongly and significantly associated to all AI perception variables. For the ease of use, enjoyment and usefulness the coefficients are positive (*b* = 0.318, *b* = 0.311 and *b* = 0.076). Meaning that **the higher the self-efficacy for the integration of AI in the classroom is, the higher the perceptions of the ease of use, enjoyment and usefulness tend to be**. On the other hand, the coefficient for the anxiety associated with the ease of use and learning about AI is statistically significant and negative (*b* = -0.367, $p < 0.001$), i.e. **the higher the self-efficacy is, the lower the anxiety for use and learning of AI tends to be**. These results are expected as, in general, self-efficacy reduces anxiety.

The overall intervention effects are weak and close to zero, with the only exception for the perceived usefulness of AI for education, where the coefficient is strong (*b* = 0.305). For the perceived ease of use and anxiety for using and learning AI, the coefficients are negative but very weak, close to zero (*b* = -0.005 and *b* = -0.094, respectively). None of the impacts, however, are statistically significant, i.e. **the intervention did not change teacher perceptions**.

The explained variances from all four models are high, except for the perceived usefulness of AI for education (4.5%). The explained variance for the perceived ease of use is 20.2%, for the anxiety associated with use and learning AI it is 16.5%, and for the enjoyment, it is 13.4%.

Table 6. Impact of the intervention on the teacher's perceptions of AI

	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	0.069	-0.069	-0.035	-0.171
	(0.109)	(0.125)	(0.120)	(0.137)
Time	0.153	0.178	-0.174	-0.438***

Co-funded by the
Erasmus+ Programme
of the European Union

	(0.109)	(0.126)	(0.121)	(0.138)
Gender (1=male)	-0.043	0.054	-0.303***	-0.224*
	(0.101)	(0.116)	(0.111)	(0.127)
Years of teaching experience	-0.018***	0.008*	-0.001	-0.002
	(0.004)	(0.005)	(0.004)	(0.005)
Subject = language	0.158	0.170	-0.067	0.002
	(0.108)	(0.124)	(0.119)	(0.136)
Subject = mathematics	0.136	0.101	-0.244**	-0.221*
	(0.101)	(0.116)	(0.111)	(0.128)
Type of school = other type of school	-0.056	-0.125	0.182	0.063
	(0.106)	(0.122)	(0.117)	(0.135)
Type of school = vocational	-0.017	-0.127	0.086	0.052
	(0.086)	(0.099)	(0.095)	(0.109)
Self-efficacy for integrating technology into the classroom	0.318***	-0.367***	0.311***	0.076*
	(0.036)	(0.042)	(0.040)	(0.046)
Intervention	-0.005	-0.094	0.168	0.305
	(0.150)	(0.172)	(0.165)	(0.189)
	0.187	0.148	0.117	0.025
Constant	-1.525***	1.838***	-1.538***	-0.261
	(0.258)	(0.297)	(0.284)	(0.326)
Observations	514	514	515	514
R2	0.202	0.165	0.134	0.045
Adjusted R2	0.187	0.148	0.117	0.025

In summary, the results show that the randomization does not affect the teacher's perceptions. The effect of the time of administration shows that Slovenian teachers tend to see AI as being less useful for education. Male teachers tend to enjoy using AI tools less and tend to find them less useful. Older teachers find using AI tools more difficult and tend to have more anxiety associated with the use of AI. Language as the subject of instruction is not related to the perceptions, while mathematics teachers tend to see the use of AI tools as less enjoyable and less useful for educational purposes. The type of school is not significantly associated with any of the AI perception variables. The self-efficacy for integrating technology into the classroom is strongly and significantly associated with all AI perception variables. The overall impact of the intervention is not significant with any of the perceptions on AI, i.e. the intervention did not change teacher perceptions.

Co-funded by the
Erasmus+ Programme
of the European Union

4.4. Teacher's intention to use AI and use of AI

Teachers' use and intention to use AI

In December 2022, **29.6%** of teachers said they had **not used educational AI tools** since the start of the 2022/23 school year, while **18.3%** said they used them on a weekly basis. Four months later, there was a notable shift, with only **12.1%** confirming that they did not use educational AI tools, and **25.7%** claiming to incorporate them into their teaching practice weekly. It is important to note that teachers' ability to identify AI tools may have influenced their responses. It is often difficult to determine whether tools contain AI or not. Data from open-ended responses and post-professional learning pathway interviews showed that some teachers perceived all digital tools, including simple online quizzes and online classrooms, as AI tools.

The most commonly used educational AI tool by mathematics teachers was **PhotoMath**. By December 2022, 33.3% of teachers were using it and 50.9% of teachers were asking their students to use it. In April 2023, 40.9% of teachers were using this tool and 67.8% of teachers were asking their students to use it. Among English teachers, there was a slight increase in the use of **automatic translators** from 56.3% (baseline) to 60.0% (endline). Similarly, there was a slight increase from 48.3% (baseline) to 54.4% (endline) in the percentage of teachers who asked their students to use automatic translators. **Grammarly** is also used by many teachers in Slovenia. Its use increased slightly between the baseline and endline periods (from 29.9% to 34.4%). The proportion of teachers who asked their students to use the tool also increased (from 24.1% to 34.4%).

We only asked about using the **ChatGPT** tool in the endline questionnaire, as the evaluation instruments were completed before this tool was launched on the 30th of November 2022. The use of ChatGPT is significantly higher among foreign language teachers (42.2%) than among mathematics teachers (15.7%). Similarly, foreign language teachers (35.5%) asked their students to use this tool more often than mathematics teachers (17.4%). Interestingly, mathematics teachers were more likely to suggest this tool to their students than to use it themselves. In contrast, foreign language teachers were more likely to use the tool themselves than to suggest it to their students.

Although teachers' declared use of AI tools is relatively low, **94.2%** of teachers answer "yes" or "probably yes" when asked if they **plan to use AI tools during class sessions in the next five years**. Similarly, **94.9%** of teachers also said they **plan to make their students use AI tools in the next five years**. This intention remains consistent in the endline questionnaire, where teachers gave practically identical responses (94.2% and 93.4%).

To better understand teachers' intentions regarding the future use of AI tools in teaching, the analysis of the interviews categorised teachers' different levels of readiness and intentions to integrate AI tools into their teaching practices. A total of 33.3% of the 18 teachers are moderately inclined or willing to use AI tools as they expressed interest in integrating AI into their teaching but may need more information or training before fully committing. A total of 27.8% of teachers expressed a strong intention to use AI tools in their future teaching practice as they are enthusiastic about integrating AI and actively seek opportunities to implement it. 22.2% of teachers are conditional adopters of AI and are open to using AI tools under specific conditions. They consider using AI in certain contexts or for specific subjects but have reservations about its universal applicability in education. Two teachers (11.1%) are still undecided and unsure about their intention to use AI tools. They may be exploring the possibilities but have not yet made a firm decision about integrating them into their teaching practice. One teacher (5.6%) expressed skepticism about using

Co-funded by the
Erasmus+ Programme
of the European Union

AI tools and may need strong evidence or convincing examples of the benefits before incorporating AI into their teaching methods.

Teachers reported **high ethical awareness related to AI** with an average score of **4.93** in baseline and **5.41** in endline on a scale of 1 to 7. On the other hand, the interviews reveal that, in practice, ethical considerations emerge as one of the most significant factors that prompt teachers to think critically about AI and lead to a more cautious and deliberate approach to integrating AI into their teaching.

Impact

The estimation of impact used the following variables as dependent in the regression models:

- Use of AI
- Frequent use of AI
- Ethical consciousness when using AI
- Intention to use AI

As with the estimation of impact on the knowledge and perceptions, the independent variables in all use and intention to use models are as follows:

- Randomization (0 - control, 1 - experimental group)
- Time (0 - baseline, 1 - endline)
- Gender (0 - female, 1 - male)
- Years of teaching experience
- Subject (language)
- Subject (mathematics)
- Type of school (other type of school)
- Type of school (vocational)
- Self-efficacy for integrating technology into the classroom

The results are presented in Table 7 below. The randomization (i.e. assignment of teachers to control or treatment group), gender, years of teaching experience and vocational type of school are unrelated to the dependent variables in the use or intention to use AI. The time of administration (baseline vs. endline) had a significant effect only on the ethical consciousness when using AI ($b = 0.312$, $p < 0.01$). The coefficient is positive, meaning that **in the endline, the teachers tended to be more conscious of the ethical aspects of AI, compared to the baseline**.

The effect of language subject is positive, strong and significant for the use of AI and frequent use of AI ($b = 0.280$ and $b = 0.345$, respectively) meaning that **teachers whose subject is a foreign language are more inclined to use and frequently use AI**. For the subject of mathematics, the effect is significant only for the intention to use AI, but the coefficient is negative, i.e. the intentions are rather not to use it.

The effect of the academic type of school is significant only for the frequent use of AI ($b = 0.214$), that is, **teachers in general academic post-secondary schools are more inclined to use AI.** Self-efficacy for integrating technology at school has an insignificant effect ($b = 0.33$) only for the use of AI. For the frequent use of AI, ethical consciousness and the intention to use AI the coefficients are positive, strong and

Co-funded by the
Erasmus+ Programme
of the European Union

significant (b = 0.133, b = 0.233 and b = 0.169, respectively), meaning that **with an increase of self-efficacy, the frequency of using AI tends to increase as well with teachers tending to have higher ethical consciousness and tend to have higher intentions to use AI.**

The overall impact of the intervention on these four dependent variables is significant for the use of AI (b = 0.279, $p < 0.05$) and intentions to use AI (b = 0.333, $p < 0.01$). For the frequent use of AI and ethical consciousness when using AI, the results are insignificant. The model for the use of AI explains 11.5% of the variance, for the frequent use of AI – 8.5%, for the ethical consciousness – 11.4% and for the intention to use AI – 8%.

Table 7. Impact of the intervention on the teacher's use and intentions to use AI

	Use of AI	*Frequent use of AI*	*Ethical consciousness when using AI*	*Intention to use AI*
Randomization	0.080	-0.047	0.030	-0.0003
	(0.104)	(0.130)	(0.141)	(0.118)
Time	0.233**	-0.064	0.312**	-0.028
	(0.105)	(0.131)	(0.141)	(0.119)
Gender (1=male)	-0.063	-0.149	-0.083	-0.123
	(0.097)	(0.121)	(0.130)	(0.109)
Years of teaching experience	0.002	0.006	0.008	0.005
	(0.004)	(0.005)	(0.005)	(0.004)
Subject = language	0.280***	0.345***	0.020	0.091
	(0.104)	(0.129)	(0.136)	(0.117)
Subject = mathematics	-0.062	-0.181	0.091	-0.208*
	(0.097)	(0.121)	(0.128)	(0.110)
Type of school = other type of school	-0.050	-0.214*	0.181	0.063
	(0.102)	(0.128)	(0.133)	(0.115)
Type of school = vocational	-0.048	-0.024	0.106	-0.024
	(0.083)	(0.103)	(0.108)	(0.094)
Self-efficacy for integrating technology into the classroom	0.033	0.133***	0.233***	0.169***
	(0.035)	(0.044)	(0.045)	(0.039)
Intervention	0.279*	0.193	0.307	0.333**

Co-funded by the Erasmus+ Programme of the European Union

	(0.144)	(0.180)	(0.189)	(0.163)
Constant	-0.217	-0.728**	-1.529***	-0.906***
	(0.248)	(0.310)	(0.323)	(0.280)
Observations	514	514	457	514
R2	0.115	0.085	0.114	0.080
Adjuster R2	0.097	0.067	0.094	0.062

In summary, the intervention had a limited impact on the use and the intention to use AI. The randomization (i.e. assignment of teachers to control or treatment group), gender, years of teaching experience and vocational type of school are unrelated to the dependent variables in the use or intention to use AI. The time of administration had a significant effect only on the ethical consciousness when using AI; after the intervention, the teachers tended to be more conscious about the ethical aspects of AI. Teachers whose subject is a foreign language are more inclined to use and frequently use AI, and mathematics teachers are more inclined towards a lower intention to use AI after the intervention. For the frequent use of AI, ethical consciousness and the intention to use AI, with an increase of self-efficacy, the frequency of using AI tends to increase as well; teachers tend to have higher ethical consciousness and tend to have higher intentions to use AI. The overall impact of the intervention on these four dependent variables is significant for the use of AI and intentions to use AI.

4.5. Heterogeneity of the effect

We further explored whether the intervention had the same effect depending on teachers' subjects and teachers' self-efficacy in integrating digital technologies in the classroom.

Subject

The results from the impact analysis depending on the subject teachers teach are presented in Table 8 below. The dependent variables are as follows:

- 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

The randomization and "other" types of schools does not have any significant effects on any of the dependent variables. Gender has a significant effect only on the identification of AI tools that are not mainly based on AI. The coefficient is negative, meaning that **male teachers are less likely to identify these tools properly**. The time of administration had positive and significant coefficients for the **knowledge of how AI works and identification of AI in tools** that are mainly based on AI, meaning that these improved

Co-funded by the
Erasmus+ Programme
of the European Union

after the intervention. Years of teaching experience have significant and negative effects on all variables, except for identifying AI in tools that are not mainly based on AI. The negative coefficients mean that **older teachers have lower self-assessment, knowledge of how AI works, familiarity with AI technologies and lower capability for identification of AI in tools that are mainly based on AI.**

When the subject teachers teach is language, coefficients are significant for the two identification-dependent variables meaning that **language teachers are better at identifying tools** that are or are not mainly based on AI. As for the mathematics subject, the coefficients are insignificant for all dependent variables. The coefficients for all dependent variables are also insignificant when regressed on the academic ('other') types of schools independent variable. For the vocational type of school, the coefficients are significant for the self-assessment of knowledge of AI, knowledge of how AI works and identification of AI in tools that are mainly based on AI. The coefficients are negative, meaning that teachers in these schools perform lower on these variables. The self-efficacy for integrating technology in the classroom has positive and significant effects on the self-assessment of knowledge, knowledge of how AI works and familiarity with AI technologies, i.e. **the higher the self-efficacy, the better knowledge on AI teachers have**.

The intervention for teachers of other subjects is positively related to familiarity and the two variables on identification of AI.

The coefficients for the interventions for language teachers are strong, positive and statistically significant for all dependent variables. Similarly, the coefficients for the mathematics teachers are strong, positive and statistically significant for all knowledge variables, except for the knowledge of how AI works. Overall, these results show that **the intervention had a positive impact on teachers' knowledge of AI for teachers of both subjects (foreign language and mathematics)**. The amount of explained variance is highest for the self-assessment of knowledge of AI (25.1%), followed by familiarity with AI technologies (19.9%), identification of AI in tools that are mainly based on AI (17.1%), identification of AI in tools that are not mainly based on AI (14.9%) and knowledge of how AI works (8.6%).

Table 8. Impact of the intervention on knowledge depending on the subject teachers teach

	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	0.077	-0.089	0.175	-0.080	-0.018
	(0.101)	(0.143)	(0.116)	(0.127)	(0.128)
Time	-0.000	0.260*	0.184	0.276**	0.078
	(0.101)	(0.144)	(0.117)	(0.128)	(0.129)
Gender (1=male)	0.036	0.034	0.050	0.068	-0.338***
	(0.094)	(0.133)	(0.108)	(0.118)	(0.119)
Years of teaching experience	-0.012***	-0.009*	-0.012***	-0.010**	0.001
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
Subject = language	0.064	-0.255	-0.037	0.423***	0.380**
	(0.116)	(0.165)	(0.134)	(0.147)	(0.148)

Co-funded by the
Erasmus+ Programme
of the European Union

Subject = mathematics	0.159	-0.208	0.005	0.018	0.075
	(0.108)	(0.153)	(0.125)	(0.137)	(0.138)
Type of school = other type of school	-0.147	0.011	0.160	-0.132	-0.108
	(0.099)	(0.140)	(0.114)	(0.125)	(0.125)
Type of school = vocational	-0.147*	-0.189*	-0.073	-0.219**	0.143
	(0.080)	(0.113)	(0.092)	(0.101)	(0.102)
Self-efficacy for integrating technology into the classroom	0.319***	0.079*	0.211***	0.038	-0.045
	(0.034)	(0.048)	(0.039)	(0.043)	(0.043)
Intervention for teachers of other subjects	0.315	0.360	0.556**	1.002***	0.853***
	(0.208)	(0.294)	(0.240)	(0.262)	(0.264)
Intervention for language teachers	0.547***	0.638***	0.715***	0.498**	0.553**
	(0.173)	(0.245)	(0.200)	(0.218)	(0.220)
Intervention for math teachers	0.479***	0.317	0.548***	0.732***	0.512**
	(0.166)	(0.236)	(0.192)	(0.210)	(0.212)
Constant	-1.553***	-0.049	-0.978***	-0.089	0.148
	(0.245)	(0.347)	(0.283)	(0.309)	(0.311)
Observations	514	514	514	514	514
R2	0.251	0.086	0.199	0.171	0.149
Adjusted R2	0.233	0.064	0.179	0.151	0.128

We also measured the effect of the intervention for math and language teachers separately on the indicators related to the use of AI. The results are presented in Table 9 below. The regression coefficients for randomization, gender, years of teaching experience and vocational school type are insignificant for all use or intention to use variables. The time of administration has a positive and significant effect on the use of AI and ethical consciousness when using AI. Language as a teaching subject has a positive and significant effect on the use of AI and frequent use of AI. Mathematics as a subject has a negative and significant effect on the intention to use AI (mathematics teachers have lower intentions to use AI). An academic type of school ("other") has a negative effect on the frequent use of AI, i.e. **teachers in an academic type of school are less likely to use AI frequently**. Self-efficacy in integrating technology in the classroom has a positive and significant effect on frequent use of AI, ethical consciousness and intention to use AI. The intervention of teachers in subjects other than language and mathematics have a positive and significant impact only for the use of AI.

Co-funded by the
Erasmus+ Programme
of the European Union

The intervention for language and mathematics teachers has different impacts depending on the subject. For the language teachers, the intervention had a positive and significant impact on their ethical consciousness when using AI and on their intention to use AI. For the mathematics teachers, the intervention had a positive and significant impact on the use of AI and the intention to use AI. It is important to note that **(1) the intervention had an impact on the intention (higher after the intervention) to use AI regardless of the subject being taught by the teachers (language or mathematics); and (2) the intervention had an effect on the use of AI for mathematics teachers, but not for language teachers.** The amount of explained variance for these models is highest for the use of AI (12.1%), followed by ethical consciousness (11.6%), frequent use of AI (8.5%) and the intention to use AI (8.2%).

Table 9. Impact of the intervention on knowledge depending on the teacher's use or intention to use AI

	Use of AI	*Frequent use of AI*	*Ethical consciousness when using AI*	*Intention to use AI*
Randomization	0.075	-0.047	0.030	-0.0002
	(0.104)	(0.131)	(0.142)	(0.118)
Time	0.233**	-0.064	0.310**	-0.028
	(0.105)	(0.132)	(0.141)	(0.119)
Gender (1=male)	-0.057	-0.147	-0.091	-0.133
	(0.097)	(0.122)	(0.131)	(0.110)
Years of teaching experience	0.002	0.006	0.007	0.005
	(0.004)	(0.005)	(0.005)	(0.004)
Subject = language	0.388***	0.350**	-0.058	0.031
	(0.120)	(0.151)	(0.162)	(0.136)
Subject = mathematics	-0.041	-0.166	0.066	-0.269**
	(0.112)	(0.140)	(0.153)	(0.127)
Type of school = other type of school	-0.053	-0.214*	0.186	0.065
	(0.102)	(0.128)	(0.133)	(0.116)
Type of school = vocational	-0.052	-0.024	0.109	-0.023
	(0.083)	(0.104)	(0.108)	(0.094)
Self-efficacy for integrating technology into the classroom	0.038	0.133***	0.230***	0.167***
	(0.035)	(0.044)	(0.046)	(0.039)
Intervention for teachers of other subjects	0.457**	0.225	0.179	0.151
	(0.215)	(0.269)	(0.276)	(0.243)

Co-funded by the
Erasmus+ Programme
of the European Union

Intervention for language teachers	0.070	0.204	0.431*	0.373*
	(0.179)	(0.224)	(0.232)	(0.203)
Intervention for maths teachers	0.377**	0.168	0.261	0.387**
	(0.172)	(0.216)	(0.226)	(0.195)
Constant	-0.285	-0.738**	-1.472***	-0.846***
	(0.253)	(0.318)	(0.332)	(0.287)
Observations	514	514	457	514
R2	0.121	0.085	0.116	0.082
Adjusted R2	0.100	0.063	0.092	0.060

Self-efficacy for integrating technologies into the classroom

We then looked at the effect of the intervention in two groups: teachers above the median level of self-efficacy for integrating technologies into the classroom and teachers under the median. The results are presented in Table 10. The randomization and the academic type of school variables have no effect on any of the knowledge variables. Time of administration has positive significant effects on the knowledge of how AI works and the identification of AI in tools that are mainly based on AI (i.e. their scores tend to be higher in the endline administration. Gender has a significant effect only on identification of AI in tools that are not mainly based on AI. The effect is negative, meaning that male teachers tend to be less able to identify these technologies.

Years of teaching have negative significant effects on all knowledge variables, except for the identification of AI in tools that are not mainly based on AI. That is, older teachers tend to have less knowledge in almost all aspects of AI. These coefficients are, however, very weak, close to zero. The language as a teaching subject has positive significant coefficients for the two identification AI variables, meaning that language teachers tend to be better at recognising and making distinctions between AI technological tools. As for mathematics as a teaching subject, the only significant effect is for the self-assessment of knowledge of AI, i.e. mathematics teachers have higher self-assessment.

The vocational school type has negative significant effects on self-assessment of knowledge of AI, knowledge of how AI works and identification of AI in tools that are mainly based on AI, i.e. teachers in this type of school tend to have lower scores on these knowledge variables.

The impact of the intervention on teacher self-efficacy shows that for teachers with low self-efficacy, there was a positive increase due to the intervention for almost all knowledge variables, except for the knowledge of how AI works. For the **teachers with high self-efficacy, the intervention had a positive impact on all knowledge variables**. That is, **teachers benefitted from the intervention**.

The explained variance from these models is fairly high, 25.8% for self-assessment of AI knowledge, 10% for knowledge of how AI works, 20.1% for familiarity with AI technologies, 16.5% for identification of AI in tools that are mainly based on AI, and 14.6% for identification of AI in tools that are not mainly based on AI.

Co-funded by the
Erasmus+ Programme
of the European Union

Table 10. Impact of the intervention on knowledge depending on the teacher self-efficacy for integrating technology into the classroom

	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	0.090	-0.067	0.183	-0.076	-0.022
	(0.100)	(0.142)	(0.116)	(0.128)	(0.128)
Time	-0.000	0.260*	0.184	0.276**	0.078
	(0.101)	(0.143)	(0.117)	(0.128)	(0.129)
Gender (1=male)	0.050	0.047	0.055	0.055	-0.354***
	(0.093)	(0.131)	(0.108)	(0.118)	(0.119)
Years of teaching experience	-0.012***	-0.009*	-0.012***	-0.010**	0.001
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
Subject = language	0.137	-0.159	0.014	0.283**	0.296**
	(0.099)	(0.140)	(0.115)	(0.127)	(0.127)
Subject = mathematics	0.211**	-0.202	0.010	-0.052	-0.015
	(0.093)	(0.132)	(0.108)	(0.119)	(0.119)
Type of school = other type of school	-0.141	0.023	0.164	-0.129	-0.108
	(0.098)	(0.139)	(0.114)	(0.125)	(0.126)
Type of school = vocational	-0.150*	-0.196*	-0.077	-0.216**	0.144
	(0.079)	(0.112)	(0.092)	(0.101)	(0.102)
Self-efficacy for integrating technology into the classroom	0.353***	0.142***	0.235***	0.032	-0.056
	(0.036)	(0.051)	(0.042)	(0.046)	(0.046)
Intervention for teachers with high self-efficacy integrating technology	0.292*	0.113	0.487***	0.705***	0.643***
	(0.158)	(0.223)	(0.183)	(0.201)	(0.202)
Intervention for teachers with low self-efficacy integrating technology	0.632***	0.745***	0.725***	0.695***	0.556***
	(0.154)	(0.218)	(0.179)	(0.197)	(0.198)
Constant	-1.791***	-0.430	-1.130***	0.023	0.278
	(0.251)	(0.354)	(0.291)	(0.319)	(0.321)
Observations	514	514	514	514	514
R2	0.258	0.100	0.201	0.165	0.146
Adjusted R2	0.241	0.080	0.183	0.147	0.128

Co-funded by the Erasmus+ Programme of the European Union

The same analyses were performed on indicators related to use. The results are presented in Table 11. Randomization, gender, years of teaching experience and vocational type of school had no effect on the use and intended use of AI. The time of administration had positive (endline higher) significant effects on the use of AI and ethical consciousness when using AI. Language as a teaching subject has a positive significant effect on the use of AI and frequent use of AI (language teachers are more likely to use it). Mathematics as a subject has a negative and significant effect on intention to use AI (mathematics teachers are less likely to use it). The academic type of school has a negative significant effect on the frequent use of AI (these are less likely to use it frequently). **The intervention had no significant impact on teachers with low self-efficacy for any of the use or intention to use AI variables. It does, however, have an impact on teachers with high self-efficacy.** The only variable where there was no impact is the frequent use of AI, but for all other variables, the impact is strong and positive.

The amount of variance explained by the model for the use of AI is 11.5%, for frequent use is 8.5%, for ethical considerations when using AI is 11.7% and for intention to use AI is 8.5%.

Table 11. Impact of the intervention on use and intended use on the teacher self-efficacy for integrating technology into the classroom

	Use of AI	*Frequent use of AI*	*Ethical consciousness when using AI*	*Intention to use AI*
Randomization	0.083	-0.044	0.040	0.012
	(0.105)	(0.131)	(0.141)	(0.118)
Time	0.233**	-0.064	0.311**	-0.028
	(0.105)	(0.131)	(0.141)	(0.119)
Gender (1=male)	-0.061	-0.148	-0.078	-0.118
	(0.097)	(0.121)	(0.130)	(0.109)
Years of teaching experience	0.002	0.006	0.008	0.005
	(0.004)	(0.005)	(0.005)	(0.004)
Subject = language	0.282***	0.347***	0.026	0.099
	(0.104)	(0.130)	(0.136)	(0.117)
Subject = mathematics	-0.060	-0.179	0.096	-0.200*
	(0.097)	(0.121)	(0.128)	(0.109)
Type of school = other type of school	-0.048	-0.213*	0.186	0.070
	(0.102)	(0.128)	(0.133)	(0.115)
Type of school = vocational	-0.049	-0.025	0.105	-0.025
	(0.083)	(0.104)	(0.108)	(0.093)
Self-efficacy for integrating technology into the classroom	0.041	0.139***	0.257***	0.197***
	(0.038)	(0.047)	(0.050)	(0.042)

Co-funded by the
Erasmus+ Programme
of the European Union

Intervention for teachers with high self-efficacy integrating technology	0.235	0.159	0.192	0.179
	(0.165)	(0.206)	(0.213)	(0.186)
Intervention for teachers with low self-efficacy integrating technology	0.319**	0.224	0.413**	0.473***
	(0.161)	(0.201)	(0.210)	(0.181)
Constant	-0.263	-0.764**	-1.662***	-1.065***
	(0.262)	(0.327)	(0.342)	(0.295)
Observations	514	514	457	514
R2	0.115	0.085	0.117	0.085
Adjusted R2	0.096	0.065	0.095	0.065

Co-funded by the
Erasmus+ Programme
of the European Union

5. School leaders' results

5.1. Technical infrastructure of the schools

School leaders generally reported a **good level of ICT equipment for teachers**. In nearly all participating schools (93.3%), more than 95% of teachers are equipped with computers they can use in the classroom. In 73.3% of schools, over 95% of classrooms have a multimedia projector or a smartboard. The majority of school leaders (92%) reported overall good internet connectivity in classrooms, and 85.3% mentioned teachers having access to ICT pedagogical support at school.

Participating schools are **less well-equipped with ICT devices for students**. In 62.7% of schools, there was one ICT device (laptop, tablet or desktop computer) for more than 3 students, while in 22.6% of schools, there was one ICT device for more than 10 students. School leaders in 96.0% of schools reported that students have access to school-provided ICT equipment in common areas such as computer labs or libraries. A total of 64.0% of schools allowed students to use ICT devices in classrooms, although 33.3% of schools reported only partial access in classrooms. Access to school ICT equipment at home varies, with 29.3% of schools reporting access, 42.7% partial access and 28.0% no access. This shows that there are significant differences in students' access to school-provided technology at home across the participating schools.

5.2. Support for professional learning

The AI4T professional learning pathway received strong support from school leaders in Slovenia, with 93.3% encouraging teacher participation in the project and 83.0% providing relevant information about the professional learning.

According to the data provided by school leaders, about half of the teachers (48.9%) were reimbursed for their expenses related to the AI4T professional learning experience, while almost half of the teachers (44.7%) had no expenses related to this learning experience. In general, teachers who participated in the AI4T project were not paid for the hours dedicated to the project (59.6%). Most schools (70.2%) arranged for teachers to be fully or partially replaced during their teaching time when they engaged in the AI4T professional learning, while around a third of participating teachers (27.7%) engaged in professional learning outside their teaching hours.

Participation in this project does not appear to have caused any significant problems in schools, as only 6.4% of school leaders indicated that teachers had encountered issues that required their intervention. The school leaders also confirmed in interviews that they had not experienced any particular problems in relation to the project.

In fact, already in April and May 2023, approximately one month after the intervention, a total of **89.4%** of school leaders reported in the questionnaire that they **had discussed with teachers their satisfaction with the AI4T professional learning pathway**. During the interviews in June and July 2023, many school leaders mentioned that they had spoken to teachers and that teachers' feedback on the training was generally positive. Some school leaders also mentioned that some teachers were not very satisfied with the fact that the webinars were organised in the afternoon (outside teachers' working hours) and that the MOOC was too massive (they had more work than planned).

Co-funded by the
Erasmus+ Programme
of the European Union

The project seems to have generated quite a lot of interest in the participating schools. It is very positive to see that a total of **61.7%** of school leaders in the intervention group indicated in the questionnaire that they already had managed to find time in their school for **peer-to-peer dissemination of knowledge gained from the AI4T professional learning**. Analysing interviews with teachers and school leaders revealed that this knowledge-sharing within schools took place in two forms, as informal conversations between teachers and as organised collaborative learning. A total of 55.6% of the teachers who participated in the interviews said that they frequently or occasionally discussed the AI4T learning experience with their colleagues.

A verbatim quote from one of the teachers interviewed about the organised collaborative learning experience in her school:

> *"We did a group at the school, those of us in training and the headteacher. […] And I have to say that we have already started disseminating within the collective. I think it is very important that those of us who were already involved here spread the word in some way. Our main aim was not to impress anyone but to make people aware of this. We have already done two rounds of training here at our school. The first one was just informative. What is this? What does it mean? Which tools, at least the most well-known ones? Maybe something to think about. Now we have had a bit more, and we have already shown some concrete examples. Before the new school year, probably in August, when we have those preparatory seminars and trainings, those of us who have been involved here at the school will do a bit more in detail for the colleagues. And I think it should be done in all schools. I stress again, not to impress anybody or to say that they have to. But perhaps more to dispel their feelings of anxiety and fear of the unknown. Because this is actually something new, something completely unknown." (Language teacher)*

The active engagement of school leadership in supporting the AI4T professional learning initiative was pivotal. It appears that this support included not only encouraging teachers to participate in 'external' AI4T learning opportunities but also fostering **'internal' learning communities within schools**. The initiative taken by many participating schools demonstrates the key role of leadership in creating an educational environment conducive to exploring new technological possibilities, such as AI integration. This approach has not only disseminated the knowledge and materials produced by the project but has also fostered a culture of collaborative learning. Such a culture is essential to empower a larger number of teachers to learn about AI, to meet new challenges in education, and to confidently navigate and harness the potential of AI in education.

Co-funded by the
Erasmus+ Programme
of the European Union

5.3. School leaders' knowledge and use of AI

Compared to teachers involved in the AI4T project, school leaders' knowledge of AI seems to be slightly lower. A total of 56.0% of school leaders self-assessed their level of knowledge of AI as "rather poor" or lower.

A total of 65.3% of school leaders reported they were aware of some AI tools that could be used for teaching and learning. When listing these tools, 85.7% of them mentioned ChatGPT (alone or in combination with other AI tools).

76.0% of school leaders indicated they don't use AI tools in their work. They gave similar responses in interviews where most of them shared that ChatGPT was the only AI tool they had tried out of curiosity and for minor tasks.

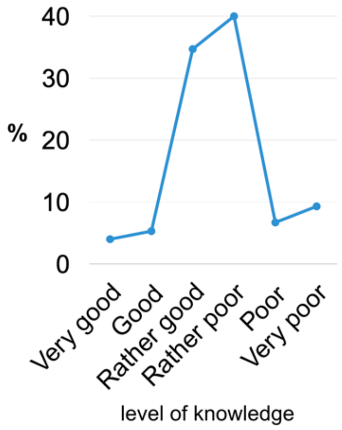

Figure 6. Self-perception of school leaders' knowledge of AI

5.4. AI leadership

Integrating AI in education involves not only technological considerations but also strategic planning and school policy development to ensure its effective and ethical use. In general, **AI leadership within the participating schools is currently still weak**. A total of **64.0%** of school leaders reported that integrating AI into their schools was **not a priority**.

At the same time, 24% of school leaders consider the integration of AI **to be a priority** for most teachers in their school, while 58.2% consider it to be a priority for a minority of teachers. The discrepancy between school leaders' perception that integrating AI is not a priority for the school and their identification that it is a priority for a significant proportion of teachers suggests a misalignment of priorities within the school. This misalignment is critical and may hinder the successful implementation of AI initiatives. It is essential for strategic planning in education to align institutional goals with individual and collective teacher objectives to ensure the effective implementation of innovative practices. The observed discrepancy highlights the future need for a more cohesive approach to strategic planning that integrates AI priorities at both the institutional and teacher levels.

Currently, 78.7% of schools do not have a committee or task force to discuss the use of AI, and **41.3%** of school leaders **have not spent any time planning, maintaining or managing the use of AI in their school. Almost half of school leaders (46.7%) also don't know if teachers in their schools have access to educational AI tools**. The analysis of the interviews showed that school leaders are generally aware of these challenges. Some of them, therefore, mentioned the need for **professional support for school leaders in the field of AI**.

School leaders are generally **aware of ethical issues related to AI**. Half of them (50.7%) consider that ethical concerns play a major role or are the most critical factor in integrating AI in their schools. In addition,

Co-funded by the
Erasmus+ Programme
of the European Union

61.3% of school leaders have already communicated ethical guidelines on AI and data protection to their teaching staff and 25.3% to students' parents.

In summary, Slovenian schools are well equipped with technical infrastructure for teachers, although students' access to ICT devices is more limited. The AI4T professional learning pathway received strong support from school leaders, with a majority encouraging teacher participation and facilitating replacement during teaching hours for the training. Although they did not have a formal role in the project, many of them used the project to actively promote peer-to-peer knowledge sharing and awareness of AI within their schools. Regarding their knowledge and use of AI, school leaders generally had a lower self-assessed understanding of AI than teachers, with many knowing only a few AI tools, primarily ChatGPT. Integrating AI into school is not a high priority for most school leaders. They do, however, show a strong awareness of the ethical issues related to AI.

Co-funded by the
Erasmus+ Programme
of the European Union

6. Students' results

6.1. Student knowledge of AI

In the questionnaire, students were asked whether they **knew what AI is**. The results reveal a somewhat optimistic self-perception, with **45.7%** of students claiming to know **"pretty much"** about AI, while **32.3%** acknowledge knowing **"a little."** However, when tested on their recognition of AI features in specific applications, a more nuanced picture emerges, showing that, despite self-reported awareness, there is room for improvement. Most students correctly identified the **presence of AI features** in some practical scenarios, such as automatic translators (67.1% of students), image recognition systems (81.6%) and search engines (59.6%). Nevertheless, when asked to define AI in an open-ended format, many students struggled to provide a clear and focused response. This suggests a potential gap between general awareness and the ability to articulate a comprehensive understanding of AI concepts.

Analysis of responses to an open-ended question asking students to define AI showed that their understanding of AI was mainly in terms of smart devices and software. A total of **37.5%** of students described **AI as smart devices or software** (i.e. smartphones, apps, computer programs, algorithms, robots) that perform tasks autonomously. **24.5%** of students described AI as **intelligent assistants** that can provide intelligent answers, make decisions, address goals or help with various tasks, often giving examples related to ChatGPT. **12.3%** of students considered AI to be a form of intelligence that **mimics human intelligence** or cognition (i.e., thinking, reasoning, learning, planning, creativity, and problem-solving). **9.3%** of students recognised AI as a **system that learns**, improves itself over time, evolves, and adapts to new information and tasks. **7.6%** of students mentioned the AI's ability to **collect, process, or analyse data and information**.

The data indicates that a significant proportion of students (**42.8%**) **faced challenges in providing a response** that could be categorised within the given classifications. Their descriptions of AI were either unclear, vague, or unrelated to the concept of AI. On the other hand, **30.3%** of students successfully formulated a definition of AI that fell into one category, while **20.9%** articulated definitions that spanned two categories. A smaller percentage (**6%**) of students demonstrated a more comprehensive understanding, as their definitions covered more than two categories. Overall, these results suggest variability in students' comprehension and articulation of the AI concepts, with a notable proportion encountering difficulties in providing clear and focused descriptions. In general, the theoretical knowledge of students to define AI appears to be quite low. The disparities between self-assessed knowledge, recognition of AI in applications, and the challenges in defining AI highlight the complexity of students' understanding. Moreover, the thematic breakdown reveals that students tend to focus on the practical aspects of AI, such as autonomous task performance and intelligent assistance, rather than on fundamental principles, such as machine learning and data analysis. This preference for practical applications in their definitions may indicate that students are more interested in the practical potential of AI and that their practical knowledge may be stronger than their theoretical knowledge.

6.2. Student attitude towards AI

The data shows that students' attitudes towards AI tend to be generally **neutral, with a slight inclination towards positive perceptions**. The measurement involved assessing responses to both positive and negative statements related to AI. On a scale ranging from 1 to 5, where 1 signifies strongly disagree and 5 signifies strongly agree, the average score for the positive attitude scale was **3.68**. This

Co-funded by the
Erasmus+ Programme
of the European Union

suggests that, on average, students tended to agree with positive statements about AI. In contrast, the average score for the negative attitude scale was **3.29**, suggesting that there is a tendency towards neutrality and that, on average, students tend to disagree more with negative statements about AI. The overall tendency towards neutrality suggests that, on average, students do not lean strongly towards either positive or negative attitudes towards AI. It is important to note that the relatively small difference between the positive and negative attitude scales means that neither positive nor negative attitudes significantly dominate students' perceptions of AI. This nuanced perspective may indicate a balanced viewpoint, where students acknowledge both the excitement and potential concerns associated with AI.

However, specific positive and negative statements uncover the nuances in their attitudes. A significant **80.3%** of students agreed or strongly agreed that **AI is exciting**, and **70.0%** that they are **impressed by what AI can do**. They generally agreed that AI would be **useful for education** (63.4%) and that AI would help to **personalise teaching to students' needs** (56.4%). Almost half of students (43.9%) also agreed or strongly agreed that the use of AI will improve the quality of teaching.

Regarding the behavioural component, students were generally interested in **discovering new AI tools for learning** (62.6%) and **planned to use AI for learning in the near future** (62.3%). However, just over half of students (**55.3%**) **wanted to use AI more in the classroom**.

On the other hand, students agreed or strongly agreed that AI will increase the **risk to students' personal data** (53.8%), that the use of AI will dehumanise education (45.9%) and that they are worried about AI (42.6%).

6.3. Student use of AI

Students' data on the use of educational AI tools is roughly consistent with the data provided by teachers in the endline questionnaire. A total of 69.2% of students reported using educational AI tools with the teacher involved in the project (compared to 84.8% of teachers who reported asking their students to use educational AI tools). Similarly, 83.7% of students reported using general AI tools (e.g. search engines, automatic translators) with the teacher involved in the project (compared to 86.4% of teachers who reported asking their students to use generic AI tools). The concurrence between the two questionnaires suggests that students **are aware** that the tools they have been presented with contain AI.

The data on students' use of specific AI tools are even more varied when comparing the students' responses with the teachers' endline responses. Students from the reference classes of mathematics and language teachers reported a much higher use of search engines with their teachers (71.6% and 88.3%) than their teachers reported to asked them (55.7% and 64.4%). On the contrary, PhotoMath is used by students (56.7%) less than their mathematics teachers asked them (67.8%). In language education, a significant proportion of students rely on automatic translators (63.5%), which is higher than the student use reported by their teachers (54.4%). On the other hand, students reported using Grammarly (12.4%) and Duolingo (10.3%) less than their teachers asked them (34.4% and 15.6% respectively).

This comparison between students and teachers regarding the use of specific AI tools by students reveals interesting dynamics that reflect varying preferences or levels of engagement with specific AI tools. The data suggest a higher level of student initiative or independent use of generic AI tools commonly used in various contexts, such as search engines and automatic translators, than explicit teacher instructions. In contrast, students' use of educational or other specialised AI tools, such as PhotoMath, Grammarly, and Duolingo, appears to be more influenced by teachers' recommendations or instructions.

Co-funded by the
Erasmus+ Programme
of the European Union

6.4. Student ethical awareness and worries regarding AI

Evaluation data shows that, on average, the level of students' **awareness of ethical debates related to AI** can be considered moderate to high. A majority of students (60.3%) **have heard about the ongoing debates** concerning potential privacy violations due to data collection by AI tools, indicating a heightened sensitivity to issues related to the use of personal data. More than half of the students (54.7%) have heard about the debate on the potential use of AI for illegitimate intents. Almost half of the students were aware of the ongoing debates about AI transparency (45.6%) and the attribution of responsibility when AI makes decisions for humans (43.5%). Slightly fewer, but still a significant percentage of the students (38.7%) were aware of debates about potential discrimination perpetuated by AI tools, showing a noteworthy level of sensitivity to potential bias and fairness issues associated with AI algorithms.

Students' concerns about AI-related ethical issues largely reflect their awareness of the ongoing ethical debates related to AI. In particular, students were most concerned about the **potential loss of privacy** due to AI data collection (63.4%), and the potential use of AI for **illegitimate intents** (63.1%). Students were also "definitely" or "pretty much" concerned regarding the attribution of responsibilities when AI makes decisions for humans (59.5%). Students are slightly less concerned about potential discrimination perpetuated by AI tools (44.5%) and the transparency of AI (38.2%).

In principle, the more students know about different aspects of AI, the better equipped they are to develop a comprehensive understanding, including ethical awareness. Information is a basis for students to develop a nuanced perspective on AI, allowing them to better navigate and understand the ethical debates surrounding it. The connection between students' expressed concerns and their awareness of specific ethical issues in the AI debate suggests that **their concerns may be influenced by their knowledge of these debates**, as informed students are more likely to consider and articulate ethical implications. This connection highlights the influence of ethical considerations on students' perceptions of AI, and implies that their concerns may not be arbitrary, but rather influenced by the ethical dimensions explored in public discourse and educational settings.

In summary, students in Slovenia showed a positive self-perception of their knowledge of AI. While many could identify AI in practical applications, such as translators and search engines, they struggled to provide clear definitions of AI, often focusing on smart devices and software, showing a preference for practical over theoretical understanding. They generally had a neutral, slightly positive attitude towards AI. They expressed excitement and recognised the usefulness of AI in education but also expressed concerns about privacy and the dehumanisation of education. Most were interested in exploring new AI tools for learning but indicated a preference for generic over educational AI tools. They showed a moderate to high awareness of ethical debates around AI, particularly around privacy and the use of AI for illegitimate purposes. Their concerns largely reflected their awareness of these debates.

Co-funded by the
Erasmus+ Programme
of the European Union

7. Takeaways from teachers and school leaders

7.1. On professional learning about AI

Many teachers and school leaders in the interviews highlighted the **need for professional support for teachers and school leaders on AI.** For this reason, many expressed their satisfaction with being involved in the project covering a topical theme at the right time, as documented in the interview quotes below:

> *"At the beginning of the project, we all asked ourselves: what is this all about? But a lot has happened since then. We have phenomenal timing here. The timing was really great. Just when this ChatGPT started." (Language teacher)*
>
> *"I feel more competent, more confident in the classroom when we talk and work with AI […]. Before, maybe there was a fear, […] but now I feel I can speak confidently. When somebody comes in, maybe not from a teaching background, it is very nice for me to be able to say that we are also in the flow of time, and we are using this and that. And it seems to me that we have really gained so much knowledge through this project that we can speak so confidently." (Maths teacher)*
>
> *"I'm quite happy to have participated. Because it seems to me that this year, AI has expanded a lot. […] Because I was there, I have some information that the teachers who weren't there don't have. And yes, I was a bit forced to do what the others will have to do. Sooner or later, we will all have to acquire this knowledge somewhere." (Maths teacher)*
>
> *"When the first invitation came, I thought, well, yes, they've got some European funding again, another round, we'll talk a lot, when the project is over, it'll be finished and that's it, as usual with all these projects. But I have the feeling that there has been so much turmoil - they have been lucky that a lot has happened in the meantime - and that this will probably be one of the more successful projects because there is, after all, a sense of security in the schools that somebody is thinking at the national level, we are in international comparative stories, we are not alone in this, and we will find together some correct answers to all the new questions." (School leader)*

Overall, teachers were satisfied with the professional learning pathway, and it had a positive impact on their knowledge. When interviewed, several teachers indicated that they would like to develop their knowledge further and **continue their professional learning about AI**. In this context, some teachers and school leaders also emphasised the importance of creating learning communities within schools. Below are some interview quotes:

> *"It would be great if this project could somehow be continued and expanded. To gradually add some teacher trainings, teacher seminars. […] But by subject area. For language teachers, for mathematics teachers. Or maybe natural sciences together, linguistics separately, humanities too." (Language teacher)*
>
> *"Continuous education should actually be the number one priority for all teachers because, after all, we need to be one step ahead of the students. In fact, they are ahead of us in many areas." (Language teacher)*
>
> *"When we thought about how to present it, we found that the best way was to use an active method. That we learn together, the whole teaching team. That we think together, that we are together and that the starting point is the same for everyone. We started with that." (School leader)*

Co-funded by the
Erasmus+ Programme
of the European Union

As shown in the analysis above, it is worth considering teachers' suggestions to include more examples of the practical use of AI in education, concrete AI tools that can be used in a classroom and pedagogical strategies on how to integrate AI into teaching methods effectively. Teachers would, therefore, like their professional learning to be focused on their **actual teaching needs**, including examples of use in specific subjects. Another point raised by some teachers is that they would like professional learning to be delivered in a **hybrid or blended format**, i.e. a combination of online and face-to-face sessions. Below are some interview quotes:

> *"It seems to me that we teachers really value concrete experience, that is to say, from practice to practice. I mean, you know some applications, you know roughly what they do, but someone has explored them in depth, and it would make sense to say, hey, look, with a linear function, you can do this and that. […] But you might not have the energy to explore that. And maybe if someone showed you, you would at least try to use it. It would also be nice for students to show them, look, using these basic principles in geometry, we can make a game in reality. But you know, students ask all the time where I am going to use this." (Maths teacher)*

> *"In principle, I think the online courses are very good […] because of the time. I might have gone for a hybrid anyway. Not for everything, but for listening to lectures. With the lecturers, you might get a different feeling when you are in the same room together. But I think that would be more of a problem for me regarding the timeline." (Maths teacher)*

7.2. On the development of AI tools

The cautious integration of AI in education and the need for critical reflection in the development of educational AI tools are key messages expressed by many of the teachers and school leaders interviewed, as demonstrated in the interview quotes below:

> *"This is where we really need to be careful about how AI is integrated into teaching so that potential pitfalls are also highlighted. […] There is definitely a need to be careful about personal data. Absolutely. And then, check all the information; it is not all to be believed either." (Language teacher)*

> *"It's certainly good that AI is being developed and that there are institutes that are developing it. But let's not push it forward until it's safe." (Maths teacher)*

> *"Integrating AI is one thing. Developing a critical mind is another. Let's say, how to recognise, how to check the accuracy, correctness, relevance of the information […] We should really prepare ourselves very well for this. We would absolutely need help from professional institutions so that we are not wandering around in the dark on our own, perhaps experimenting with the wrong things. The needs are already here, and now, we are already a bit late. So this is going to be difficult; we really have a lot of work to do together." (School leader)*

In order to identify the professional needs that AI could address, teachers answered a baseline open-ended question about which **'superpowers' they would like to have to help them in their work**. This question is metaphorical and aims to understand what types of skills or enhancements teachers feel would be most beneficial to them. Teachers' responses were categorised into different types of desired superpowers, each

Co-funded by the
Erasmus+ Programme
of the European Union

representing a specific professional need or challenge that teachers face. The highest percentages of teachers wished for a superpower **to help them motivate or engage students** (18.2%), **to help them correct student work** (16.7%), **to have more time or be faster** (16.0%), **to better understand their students' thoughts and needs** (13.4%), **to have more knowledge or better memory** (10.0%) and **to have a greater ability to help students learn or memorise better** (6.7%). These responses suggest a number of potential applications for AI in education, such as creating engaging learning materials that can capture and maintain students' interest and enthusiasm for learning or developing intelligent grading systems that can assist in assessment and feedback processes.

The integration of AI tools presents an opportunity to revolutionise how teaching and learning are conducted. However, to truly realise the potential of AI in education, **the development of educational AI tools should address the specific needs and desires expressed by teachers**. It is essential that educational AI solutions are developed in collaboration with teachers and school leaders to ensure that these solutions are relevant to educational settings. Developing AI solutions for education is not just about bringing cutting-edge technology into the classroom. It's about creating tools that are based on an understanding of the unique dynamics of teaching and learning, and that address the real needs and challenges faced by teachers and students.

> *"There is a dilemma in developing platforms, different applications, programs, web robots and everything else. Is this really for education? I remember […] at a seminar in London, developers were saying, how wrong is it that we bring all this equipment and ask what part of it would be useful for you in education? We already have a product, you can't change it […] the screen is the way it is. But maybe we should take the initiative so that the development comes from the field, from the practice. That might make sense. I mean, they probably have practitioners in their development departments." (School leader)*

7.3. On addressing ethical issues associated with AI

Ethical concerns related to AI were included in the responses of teachers and school leaders in both questionnaires and interviews. **Teachers** reported a **high level of ethical awareness** in relation to AI with an average score of **4.93** in baseline and **5.41** in endline on a scale of 1 to 7, where 1 represents the lowest level of ethical awareness and 7 represents the highest. Teachers generally agreed that they have **a good understanding of the ethical issues** when using AI tools (44.7% in baseline, 71.4% in endline), that they always **comply with ethical principles** when using AI tools (53.3% in baseline, 82.4% in endline) and that they are always **alert to the potential abuse** of AI technology (40.1% in baseline, 71.1% in endline). Only about 14% of teachers reported that they are never alert to privacy and information security issues when using AI tools (13.2% in baseline, 14.6% in endline). The data show a positive trend in teachers' ethical awareness and practices related to the use of AI in education, as measured at two different points in time (baseline in December 2022 and endline in March and April 2023). This increased awareness is crucial for the responsible and effective integration of AI in education.

On the other hand, **school leaders' perspectives on the role of ethical concerns in the adoption of AI in their schools are varied**. While a majority (**50.7%**) of school leaders considered ethical concerns as either **the most important or a major factor**, there's still a significant proportion (49.3%) that viewed them as having an average, minor, or no role at all. This diversity suggests that while some school leaders are highly sensitive to the ethical dimensions of AI, others may prioritise other dimensions, such as perceived educational benefits or alignment with educational goals over potential ethical dilemmas.

Co-funded by the
Erasmus+ Programme
of the European Union

The data shows that there is still room for improvement in AI leadership, particularly in the realm of comprehensive communication strategies within schools. While a significant proportion of school leaders (**61.3%**) have **communicated AI ethics and data protection guidelines to their staff**, the considerably lower rate of communication with **parents** (**25.3%**) indicates an area where AI leadership can be enhanced to ensure a more inclusive approach to AI adoption in schools. Effective AI leadership requires not only the implementation of technology but also the establishment of a communicative and ethically aware environment that includes teachers, administrative staff, students, and their families. Such communication should aim to demystify AI technologies, clarify ethical and data protection standards, and address any concerns or expectations that both teachers and parents may have.

In the interviews, teachers' and school leaders' ethical concerns were mostly related to **data privacy protection** for them and their students. Many of them also highlighted issues of **equity in education**. The first aspect of equity refers to **assessment**, namely, a fair treatment of all students, ensuring equal educational opportunities and assessments that accurately reflect each student's abilities and efforts. Teachers highlighted particular challenges they face in assessing the authenticity of student work. In an educational environment increasingly embedded with AI tools, it becomes difficult to determine whether a student's work reflects their own knowledge, or it has been significantly influenced or even completed by AI tools, as demonstrated by teachers' interview quotes below:

> *"AI is here; we cannot close our eyes. It will certainly provide some new opportunities for students to create their own shortcuts to grades in particular. So, it will probably be necessary to change the way education is delivered, to change the way assessments are made. For various written assignments, students can simply get help from ChatGPT. […] It might be necessary to start assessing in a more procedural way." (Language teacher)*

> *"For example, I have seen plagiarism twice now that ChatGPT has been launched. The first was when a student refused to reveal to me who had written his essay, even though it was very obvious. The second time, during an activity we did in class, students admitted to me that they had asked ChatGPT to write a letter for them […] because they didn't feel in the mood to write." (Language teacher)*

The other aspect of equity that concerns teachers and school leaders in Slovenia is the issue of **access to AI tools**. If AI tools are used by some students but not accessible to others, this can create new educational inequalities, as summarised by one school leader interviewed:

> *"Some things will have to be rethought. […] There is also the question of the access to these tools. It is a question of equity. The school system is supposed to be equitable, not only in Slovenia, but anywhere in the world […]. Otherwise, it will be elitism all over again, and those who already have better opportunities will have even better opportunities in the future." (School leader)*

Co-funded by the
Erasmus+ Programme
of the European Union

Appendices

Appendix A: monitoring of the data cleaning process in Slovenia

	Teacher baseline	Teacher endline	School leader	Pupils
Number of answers (non-empty)	270	272	87	4745
Number of answers without duplicates	269	257	75	x
Number of answers who completed at least the first module of outcomes	269	257	x	4690
Number of answers who completed both questionnaires	257	257	x	x

Appendix B.

Table 1. 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	
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

Co-funded by the Erasmus+ Programme of the European Union

	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 that explains the variance. 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 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.

Co-funded by the
Erasmus+ Programme
of the European Union

Table 2. 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.

Appendix C: comparisons of control variables and outcomes at the initial stage between the control group and the intervention group

Table 1: comparisons of control variables in the intervention and control group

Control variable	Control group	Intervention group	p-value
Gender ***(Percentage of men)***	28%	14%	**0.01*****
Teaching experience ***(Average number of years of teaching experience)***	15.27	18.17	**0.01*****
Class size ***(Number of students in the class participating in the experiment)***	23.87	24.93	**0.07****
Student academic difficulties ***(Percentage of students with academic difficulties in the class)***	43.40	43.21	0.94

Table 2: comparisons of the means in the main outcomes at the beginning of the intervention

Outcome	Control group	Intervention group	p-value
Knowledge			
Self-assessment of knowledge of AI	0.00	-0.01	0.94
Knowledge of how AI works	0.00	0.22	**0.07***

Co-funded by the
Erasmus+ Programme
of the European Union

Familiarity with AI technologies	0.08	0.04	0.71
Identification of AI in tools that are mainly based on AI	0.00	-0.02	0.85
Identification of AI in tools that are not mainly based on AI	0.00	-0.06	0.58
Perceptions			
Perceived ease of use	0.00	0.03	0.85
Anxiety associated with used of AI and learning about AI	0.00	-0.10	0.41
Enjoyment associated with use of AI and learning about AI	0.00	0.02	0.91
Perceived usefulness of AI for education	0.00	0.02	0.81
Use			
Use of AI	0.00	0.05	0.70
Frequent use of AI	0.00	0.08	0.51
Ethical consciousness when using AI	-0.02	-0.14	0.37
Intention to use AI	0.00	0.10	0.39

Co-funded by the
Erasmus+ Programme
of the European Union

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

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

Casper, W., Edwards, B., Wallace, C., Landis., R., & Fife, D. (2019). Selecting response anchors with equal intervals for summated rating scales. *Journal of Applied Psychology* 105. 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

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. (2022). *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. https://data.europa.eu/doi/10.2766/65087.

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

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher Beliefs and Technology Integration Practices: A Critical Relationship ». *Computers & Education* 59 (2), 423-35. https://doi.org/10.1016/j.compedu.2012.02.001.

Fengchun, M., Holmes, W., Ronghuai, H., & Hui, Z. (2021). *AI and education: guidance for policy-makers*. UNESCO, 2021. https://unesdoc.unesco.org/ark:/48223/pf0000376709.

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.

Co-funded by the
Erasmus+ Programme
of the European Union

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.

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, S., Montserrat, L. C., Delipetrev, B., Martinez-Plumed, F., Gomez, E., & De Prato, G. (2021). *AI Watch. Defining Artificial Intelligence 2.0.* 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

Statistical Office of the Republic of Slovenia. *SiStat Database*. https://pxweb.stat.si/SiStat/sl

Tricot, A. (2020). *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 Technology*. https://www.tandfonline.com/doi/abs/10.1080/0144929X.2022.2072768?journalCode=tbit20

Wang, Y.-Y., & Wang, Y.-S. (2019). Development and validation of an artificial intelligence anxiety scale: An initial application in predicting motivated learning behaviour. *Interactive Learning Environments*, 30(4), 619–634. 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. In *Theses.fr*. https://www.theses.fr/2014PA100122

Co-funded by the
Erasmus+ Programme
of the European Union