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Research Article

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A professional intervention to improve the AI skills of high school teachers through comics

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ABSTRACT

This study evaluates the Comix4AI blended learning program, developed under the Erasmus+ framework, which aimed to enhance teachers' understanding of artificial intelligence (AI) through innovative, comics-based instruction. Combining synchronous sessions with asynchronous learning on the *e-Class* platform, the program involved 25 teachers in online and hybrid formats. Quantitative results showed improvement in self-efficacy and engagement, while qualitative feedback highlighted the clarity, accessibility, and motivational value of the comics. Participants emphasized the program's practical relevance and its role in demystifying AI for classroom use. Overall, Comix4AI has been judged as effective in making complex technological concepts approachable, underscoring the potential of multimodal and creative approaches in teacher professional development.

Keywords: artificial Intelligence, teacher training, distance learning, blended teaching model, training, Comix4AI

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INTRODUCTION

Artificial intelligence (AI) represents one of the most dynamic and transformative technologies of the modern era, profoundly influencing nearly every domain of social, economic, and professional life. Education is no exception, as AI opens new frontiers for personalizing learning, developing intelligent support systems for both teachers and students, and enhancing the overall quality and effectiveness of teaching practices. The integration of AI into education offers opportunities to create adaptive learning environments, automate administrative processes, and provide data-driven insights that improve pedagogical decision-making.

However, realizing these opportunities depends heavily on the capacity of educators to understand, utilize, and meaningfully integrate AI tools into their daily practice. The ability of teachers to critically engage with AI, not only as users but also as informed interpreters of its possibilities and limitations, is essential to the modernization and digital transformation of education (George, 2023). Yet, many teachers currently exhibit limited familiarity with the fundamental concepts, ethical implications, and practical applications of AI, highlighting the need for targeted professional development initiatives (Akgun & Greenhow, 2022; Ng et al., 2021). These initiatives should combine theoretical understanding with experiential, hands-on learning that promotes confidence and competence in AI-enhanced teaching.

In this context, the present paper discusses a case study on the development of teachers' competencies through a blended learning program focused on the teaching and pedagogical use of AI. The program was implemented within the framework of the European Erasmus+ project Comix4AI (https://comix4ai.com; project number: 2023-1-FR01-KA220-SCH-000150994). Its design combined an initial face-to-face training phase with an asynchronous distance learning component, delivered through the *e-Class* digital platform. During the face-to-face sessions, participants were introduced to core AI principles and educational applications, and they received guidance on how to continue their work during the online phase. The asynchronous phase allowed participants to explore the pedagogical potential of AI in greater depth. Teachers engaged with a range of theoretical and practical materials, implemented guided activities, and participated in discussions through online forums. This blended approach emphasized both knowledge acquisition and active engagement, aiming to cultivate teachers' skills in critical thinking, collaboration, and the application of AI in authentic educational contexts.

The article presents the educational material and methodology adopted in the training program, alongside quantitative data on participation, progress, and completion rates. Furthermore, it analyzes teachers' feedback collected through evaluation questionnaires, offering insights into their perceptions of AI's educational value, their motivation to integrate AI tools into teaching, and the challenges they faced during implementation. Particular emphasis is placed on participants' attitudes toward the usefulness, accessibility, and transformative potential of AI in education, as well as on the broader implications for teacher training and educational innovation.

ARTIFICIAL INTELLIGENCE IN EDUCATION

The integration of AI in education has initiated a profound transformation in teaching and learning practices, reshaping both the role of teachers and the learning experiences of students (Vashishth et al., 2024). AI technologies are increasingly embedded across multiple levels of the educational process, enhancing efficiency, personalization, and engagement. Applications of AI in education encompass intelligent tutoring systems (ITS), personalized learning platforms, virtual assistants, and AI-driven assessment tools (Tahiru, 2021). These technologies are designed to support the creation of adaptive learning environments capable of responding to individual learners' needs, thereby promoting differentiated instruction and improved educational outcomes.

AI systems have the capacity to analyze vast amounts of learner data, provide real-time feedback, and identify learning gaps that might otherwise go unnoticed (Rane et al., 2023). For example, platforms such as Carnegie learning and squirrel AI learning utilize adaptive algorithms to personalize instructional content based on each learner's progress and performance. Beyond individual learning support, AI also facilitates the automation of administrative and evaluative tasks, such as grading, scheduling, attendance tracking, and performance analytics (Ashraf, 2024). By automating routine processes, educators are able to allocate more time to direct instruction and student interaction (Chen et al., 2020). Although AI-assisted grading and automated essay scoring systems demonstrate promising efficiency, they are not yet fully accredited or capable of replicating the nuanced judgment of human assessors (Ramesh & Sanampudi, 2022).

Another significant contribution of AI to education lies in enhancing the quality and interactivity of learning materials. AI-powered systems can generate summaries, design customized resources, and create adaptive digital textbooks that dynamically adjust to the learner's pace and level of understanding (Anggoro & Pratiwi, 2023; Sayed et al., 2023). Similarly, ITS emulate the guidance of a human tutor by delivering personalized instruction, monitoring performance in real time, and responding adaptively to learners' needs. Empirical studies suggest that ITS can significantly improve academic performance, particularly in STEM education (McDonald, 2016; Mousavinasab et al., 2021).

Despite these advantages, the integration of AI in educational contexts presents several challenges. Effective implementation requires educators to develop new competencies that extend beyond technical literacy. Teachers must cultivate an understanding of the pedagogical, ethical, and societal dimensions of AI, including algorithmic bias, data privacy, and the implications of AI-assisted decision-making (Ng et al., 2023). The success of AI-enhanced education thus depends not only on technological availability but also on teachers' preparedness to integrate such systems into meaningful pedagogical practice (Zawacki-Richter et al., 2019).

The literature highlights growing interest in teacher and student perspectives regarding the necessity and structure of supplementary qualifications in AI (Rott et al., 2022). As AI competencies become increasingly relevant across professions, specialized training programs for educators are essential to bridge existing knowledge and skill gaps. However, research identifies persistent obstacles to successful professional development, including low motivation among teachers and an overemphasis on theoretical content at the expense of practical, classroom-oriented applications (Aljemely, 2024; Lee et al., 2024). Furthermore, while students frequently engage with AI tools, educators often lack the technical understanding required to explain or critically evaluate the underlying technologies (Fissore et al., 2024). These findings reinforce the need for professional training programs that balance theoretical knowledge with experiential, practice-based learning, enabling teachers to design innovative, AI-informed educational activities.

In summary, AI holds substantial promise for transforming education through personalization, automation, and innovation. Yet, the full realization of its potential depends on equipping teachers with the necessary knowledge, skills, and critical awareness to harness AI responsibly and effectively within pedagogical contexts.

DESCRIPTION OF THE TRAINING INTERVENTION

The training intervention was designed according to a blended learning model, combining elements of synchronous instruction with asynchronous, self-directed learning. This approach was selected to balance direct pedagogical support with the flexibility of independent study, thereby promoting both guided understanding and autonomous engagement with the learning material. The overall duration of the program was 23 hours, consisting of 8 hours of synchronous or face-to-face sessions and 15 hours of asynchronous learning activities.

The program was implemented at the 5th General Lyceum of Agrinio (Greece), a partner on the Comix4AI Erasmus+ project and involved two distinct groups of in-service teachers. The first group, comprising 14 participants, completed the program exclusively online. Their synchronous meetings were conducted via *Cisco Webex*, while asynchronous learning activities were hosted on the Greek schools' national e-learning platform *e-Class* https://eclass01.sch.gr/courses/0190100177/ (**Figure 1**) and in project's website https://comix4ai.com/the-ai-ml-comics-module/ (**Figure 2**). The second group, consisting of 11 teachers, followed a hybrid model beginning with in-person sessions held at the school and continuing with asynchronous participation through the same platform. This dual implementation allowed for a comparative understanding of engagement and learning dynamics between purely remote and partially in-person learning modalities.

The educational content of the program was developed within the framework of the Erasmus+ project Comix4AI. The material was grounded in the innovative use of educational comics, which were created to convey the fundamental principles of AI in an accessible, engaging, and conceptually coherent manner. The use of illustrated storytelling as a pedagogical medium was based on evidence from contemporary learning research, which suggests that visual narratives can facilitate comprehension of abstract concepts, reduce cognitive load, and enhance learner motivation and retention. The comics served as the primary didactic tool for introducing topics such as machine learning, neural networks, and data ethics in ways that are meaningful and approachable to non-specialist audiences.

During the synchronous and face-to-face sessions, participants engaged in guided discussions, collaborative exercises, and short practical activities aimed at familiarizing them with the core concepts of AI and exploring its educational implications. These sessions encouraged active participation, peer learning, and immediate feedback

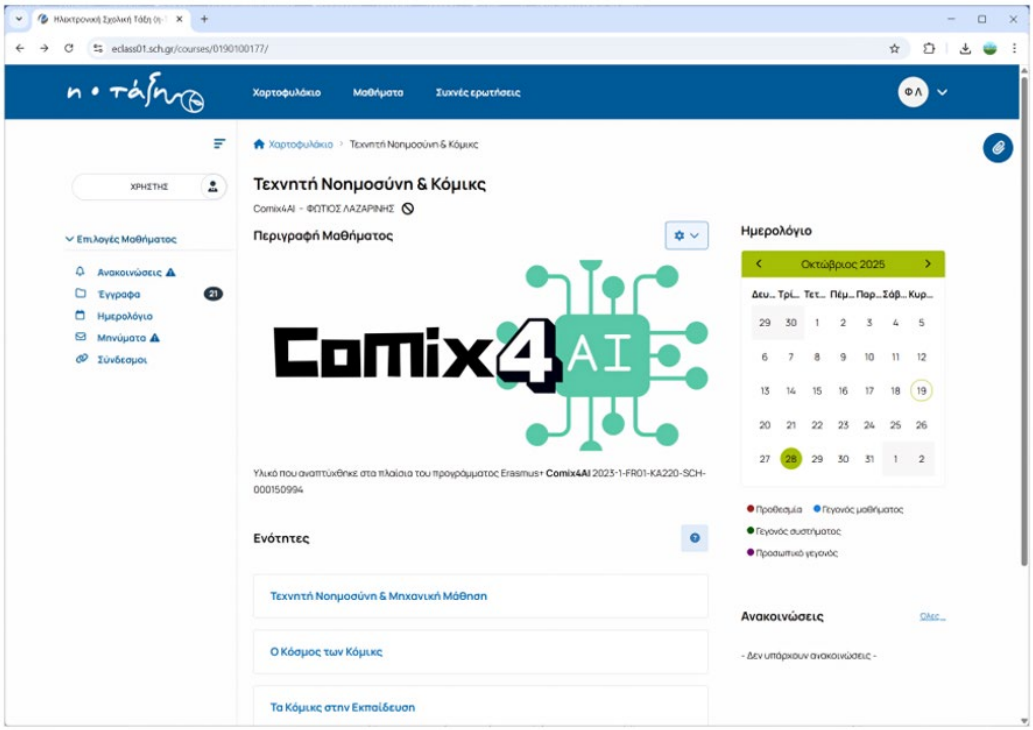

Figure 1. Online training in AI using educational comics (Source: https://eclass01.sch.gr/courses/0190100177/)

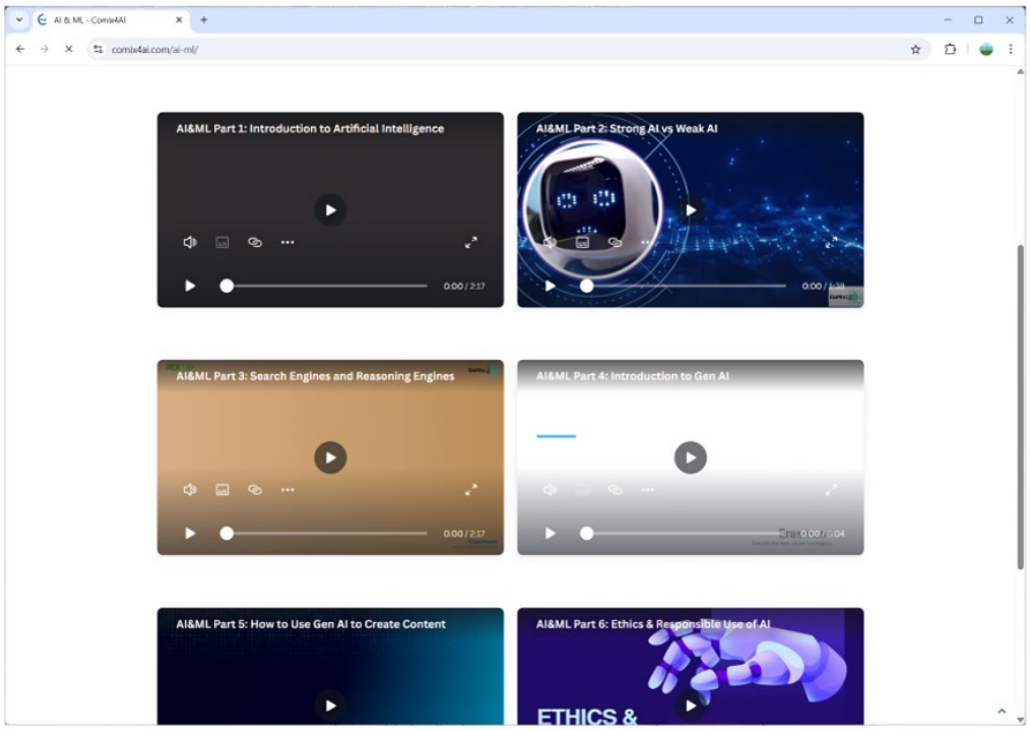

Figure 2. Some of the key topics (Source: https://comix4ai.com/ai-ml/)

through open dialogue between instructors and trainees. The asynchronous phase, lasting approximately 15 hours, provided opportunities for participants to consolidate their understanding through independent study, reflection, and participation in online forums. Tasks during this phase included reviewing supplementary resources, completing short assignments, and interacting with peers and instructors through the *e-Class* discussion spaces.

The pedagogical design emphasized the principles of active and experiential learning, encouraging participants not only to absorb theoretical knowledge but also to apply it in authentic educational contexts. This included designing sample lesson activities incorporating AI tools or discussing ethical and pedagogical considerations related to AI use in classrooms. The combination of synchronous, asynchronous, and self-directed learning components fostered a flexible yet structured environment supported diverse learning preferences and schedules.

EVALUATION METHODOLOGY

The evaluation of the Comix4AI training program was designed to provide a comprehensive understanding of how the blended learning approach and comics-based educational materials contributed to the professional development of teachers in AI education. It followed a mixed-methods design, integrating quantitative analysis with qualitative insights to capture both measurable learning outcomes and participants' subjective experiences. This approach ensured that the evaluation not only measured what participants learned but also how they perceived, interpreted, and applied the training content within their professional context.

Participants and Context

The initiative aimed to strengthen teachers' understanding of AI, foster digital literacy, and encourage the adoption of innovative pedagogical tools. A total of 25 in-service teachers participated in the training, representing a variety of academic disciplines including science, technology, engineering, humanities, and social sciences. The teachers possessed differing levels of digital competence and teaching experience, ranging from early-career educators to experienced practitioners. This diversity enriched the learning environment, enabling the exchange of ideas and the sharing of best practices across subject areas.

Two groups were formed to explore different delivery modalities:

1. Group 1 (n = 14) attended the program fully online, combining synchronous sessions via *Cisco Webex* with asynchronous learning through the *e-Class* platform.
2. Group 2 (n = 11) followed a hybrid model, beginning with in-person workshops at the school and continuing asynchronously online.

This design made it possible to compare the engagement patterns, interaction quality, and learning outcomes between teachers participating in digital-only environments and those who experienced a blended setting with physical collaboration.

Research Design

The evaluation employed a post-training design with retrospective elements, focusing on participants' perceptions before and after the course. The aim was to identify changes in familiarity, confidence, and readiness to use AI tools in education.

A structured questionnaire served as the central data collection instrument to measure mainly the usefulness and the impact of the training activity. It included 20 items, of which 18 were close-ended Likert-scale questions and 2 were open-ended reflective prompts. The Likert items were organized across eight thematic dimensions, each corresponding to a specific aspect of the learning experience.

The instrument was developed based on existing validated models of teacher professional development and technology acceptance (adapted from Ng et al., 2023; Zawacki-Richter et al., 2019) and was reviewed by two educational technology experts for content validity. The combination of quantitative and qualitative questions allowed the researchers to triangulate findings and identify both trends and deeper insights that might not emerge through statistics alone.

Dimensions of Evaluation

The questionnaire used in the evaluation is presented in **Appendix A**. The quantitative section explored eight dimensions:

1. *Prior familiarity with AI:* Assessed baseline awareness of AI concepts, tools, and their potential educational applications before participating in the training.
2. *Perceived usefulness:* Measured how relevant and beneficial the participants found the program for their own teaching practice.
3. *Engagement:* Captured the degree to which participants felt motivated and involved during sessions, including discussions and online activities.
4. *Comics impact:* Evaluated the role of the comic-based narratives in simplifying abstract AI concepts, fostering emotional engagement, and enhancing comprehension.
5. *Blended model and platform usability:* Examined satisfaction with the learning structure, pacing, and functionality of the *e-Class* platform.
6. *Ethical awareness:* Investigated participants' ability to recognize ethical challenges in AI, such as bias, data privacy, and transparency.
7. *Post-training self-efficacy:* Measured confidence in applying AI-related content and integrating it into lesson plans after the training.
8. *Intention to integrate:* Assessed participants' motivation and readiness to include AI topics or digital tools in future classroom activities.

The qualitative section included two open-ended prompts encouraging deeper reflection:

1. *What was the most valuable aspect of the training?*
2. *What is one change that would improve the training experience?*

These responses provided context and depth to the numerical data, revealing emotional, motivational, and practical factors behind teachers' perceptions.

Data Collection and Analysis

Data collection took place during the final week of the course through the *e-Class* online platform, ensuring ease of access and participation. Respondents completed the questionnaire voluntarily and anonymously, which encouraged openness and honest feedback.

Quantitative data were analyzed using descriptive statistics (means [Ms] and standard deviations) to summarize central tendencies and patterns across the sample. Internal consistency reliability was measured using Cronbach's alpha, which ranged between 0.68 and 0.81, confirming acceptable reliability for short, two- and three-item scales.

To compare the online-only and hybrid groups, M scores for each scale were calculated separately, enabling cross-modal interpretation of the learning experience. Visualizations such as bar charts were used to present contrasts between the two groups in familiarity, self-efficacy, and engagement.

The qualitative responses were analyzed thematically following Braun and Clarke's (2006) framework. Recurring themes were coded inductively, identifying participants' perceptions of the comics-based methodology, their emotional engagement, perceived learning benefits, and suggested improvements. Quotes were used illustratively to capture authentic participant voices.

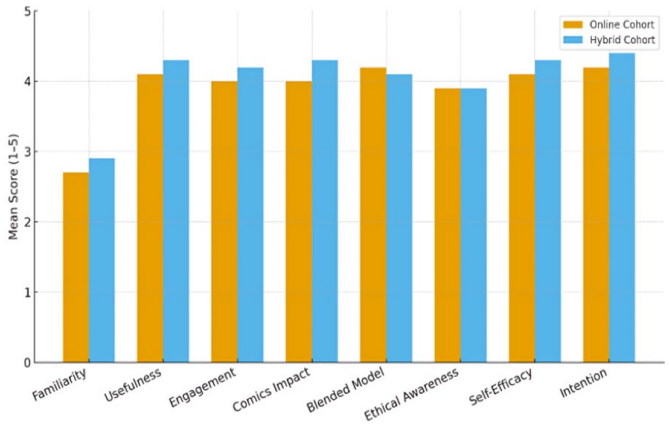

Figure 3. Scale Ms by cohort (Chart created by the author)

Figure 4. Pre vs. post: Familiarity and self-efficacy (overall) (Chart created by the author)

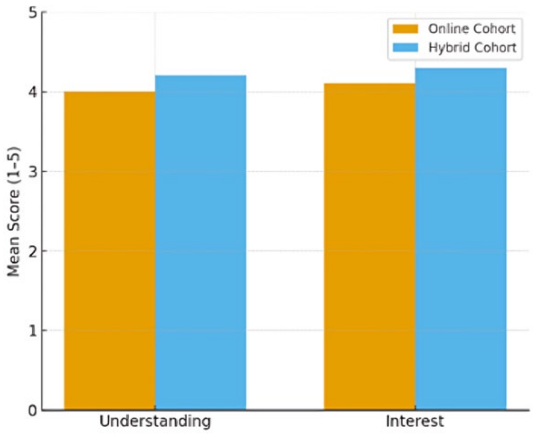

Figure 5. Comics impact items by group (Chart created by the author)

Ethical integrity was upheld throughout the evaluation process. Participation was voluntary and fully anonymous, with informed consent obtained electronically prior to questionnaire completion. No personal data, such as names or contact information, were collected. The research adhered to the ethical guidelines for educational research established by the European Commission and institutional data protection protocols under GDPR. Participants were informed that their responses would be used exclusively for research and quality assurance purposes, and that aggregated findings might be included in project reports or academic publications. All data were stored securely on institutional servers, and results were presented in a way that prevents individual identification.

RESULTS

The evaluation of the Comix4AI training revealed consistently positive outcomes across all measured dimensions. Both quantitative and qualitative data demonstrate that the blended learning model–supported by comics-based educational materials–was effective in enhancing teachers' engagement, comprehension, and self-efficacy in AI education.

Quantitative Findings

Analysis of the questionnaire responses showed high levels of satisfaction and perceived learning gains among participants. M scores for all dimensions ranged between 3.9 and 4.3 on a five-point Likert scale, indicating a strong positive evaluation of the training experience (**Figure 3**). Teachers' prior familiarity with AI was relatively limited before the program (M = 2.7), while their post-training self-efficacy increased substantially (M = 4.2).

The quantitative analysis provides strong evidence of the Comix4AI program's pedagogical effectiveness and relevance for teacher professional development in AI education. Across all eight dimensions, the M values were consistently high, indicating that participants perceived training as both engaging and practically useful.

The largest measurable improvement was observed between prior familiarity (M = 2.7) and post-training self-efficacy (M = 4.2), showing that the program effectively bridged the gap between awareness and actionable understanding (**Figure 4**). This suggests that the blended model succeeded in scaffolding learning from basic conceptual exposure to confident pedagogical application. Such gains align with findings from prior research indicating that combining theory with experiential learning significantly enhances teacher competence in digital innovation contexts.

The high M scores for perceived usefulness (M = 4.3) and engagement (M = 4.1–4.2) further demonstrate that participants valued the course's structure and content. Teachers particularly appreciated the authentic classroom relevance of the materials and the opportunity to reflect on how AI could be integrated across disciplines. These results indicate that the course not only improved technical understanding but also fostered reflective thinking about the societal and ethical implications of AI.

The comics-based instructional materials were rated very positively (M ≈ 4.1–4.3), confirming that visual storytelling was an effective tool for simplifying complex concepts and maintaining learner motivation (**Figure 5**). This supports the growing body of evidence in educational research emphasizing that multimodal learning materials can reduce cognitive load and enhance engagement, especially in subjects involving abstract or technical content.

Although both groups evaluated the program positively, modest modality-related differences warrant further consideration. Participants in the hybrid condition reported slightly higher engagement and comprehension, which may be attributable to the pedagogical affordances of in-person interaction. In particular, face-to-face sessions can facilitate immediate clarification, dialogic feedback, and collaborative sense-making, thereby supporting deeper processing of course content. Also, structured in-person meetings may strengthen

social presence and accountability, which can contribute to sustained participation and more consistent engagement with learning activities.

In contrast, participants in the online-only condition emphasized flexibility and autonomy as salient strengths of the asynchronous format. The ability to self-pace, revisit instructional materials, and integrate coursework into variable professional schedules may enhance perceived usefulness and feasibility, especially for learners balancing competing time demands. Collectively, these findings suggest that the program's instructional design is adaptable across delivery modes: the hybrid format may confer added benefits through interaction and peer exchange, whereas the online format may reduce logistical constraints and support self-regulated learning. This pattern underscores the value of maintaining multiple delivery options to accommodate heterogeneous learner preferences and contextual constraints while preserving overall program effectiveness.

Finally, the relatively high scores for ethical awareness ($M \approx 3.9$) and intention to integrate AI ($M = 4.3$) show that the program successfully promoted not only conceptual understanding but also attitudinal readiness for implementing AI education. Participants concluded the training with both the confidence and motivation to bring AI-related discussions into their classrooms, reflecting a positive shift toward digital inclusion and critical engagement with emerging technologies.

In summary, the quantitative findings confirm that the Comix4AI blended learning model provided a meaningful, relevant, and pedagogically innovative experience. The combination of visual learning, active engagement, and flexible participation modes contributed to strong learning outcomes and high overall satisfaction.

Qualitative Findings

The open-ended responses helped us to contextualize and deepen the interpretation of the findings. A thematic analysis was conducted using an inductive approach. Responses were coded and grouped into key themes based on patterns in participants' feedback. Four primary themes emerged:

(a) pedagogical clarity and accessibility,

(b) professional relevance and applicability,

(c) engagement and motivation through comics, and

(d) suggestions for improvement and future development.

What participants found most valuable or impactful?

Participants emphasized that the training demystified AI and made the subject approachable even for those without a technical background. The combination of clear explanations, structured content, and visual learning materials was described as particularly effective in building understanding and confidence.

Many teachers expressed appreciation for the comics-based approach, describing it as "creative," "engaging," and "memorable." The illustrated narratives were seen as a bridge between abstract technical concepts and real-world educational applications. One participant noted that

> "the comics made difficult ideas simple and engaging; I could finally visualize how AI works and how to explain it to students."

Another recurring theme was pedagogical relevance. Participants found the training valuable because it provided direct connections between AI concepts and classroom practice. They reported feeling better equipped to discuss topics such as algorithmic bias, automation, and ethical implications of technology. As one respondent summarized,

> "The program made me realize that AI is not just a topic for computer science – it's something every teacher should talk about with their students."

Furthermore, several participants highlighted the blended learning design as impactful. They valued the flexibility of asynchronous learning combined with opportunities for interaction and reflection during synchronous sessions. Participants in the hybrid cohort appreciated the sense of community and shared learning that developed through in-person discussions.

Suggestions for improvement and future development

When asked what could be improved, participants provided thoughtful feedback aimed at strengthening the program's practical and collaborative dimensions. The most common recommendation was to include more ready-to-use teaching resources, such as sample lesson plans, classroom activities, or project ideas integrating AI concepts into different subjects.

Several participants suggested the addition of more advanced content or follow-up modules that would explore ethical and societal dimensions of AI in greater depth. As one teacher commented,

> "It would be great to have a second part of the course focusing on AI in everyday school practice, with examples of classroom activities."

A number of respondents also emphasized the importance of enhancing peer collaboration, particularly in the asynchronous phase. They proposed discussion-based assignments, shared online workspaces, or collaborative project components to promote exchange of ideas among educators.

Some participants recommend extending the duration of the training or including more synchronous meetings, allowing for additional feedback, reflection, and personalized support. Others suggested developing differentiated tracks based on teachers' prior knowledge, to better accommodate both beginners and more experienced participants.

In summary, the open-ended responses illustrate that the Comix4AI training achieved its core objectives: enhancing teachers' understanding of AI, increasing confidence in applying AI-related content, and demonstrating the pedagogical value of creative, visual learning methods.

Limitations

This study is limited by the number of participants and the national educational parameters. The findings may not be generalizable beyond the specific context of the research. With respect to the validation of the questionnaires, while Cronbach's alpha ≥ 0.70 are generally considered acceptable, the lower end (0.68) suggests borderline internal consistency for some short subscales, so results should be interpreted with some caution.

CONCLUSIONS

The evaluation of the Comix4AI training program confirms its effectiveness in enhancing teachers' understanding, confidence, and motivation to integrate AI into education. The combination of a blended learning structure and comics-based materials proved highly engaging and accessible, helping participants grasp complex AI concepts in a clear and enjoyable way.

Quantitative results showed significant improvement in self-efficacy and strong ratings for engagement, perceived usefulness, and pedagogical relevance. Qualitative feedback reinforced these findings, emphasizing the value of visual learning, practical applicability, and an inclusive, supportive learning environment.

Overall, the Comix4AI program successfully met its objectives by promoting both conceptual understanding and professional readiness. The results highlight the importance of innovative, multimodal approaches in teacher training and suggest that creative design methods can effectively bridge the gap between emerging technologies and classroom practice, e.g., illustrated narratives.

Future developments should focus on expanding practical resources, fostering collaboration, and offering advanced modules to sustain teachers' engagement and deepen their expertise in AI education. Also alternative teaching methods and a control group should be

AI integration into school environments is an important issue requiring various learning interventions (Lazarinis, 2026). Longer-term support for teachers' AI integration could benefit communities of practice for peer exchange and problem-solving, complemented by brief follow-up modules and mentoring to reinforce skills and adapt to evolving tools and classroom needs.

Educators and institutions adopting comics-based or game-based training for teaching various concept should align the learning scenarios with teachers' everyday classroom needs and explicit curricular outcomes, and pair brief conceptual input with hands-on tasks. To support implementation on a scale, programs can offer flexible online/hybrid delivery, shared templates and exemplars, and ongoing support via communities of practice and short follow-up modules. To strengthen long-term impact, professional development training programs could be scaled through modular content and train-the-trainer delivery, with ongoing teacher support provided via communities of practice and brief follow-up modules.

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Ethics declaration: This study was conducted in accordance with the academic integrity code of the 5th Senior High School of Agrinio, Greece, where all the tests have been run. All participants gave informed consent prior to taking part in the study. For minors, consent was also obtained from parents or guardians. No sensitive personal data were collected, and all information was anonymized.

AI statement: During the preparation of this manuscript, the author used ChatGPT (GPT-5, OpenAI) for the purposes of language editing. The author has reviewed and edited the output and takes full responsibility for the content of this publication.

Declaration of interest: The author declares no competing interest.

Data availability: Data generated or analyzed during this study are available from the author on request.

REFERENCES

Akgun, S., & Greenhow, C. (2022). Artificial intelligence in education: Addressing ethical challenges in K-12 settings. *AI and Ethics, 2*(3), 431-440. https://doi.org/10.1007/s43681-021-00096-7

Aljemely, Y. (2024) Challenges and best practices in training teachers to utilize artificial intelligence: A systematic review. *Frontiers in Education, 9*. https://doi.org/10.3389/feduc.2024.1470853

Anggoro, K. J., & Pratiwi, D. I. (2023). Fostering self-assessment in English learning with a generative AI platform: A case of Quizizz AI. *Studies in Self-Access Learning Journal, 14*(4), 489-501. https://doi.org/10.37237/140406

Ashraf, M. (2024). Generative AI: Challenges and the road ahead. *International Journal of Science and Research, 13*(10), 716-725. https://doi.org/10.21275/SR241009154508

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Chen, X., Zou, D., Xie, H., Cheng, G., & Liu, C. (2022). Two decades of artificial intelligence in education. *Educational Technology & Society, 25*(1), 28-47.

Fissore, C., Floris, F., Conte, M. M., & Sacchet, M. (2024). Teacher training on artificial intelligence in education. In D. G. Sampson, D. Ifenthaler, & P. Isaías (Eds.), *Smart learning environments in the post pandemic era. Cognition and exploratory learning in the digital age* (pp. 227-244). Springer. https://doi.org/10.1007/978-3-031-54207-7_13

George, A. S. (2023). Preparing students for an AI-driven world: Rethinking curriculum and pedagogy in the age of artificial intelligence. *Partners Universal Innovative Research Publication, 1*(2), 112-136.

Lazarinis, F. (2026). A case study on AI integration in secondary education: Insights from STEM educators in Greece. *International Journal of Innovation and Learning*.

Lee, Y. J., Davis, R. O., & Ryu, J. (2024). Korean in-service teachers' perceptions of implementing artificial intelligence (AI) education for teaching in schools and their AI teacher training programs. *International Journal of Information and Education Technology, 14*(2), 214-219. https://doi.org/10.18178/ijiet.2024.14.2.2042

McDonald, C. V. (2016). STEM education: A review of the contribution of the disciplines of science, technology, engineering and mathematics. *Science Education International, 27*(4), 530-569.

Mousavinasab, E., Zarifsanaiey, N., R. Niakan Kalhori, S., Rakhshan, M., Keikha, L., & Ghazi Saeedi, M. (2021). Intelligent tutoring systems: A systematic review of characteristics, applications, and evaluation methods. *Interactive Learning Environments, 29*(1), 142-163. https://doi.org/10.1080/10494820.2018.1558257

Ng, D. T. K., Leung, J. K. L., Chu, K. W. S., & Qiao, M. S. (2021). AI literacy: Definition, teaching, evaluation and ethical issues. *asis&t, 58*(1), 504-509. https://doi.org/10.1002/pra2.487

Ng, D. T. K., Leung, J. K. L., Su, J., Ng, R. C. W., & Chu, S. K. W. (2023). Teachers' AI digital competencies and twenty-first century skills in the post-pandemic world. *Educational Technology Research and Development, 71*(1), 137-161. https://doi.org/10.1007/s11423-023-10203-6

Ramesh, D., & Sanampudi, S. K. (2022). Automated essay scoring systems: A systematic literature review. *Artificial Intelligence Review, 55*(3), 2495-2527. https://doi.org/10.1007/s10462-021-10068-2

Rane, N., Choudhary, S., & Rane, J. (2024). *Contribution of ChatGPT and similar generative artificial intelligence for enhanced climate change mitigation strategies*. SSRN. https://doi.org/10.2139/ssrn.4681720

Rott, K. J., Lao, L., Petridou, E., & Schmidt-Hertha, B. (2022). Needs and requirements for an additional AI qualification during dual vocational training: Results from studies of apprentices and teachers. *Computers and Education: Artificial Intelligence, 3*, Article 100102. https://doi.org/10.1016/j.caeai.2022.100102

Sayed, W. S., Noeman, A. M., Abdellatif, A., Abdelrazek, M., Badawy, M. G., Hamed, A., & El-Tantawy, S. (2023). AI-based adaptive personalized content presentation and exercises navigation for an effective and engaging e-learning platform. *Multimedia Tools and Applications, 82*(3), 3303-3333. https://doi.org/10.1007/s11042-022-13076-8

Tahiru, F. (2021). AI in education: A systematic literature review. *Journal of Cases on Information Technology, 23*(1), 1-20. https://doi.org/10.4018/JCIT.2021010101

Vashishth, T. K., Sharma, V., Sharma, K. K., Kumar, B., Chaudhary, S., & Panwar, R. (2024). Transforming classroom dynamics: The social impact of AI in teaching and learning. In Z. E. Ahmed, A. A. Hassan, & R. A. Saeed (Eds.), *AI-enhanced teaching methods* (pp. 322-346). IGI Global. https://doi.org/10.4018/979-8-3693-2728-9.ch015

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education–Where are the educators? *International Journal of Educational Technology in Higher Education, 16*, Article 39. https://doi.org/10.1186/s41239-019-0171-0

APPENDIX A

Table A1. Evaluation questionnaire

Dimension	Item code	Question/statement	Response type
Prior familiarity with AI	PRE_FAM1	Before the program, I was familiar with basic concepts of AI.	Likert (1-5)
Prior familiarity with AI	PRE_FAM2	Before the program, I felt confident explaining AI-related ideas to my students.	Likert (1-5)
Perceived usefulness	PU1	The training will help me improve my students' learning outcomes.	Likert (1-5)
Perceived usefulness	PU2	The content of the course is directly relevant to my teaching practice.	Likert (1-5)
Perceived usefulness	PU3	I can apply what I learned in my classroom.	Likert (1-5)
Engagement	ENG1	The activities kept me motivated and engaged throughout the training.	Likert (1-5)
Engagement	ENG2	Interaction with peers and trainers enhanced my learning experience.	Likert (1-5)
Comics impact	COM1	The use of comics made complex AI concepts easier to understand.	Likert (1-5)
Comics impact	COM2	The illustrated narratives increased my interest and curiosity about AI.	Likert (1-5)
Blended model and platform usability	BLD1	The balance between synchronous and asynchronous activities was effective.	Likert (1-5)
Blended model and platform usability	BLD2	The e-Class platform was user-friendly and easy to navigate.	Likert (1-5)
Ethical awareness	ETH1	I can recognize ethical challenges in AI (e.g., data bias, privacy, and fairness).	Likert (1-5)
Ethical awareness	ETH2	I feel capable of discussing AI-related ethical issues with my students.	Likert (1-5)
Post-training self-efficacy	POST_SE1	After the training, I feel confident in integrating AI-related content into my lessons.	Likert (1-5)
Post-training self-efficacy	POST_SE2	I can identify and curate appropriate AI resources for my classroom.	Likert (1-5)
Intention to integrate	INT1	I intend to include AI-related topics in my teaching in the near future.	Likert (1-5)
Intention to integrate	INT2	I plan to design at least one classroom activity involving AI tools or concepts.	Likert (1-5)
Open-ended reflections	OE1	What did you find most valuable or impactful about the training?	Open-ended
Open-ended reflections	OE2	What improvement or change would you suggest for future versions of the training?	Open-ended

Note. 5-point Likert scale: 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, & 5 = Strongly agree