

Prompt'n'Play: improving teachers' AI literacy through secondary learning outcomes of a serious game

Massimiliano Andreoletti¹, Andrea Tinterri², Maria Concetta Carruba², Anna Dipace², Maria Clara Dicataldo², Marika Lamacchia³, Francesco Facciorusso³

¹ Department of Pedagogy, Università Cattolica del Sacro Cuore, Milano, Italy

² Faculty of Humanities, Education and Sports, Pegaso Telematic University, Naples, Italy

³ Department of Education, Cultural Heritage and Tourism, University of Macerata, Italy

massimiliano.andreoletti@unicatt.it

andrea.tinterri@unipegaso.it

mariaconcetta.carruba@unipegaso.it

anna.dipace@unipegaso.it

mariaclara.dicataldo@unipegaso.it

m.lamacchia2@unimc.it

f.facciorusso@unimc.it

Abstract: The increasing diffusion of generative artificial intelligence in educational contexts calls for strengthening teachers' AI literacy. AI literacy is increasingly understood as a multidimensional construct encompassing cognitive, operational, critical, and ethical competencies, including understanding AI systems, evaluating their outputs, and applying them responsibly in educational settings (Ranieri et al., 2024; Chiu et al., 2024; Tenberga & Daniela, 2024; Pei et al., 2026). In line with self-efficacy theory (Bandura, 1997), teachers' perceived competence and confidence are crucial for translating such knowledge into pedagogical practices. However, while many studies focus on students, research examining how interventions designed for pupils may also produce professional learning benefits for the teachers who implement them remains limited (Traga Philippakos & Rocconi, 2025). This study addresses this gap by analyzing the indirect effects of Prompt'n'Play, a serious board game designed to develop primary school students' skills in prompt engineering, understanding generative models, bias awareness, and responsible AI use. The intervention builds on evidence highlighting the significant impact of serious games and game-based learning on motivation, cognitive engagement, and deep learning (Schrader, 2023), as well as on situated teacher professional development (Pozzi & Persico, 2024). After a short introductory training session, teachers implemented the game in their classrooms as facilitators. A single-group pre-post design with repeated measures was adopted with 15 primary school teachers. Data were collected through Likert-scale instruments measuring perceived understanding of AI, instructional use of AI tools, self-efficacy in AI integration, and intention for future use, in line with technology acceptance models (Davis, 1989; Venkatesh et al., 2012). Paired-sample analyses and regression analyses were conducted to examine pre-post changes and the predictive role of perceived understanding and self-efficacy on teachers' intention to integrate AI into future practice. The results suggest that facilitating AI-focused game-based activities, although designed for students, can also constitute a form of situated professional learning for teachers, strengthening AI literacy and teaching agency.

Keywords: AI Literacy; Game-Based Learning; Serious Games; Teacher Professional Development; Prompt Engineering; Self-Efficacy.

1. Introduction

1.1 AI in Primary Education from a teacher-centred perspective

The rapid integration of Artificial Intelligence into primary education marks a major transformation in contemporary schooling. As AI technologies become increasingly embedded in educational environments, understanding how teachers perceive, adopt, and mediate these tools is crucial for sustaining pedagogical innovation. AI literacy extends beyond functional use and includes the ability to critically evaluate AI outputs and reflect on their educational and societal implications (Long & Magerko, 2020; Ranieri et al., 2024; Yim & Su, 2025; Tenberga & Daniela, 2024; Pei et al., 2026).

This review informs an empirical study on the indirect professional learning effects of Prompt'n'Play, a serious board game designed to foster primary students' competencies in prompt engineering, understanding generative AI, bias awareness, and responsible AI use. Grounded in situated learning, the game requires players to formulate prompts evaluated in real time by an AI agent according to clarity, relevance, and creativity, providing immediate feedback on how communicative choices shape outputs. Teachers participate as facilitators rather than learners, suggesting that leading AI-focused game-based activities may itself represent situated professional learning.

The literature clusters around five themes: teachers' AI-related perspectives and competencies; professional development models; expectations, barriers, and equity challenges; game-based and AI-enhanced pedagogies; and assessment tools for pupil learning and teacher growth.

1.2 Teachers' AI perspectives, competencies, and the AI-TPACK Framework

Teacher attitudes toward AI in primary education are generally positive but ambivalent. Italian teachers recognise AI's potential to enhance teaching, creativity, and reflection (Pellegrini et al., 2025), while expressing concerns about ethics, privacy, and reduced human interaction (Demirhan, 2025; Pellegrini et al., 2025). This tension is associated with prior digital competence: more experienced teachers are more open to AI adoption (Cacciamani et al., 2022; Guzzo et al., 2022), whereas less experienced teachers report greater anxiety (Yumbul & Sulak, 2024). At the same time, important literacy gaps persist. Studies in South Korean, Chinese, and Turkish primary contexts show that teachers often have basic AI awareness but limited understanding of AI functioning, limitations, and pedagogical appropriateness (Kim & Kwon, 2023; Liu, 2024; Yumbul & Sulak, 2024). Confusion between AI tools and general digital resources further limits meaningful use (Liu, 2024). These gaps involve technical, pedagogical, and ethical knowledge (Kim & Kwon, 2023). Findings suggest that positive attitudes toward AI do not necessarily translate into readiness for pedagogical integration. While teachers often recognise AI's innovative potential, concerns related to ethics, reliability, loss of professional autonomy, and classroom management may limit sustained adoption. AI integration is therefore not determined solely by technical competence, but also by teachers' critical beliefs, contextual constraints, and professional identity negotiations. The AI-TPACK framework helps explain these challenges. Teachers with stronger AI-TPACK are better able to design AI-enhanced lessons aligned with learning goals (Wang et al., 2025). Since AI-TPACK develops through authentic pedagogical practice rather than technical training alone, Prompt'n'Play may support this process by engaging teachers in iterative prompt refinement and implicit pedagogical reasoning about AI. Similar effects have emerged through collaborative curriculum co-design (Dai et al., 2023).

1.3 Professional development: from fragmented training to situated learning

The limited preparation of teachers for AI integration is a recurring issue in the literature. Pre-service programs often prioritise general ICT skills over AI-specific pedagogy (Salmieri, 2019), while in-service training focuses mainly on technical aspects (Galindo-Domínguez et al., 2024). This gap is seen as a major barrier to AI adoption (Erol & Erol, 2024; Yumbul & Sulak, 2024) and was further exposed during the COVID-19 pandemic (Guzzo et al., 2022).

More effective models combine theory, hands-on practice, collaboration, and reflection, improving teachers' confidence and AI integration skills (Fissore et al., 2024). Problem-based and collaborative approaches also support AI-TPACK development (Glazewski et al., 2022; Dai et al., 2023).

Prompt'n'Play may offer a situated alternative by placing teachers in the role of facilitators. Observing students refine prompts and interpret AI feedback can foster vicarious professional learning (Bandura, 1997) and situated professional development (Pozzi & Persico, 2024).

1.4 Barriers, expectations, and equity in AI-Enhanced education

Teachers' expectations of AI focus on three main benefits: personalized learning through adaptive systems (Erol & Erol, 2024; Liu, 2024), greater student engagement through interactive and gamified experiences (Kerneža & Zemljak, 2025; Li, 2025; Henry et al., 2021; Sánchez-Rivas et al., 2019), and improved efficiency through AI-supported differentiation and formative feedback (Galindo-Domínguez et al., 2024; Liu, 2024).

These expectations are constrained by significant barriers. Limited infrastructure, especially in rural and under-resourced schools, restricts AI adoption (Castro et al., 2025; Addeo et al., 2021; Salmieri, 2019). Workload, rapid technological change, and unclear institutional policies further reduce teachers' willingness to experiment (Döğər & Göçen, 2025; Galindo-Domínguez et al., 2024; Salmieri, 2019).

Equity and ethics add further complexity. Teachers report concerns about the digital divide, algorithmic bias, privacy, and the risk of amplifying inequalities (Addeo et al., 2021; Salmieri, 2019; Kim & Kwon, 2023; Pellegrini et al., 2025), yet often feel unprepared to address these issues with young learners. Prompt'n'Play may help reduce this gap by embedding bias awareness into gameplay, encouraging teachers to practice ethical reasoning while facilitating student-AI interactions. These findings suggest that AI adoption is a complex process in which teachers balance pedagogical opportunities with ethical concerns, institutional constraints, and professional values.

1.5 Game-Based Learning strategies and prompt quality as learning indicator

Game-Based Learning emerges as a particularly effective strategy for AI literacy development in primary education. Role-playing and narrative-driven games help students develop a more nuanced understanding of AI capabilities and limitations than direct instruction by making AI processes visible, interactive, and manipulable (Henry et al., 2021). Through game-mediated challenges, students build more sophisticated mental models of AI behaviour (Henry et al., 2021).

Serious games and AI-powered simulations also support learning in complex domains and increase motivation, including in assessment contexts (Kerneža & Zemljak, 2025; Sánchez-Rivas et al., 2019). This is reflected in Prompt'n'Play's design, where clarity, relevance, and creativity of prompts—evaluated in real time by AI—act as scaffolds for students and observable quality indicators for teachers. These dimensions align with the AI literacy constructs measured in this study: perceived understanding, instructional use, self-efficacy, and future intention (Davis, 1989; Venkatesh et al., 2012).

Collaborative and inquiry-based approaches further strengthen these effects. Students engaged in authentic AI-related problem solving show greater agency and deeper understanding (Glazewski et al., 2022), while AI-supported collaborative curriculum construction fosters both AI literacy and collaboration skills (Dai et al., 2023).

1.6 Assessment of student learning and teacher growth

AI-powered formative assessment offers important innovations, including rapid personalized feedback, adaptive difficulty, and multidimensional progress tracking (Liu, 2024; Li, 2025). Gamified and game-based assessments can reduce test anxiety and provide richer evidence of learning through more authentic and adaptive conditions (Sánchez-Rivas et al., 2019; Henry et al., 2021). However, teachers remain reluctant to view AI as a substitute for professional judgment, especially in assessing higher-order thinking, creativity, and complex problem solving (Demirhan, 2025; Galindo-Domínguez et al., 2024).

Assessment of teacher AI competencies remains underdeveloped. Existing frameworks include technical, pedagogical, and ethical dimensions (Kim & Kwon, 2023), while professional development programs often rely on reflective and collaborative evaluation practices (Fissore et al., 2024). Validated tools for assessing AI-TPACK, pedagogical reasoning, and ethical facilitation are still limited. The Prompt'n'Play study addresses this gap through Likert-scale pre-post questionnaires measuring perceived understanding, instructional use, self-efficacy, and future intention, grounded in technology acceptance theory (Davis, 1989; Venkatesh et al., 2012; Bandura, 1997). The following sections present quantitative analyses of these instruments with 15 primary school teachers.

2. Methods and Materials

2.1 Prompt'n'Play: the game

Prompt'n'Play (<https://promptandplay.it>) is a serious card board game designed to help children learn how to create clear, creative and effective prompts for interacting with Artificial Intelligence.

During the game, players use different cards that define a challenge, an audience, a style and a format. Starting from these elements, they work in groups to write a prompt that is coherent, specific and imaginative. Once the prompt has been created, it is submitted to an AI assistant, which provides feedback on its quality, focusing on aspects such as creativity, relevance, clarity and originality. The feedback is then discussed by the whole class, so that students can reflect on their choices, compare different solutions and understand how to improve their prompt. The game encourages creativity, problem solving, collaboration and communication skills. It also helps students understand that a good prompt is not just a simple question, but a well-structured instruction that guides the AI towards a useful and meaningful answer. Through play, feedback and class discussion, children gradually learn how to improve their ideas, revise their texts and give or receive suggestions from classmates.

2.2 Sample

The primary target group for the project consists of 122 children aged between 8 and 10, from 8 classes in 4 Italian schools located in the provinces of Bergamo, Milan, Trento (north of Italy) and Potenza (south of Italy). Only 108 children completed the three questionnaires (Pre-Test T0, Post-Test T1 and Follow-up) (number shown outside the brackets).

The secondary (derivative) target group consists of 18 primary school teachers. Only 15 teachers completed the two questionnaires, Pre-Test T0 and Post-Test T1 (number shown outside the brackets).

Table 1

ID	School	Province	School complex	Class	Students	Teachers
1	IC Clusone	Bergamo	Villa d'Ogna	4A	12 (13)	2
2	IC "Copernico" Corsico	Milano	Copernico	5B	19	1 (2)
3			Copernico	5C	15 (21)	2 (3)
4	IC Rapolla-Barile	Potenza	Barile	4A	9 (11)	2
5			Rapolla	4B	16 (20)	2
6			Ripacandida	4B	6 (7)	2
7	IC Val Rendena	Trento	Carisolo	5A	15	1 (2)
8			Pinzolo	5A	16	3
Total					108 (122)	15 (18)

2.3 Design, Participants and Measures

Eighteen teachers participated in the intervention, of whom fifteen completed both pre- and post-questionnaires and were included in repeated-measures analyses. Participants were predominantly experienced and older professionals, with most aged over 50 and teaching upper primary grades. They represented diverse disciplinary areas, including STEM, humanities, and interdisciplinary domains (see Table 2).

Table 2: Participant characteristics (N = 18 enrolled; n = 15 completed pre-post questionnaire)

Variable	Category	n (%)
Age	≤ 50 years	7 (38.9)
	> 50 years	11 (61.1)
Teaching experience	≤ 10 years	7 (38.9)
	> 10 years	11 (61.1)
Grade taught	Grade III only / mixed with III	6 (33.3)
	Grades IV–V	12 (66.7)
Subject area	STEM-related	8 (44.4)
	Humanities-related	5 (27.8)
	Mixed / interdisciplinary / support	5 (27.8)

2.4 Research Questions and Hypotheses

Based on the literature and the situated professional learning framework underpinning Prompt'n'Play, this study investigated whether facilitating an AI-focused game-based activity could generate indirect professional learning effects on primary school teachers' AI literacy and teaching agency.

The study hypothesized increases in teachers' perceived understanding of AI, didactic use of AI tools, daily AI use, and post-intervention self-efficacy. It was also expected that future intention to use AI would be positively associated with perceived understanding and self-efficacy, and that teachers would report positive perceptions of Prompt'n'Play and Game-Based Learning.

2.5 Data Analysis

All analyses were conducted using Jamovi. Preliminary analyses included descriptive statistics, normality assessment (Shapiro–Wilk test), and reliability analyses using Cronbach's alpha. Pre–post differences were examined using Wilcoxon signed-rank tests, with paired-samples t-tests reported for comparison; effect sizes were calculated using Cohen's d and rank-biserial correlation.

Post-intervention variables were analysed descriptively, while associations among variables were examined through Spearman's rank-order correlations. Finally, a linear regression model tested whether gains in understanding and self-efficacy predicted future intention to use AI, with assumptions of normality, multicollinearity, and influential cases verified.

3. Results

3.1 Pre–post changes

Teachers' perceived understanding of AI increased significantly after the intervention, with a large effect size. Similarly, didactic use of AI showed a significant improvement with a very large effect size. Daily AI use showed a positive but non-significant trend. Detailed statistics are reported in Table 3.

Table 3: Pre–post comparison of key variables

Variable	Pre-test M (SD)	Post-test M (SD)	Wilcoxon W	p	Effect size (r)	Cohen's d
AI understanding	3.07 (0.96)	3.60 (0.83)	11.00	.018	.67	0.64
Didactic use	0.92 (0.76)	1.77 (0.73)	4.50	.008	.84	0.86
Daily AI use	2.00 (0.66)	2.40 (0.83)	6.00	.094	.57	—

Note. Wilcoxon signed-rank tests are reported due to small sample size and non-normality. Paired-samples t-tests were conducted for comparison. r = rank-biserial correlation; d = Cohen's d.

3.2 Post-intervention outcomes

3.2.1 Reliability of post-intervention scales

Cronbach's alpha indicated excellent internal consistency for both post-intervention scales. The four-item Prompt'n'Play scale, assessing perceptions of the project as an educational tool, showed excellent reliability ($\alpha = .91$). Similarly, the six-item Game-Based Learning scale, assessing perceptions of game-based learning as a methodological approach, demonstrated equally high reliability ($\alpha = .92$).

3.2.2 AI-related competencies

Participants reported generally high levels of AI-related competencies. Conscious use ($M = 3.60$, $SD = 0.74$) and safe AI use ($M = 3.53$, $SD = 0.64$) were relatively high, while prompt understanding reached particularly strong levels ($M = 4.27$, $SD = 0.46$), with all participants scoring at least 4, indicating consistent acquisition of operational AI skills.

3.2.3 Perception of the game-based intervention

Teachers reported generally positive perceptions of the Prompt'n'Play intervention. Composite scores on the Prompt'n'Play scale yielded a mean of 3.70 (SD = 0.81), indicating moderate to high perceived usefulness for teaching practice.

3.2.4 GBL pedagogical beliefs

Teachers expressed strong agreement with key pedagogical principles of game-based learning. Composite scores on the GBL scale were particularly high ($M = 4.29$, $SD = 0.92$), reflecting broad consensus regarding its applicability and educational value. Despite these positive perceptions, no clear association with stronger future intention emerged.

3.3 Relationships among variables

Spearman correlations revealed a strong positive association between prompt understanding and self-efficacy ($\rho = .75$, $p = .001$). Conversely, gains in understanding were negatively associated with both future intention ($\rho = -.54$, $p = .038$) and conscious use ($\rho = -.54$, $p = .037$), while no significant association emerged between self-efficacy and future intention. These findings suggest that greater understanding may be associated with a more cautious and critical orientation toward future AI use.

The regression model explained 29% of the variance in future intention ($R^2 = .29$), although it was not statistically significant. Gains in understanding showed a negative trend ($\beta = -.44$, $p = .094$), whereas self-efficacy showed a positive but non-significant effect ($\beta = .30$, $p = .239$). No major violations of model assumptions were detected.

No significant associations emerged between GBL-related variables and future intention. Perceived usefulness of the intervention was not significantly related to self-efficacy ($\rho = -.26$, $p = .365$) or future intention ($\rho = -.41$, $p = .144$), and pedagogical beliefs showed no association with intention ($\rho = .01$, $p = .980$). However, a moderate positive association was found between GBL perception and pedagogical beliefs ($\rho = .49$, $p = .057$), suggesting partial alignment between experience and underlying beliefs.

4. Discussion

The present study examined whether implementing an AI-focused serious game for primary school students could also generate indirect professional learning effects for teachers. Findings suggest that participation in the Prompt'n'Play intervention was associated with significant improvements in teachers' perceived understanding of AI and didactic use of AI tools, supporting the idea that classroom facilitation of innovative learning activities can function as situated professional development. In line with the literature, AI literacy involves not only technical knowledge but also the ability to understand, apply, and critically reflect on AI in educational contexts (Chiu et al., 2024; Ranieri et al., 2024).

The demographic profile of the sample is noteworthy because older and more experienced teachers are often reported as being more resistant to technology adoption (Bingimlas, 2009; Teo, 2011). The positive outcomes observed may therefore reflect both openness to innovation and the supportive nature of the intervention. The strong increase in didactic AI use suggests that even a short intervention may shift teachers from general awareness toward a more concrete perception of AI's pedagogical applicability, consistent with research on serious games, situated cognition, and practice-based professional development (Schrader, 2023; Andreoletti & Tinterri, 2023; Pozzi & Persico, 2024).

A particularly relevant finding concerns the negative association between gains in AI understanding and future intention to use AI. Rather than indicating resistance, this may reflect a more critical and reflective orientation: as teachers become more aware of the functioning, limitations, and risks of generative AI, they may adopt a more cautious stance. This finding partially challenges techno-optimistic assumptions frequently present in AI adoption research, where increased knowledge is often expected to correspond to stronger adoption intentions. This interpretation is consistent with technology acceptance models, in which intention depends on multiple interacting factors rather than knowledge alone (Davis, 1989; Venkatesh et al., 2012), and with multidimensional views of AI literacy that emphasise ethical and critical awareness (Tenberga & Daniela, 2024; Ranieri et al., 2024). The strong correlation between prompt understanding and self-efficacy further highlights the importance of operational familiarity in shaping confidence (Bandura, 1997), although self-efficacy alone did not predict future intention. Similarly, although teachers reported highly positive perceptions of Prompt'n'Play and strong agreement with the pedagogical value of game-based learning, these factors were not associated with stronger intention to adopt AI. This suggests a gap between positive pedagogical beliefs and actual instructional

enactment, likely influenced by contextual constraints, perceived effort, or implementation concerns, as noted in prior research on educational technology adoption. Several limitations should be considered. The small sample size and reliance on self-report measures limit generalizability and prevent strong causal inferences. In addition, the study examined only short-term changes, without assessing whether effects persist over time or translate into stable teaching practices. Future research should adopt larger samples, longitudinal designs, and mixed-method approaches to capture both perceived and observed changes in teachers' AI-related practice.

5. Conclusion

This study explored whether facilitating an AI-focused serious game with primary school pupils could also foster teachers' professional learning. The findings provide preliminary evidence that Prompt'n'Play may function as an effective practice-based professional development experience. By engaging directly with prompting, AI-generated responses, and classroom mediation, teachers reported increased perceived understanding of AI and more frequent didactic use of AI tools. These findings are consistent with previous research suggesting that authentic and situated experiences can support the development of teachers' AI literacy and confidence in educational innovation (Long & Magerko, 2020; Pei et al., 2026). They also reinforce the importance of experiential and context-sensitive forms of teacher education in AI, as highlighted in recent literature reviews (Dicataldo et al., 2025).

Increased understanding of AI was associated with a more critical and selective orientation toward future use. This finding suggests that AI literacy may support reflective professional judgment rather than simply encouraging greater adoption (Ranieri et al., 2024).

These findings should be interpreted with caution due to the small sample size and the reliance on self-reported measures. Future research should involve larger samples, longitudinal designs, and observational measures to examine whether these effects persist over time and translate into stable classroom practices.

Overall, this study suggests that serious games originally designed for pupils may represent meaningful tools for teacher professional development, supporting more reflective, critical, and pedagogically grounded forms of AI integration in schools.

6. Ethics declaration

The data collected through the questionnaire comply with ethical standards for the treatment of personal data. All participants were informed about the purpose of the study, and their participation was entirely voluntary. Informed consent was obtained, and all responses were anonymized to ensure confidentiality. The study adheres to relevant data protection regulations and ethical guidelines governing research involving human participants.

7. AI declaration

Artificial intelligence (AI) tools were used to support the preparation of this manuscript. Specifically, AI language models were employed to assist in the revision and refinement of certain sections of the text, including improving clarity and coherence. Additionally, SciSpace was utilized to aid in the literature search and bibliographic exploration. The authors maintained full responsibility for the final content, interpretation, and conclusions presented in the paper.

8. Authors' Contributions

The article is the result of a joint work of all the authors. The Introduction, paragraphs 1.1–1.3, was written by Massimiliano Andreoletti, while paragraphs 1.4–1.6 were written by Andrea Tinterri. The Methods section was written by Marika Lamacchia (paragraphs 2.1 and 2.2) and Francesco Facciorusso (paragraphs 2.3 and 2.4). The Results section (paragraphs 3.1–3.3) was written by Maria Clara Dicataldo. The Discussion section (paragraph 4) was written by Anna Dipace. The Conclusions section (paragraph 5) was written by Maria Concetta Carruba.

References

- Addeo, F., Masullo, G., Ruopolo, A. and Delli Paoli, A. (2021) "Learning with ICTs at Primary Level: Teachers' and Pupils' Perceptions", *Italian Journal of Sociology of Education*, Vol. 13, No. 3, pp. 21–44.
- Andreoletti, M., and Tinterri, A. (2023). *Apprendere con i giochi: Esperienze di progettazione ludica*. Carocci, Roma.
- Bandura, A. (1997) *Self-efficacy: The Exercise of Control*, W. H. Freeman, New York.
- Bingimlas, K. A. (2009) "Barriers to the Successful Integration of ICT in Teaching and Learning Environments: A Review of the Literature", *Eurasia Journal of Mathematics, Science and Technology Education*, Vol. 5, No. 3, pp. 235–245.

- Cacciamani, S., Cesareni, D., Fiorilli, C. and Ligorio, M. B. (2022) "Teachers' Work Engagement, Burnout, and Interest toward ICT Training: School Level Differences", *Education Sciences*, Vol. 12, No. 7, p. 493.
- Castro, A., Díaz, B., Aguilera, C., Prat, M. and Chávez-Herting, D. (2025) "Identifying Rural Elementary Teachers' Perception Challenges and Opportunities in Integrating Artificial Intelligence in Teaching Practices", *Sustainability*, Vol. 17, No. 6, p. 2748.
- Chiu, T. K., Ahmad, Z. and Çoban, M. (2025) "Development and validation of teacher artificial intelligence (AI) competence self-efficacy (TAICS) scale", *Education and Information Technologies*, Vol. 30, No. 5, pp. 6667-6685.
- Dai, Y., Liu, A., Qin, J., Guo, Y., Jong, M. S.-Y., Chai, C.-S. and Lin, Z. (2023) "Collaborative Construction of Artificial Intelligence Curriculum in Primary Schools", *Journal of Engineering Education*, Vol. 112, No. 1, pp. 23-42.
- Davis, F. D. (1989). "Perceived usefulness, perceived ease of use, and user acceptance of information technology". *MIS Quarterly*, Vol 13, No. 3, pp 319-340.
- Demirhan, M. (2025) "Artificial Intelligence and Education: Classroom Teachers' Experiences and Perceptions", *International Journal of Social, Humanities and Administrative Sciences*, Vol. 11, No. 5, pp. 388-397.
- Dicataldo, M. C., Guerriero, M. A., Lamacchia, M. and Dipace, A. (2025) "Intelligenza artificiale e formazione dei docenti di scuola: una revisione della letteratura", *IUL Research*, Vol. 6, No. 12, pp. 102-116.
- Döğër, M. F. and Göçen, A. (2025) "Artificial Intelligence (AI) as a New Trajectory in Education", *The Journal of Educational Research*, Vol. 118, No. 6, pp. 581-595.
- Erol, M. and Erol, A. (2024) "Use of Artificial Intelligence (AI) Technologies in Education According to Primary School Teachers: Opportunities and Challenges", *Sakarya University Journal of Education*, Vol. 14, No. 3, pp. 426-446.
- Fissore, C., Floris, F., Conte, M. M. and Sacchet, M. (2024) "Teacher Training on Artificial Intelligence in Education", in Sampson, D. G., Ifenthaler, D. and Isaías, P. (eds) *Smart Learning Environments in the Post Pandemic Era. Cognition and Exploratory Learning in the Digital Age*, Springer, Cham, pp. 227-244.
- Galindo-Domínguez, H., Delgado, N., Losada, D. and Etxabe, J. M. (2024) "An Analysis of the Use of Artificial Intelligence in Education in Spain: The In-Service Teacher's Perspective", *Journal of Digital Learning in Teacher Education*, Vol. 40, No. 1, pp. 41-56.
- Glazewski, K., Ottenbreit-Leftwich, A., Jantaraweragul, K., Jeon, M., Hmelo-Silver, C., Scribner, J. A., Lee, S., Mott, B. and Lester, J. (2022) "PrimaryAI: Co-Designing Immersive Problem-Based Learning for Upper Elementary Student Learning of AI Concepts and Practices". In Becker, B. A., Quille, K. and Laakso, M.-J. (eds) *Proceedings of the 27th ACM Conference on Innovation and Technology in Computer Science Education*, Vol. 2, Association for Computing Machinery, New York, p. 628.
- Guzzo, T., Boffo, S., Ferri, F., Gagliardi, F. and Grifoni, P. (2022) "Towards Quality Digital Learning: Lessons Learned during COVID-19 and Recommended Actions. The Teachers' Perspective", *Sustainability*, Vol. 14, No. 14, p. 8438.
- Henry, J., Hernalesteen, A. and Collard, A. S. (2021) "Teaching Artificial Intelligence to K-12 Through a Role-Playing Game Questioning the Intelligence Concept", *Künstliche Intelligenz*, Vol. 35, pp. 171-179.
- Kerneža, M. and Zemljak, D. (2025) "Umetna inteligenca kot pedagoško orodje: izkušnje učiteljev v osnovnih šolah s poudarkom na pouku slovenščine ter tehnike in tehnologije", in Mlekuž, A. and Žagar, I. Ž. (eds) *Raziskovanje v vzgoji in izobraževanju: Umetna inteligenca v vzgoji in izobraževanju*, Pedagoški inštitut, Ljubljana, pp. 63-78.
- Kim, K. and Kwon, K. (2023) "Exploring the AI Competencies of Elementary School Teachers in South Korea", *Computers and Education: Artificial Intelligence*, Vol. 4, 100137.
- Li, M. (2025) "Integrating Artificial Intelligence in Primary Mathematics Education: Investigating Internal and External Influences on Teacher Adoption", *International Journal of Science and Mathematics Education*, Vol. 23, pp. 1283-1308.
- Liu, L. (2024) "Survey and Analysis of Primary School Teachers' Use of Generative Artificial Intelligence", *Lecture Notes in Education Psychology and Public Media*, Vol. 74, pp. 43-52.
- Long, D., and Magerko, B. (2020). "What is AI Literacy? Competencies and Design Considerations", In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20)*. Association for Computing Machinery, New York, NY, USA, pp. 1-16.
- Pei, B., Lu, J., Zhang, Z., Tuffour, P. and Park, S. (2026) "Enhancing AI Literacy for Educators: Where to Start and to What End?", *Computers and Education: Artificial Intelligence*, 100550.
- Pellegrini, S., Sebastiani, R., Ninassi, P. and Lampis, E. (2025) "A Pluralistic Approach to Artificial Intelligence: Ethical and Educational Challenges in Educational Institutions", *Community Notebook. People, Education and Welfare in the Society 5.0*, Vol. 1, No. 1, pp. 59-87.
- Pozzi, F. and Persico, D. (2024) "Gamification for Teacher Professional Development: The Case for Narrative Approaches", *Interaction Design and Architecture(s) Journal — IxD&A*, Vol. 62, pp. 26-40.
- Ranieri, M., Biagini, G. and Cuomo, S. (2024) "Less Knowledge, More Trust? Exploring Potentially Uncritical Attitudes towards AI in Higher Education", *Italian Journal of Educational Technology*, Vol. 32, No. 1, pp. 37-52.
- Salmieri, L. (2019) "The Rhetoric of Digitalization in Italian Educational Policies: Situating Reception among Digitally Skilled Teachers", *Italian Journal of Sociology of Education*, Vol. 11, No. 1, pp. 162-183.
- Sánchez-Rivas, E., Ruiz-Palmero, J. and Sánchez-Rodríguez, J. (2019) "Gamification of Assessments in the Natural Sciences Subject of Primary Education", *Educational Sciences: Theory & Practice*, Vol. 19, No. 1, pp. 95-111.
- Schrader, C. (2023). "Serious Games and Game-Based Learning". Zawacki-Richter, O., Jung, I. (eds) *Handbook of Open, Distance and Digital Education*. Springer, Singapore, pp 1255-1268.
- Tenberga, I. and Daniela, L. (2024) "Artificial Intelligence Literacy Competencies for Teachers Through Self-Assessment Tools", *Sustainability*, Vol. 16, No. 23, 10386.

- Teo, T. (2011) *Technology Acceptance in Education: Research and Issues*, Sense Publishers, Rotterdam.
- Traga Philippakos, Z. A., and Rocconi, L. (2025). "AI Literacy: Elementary and Secondary Teachers' Use of AI-Tools, Reported Confidence, and Professional Development Needs". *Education Sciences*, Vol. 15, No. 9, 1186.
- Venkatesh, V., Thong, J. Y. L. and Xu, X. (2012) "Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology", *MIS Quarterly*, Vol. 36, No. 1, pp. 157–178.
- Wang, Q., Huang, L. and Wang, R. (2025) "Exploring the Development of AI-TPACK for Primary School English Teachers", 2025 International Conference on Distance Education and Learning (ICDEL), Kunming, China, pp. 370–374.
- Yim, I. H. Y. and Su, J. (2025). "Artificial intelligence literacy education in primary schools: A review". *International Journal of Technology and Design Education*, Vol. 35, No. 5, pp. 2175–2204.
- Yumbul, E. and Sulak, S. E. (2024) "Examining the Views of Primary School Teachers on the Use of Artificial Intelligence in Education", *Education Mind*, Vol. 3, No. 3, pp. 303–317.