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TEACHERS' PERSPECTIVES ON THE USE OF INTERACTIVE EDUCATIONAL AVATARS: INSIGHTS FROM NON-FORMAL TRAINING CONTEXTS[4]

Abstract: The present study explores how experiences gained through non-formal education influence teachers' attitudes toward the use of interactive educational avatars in pedagogical practice. Employing a quantitative design, data were collected from a sample of 34 educators in Serbia across diverse educational levels (preschool, primary, secondary, and higher education). Data were obtained via an online survey and analyzed using regression analysis, one-way ANOVA, Tukey HSD test, correlation models, and interaction regression models, with support of R statistical software. The findings reveal that respondents generally recognize the educational potential of interactive avatars, particularly in the domains of personalized learning, adaptation to learners' interests and cognitive styles, and fostering intrinsic motivation. University professors displayed the most favorable attitudes, while secondary school teachers showed slightly lower scores. Statistically significant group differences emerged, demonstrating that higher educational attainment corresponds to more favorable perceptions of avatar integration. Participants emphasized the need for additional training to effectively apply avatars in teaching. The study concludes that, with proper teacher training and the development of pedagogically grounded scenarios, interactive avatars can significantly contribute to the digital transformation of education and enhance the learning process through personalized and emotionally intelligent instruction.

Keywords: Artificial intelligence in education; Digital transformation; Interactive educational avatars; Personalized learning; Teacher training.

Introduction

In recent years, the exponential development of artificial intelligence (AI) technologies has significantly reshaped the landscape of educational innovation. Educational interactive avatars (digitally generated characters or agents) today can provide educational scalability, allowing the expansion to a larger number of students without quality loss and enabling digital transformation to enhance teaching and training processes. Smart education is increasingly based on personalized digital tutors that function as adaptive learning support across all educational levels. The implementation of AI and educational software solutions in teaching can be observed through the lens of functional digitalization, which not only automates operational tasks but also transforms how teachers plan, conduct, and evaluate the educational process. Didactic AI agents enable student self-monitoring and metacognitive reflection on learning, aligning AI with the broader framework of self-regulated learning. OECD (2021) in its report *AI and the Future of Skills* emphasizes

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that education systems must focus on developing competencies resistant to automation. These include problem-solving, social and emotional intelligence, collaboration, and creativity. In this context, interactive avatars and AI systems represent not only knowledge transmission tools but also opportunities for developing these essential skills. The use of AI technology is recommended for formative assessment and adaptive learning, which aligns with the pedagogical role of interactive avatars. These avatars allow continuous real-time data collection and analysis to personalize education according to students' actual needs. Building transparent and explainable AI systems is also emphasized to help teachers understand pedagogical decisions made by AI. According to UNESCO IITE (Huang *et al.,* 2024), smart education must align with equity, ethics, and local relevance principles. Institutions implementing AI systems should ensure inclusive access and create environments where students actively participate in learning rather than passively consume content. UNESCO's concept of 'AI Ready Schools' promotes dynamic school environments that leverage intelligent systems for learning analytics, content adaptation, and real-time pedagogical decision-making. These principles also support educational policy recommendations in CEE countries, where integrating digital competencies into national curricula and systematically introducing AI technologies into initial teacher education programs have become increasingly important. In this context, the pedagogical value of avatar technology becomes crucial for operationalizing these reform requirements. Measurement frameworks comparing AI capabilities with human skills are also emerging (Mandic, Miscevic, Bujisic, 2024; OECD, 2023).

The Importance of Teacher Training for Using Smart Technologies

Smart technologies allow teachers to monitor student behavior and evaluate each step of the teaching process, transitioning from traditional assessment to holistic tracking of students' activities, interests, and understanding (Mandic, 2023). Six key characteristics of smart education are emphasized: personalization, adaptivity, interactivity, learning analytics, digital inclusion, and collaborative learning. In Serbia's context, the importance of e-communities for teachers and students is highlighted, providing resource exchange and experience sharing, thereby fostering professional development and improving teaching quality. Special attention must be paid to teacher training and the development of their professional competencies (Radulovic, Haskova, Mandic, & Lomnicky, 2024) to improve teaching and empower students for critical and safe AI use. The AI Competency Framework for Teachers offers five areas: (1) Human-centered perspective – teachers should promote ethical and empathetic relationships in AI-supported education; (2) AI ethics – understanding and applying ethical and legal principles when using AI tools; (3) Theoretical and applied aspects of AI – teachers must have knowledge of AI and the ability to adapt tools to students' needs; (4) AI pedagogy – meaningful integration of AI into all aspects of teaching; (5) AI and professional development – AI should support teachers' continuous learning and development (Cukurova & Miao, 2024).

A recent analysis of studies from 2015 to 2024 highlights the imbalance between research on AI applications in teaching and AI in teacher professional development (Tan, Cheng, & Ling, 2024). Few studies have explored how to support teachers based on their experiences with effective AI integration. Research on teachers' experiences with Bitmoji avatars in English language teaching shows increased student motivation and engagement while teachers reported a need for technical support and training (Santosa & Wahyuni, 2024). Researchers have identified misconceptions arising from inadequate knowledge and underdeveloped digital competencies among future teachers, which serve as guidelines for shaping professional development programs (Mandic, Miscevic, Babic, & Matovic, 2024; Matovic, 2024). Future teachers should be trained not only for administrative ICT use but also for advanced application in teaching itself (Ristić & Mandic, 2018).

Evolution of Educational Avatars

The development of educational avatars began with animated pedagogical agents (1990–2005), which can be considered the first forms of virtual instructors and teachers. Classic avatars, whether 2D or 3D, are typically static or animated representations of persons or characters that do not actively respond to users. Their primary role is to represent teachers in digital environments (platforms, social networks, educational games) through predefined animations or scripts. The next generation includes 3D avatars in virtual environments such as *Second Life*, focusing on simulation and experiential learning (Warburton, 2009). The recent development of AI has enabled adaptive systems incorporating autonomous agents that learn from student behavior, learning analytics systems, voice recognition, and speech synthesis. Continuous advancements in generative AI have allowed for the creation of powerful interactive educational avatars capable of real-time human-like interaction, including generating multilingual responses using synthetic voices. For example, open-source GPTAvatar enables fully individualized and contextualized instruction (Fink, Robinson, & Ertl, 2024). Key educational potentials of modern interactive avatars include connecting with students through visual and verbal communication, supporting interaction, motivation, collaboration, personalized learning, and simulating social and emotional situations. Clear legal frameworks and guidelines are essential for the responsible use of generative AI and educational interactive avatars.

Pedagogical Value and Ethical Considerations

The educational potential of interactive avatars extends beyond content delivery. Research suggests that avatars can: Facilitate adaptive learning by adjusting instruction to learners' cognitive readiness (OECD, 2023); Support emotional engagement through affective responsiveness (Lang et al., 2024); Promote motivation and agency by simulating social interaction (Santosa & Wahyuni, 2024); Enable metacognitive regulation by guiding learners in self-monitoring and reflective learning (Herzallah & Makaldy, 2025; Mandic, 2024); Function as mediators of inclusive education by offering differentiated learning trajectories for diverse student populations (Carter et al., 2023). Nevertheless, the deployment of AI-based avatars also raises profound ethical and policy challenges related to transparency, data privacy, algorithmic bias, pedagogical control, and teacher agency (Cukurova & Miao, 2024; Huang et al., 2024). UNESCO emphasizes that the successful integration of AI in education requires adherence to global ethical standards, ensuring that technology serves to augment—rather than displace—the teacher's pedagogical authority (Huang et al., 2024).

The successful integration of interactive avatars into educational practice is strongly contingent upon teachers' technological competence, pedagogical flexibility, and familiarity with AI tools (Tan, Cheng, & Ling, 2024). However, most teacher education programs — particularly in developing and transitional systems such as Serbia's — remain underprepared to provide structured AI literacy and pedagogical training (Radulovic *et al.*, 2024). Recent meta-analyses point to the importance of non-formal learning experiences as alternative developmental pathways for teachers' professional preparation in emerging technologies (Mandic, Miscevic, Babic, & Matovic, 2024; Santosa & Wahyuni, 2024). Informal engagement with avatar technologies—whether through self-directed learning, experimental classroom practice, or participation in pilot programs—may serve as critical scaffolding for teachers to explore, adapt, and internalize AI-enhanced pedagogical strategies.

The CRAIE Center: Institutional Context for Applied Avatar Integration

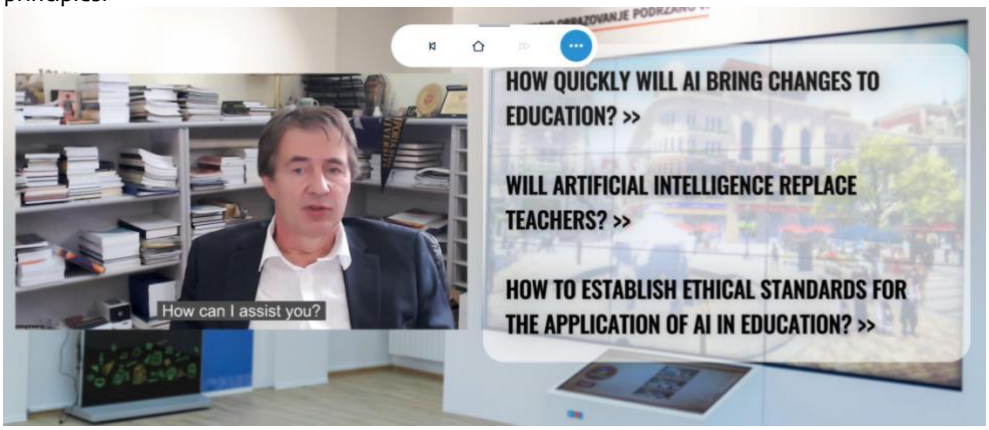
A key applied framework for investigating the implementation of educational avatars in the Serbian context is provided by the Center for Robotics and Artificial Intelligence in Education (CRAIE)[5], operating within the University of Belgrade – Faculty of Education. The CRAIE Center represents one of the pioneering regional research and development hubs dedicated to the integration of AI and

[5] https://craie.edu.rs

robotics in formal and non-formal education, teacher preparation, and policy development. Established through a strategic collaboration between the University of Belgrade, Beijing Normal University (China), and the globally renowned technology corporation NetDragon Websoft, CRAIE embodies a transnational partnership committed to advancing AI-based educational innovation. The Center's infrastructure integrates multiple state-of-the-art technological domains, including:

- Multimedia educational software platforms
- 3D simulation environments and immersive learning scenarios
- Augmented reality (AR) and virtual reality (VR) applications
- Online learning management systems and virtual classrooms
- Educational robotics and AI-driven cognitive tutoring systems

Within this environment, interactive avatars function as integral components of the CRAIE platform, offering real-time access to educational resources, pedagogical innovations, student assessment frameworks, and faculty training modules. The avatars are multilingual, currently operating in Serbian, English, and Chinese, thereby facilitating cross-cultural and international educational cooperation. The CRAIE avatars have been systematically designed to support various instructional tasks aligned with both content delivery and professional development needs. Specifically, the avatars provide: Information on institutional procedures (admissions, program syllabi, degree structures); Access to evidence-based research and publications in educational technology; Simulation of adaptive lesson planning, student evaluation models, and feedback mechanisms; Interactive consultation for teacher training in AI pedagogy, ethical AI use, and digital inclusion principles.



Picture 1. *Interactive virtual avatar*

As a research hub, CRAIE actively participates in international scientific networks, engaging in joint projects with organizations such as UNESCO, UNICEF, UNDP, the Ministry of Education of Serbia, and the Institute for Educational Advancement. The Center also serves as a laboratory for empirical studies investigating teachers' readiness, technological self-efficacy, and pedagogical integration of AI-enhanced tools. Given that the CRAIE Center remains the only institution in Serbia providing access to fully operational educational avatars and associated teacher training, it offers a highly relevant experimental ecosystem for studying how non-formal exposure to avatar technologies may influence teachers' perceptions, competencies, and readiness for broader system-wide adoption.

The present study situates itself within this applied context, leveraging CRAIE's resources to empirically investigate how Serbian teachers — across multiple educational sectors — evaluate the pedagogical potential of interactive avatars following their participation in non-formal learning activities.

Method

Research Problem. Despite growing interest in the integration of artificial intelligence (AI) and interactive avatars in education, empirical studies exploring teachers' practical experiences with such technologies remain limited—particularly within the Serbian educational context. The formal integration of educational avatars into national teacher education curricula has not yet been systematically implemented, resulting in limited structured opportunities for professional preparation in this domain. Therefore, understanding how teachers' informal and non-formal encounters with avatar-based technologies shape their pedagogical attitudes becomes a critical avenue of inquiry. The present study addresses this gap by investigating:

- Whether prior non-formal training experiences with educational avatars influence teachers' professional perceptions of avatar integration in instructional practice.
- How these perceptions vary across different educational levels (preschool, elementary, secondary, and university education).

Research Objectives. The study was designed to pursue the following objectives:

- To examine teachers' overall perceptions of educational avatars based on non-formal learning experiences;
- To analyze how these perceptions differ depending on teachers' educational levels and institutional affiliations;
- To assess specific dimensions of avatar functionality perceived as pedagogically valuable, including personalization, interaction quality, cognitive adaptability, motivational impact, and teacher support in instructional planning;
- To provide empirical guidance for the development of future teacher training programs on AI-based educational tools.

Research Design and Participants. The study employed a quantitative research design, drawing upon a purposive sample of 34 teachers who had previously engaged in non-formal learning activities involving educational avatars. Participants represented various levels of the Serbian education system: preschool teachers, elementary school teachers (classroom teachers), elementary school subject teachers, secondary school teachers, university professors. The average teaching experience across the entire sample was 14.6 years, ensuring sufficient professional maturity to evaluate emerging instructional technologies.

Instruments. Data were collected through an online structured questionnaire specifically designed for this study. The instrument included the following components: Demographic section (educational level, work experience, institutional affiliation); Experience section measuring participants' prior non-formal exposure to classical (non-interactive) and interactive avatars; Attitude assessment section consisting of 9 closed-ended items evaluating teachers' perceptions of avatar functionality across multiple pedagogical domains. The attitude items were operationalized on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The internal consistency of the attitude scale was evaluated via Cronbach's alpha ($\alpha = 0.89$), indicating excellent reliability and unidimensional coherence of the measurement model.

Statistical Procedures. Data analysis was conducted using R statistical software. Data were analyzed using regression analysis, one-way ANOVA, Tukey HSD test, correlation, and interaction regression models.

Results and Discussion

The sample structure across institutional affiliations is presented in Table 1.

Table 1. *Structure of the sample by institution*

Educational Institution	N	Percentage (%)
Preschool teachers	8	23.5
Elementary school - classroom teachers	7	20.6
Elementary school – subject Teachers	8	23.5
Secondary school teachers	6	17.6
University professors	5	14.7

The average work experience was 14.6 years. Although the sample size is small, it includes teachers from all educational levels, which is significant given that interactive educational avatars are a newly emerging innovation in Serbia, with CRAIE currently being the only institution offering comprehensive training.

Teachers' perceptions of interactive educational avatars were assessed through nine key items measuring various pedagogical dimensions of avatar functionality. The descriptive statistics for these items, disaggregated by institutional group, are presented in Table 2**.**

Table 2. *Mean Item Scores for Interactive Virtual Avatars by Institution (Scale 1–5)*

Group	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9
Preschool teachers	2.9	3.1	3.0	2.9	2.7	2.8	2.5	2.7	2.8
Elementary school - classroom teachers	3.0	3.2	3.1	3.0	2.9	2.8	2.6	2.9	3.0
Elementary school- subject teachers	2.8	3.0	2.9	2.7	2.5	2.8	2.4	2.6	2.7
Secondary school teachers	2.7	2.9	2.8	2.6	2.4	2.5	2.6	2.5	2.7
University professors	3.4	3.2	3.6	3.0	3.0	3.2	2.8	3.0	3.2

Item descriptions:

- *Item 1*: Age-appropriate interaction
- *Item 2*: Adaptation to students' interests and learning styles
- *Item 3*: Adaptation to prior knowledge
- *Item 4*: Contribution to knowledge quality
- *Item 5*: Development of critical thinking
- *Item 6*: Stimulation of intrinsic motivation
- *Item 7*: Stimulation of extrinsic motivation
- *Item 8*: Encouraging active participation
- *Item 9*: Support for teachers in planning, implementation, and assessment

By observing the average of all numerical item values together, it can be noted that attitudes toward the educational potential offered by the use of interactive avatars are most positive among university professors, followed by elementary school - classroom teachers, preschool teachers, elementary school- subject teachers, and finally secondary school teachers, who rated the possibilities for improving teaching with this modern tool the lowest. The values of individual items ranged from 2.4 to 3.6 on a scale from 1 to 5, indicating that all respondents, who in informal education gained experience with avatars, positively assessed their contribution. However, in order for these possibilities to be better utilized, professional training is necessary (Brandao, Pedro, & Zagalo, 2024; Mandic, 2024; Ruzicic, Simenuovic, & Gojic, 2024; Tan, Cheng, & Ling, 2024).

The obtained average values of individual items, considered numerically, were highest among university professors, ranging from 3.0 to 3.6. They believed that the use of interactive virtual avatars can mostly provide communication and interaction in line with the cognitive predispositions of users, as well as interaction in accordance with their age, which has also been observed in other studies (Fink, Robinson, & Ertl, 2024; Raza, 2023;). The Faculty of Education in Belgrade pays special attention to monitoring innovations in the field of education, regularly updating its curriculum and study programs, and therefore, after the completion of professional development in the field of the latest educational trends, students of this faculty demonstrated higher average values compared to teachers and preschool teachers from other faculties in the region (Matovic, 2024; Ristić, 2022). Respondents, generally speaking, believed that the interactive virtual avatar can mostly provide communication in accordance with the cognitive studies and learning styles of users, which has also been confirmed by other authors (Carter et al., 2023). Among all the perceived values, respondents agreed the least with the claim regarding the development of internal motivation for independent exploration and user activity (the average value on a scale from 1 to 5 expressed by respondents was 2.58), while they believed that internal motivation develops through external stimuli, as they rated this item with an average score of 2.82 (Lang et al., 2024; Raut, Pawar, & Sharma, 2025; Santosa & Wahyuni, 2024).

ANOVA analysis was used to examine differences in perceived overall value of the educational classical and interactive avatar acquired through informal education in relation to the level of education. It was determined that there is a statistically significant difference between the groups $F(3.30)=4.02$, $p=0.015$. According to the Tukey HSD test, university professors had a significantly more positive attitude compared to elementary and secondary school teachers. Other differences did not reach the level of statistical significance, which is in line with expectations – higher education groups show a more positive attitude toward avatars. Our respondents, regardless of their level of education, expressed generally positive attitudes toward the educational classical and interactive avatar acquired through informal education, which is in line with research focused on identifying and exploring possibilities provided by educational technologies. Independently of discovering and practically applying different educational models, most respondents agreed that the use of avatars is perceived as easy to apply and useful due to the expressed positive attitudes, which is also in line with the findings of other studies where a significant positive correlation was found between perceived usefulness, perceived ease of use, and positive attitude toward AI (Herzallah & Makaldy, 2025).

Study Limitations. Although the study offers valuable insights into pedagogical values and teachers' perceptions of AI avatars—a largely unexplored topic—there are methodological limitations. The sample is small since most teachers in Serbia have not yet used interactive avatars. Additionally, data were collected through self-assessment, which may introduce bias, particularly toward expressing positive attitudes about innovation. Longitudinal studies are planned following systematic teacher training to monitor changes in attitudes over time.

Conclusion and pedagogical implications

Based on the analysis, it can be concluded that interactive educational avatars have evolved to make digital learning more personalized, accessible, and emotionally intelligent. With advancements in AI, avatars have developed into sophisticated agents capable of two-way communication, emotion recognition, and adaptive educational support. Further development will continue expanding their educational potential.

The findings indicate that teachers, despite lacking systematic AI training (having gained knowledge through non-formal education), largely recognize the educational potential of interactive avatars. Positive perceptions primarily relate to avatars' capacity to personalize communication based on students' interests and learning styles, aligning with modern pedagogical approaches emphasizing personalization. Simultaneously, all participants expressed the need for additional training to ensure effective and safe implementation in practice. This highlights the importance of providing systematic support for teachers in the digital transformation of education.
Conversely, some reservations were noted—participants expressed lower agreement regarding avatars' impact on extrinsic student motivation. This suggests that teachers perceive avatars primarily as tools for fostering intrinsic motivation through engagement, interaction, and connectedness, rather than external incentives.

In light of these findings, experiences acquired through non-formal education influence teachers' attitudes toward using interactive educational avatars. AI-powered interactive avatars can enrich the educational process, but their effective application depends on teacher training and the development of pedagogically sound usage scenarios. Future research should examine the long-term effects of avatars in formal education and develop training models integrating technical, pedagogical, and ethical aspects of this technology.

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