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Advancing digitally informed teacher education: exploring the role of Serious Games in lifelong learning and digital well-being

Promuovere una formazione docente digitalmente informata: esplorare il ruolo dei Serious Games nell'apprendimento permanente e nel benessere digitale

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Abstract (EN)

This paper explores the role of Serious Games in pre-service teacher education within the broader perspective of lifelong learning and digital well-being. Building on recent European frameworks such as DigCompEdu and OECD (2025) indicators, it argues that developing teachers' digital awareness and professional resilience requires integrating play-based and reflective methodologies. The study presents the results of an experimental training with 133 pre-service special education teachers at the University of Palermo. Using the Serious Games Evaluation Scale (SGES), the research examines perceived educational effectiveness and usability. Findings show high levels of perceived learning effectiveness and clarity of goals, alongside lower scores in motivation and perceived adequacy of learning materials. These results provide indirect evidence of how structured, reflective game-based environments may support dimensions related to digital well-being, particularly in terms of cognitive engagement, self-regulation, and awareness in the use of digital tools.

Keywords: digital competence, digital well-being, lifelong learning, Serious Games, teacher education

Abstract (IT)

Questo articolo esplora il ruolo dei Serious Games nella formazione iniziale degli insegnanti, all'interno della più ampia prospettiva dell'apprendimento permanente e del benessere digitale. Sulla base di recenti riferimenti europei, come il DigCompEdu e gli indicatori OCSE (2025), si sostiene che lo sviluppo della consapevolezza digitale dei docenti e della loro resilienza professionale richieda l'integrazione di metodologie ludiche e riflessive. Lo studio presenta i risultati di un percorso formativo sperimentale rivolto a 133 futuri insegnanti di sostegno dell'Università di Palermo. Utilizzando la Serious Games Evaluation Scale (SGES), la ricerca analizza la percezione dell'efficacia educativa e dell'usabilità. I risultati evidenziano elevati livelli di efficacia percepita dell'apprendimento e chiarezza degli obiettivi, a fronte di punteggi più bassi relativi alla motivazione e all'adeguatezza percepita dei materiali didattici. Tali esiti forniscono evidenze indirette di come ambienti di apprendimento ludico strutturati e riflessivi possano sostenere dimensioni riconducibili al benessere digitale, in particolare in termini di coinvolgimento cognitivo, autoregolazione e consapevolezza nell'uso degli strumenti digitali.

Parole chiave: competenza digitale, benessere digitale, apprendimento permanente, Serious Games, formazione degli insegnanti

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1. Introduction

Lifelong learning (LLL) is one of the fundamental directions in which contemporary educational thought has developed, both theoretically and politically. Initially conceived as a response to the need for continuous learning in a rapidly evolving society, LLL is now recognised as a structural principle of international education policies. In particular, the European Union has adopted lifelong learning as a cornerstone of its strategies for employment, competitiveness, and social cohesion, intervening through structured programmes (such as Erasmus+, the Skills Agenda, and the European Year of Skills) and a holistic vision of lifelong learning (Biasin & Barros, 2025; Milana et al., 2025).

This evolution has profoundly transformed not only adult education practices but also the epistemological and normative frameworks that guide European education policies. As Mikulec (2025) and Berendi & Longworth (2025) emphasise, lifelong learning has become a discursive and normative device shaping national educational agendas, promoting a logic of continuous training closely linked to the digital, green, and demographic transitions. At the same time, as Ioannidou and Zarifis suggest (2024), lifelong learning is not limited to adapting to the needs of the labour market: it is a cultural and civic right, aimed at supporting democratic participation, social inclusion, and the personal fulfilment of European citizens.

Lifelong learning, therefore, is not only a response to the need for adaptability, but also an educational paradigm that redefines the very meaning of being citizens, professionals, and informed individuals in a complex and interconnected society.

According to Mailis and Mansor (2025), educational institutions today are called upon not only to transmit knowledge but also to develop in students, including future teachers, the capacity for autonomous, reflective, and lifelong learning.

In particular, education must promote the development of key 21st-century skills such as complex problem-solving, critical thinking, intercultural collaboration, and adaptability (Ulfah et al., 2025). However, teachers themselves often report difficulties integrating these skills into daily practice due to inadequate training and structural limitations (Salgado & Paglinawan, 2024).

However, the growing digitalization of educational environments challenges traditional teaching models. Future teachers need both digital competence and digital well-being – the ability to manage technology consciously while maintaining psychological balance (Passey, 2021). This paper addresses the pedagogical potential of Serious Games as an innovative strategy to support these intertwined dimensions in teacher education.

2. Theoretical Framework

2.1 Lifelong Learning and Digital Teacher Education

The European lifelong learning agenda emphasizes the continuous development of digital and transversal competences across all educational levels (Milana et al., 2025).

Frameworks such as DigCompEdu (Redecker, 2017; Vuorikari et al., 2022) encourage teachers to act as reflective practitioners, integrating technology for learning, collaboration, and well-being.

Research highlights the need for innovative methods capable of stimulating engagement, creativity, and critical awareness (Caena & Redecker, 2019).

Unlike other prescriptive tools, DigCompEdu offers a flexible model focused on the pedagogical enhancement of technology. Its application in initial teacher training has proven

promising, especially when combined with self-assessment tools (such as the Check-In Tool), laboratory experiences, and situated learning paths.

This approach enables a move beyond an instrumental view of technologies and promotes educational innovation, encouraging teachers to select, adapt, and evaluate digital solutions based on learning objectives and students' specific needs.

In recent years, the digital competence framework has been further updated with the publication of DigComp 2.2 (Vuorikari et al., 2022), which expands the scope to include dimensions such as digital citizenship, data ethics, digital well-being, and sustainability.

Although DigCompEdu is a conceptually sound tool, its practical implementation requires favourable systemic conditions: adequate infrastructure, ongoing training, and peer support.

As Caena and Redecker (2019) highlight, the framework's effectiveness depends greatly on teachers' professional autonomy, digital mindset, and reflective capacity. Integrating DigCompEdu into educational practice not only fulfils a European mandate, but also creates educational contexts that foster critical awareness, methodological innovation, and professional well-being.

2.2 Digital Well-Being and Professional Resilience

Digital well-being is increasingly recognized as a core component of professional sustainability. Excessive screen exposure, multitasking, and information overload may lead to burnout and digital fatigue (OECD, 2025). A balanced approach integrates digital competence with emotional regulation, self-awareness, and ethical technology use – key traits of resilient educators.

The latest OECD evidence highlights that teachers' digital competence should no longer be regarded as an ancillary skill, but as a central element of both initial and in-service teacher training. In particular, digital education must encompass the critical selection of educational technologies, the integration of digital tools into learner-centred methodologies, and the responsible, ethical, and sustainable use of technology in the classroom.

OECD data show that intensive and poorly managed use of digital technologies can lead to burnout, digital fatigue, and a perceived loss of control over one’s professional environment.

Consequently, digital well-being is increasingly recognised as a key component of professional resilience. Teachers must be equipped to intentionally disconnect, manage digital interactions (including emails and chats), and protect their psychological health in hyper-connected school environments.

The OECD advocates the development of measurable indicators to assess how education systems are preparing digitally aware, reflective, and competent teachers. These indicators include:

- the use of digital tools for personalised learning pathways;
- the capacity to implement formative assessment using educational technology;
- the ethical and secure management of student data in digital environments.

The OECD 2025 report highlights several structural weaknesses in Italy’s education system that hinder the effective digital transformation of teacher training.

Firstly, Italy lags significantly behind in tertiary attainment: only 22% of adults aged 25–64 hold a degree, compared to the OECD average of 42%. In addition, digital and literacy skills among adults are also below average, with 37% scoring at the lowest level in literacy, compared to the OECD average of 27%.

Finally, the report identifies digital competence and equity as critical areas requiring urgent attention. The low integration of digital skills into both curricula and teacher training

programmes, combined with significant regional disparities, undermines the system's ability to prepare digitally competent and resilient educators.

2.3 Serious Games in Education

Serious Games-digital games designed with educational purposes (Abt, 1970) – combine entertainment with structured learning objectives. Research demonstrates their effectiveness in promoting engagement, collaboration, and metacognitive reflection (Gee, 2003; Sailer & Homner, 2020). By simulating authentic scenarios, Serious Games foster experiential learning and emotional involvement, enhancing skill transfer to professional contexts (Ritterfeld et al., 2009; Vlachopoulos & Makri, 2017). Within teacher education, they encourage critical use of digital tools and promote lifelong learning habits.

While fun and entertainment are key drivers that attract players and keep them engaged for hours, what truly fosters learning and sustains motivation and focus are the educational principles and pedagogical strategies embedded in the game design (Erhel & Jamet, 2013; Papoutsi et al., 2022).

Recent literature converges on a key point: Serious Games are digital games that combine playfulness with purposes that go beyond mere entertainment. Their use in educational and professional settings is steadily growing, driven by the global expansion of the Serious Games market. According to forecasts, the market is expected to grow from $6.29 billion in 2020 to over $26 billion by 2026. This trend reflects the increasing recognition of Serious Games as an innovative means of rethinking the teaching and learning process, capitalising on advancements in information and communication technologies (ICTs).

Through gameplay, learners can interact with digital objects, identify with characters, experience emotions, and develop action strategies. To be a successful player, one must exercise control over situations, formulate strategies, and solve problems-skills that are equally fundamental in educational contexts, where effective strategies often lead to meaningful learning outcomes.

In general, Serious Games are computer-based simulation games in which players interact with virtual scenarios and characters, either controlled by artificial intelligence or represented by other human players via avatars. These environments allow for authentic, experiential learning in safe yet realistic settings, making them increasingly valuable in teacher education and lifelong learning pathways.

2.3.1 The Transformative Potential of Serious Games in Teacher Training

Serious Games should not be viewed as a threat to traditional teaching practices, but rather as their evolution – a bridge between playful experience and knowledge construction, capable of fostering emotional engagement, developing key competencies, and promoting authentic learning. In the context of teacher education, they represent one of the most promising frontiers for delivering instruction that is not only effective and efficient, but also deeply engaging and learner-centred.

As highlighted by Kara (2021), Serious Games are increasingly adopted in school settings to support subject-specific learning and are often developed by multidisciplinary teams targeting specific educational goals, structured around sound instructional design models.

Importantly, Serious Games are not merely about delivering content in subjects like history, art history, or digital literacy. As Zyda (2022) asserts, what makes a game "serious" is not its format but its intentional pedagogical design: these are games that teach, instruct, or train by imparting

knowledge or skills through interaction and decision-making. Serious Games can convey learning content more efficiently and deepen skill acquisition among learners – provided they are not limited to pure entertainment and are meaningfully integrated with complementary educational materials.

The effective use of Serious Games in teacher education invites a reconceptualisation of teaching practices – one that embraces active learning, multimodal literacy, and digital fluency. Such integration contributes not only to increased learner engagement and motivation, but also to the development of reflective and adaptive educators who are better prepared to navigate the complexities of digital-age teaching.

Building on the theoretical framework outlined above, this study aims to explore the role of Serious Games in initial teacher education, with particular attention to their perceived educational value and their potential contribution to dimensions related to digital well-being.

Specifically, the study addresses the following research questions:

RQ1: How do pre-service teachers perceive the educational effectiveness and usability of Serious Games in a structured training programme?

RQ2: Which dimensions of the Serious Games experience (e.g., engagement, feedback, clarity, usability) are perceived as more or less effective?

RQ3: To what extent are dimensions of the Serious Games experience (e.g., cognitive engagement, self-regulation, awareness) associated with aspects theoretically related to digital well-being?

3. Methodology

3.1 Research Design

This study employed a quantitative descriptive design to explore pre-service teachers' perceptions of Serious Games' educational value. Participants (N = 133) were enrolled in a special education programme at the University of Palermo during the academic year 2024/2025.

The sample showed a wide age range (approximately 21–57 years), reflecting the heterogeneity of access to the programme, with an estimated mean age of around 39 years. Female participants represented 75.2% of the sample, while male participants accounted for 24.8%.

The training integrated twelve interactive modules, each targeting a metacognitive skill (planning, monitoring, evaluation, self-regulation, attention control, etc.). The activities were implemented in a blended format, combining asynchronous individual interaction with the game scenarios and synchronous moments of group discussion and reflection. Each activity had an average duration of approximately 10–15 minutes, for a total of twelve game-based learning experiences.

The Serious Games used in this study were specifically designed for the training programme. They consisted of digitally mediated, web-based activities developed using educational platforms (e.g., Genially, Wordwall, Educaplay), integrating game elements such as challenges, progression, feedback, and time constraints. These activities can be classified as lightweight, scenario-based Serious Games aimed at fostering metacognitive engagement rather than entertainment.

Each module aimed to promote an in-depth understanding of the targeted skill, highlight its relevance in the learning process, and provide tools to identify how it appears in student behaviour.

Through simulated game dynamics, participants actively experimented with metacognitive strategies, reflected on their own learning styles, and engaged in group discussions about the pedagogical implications that emerged.

For example, in a module focused on self-regulation, participants engaged in a timed challenge requiring them to complete a sequence of tasks under conditions of increasing cognitive load (e.g., time pressure and distractors). The activity required the application of attentional control and monitoring strategies. At the end of the task, participants received automated feedback and were guided through a structured reflection on the strategies used and their potential transfer to classroom contexts.

At the end of the training programme, the Serious Games Evaluation Scale (SGES) was administered to assess participants' perceptions of the educational effectiveness of the games used. The scale enabled measurement of both the experiential and pedagogical components of the activities, providing useful data to analyse the impact of Serious Games in initial teacher education

3.2 Instrument and Data Collection

Data were collected using the Serious Games Evaluation Scale (SGES) (Fokides et al., 2019), a validated instrument assessing educational and ludic dimensions such as enjoyment, motivation, learning effectiveness, clarity, and usability. Participants rated 53 items on a 5-point Likert scale.

3.3 Data Analysis

Quantitative data analysis (Tab. 1) was conducted on a sample of 133 pre-service special education teachers using the Serious Games Evaluation Scale (SGES). This validated instrument comprises multiple dimensions designed to evaluate both the experiential and pedagogical effectiveness of Serious Games in educational settings.

Descriptive statistical analysis was conducted to calculate mean scores and standard deviations for each SGES dimension. Results are presented in aggregated form for interpretative clarity.

To assess the internal consistency of the instrument, Cronbach's alpha coefficients were calculated for each dimension. The results indicated acceptable to excellent levels of reliability (α ranging from .76 to .97), confirming the robustness of the scale in the present sample.

In addition to descriptive statistics, the analysis included an examination of variability within each SGES dimension to identify potential inconsistencies or divergent perceptions among participants.

Table 1. Quantitative data analysis

Dimension	N° items	Mean	Standard Deviation
Presence	4	3.52	0.76
Enjoyment	6	3.91	0.64
Perceived learning effectiveness	6	4.03	0.67
Perceived narration's adequacy	4	3.95	0.68
Perceived realism	4	3.59	0.87
Perceived feedback's adequacy	3	4.02	0.66
Perceived audiovisual adequacy	7	3.98	0.69
Perceived relevance to personal interests	3	3.86	0.72
Perceived goal's clarity	3	4.00	0.68
Perceived ease of use	6	3.65	0.39
Perceived adequacy of the learning material	4	3.57	0.83
Motivation	3	3.41	1.04

Standard deviations were inspected to detect items that elicited heterogeneous responses, signalling aspects of the Serious Games that may have been interpreted differently or perceived as less effective. This analytic procedure allowed for a more nuanced interpretation of user experience and provided a basis for identifying dimensions that require refinement in future implementations.

3.4 Methodological limitations

This study presents several limitations. First, the use of a single self-report instrument administered at the end of the training programme may introduce response bias and does not allow for the measurement of changes over time.

Second, the absence of a control group limits the possibility of causal interpretations.

Finally, the study relies on indirect indicators of constructs related to digital well-being and does not include specific measures explicitly designed to assess this dimension. Future research should therefore adopt mixed-methods approaches and longitudinal designs to better capture the complexity of these processes.

4. Results

Items assessing perceived learning effectiveness consistently reported high mean scores, with an overall average of M = 4.03 (SD = 0.67). These results suggest a positive and relatively homogeneous perception among participants, who recognised Serious Games as valuable tools for acquiring knowledge and skills.

The enjoyment dimension also showed positive results (M = 3.91, SD = 0.64), indicating a generally engaging experience, although some variability across individual items suggests that not all aspects were perceived uniformly.

The clarity of goals dimension displayed strong results (M = 4.00, SD = 0.68), confirming that the educational objectives of the activities were perceived as clear and well structured.

Conversely, the motivation dimension reported the lowest mean score among all dimensions (M = 3.41, SD = 1.04), together with the highest variability. This suggests that the motivational impact of the Serious Games was not uniformly perceived across participants, reflecting differences in individual engagement and responsiveness to the activities.

Similarly, the adequacy of learning materials dimension showed comparatively lower values (M = 3.57, SD = 0.83), indicating a more critical evaluation of the instructional content integrated into the game scenarios.

On the other hand, dimensions related to feedback (M = 4.02, SD = 0.66), audiovisual quality (M = 3.98, SD = 0.69), and narration (M = 3.95, SD = 0.68) received positive evaluations, suggesting overall satisfaction with the design and delivery of the activities.

Overall, participants reported a positive perception of Serious Games as learning tools. The highest ratings concerned learning effectiveness (M = 4.03) and clarity of goals (M = 4.00), indicating that the games were perceived as pedagogically coherent and well structured. Ease of use (M = 3.65, SD = 0.39) and audiovisual quality (M = 3.98) also received favourable evaluations. Conversely, motivation (M = 3.41) and adequacy of learning materials (M = 3.57) obtained comparatively lower scores, suggesting areas for improvement.

5. Discussion

The findings highlight the pedagogical potential of Serious Games for fostering reflective, autonomous, and digitally aware teachers.

However, the low motivation scores suggest that pre-service teachers may perceive Serious Games more as academic exercises than engaging experiences, pointing to the need for enhanced narrative and feedback elements.

These results align with previous literature emphasising the role of Serious Games in promoting deep learning, metacognitive awareness, and soft skills (Erhel & Jamet, 2013; Kara, 2021). They also support the OECD's call for digital teacher training that prioritises professional well-being and sustainable technology use.

These findings also raise important reflections on the role of Serious Games in initial teacher education. The discrepancy between high scores in clarity and learning effectiveness and lower scores in motivation suggests that pre-service teachers may value Serious Games more for their functional instructional contribution than for their intrinsic engagement potential. This distinction is relevant, as it indicates that the educational design was effective but that game elements may require further enhancement to fully support emotional involvement and sustained engagement.

Finally, the results highlight the need to consider the dual function of Serious Games in teacher education: they serve both as learning tools and as models of pedagogical innovation. Ensuring that future teachers recognise their value on both levels is essential for fostering a digitally competent and reflective teaching workforce capable of integrating playful, experiential, and technology-enhanced practices in their future classrooms.

6. Conclusions and implications

This study contributes to the understanding of Serious Games as effective tools in lifelong teacher education, showing how they offer a powerful medium to develop metacognitive and digital competences while simultaneously promoting reflective awareness and digital well-being.

From a practical perspective, the findings suggest the importance of integrating Serious Games systematically within pre-service teacher curricula, so as to strengthen experiential and inclusive learning opportunities.

They also highlight the value of combining quantitative evaluation methods, such as the SGES, with qualitative reflection activities capable of capturing emotional and motivational dimensions that often remain implicit.

Furthermore, aligning the design of Serious Games with the areas identified in the DigCompEdu framework emerges as a key element to ensure coherence between digital competence development and the promotion of digital well-being.

The study nonetheless presents some limitations. It focuses on a single cohort of pre-service teachers and relies exclusively on self-reported measures. Future research should therefore seek to broaden the participant sample and adopt mixed-methods approaches, allowing the triangulation of perceptions with observable learning outcomes.

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