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Playing on Their Strengths: The Impact of Self-Perceived Digital Skills on Teachers' Perception of Gamification in Mathematics

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Abstract

In today's rapidly evolving society, where students' needs have shifted, primary school teachers must adapt, reconfigure their approaches, and acquire the language of the digital generation. The incorporation of technology and gamification in the classroom embodies the potential to increase the' attractiveness and relevance. To assess the impact of this strategy in Romanian education, a preliminary step is to examine primary school teachers' perceptions. The fundamental purpose of the study was to delve into this topic by analysing the responses of 360 primary school teachers through questionnaires targeting self-perceived digital competencies and their perception towards gamification in Mathematics. Participants' perceptions were predominantly positive, with most self-assessing their digital competencies at an intermediate level. The regression analysis further highlighted that the self-perceived level of digital competencies serves as a significant predictor of both gamification usage and its perceived utility in mathematics instruction, although the explanatory power of this variable was relatively modest to weak. These outcomes underscore the necessity of investing in the optimization of teachers' digital competencies and the promotion of gamification.

Keywords: digital skills; perception towards gamification; primary school teachers

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1. Introduction

The swift expansion of knowledge in the 21st century is engendering a myriad of societal challenges. As articulated by Romero (2015), both individuals and organizations have to embrace lifelong learning strategies to sustain a competitive edge in an increasingly globalized landscape. All the transformations have profoundly affected students. In today's digital landscape, students, known as digital natives of the "Net Generation" or "Game Generation" (Prensky, 2001a), embody a distinctly different learning and cognitive-behavioral profile compared to previous generations. They warmly and enthusiastically embrace the technological revolution, along with all forms of technological devices (Opre & Opre, 2018). Characterized by a marked impatience (Prensky, 2001b; Tapscott, 2009) and an insatiable craving for swift information delivery, they thrive in an environment where multiple activities occur simultaneously (Prensky, 2001b; Tapscott, 2009). This generation expects instant feedback and rewards mirroring those found in their beloved digital games (Prensky, 2001b; Rosen, 2010). Their inclinations lean towards fantastical contexts and narratives, akin to the immersive storytelling found in video games (Prensky, 2001b), reflecting a transformative approach to learning that seeks to intertwine engagement with instant gratification. The harmonious blend of work-related activities and effort with game-like engagement, coupled with a pronounced preference for image and audio processing over written text, constitutes other defining characteristics of "digital natives" (Opre & Opre, 2018; Prensky, 2001b; Tapscott, 2009).

Acknowledging the existence of the involuntary transformation of students, educators must abandon their nonchalant resistance to change by adopting modern strategies to effectively address the unique needs of this digitally fluent generation (Romero, 2015). The alignment ensures their relevance in students' eyes, captivates their interest, effectively guides learners through their educational trajectories, instills essential values, and equips them with both theoretical and practical knowledge necessary for long-term success. Much like in a game, where players encounter various challenges and must devise solutions to overcome them, education should prepare students to handle life's complexities with resilience and adaptability.

Given the distinctive characteristics that delineate the profile of students in the current generation, educators are charged with the responsibility of conveying information and content in the vernacular of these "digital natives" (Prensky, 2001a), thereby fostering a communication dynamic that is both effective and bilateral, rather than unilateral and disruptive. Furthermore, it is incumbent upon educators to adapt their pedagogical strategies and instructional tools to align with the needs of these individuals who navigate the lexicons of technology, video games, and the internet (Prensky, 2001b). Such adaptation may be accomplished through innovative methodologies such as gamification, which may play an important role in cultivating a positive disposition towards mathematics. Nevertheless, educators' perceptions of this strategy are pivotal in determining the extent of its application within educational contexts. The occasional use of gamification is unlikely to yield sustainable outcomes. Consequently, an initial step entails assessing their perceptions regarding this strategy, which can facilitate the transmission of information in a manner that is more accessible and engaging for students. Furthermore, it is essential to identify the fears and sources of hesitation that educators experience concerning this strategy, as well as the limitations they face and the areas in which they require support. This understanding will empower them to implement the strategy effectively, thus enhancing the educational experience of their students.

Gamification has progressively gained increasing attention worldwide, as most studies highlight its benefits, which significantly outweigh and even overshadow any potential drawbacks for students at all educational levels. Teachers, as key actors in the educational process, may hold diverse perspectives on the integration of gamification, particularly in primary school mathematics lessons, and these perceptions may influence the adoption and dissemination of this strategy. Although gamification is well-known and widely implemented in education globally, in

Romania, it remains in its early stages. Some teachers are entirely unfamiliar with the concept and do not use it, while others, drawing from the etymology of the term, associate it with the realm of play and game elements but apply it rarely in their teaching. Even among those who do integrate gamification into their lessons, many do so without a deep understanding of its terminology and principles, merely incorporating certain elements in specific lesson stages without fully recognizing their connection to gamification. Moreover, the Romanian academic literature lacks sufficient studies examining teachers' perceptions of gamification in education, particularly in mathematics instruction. The majority of studies have taken place outside the Romanian educational context, concentrating either on teachers' perspectives related to video games and game-based learning (Gillern et al., 2024; Gutierrez et al., 2023; Jobert & Sanchiz, 2025; Sánchez-Mena & Martí-Parreño, 2017) or on the implementation and impact of gamification (Alabbasi, 2018; Alenezi, 2023; Cramariuc et al., 2023; Mårell-Olsson, 2022; Sáez-López et al., 2022). Furthermore, a significant research gap exists regarding how teachers' frequency of digital game use for recreational or personal purposes, along with their self-perceived digital competencies, influences their perspectives towards this strategy.

This gap underscores the relevance of the current research, which aims to explore these aspects within the Romanian context, ultimately contributing to a more comprehensive understanding of primary school teachers' perceptions of gamification. It also seeks to examine the factors that shape their perspectives and its potential in educational settings.

2. Literature Review

2.1. Gamification and game-like elements

At the core of this discussion lies the concept of play, which, while seemingly simple and easily understood, is profoundly complex and cherished by both children and adults. This interplay between perceived simplicity and inherent depth renders plays a universal element, bridging generational gaps through an activity that transcends age and context. Consequently, the game serves as both a medium of expression and a learning tool, captivating and enriching the experiences of all participants and serving both as a powerful source of recreation and a means of education (Phetteplace & Felker, 2014). The variables that sway and stimulate players to extend the time spent playing include the social aspect of collaborative gameplay and the enhanced experiences of proficiency, autonomy, and affiliation throughout gameplay, as highlighted by the findings of Johnson et al (2016). Zichermann and Cunningham (2011) further identify and delineate four additional key motivations for individuals to participate in gaming, which, alongside those previously mentioned, include acquiring knowledge about the game, seeking relaxation, deriving pleasure, and fostering social connections.

Engagement in playing games is characterized as a spontaneous activity that is inherently lighthearted and immersive, capturing the player's full attention within a specifically defined spatial and temporal framework governed by established rules and a certain sequence (Huizinga, 1949; Kapp, 2012). Educators, viewing their responsibilities through a pedagogical lens, must recognize the imperative of harmonizing enjoyment with education. This recognition presents them with the challenge of implementing innovative strategies for incorporating games into non-gaming environments because for "Net Generation", gaming represents not merely an option, but rather an intrinsic expectation (Johnson et al., 2012; Prensky, 2001b; Tapscott, 2009), and as technology is evolving, digital games are seen as vital learning tools. This leads to the emergence of gamification, a strategy that encompasses the adoption of gaming elements and principles within non-gaming scenarios to elevate engagement and enable a more dynamic and interactive learning experience. By leveraging the intrinsic appeal of game mechanics and by boosting both extrinsic and internal motivation, gamification aims to create an environment where educational objectives can be pursued with enthusiasm and efficacy (Buckley & Doyle, 2014).

This strategy, through the elements it encompasses, can effectively address students' needs for active engagement (Măirean, 2022; Prensky, 2001b) by fostering a dynamic learning environment characterized by speed and continuous interactivity. It would incorporate multiple tasks in which students can actively participate, providing immediate rewards for their efforts, consistent with their anticipated outcomes (Prensky, 2001b; Rosen, 2010). Additionally, by integrating a variety of playful elements aimed at actively engaging students in tasks, this approach has the potential to mitigate the inclination towards passive or superficial participation in the educational process, tendency that has been observed, according to Măirean (2022), to be present in activities that do not incorporate ludic elements, for which students show a natural attraction.

Gamification, whether facilitated by technology or not, represents an innovative and evolving student-centered approach in education (Kapp, 2016), which involves integrating game-inspired features and mechanics in settings outside of gaming (Deterding et al., 2011) to refine the traditional activities and make them closer to games (Werbach, 2014). Rather than transforming routine tasks into games, it reimagines workflows through the application of game dynamics, thereby fostering engagement and enjoyment while enriching the overall educational experience (Pânișoară, 2022). For an educator to effectively cultivate a transformative and valuable gamified experience, Smith-Robbins (2011) outlined four essential components. Specifically, these include clearly defined goals and objectives for players to attain, engaging and compelling challenges to overcome, opportunities for collaboration or competition, and a reward system designed to incentivize participation.

According to Werbach and Hunter (2012), the most fundamental and frequently encountered ludic elements in gamification include points and badges, both of which serve as elementary mechanisms for acknowledging the successful completion of a task while simultaneously providing immediate feedback (Jacob et al., 2021; Zichermann & Cunningham, 2011), and leaderboards that display real-time rankings based on relative success, fostering a competitive yet motivational environment that encourages sustained engagement in tasks (Costa et al., 2013). Together, these elements constitute a defining triad of gamification, underpinning its core mechanics and contributing to its efficacy in educational and interactive applications (Werbach & Hunter, 2012).

Another essential component of gamification is the narrative context, which has the potential to enrich the overall experience, captivate players' interest, and provide an engaging framework in which they can navigate challenges with enthusiasm and sustained motivation, minimizing the risk of disengagement (Kapp, 2012). Likewise, the integration of **avatars** constitutes a distinctive gamification element, serving as visual representations of players and fostering a heightened sense of identity and immersion within the gamified environment (Werbach & Hunter, 2012). All of these ludic elements, inherent to gamification, which can be integrated either individually or in combination into gamified educational activities, orchestrate the cognitive trajectory of students, facilitating active participation in their learning process, instilling a sense of autonomy, and catalysing the actualization of their maximal potential (Lee & Hammer, 2011). By consciously embedding game-like elements, educators can design an absorbing and dynamic gamified learning environment aligned with students' needs, fostering motivation and academic persistence (Yan, 2023), which contributes to the improvement of educational outcomes (Hamari et al., 2014).

2.2. Benefits and disadvantages of gamification

Numerous studies, both quantitative and qualitative, have demonstrated that teachers generally tend to possess positive perceptions about employing digital games within educational contexts, as well as towards learning processes mediated by digital technologies. Their overarching inclination is towards favourable support for the benefits and importance of these

digital resources (Alqurashi & Williams, 2019; Cózar-Gutiérrez & Sáez-López, 2016; Matic et al., 2023; Michos et al., 2023; Noraddin & Kian, 2014, 2015; Smith, 2018). However, a limited number of studies have explored teachers' perceptions and attitudes regarding the implementation of digital technology-mediated gamification in education. The majority of findings indicate that educators generally express positive perceptions about gamification (Aksoy & Usta, 2023; Alabbasi, 2018; Palacios-Hidalgo, 2022; Sáez-López et al., 2022; Sajinčič et al., 2022). This perspective is further reinforced by the substantial volume of perceived benefits, which stands in stark contrast to the relatively low number of barriers and disadvantages associated with this strategy, as reported by the teachers themselves (Cózar-Gutiérrez & Sáez-López, 2016; Demirbilek & Tamer, 2010; Smith, 2018; Williamson, 2009).

According to the personal perspectives expressed by educators involved in studies on gamification, this innovative strategy has the potential to enhance students' motivation for learning, foster active participation in their educational processes, and increase engagement in completing academic tasks, even among less participative students (Mårell-Olsson, 2022; Cózar-Gutiérrez & Sáez-López, 2016; Pektaş & Kepceoğlu, 2019; Russo et al., 2021; Sáez-López et al., 2022; Smith, 2018). Palacios-Hidalgo (2022) validates these findings through his research, in which participants assert that the integration of gamification prompts students to actively engage, thereby heightening their interest and enhancing their motivation in mathematics studies. In contrast, research conducted by Pozo et al. (2022) revealed that teachers believe motivation, along with other intrinsic dimensions of video games, such as physical and emotional engagement, are not as significant in the learning process compared to the promotion of metacognition, particularly when game-based activities are supervised by educators.

The ludic components embedded in gamification, such as points accumulation derived from task completion, enable students to directly assess their efforts, initiatives, and progress (Aksoy & Usta, 2023; Alabbasi, 2018), empowering them in a reflective self-evaluation. These benefits have also been linked to digital games (Akkaya et al., 2021; Alqurashi & Williams, 2019; Demirbilek & Tamer, 2010; Kebritchi et al., 2010; Williamson, 2009), which, according to teachers, cultivate a pedagogically sound, student-centered learning ecosystem (Noraddin & Kian, 2014). Teachers' positive perceptions of implementing gamification were also shaped by other reported benefits, including enhanced social interaction, improved communication skills, and the creation of a collaborative learning environment with a supportive classroom ambiance (Cózar-Gutiérrez & Sáez-López, 2016; Mårell-Olsson, 2022; Sáez-López et al., 2022). Similarly, digital games were recognized as valuable resources that foster collaboration, develop social skills (Alqurashi & Williams, 2019; Williamson, 2009), and promote experiential learning, providing students with a sense of autonomy (Akkaya et al., 2021; Alabbasi, 2018; Kebritchi et al., 2010).

Although the benefits overshadow the drawbacks, teachers are aware of and highlight the less favourable aspects involved in the implementation of this instructional strategy. Some of them reported that challenges associated with gamification and digital games comprise ineffective classroom management and technical problems that can disrupt the educational process, as noted by Pektaş & Kepceoğlu (2019). Furthermore, additional research has shown that teachers express worries regarding socio-affective issues arising from digital game-based strategies, including the emergence of antisocial behaviors and increased anxiety levels among students (Alabbasi, 2018; Kebrotchi et al., 2010; Sáez-López et al., 2022). Additionally, educators view the emergence of problematic competitiveness as a noteworthy barrier to the successful implementation of the strategy, as it fosters a highly competitive environment that may ultimately demotivate students (Alabbasi, 2018; Sáez-López et al., 2022; Sajinčič et al., 2022). Moreover, according to Xie et al. (2021), who investigated the perceptions of teachers, students, and their parents, revealed that both parents and teachers generally tend to see digital educational games in a more negative light compared to students, with their views influencing one another. Additionally, these games were perceived as particularly effective for teaching complex and abstract scientific concepts and were seen as especially beneficial for younger students.

A lack of expertise in implementing strategies involving digital technologies has been identified as a significant challenge in numerous studies (Al Mulhim, 2014; Easterling, 2021; Ertmer et al., 2012; Petko, 2012; Ruggiero, 2013; Sánchez-Cruzado et al., 2021; Warwick, 2019), alongside limited knowledge of digital games (Matic et al., 2023; Sajinčič et al., 2022; Williamson, 2009), and low engagement in training related to digital games and gamification (Gutiérrez & Sáez-López, 2016; Sáez-López et al., 2022). Consequently, while perceptions vary across the global landscape, this study intends to concentrate on the Romanian educational context, specifically targeting a distinct group of educators within primary education and focusing on a particular subject, mathematics.

2.3. Digital competencies

Competence pertains to an individual's ability to select, integrate, and effectively "apply knowledge, skills, and attitudes" to successfully address specific situations while ensuring both efficacy and efficiency (Potolea et al., 2012). Digital competence stands as one of the eight key competences fundamental in learning through the entire life, articulated by the European Parliament and the Council (2006). It is esteemed as a core skill, characterized by the ability to critically utilize Information Society Technology (IST) in various contexts, including professional, recreational, and communicative activities. It fundamentally relies on essential ICT skills for retrieving, evaluating, creating, presenting, and exchanging information, as well as for online collaboration (European Parliament and the Council, 2006).

The five fundamental areas of analysis of digital competencies, as outlined in the European Commission's report (2016), encompass not only digital information and literacy but also specific competences in effective communication in the digital environment, the creation and editing of digital content, ensuring online security, and the ability to solve problems through digital technologies, each having its distinct competencies. All of these competencies are essential for educators, the indispensable formative agents in the process of school digitalization (OECD, 2023), as they increasingly work with digital natives and cannot afford to disregard technology. Although it is essential for them to successfully integrate these tools into their teaching practices and ensure that their students use technology correctly, responsibly, and, most importantly, for beneficial purposes that contribute to their overall development, some educators do not feel adequately prepared, expressing a need for additional training programs, as reported by the OECD (2023).

The situation regarding the digital competencies among Romanian citizens remains unfavourable and concerning. Although Romania demonstrates relatively strong connectivity, the findings revealed a low level of digitalization, with basic digital skills coverage of only reported at a mere 27.7%, considerably below the EU average of 55.6% (European Commission, 2024). Furthermore, the situation within the education sector is similarly challenging. A survey conducted in 2020, involving teachers, students, and their parents, revealed that while the pandemic accelerated the digitalization of education, enhanced teachers' digital skills to some extent, and educators remain optimistic about the integration of digital tools in classrooms following the return to face-to-face instruction, parents and their children are notably more reticent, with only 23% of students and 36% of parents believing that digital elements and devices will continue to persist in traditional education in the future (Fundația Agenția de Dezvoltare Comunitară "Împreună", 2020). Moreover, they expressed their concerns regarding the inadequacy of teaching didactical methods and strategies in adapting to online formats, as many teachers continue to rely on rote learning and textbook dictation. Students felt that educators only partially adjust content and teaching strategies to meet their needs, with those employing innovative techniques – such as games, quizzes, and projects being the most highly valued.

As educators face rapidly evolving professional demands, it is essential for them to possess an increasingly complex and refined set of competencies. In particular, the ubiquity of digital

devices and the responsibility of educators to assist learners in acquiring digital competence highlight the necessity for these professionals to develop their digital skills.

2.4. The current study

The study investigates the perceptions of primary school teachers within the Romanian educational framework regarding gamification, with a particular focus on its application in mathematics classes. Furthermore, it endeavours to ascertain whether specific factors, such as the self-perceived level of digital competencies, exert a noteworthy influence on their perspectives.

The primary assumptions underpinning our research were the following:

(H_1): The usage of gamification facilitated by digital technologies is significantly influenced by primary school teachers' self-perceived level of digital competencies.

(H_2): The perceived utility of gamification facilitated by digital technology is significantly influenced by primary school teachers' self-assessed level of digital competencies.

3. Method

3.1. Participants

Out of 364 responses, 4 were deemed invalid, resulting in a total of 360 primary education teachers participating in this study, 8.3% males (30) and 91.7% females (330), working in schools across both rural (53.6%) and urban environments (46.4%), teaching at various grade levels, ranging from preschool to fourth grade.

3.2. Tools

To reveal the perceptions of teachers and the factors that can influence the intentions of primary school teachers to use gamification and digital games for math education, an online survey questionnaire adapted from Palacios-Hidalgo (2022) and DigCompEdu CheckIn RO was applied. The first section, "Personal Information", collects demographic data and explores teachers' familiarity with digital tools and games. The second section, covering "General Knowledge about Gamification" (5 items, alpha = .869), "Training in Gamification" (4 items, alpha = .55), and "Implementation in Mathematics Classes" (5 items, alpha = .819), evaluates teachers' expertise, training, and application of gamification in teaching. The final section, "The Utility of Gamification in Mathematics" (5 items, alpha = .94), examines perceptions of gamification's benefits in motivating young learners. Except for two dichotomous and one multiple-response item, all responses were measured on a four-point Likert scale from "strongly disagree" to "strongly agree". For each subscale, except for the demographic one, the score was computed as the mean of the corresponding items.

To evaluate teachers' self-perceived digital competence, an adapted version of the ACDC – "Analysis of Common Digital Competences" questionnaire (Sánchez-Cruzado et al., 2021) was used. This instrument comprises 94 items, each rated on a 4-point Likert scale ranging from 1 (Very Low Level) to 4 (Very High Level), and was designed with consideration of the five key areas of digital competence and the 21 distinct competencies, as delineated in the DigComp 2.0 framework. Each competency is examined from two perspectives: the level of knowledge and the level of usage. The "digital_competence_level" variable, which represents the global score of digital competencies, was determined by calculating the average scores of two sections, each containing 47 items, focused on usage and knowledge. A reliability coefficient of .988 attests to the scale's outstanding internal consistency, significantly exceeding the standard threshold of .8 (Labăr, 2008).

3.3. Research procedure

The research follows a quantitative, descriptive, cross-sectional approach (Creswell, 2012). Participation in this study was entirely voluntary. Upon providing informed consent, participants proceeded to complete a web-based self-report questionnaire hosted on Google Forms. Invitations to take part in the study were disseminated via email and social media platforms. All participants were explicitly informed about the anonymity and confidentiality of their responses, as well as their right to withdraw from the study at any point without any consequences. Furthermore, they were assured that their responses would be used exclusively for research purposes. The completion of the questionnaire required approximately 20 to 25 minutes. During the administration of the questionnaires, after providing details about the research's purpose and objectives, the educators were also presented with a rigorous definition of the concept of gamification. This was done to ensure that they understood the concept and to determine whether they had potentially utilized it, perhaps inadvertently, in the classroom.

4. Results

4.1. Preliminary Analysis

The global digital competency score, calculated as an average between the declared usage of digital competencies and the self-assessed level of related knowledge, ranged from 1.47 (minimum, see Table 1) to 4 (maximum). Although the descriptive statistical analysis highlights a moderately high level of perceived digital competence (M = 2.904, see Table 1), the standard deviation (SD = .515, see Table 1) suggests some variability among participants. It implies that while a considerable number of teachers demonstrate adequate digital skills, a subset exhibits lower competency levels, requiring additional external support. From a pedagogical standpoint, these results emphasize the imperative for differentiated training approaches that not only accommodate varying degrees of digital proficiency but also promote the integration and practical application of competencies across the five essential domains – digital literacy, communication and collaboration, digital content creation, security, and problem-solving. Targeted interventions, customized support, and consistent upskilling are vital to foster effective digital engagement in educational contexts.

Table 1. *Descriptive statistics of self-perceived digital competencies*

Variable	Minimum	Maximum	M	SD
Level of digital competencies	1.47	4	2.904	.515

Regarding the participants' preference for accessing digital games for purely recreational purposes, the frequency analysis indicates that a significant number of participating teachers, specifically 74 individuals (20.6%), engage in digital gaming 2-4 times per week. This category is followed by 58 respondents (16.1%) who reported never participating in digital leisure activities. Additionally, 56 teachers (15.6%) indicated that they play digital games as a means of relaxation once a week, while 44 respondents (12.2%) reported accessing these games daily, with the same number engaging in gaming once every few months. Furthermore, 31 individuals (8.6%) stated they participate in these activities once a month, and another 31 (8.6%) only once or twice a year. The remaining participants, a total of 22 teachers (6.1%), declared that they utilize digital games 2-3 times a month for relaxation. These results underscore the diversity of relaxation habits among teachers using digital games.

Gamification represents an innovative approach in education; however, the degree of preparedness and implementation of this strategy varies considerably among teachers, as evidenced by the descriptive statistical analysis conducted on the 360 responses. Initially, the average score was determined for each participant concerning each of the four subscales proposed

by Palacios Hidalgo (2022): knowledge of the concept, professional training in this field, its integration in the teaching-learning process during mathematics lessons, and the perceived utility of gamification in fostering mathematical learning among young students.

The mean score on knowledge about gamification is 2.90, signifying a moderate level of familiarity with this concept and its implementation among participants (see Table 2). However, the standard deviation of 0.59 reveals relatively high variability in responses, indicating marked differences between individuals in terms of comprehending gamification. Regarding training in the domain of gamification, the recorded average score is 1.81, the lowest among all the analyzed subscales. This outcome underscores an evident insufficiency in specialized training, while the standard deviation of 0.37 (see Table 2) reflects a relative homogeneity of responses, indicating a consensus concerning the limited level of professional development in this specific area. Conversely, the practical implementation of gamification in educational activities yielded a mean score of 2.45 (see Table 2), indicative of a moderate application of gamification principles. Nonetheless, the standard deviation of 0.49 points to disparities among educators regarding the frequency or manner of utilization.

The highest average score (3.13, Table 2) emerged with the perceived utility of gamification, demonstrating that the majority of participants acknowledge the educational benefits generated by this approach. The standard deviation of 0.48 indicates moderate variability. However, responses exhibit a general consistency about this perception. Therefore, although the usefulness of gamification is widely recognized, the level of professional training remains limited, and practical implementation varies substantially. This discrepancy highlights the imperative for the development of targeted training programs to facilitate a comprehensive understanding and coherent use of gamification in educational practice, thereby ensuring the optimization of its pedagogical potential. If this strategy can be fully exploited, then both teachers and students will benefit from its advantages and outcomes that they have already highlighted.

Table 2. *Descriptive Statistics for the subscales assessing Teachers' Perceptions of Gamification*

Subscales	Knowledge about gamification	Training in gamification	Gamification usage	Perceived utility of gamification
Mean	2.900	1.805	2.447	3.132
Std. Deviation	.588	.372	.498	.478

4.2. Effects of primary school teachers' digital competencies on the use and perceived utility of gamification in mathematics education

Two separate linear regression analyses were conducted to examine the predictive role of self-perceived digital competence on (1) the level of gamification usage and (2) the perceived utility of gamification. In both models, digital competencies served as the independent variable. Before conducting the regression analyses, the assumption of linearity was assessed through preliminary Pearson correlation tests. Results revealed a statistically meaningful and moderate positive association between self-perceived digital competence and the level of gamification use ($r = .425$, $p < .01$, see Table 3), as well as a noteworthy positive but weak association between digital competencies and the recognized effectiveness of gamification ($r = .29$, $p < .01$, see Table 3). These findings provided empirical support for proceeding with linear regression analyses.

Table 3. *Correlations between teachers' digital competencies and both gamification usage and perceived utility of gamification*

Variables	1. Level of digital competencies
2. Gamification usage	.425*
3. Perceived utility of gamification	.290*

Note: * $p < .001$

Results indicated that the degree of proficiency in digital skills substantially predicted both outcomes. The results of both regression models were statistically significant: Model 1, F (1, 358) = 78.729, $p < .01$; Model 2, F (1, 358) = 32.785, $p < .01$. The corresponding regression equations are:

Model 1: Gamification usage = 1.254 + .411 · (Self-perceived digital competence) (see Table 4).

Model 2: Perceived utility of gamification = 2.352 + .269 · (Self-perceived digital competence) (see Table 4).

The adjusted R^2 value for the first model was .178, indicating that 17.8% of the variance in the level of gamification implementation in mathematics classes can be explained by self-perceived digital competence. In the second model, the adjusted R^2 was .081, suggesting that only 8.1% of the variance in perceived usefulness of gamification can be attributed to the same predictor. According to Cohen's criteria for effect size interpretation, although statistically significant, these effects are considered weak.

Table 4. *The results of the regression analysis regarding the estimation of gamification usage and perceived utility of gamification based on teachers' self-perceived level of digital competence*

Independent variable	Dependent variable	R	R^2	β	b	SE b
Self-perceived level of digital competence	Gamification usage	.425	.180	.425*	.411	.046
	Perceived utility	.290	.084	.290*	.269	.047

Note: * $p < .001$

Consequently, the results supported both hypotheses (H_1) and (H_2), as both regression models yielded statistically significant effects ($p < .01$). These findings confirm the predictive role of self-perceived digital competencies in shaping both the integration of gamification and its perceived benefits in mathematics education.

5. Discussion and conclusion

In examining the level of digital competencies among Romanian primary school teachers, it appears that the majority self-identified as possessing intermediate to advanced skills, a perception substantiated by the average score associated with self-perceived digital competencies. This result aligns with the study conducted by Palacios Hidalgo (2021), which highlighted that 63% of respondents placed themselves at the same levels. In contrast, the research by Al Mulhim (2014) and Petko (2012) indicated a deficiency in the training of teaching staff regarding digital competencies, with self-perceptions reflecting a medium to insufficient level.

Despite the moderately high mean score of global digital competencies revealed in this study, the relatively low-to-moderate standard deviation indicates a certain degree of variability among teachers' digital competence levels. This suggests that while some individuals have advanced proficiency, others may require additional support through tailored scaffolding and continuous skills enhancement initiatives. It may also indicate the presence of specific barriers, such as inadequate institutional support, insufficient contextualized training on the practical application of digital competencies and their pedagogical integration, as well as limited or non-existent access to technological resources. These challenges underscore the need for strategic professional growth programs that not only upskill teachers in digital literacy but also foster confidence and provide concrete, practical approaches and methods for applying these skills, and assist educators in seamlessly integrating digital tools and modern technology-based strategies into daily instruction. Moreover, in light of the accelerating pace of technological advancement (Prensky, 2001a), digital proficiency is no longer optional, but a fundamental requirement for effective and future-oriented teaching practices.

Concerning teachers' habits regarding the use of digital games, the results indicate that a considerable number of them exhibit a pronounced preference for engaging in digital games during their leisure time, using them as a means of relaxation and disengagement from their professional responsibilities. Nearly half of the participants (approximately 48.4%) play at least once a week, suggesting that the use of digital technology is integrated into their recreational routines, serving as a vital source of enjoyment and mental rejuvenation. Overall, the percentage value reflects not only a notable engagement in recreational activities via technology, – particularly given the recurrently demanding schedules faced by educators, – but also emphasizes the relevance of digital games in their personal lives, underscoring their potential role in enhancing overall well-being.

A similar pattern was observed in the case of gamification, echoing the findings related to digital competencies. The highest score was recorded for the perceived utility of gamification, followed by knowledge in this area, then usage, with the lowest score attributed to training in gamification. Although teachers recognize the salience and utility of gamification, are cognizant of its benefits in education, especially in the realm of mathematics, and consider themselves relatively knowledgeable in this area, its practical implementation is notably constrained. Furthermore, their training appears to be similarly limited. This reinforces the idea that self-assessed knowledge does not automatically lead to integration into teaching practice. As with digital competence, the gap suggests an urgent need for structured, practice-oriented training programs that support the transition from theoretical understanding to effective classroom application. This challenge of insufficient preparation and limited engagement in professional development courses within this emerging field is further reinforced by participants' perceptions. A noteworthy proportion of teachers (65.83%) acknowledge their training in gamification as insufficient, while an even greater majority, 88.34% of the total of 360 respondents, expressed a clear interest in pursuing further training related to gamification. It is plausible that, despite recreational gaming, the lack of formal training or structured guidance may hinder the effective translation of gaming skills into pedagogical practice. The novelty of gamification as an educational strategy in Romanian education may contribute to the cautious and inconsistent application of its principles, reflecting a need for systematic training programs that bridge the gap between personal gaming experiences and professional implementation. Given that, as Prensky (2001a) argues, effective communication with digital natives requires the use of a language shaped by technology and strategies that embed its integration, the results underscore not only their desire to grow and explore in depth this domain, but also their awareness of the evolving nature of gamification, driven by rapid technology progress.

This need to discover better new strategies, which emerged against the backdrop of an acute necessity to adapt to the current generational profile, has also been highlighted by other studies. Palacios-Hidalgo (2022) reinforces previous findings, as the majority of teachers expressed a strong desire to continue their professional development in the field of gamification. Additionally, Mårell-Olsson (2022) revealed the necessity of specialized training for teachers. The educators considered that they lack the necessary skills to design gamified activities which incorporate contemporary technologies meaningfully into the teaching and learning process, thus going beyond the usual use of computers and other devices for searching information on the internet. Similarly, Sáez-López et al. (2022) report that slightly less than 90% of teachers highlighted the imperative of ongoing digital competency development in the context of gamification, emphasizing the value of this approach in enhancing professional training. Notably, about 80% of participants perceive gamification as a groundbreaking innovation in education. Moreover, they advocate for early immersion in digital environments as a fundamental aspect of university-level training, underscoring the importance of integrating innovative educational strategies from the initial stages of academic formation (Sáez-López et al., 2022). Furthermore, this desire for professional growth is mirrored in the positive perception that teachers hold towards this strategy, indicating that they view modern gamification as a beneficial approach.

However, a small segment remains skeptical or critical, which can imply a need for further professional development and training to enhance understanding and acceptance of gamification's potential benefits. Therefore, the overall favourable perceptions reveal openness to adopting and implementing this strategy in educational settings and suggest that educators tend to weigh its advantages in detriment of its drawbacks, particularly when applied to mathematics instruction in primary education.

The same optimism and positive perceptions regarding the integration of gamification have been highlighted in the studies conducted by Aksoy and Usta (2023), Alabbasi (2018), Palacios-Hidalgo (2022), Sáez-López et al. (2022), and Sajinčič et al. (2022), which also revealed the substantial number of benefits perceived by teachers despite the barriers and disadvantages. This assertion is further corroborated by Alenezi (2023), who discovered that primary school teachers conveyed overwhelmingly favourable perceptions towards AI-based gamification, acknowledging its transformative potential in fostering democratic and impactful educational environments.

The regression analysis revealed a significant yet relatively limited contribution of self-perceived level of digital competence in shaping teachers' use and perception of gamification in mathematics education. Although digital competencies notably predicted both the frequency of gamification usage and its perceived utility, the explained variance was relatively modest (17.8% and 8.1%, respectively). Thus, digital competences appear to account for only a limited extent of the variability in these outcomes, suggesting that the research hypotheses (H_1) and (H_2) are supported, yet only partially. However, other possible factors not examined in this study may also contribute to a more comprehensive understanding of this phenomenon. Given that 82.2% of the variance in gamification usage and 91.9% of the variability in perceived utility remain unexplained by the respective regression models, it is evident that digital competencies alone do not fully account for the observed results. The previous outcomes complement the findings of Petko (2012), and Michos et al. (2023), which demonstrated that a positive self-evaluation of one's digital competencies, crucial for the integration of technology within the educational context, fosters a more favorable perception of digital technologies and promotes their extensive utilization in the classroom.

In conclusion, there is an imperative need for comprehensive training of teaching staff in the field of ICT to fully leverage the myriad advantages technology provides and to successfully integrate it into mathematics lessons and beyond. Additionally, specialized training in gamification is essential, enabling educators to independently design engaging activities that incorporate specific ludic elements tailored to achieving the potential benefits they have recognized themselves, as well as the perceived utility of this modern strategy. With a cautious yet optimistic approach, gamification is beginning to take root in the Romanian educational landscape. Their positive perceptions towards it reflect a commitment to participating in various training sessions and specialized courses within this rapidly evolving domain, which is set to gradually gain prominence in Romania.

6. Limitations and future directions

The results constitute a compelling argument for promoting gamification in the Romanian educational space, as well as a positive signal for teacher trainers, given the openness demonstrated towards innovative approaches and the desire for professional development. However, the interpretation of the conclusions should be approached with caution, considering certain methodological limitations.

A primary limitation lies in the fact that the study was conducted exclusively with active teachers, thus excluding the perspective of future educators at the beginning of their careers. Including their opinions could have provided valuable insights into their willingness to use gamification in the educational process. Equally interesting to analyse would be the perception of parents and students regarding this strategy, especially after conducting a quasi-experimental

study. The opinions of all those involved in education—namely, the student-parent-teacher triad—hold particular importance and are valuable for identifying optimal ways of implementing this strategy in the future. Such insights can help enhance the quality of education and make the learning experience more enjoyable for children. Additionally, it should be noted that variables such as gender, age, and teaching experience, although collected in the questionnaire, were not included in the final analysis. These variables could have contributed to identifying significant differences among participants regarding their perception and use of gamification.

Lastly, the instrument used was predominantly focused on collecting quantitative data, without considering qualitative sources that could have offered a broader perspective on the context and motivations behind the responses. Conducting complementary interviews or focus groups could provide additional insights and support a more in-depth interpretation of the collected data. Thus, all the aspects highlighted above are intended to be considered in future studies, which could contribute to creating a more detailed image of teachers' perceptions about gamification in mathematics education, as well as potential explanatory factors.

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