Educational Digital Games in K-12: Teacher Adoption, Barriers, and Benefits

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Abstract: Game-based learning (GBL) has interdisciplinary overlaps with media studies, and findings from educational research confirm its ability to foster student engagement, critical thinking, and 21st-century skills (Mao et al, 2022; Qian & Clark, 2016; Romero, Usart, and Ott, 2015). However, its systematic adoption in formal K-12 education remains relatively low, particularly in the Slovak education system. This research paper addresses the long-standing gap in the implementation of digital games by examining decision-making processes, pedagogical acceptance, and barriers to adoption among teaching staff in the regional education system of the Slovak Republic. To establish the conceptual foundation of the study, it synthesises three complementary theoretical perspectives: Self-Determination Theory (SDT) to explain students' intrinsic motivation through the fulfilment of psychological needs; Technology Acceptance Models (TAM) to assess teachers' perceived usefulness and supporting conditions; and Ertmer's barrier model for categorisation. The study maps the attitudes of a representative sample of teachers in Slovakia's regional education system toward the implementation of digital games in formal education. Quantitative empirical data were collected using a combined data collection methodology (CAPI and CAWI) in collaboration with the independent research agency IPSOS. The results suggest that teachers in regional schools perceive increased student motivation, creative thinking, and digital skills development as the main determinants of games' usefulness, confirming that they consider digital games pedagogically beneficial. A key finding is that the non-use of games is not driven by second-order intrinsic barriers in Ertmer's model, such as personal resistance, fear of technology, or fear of losing authority in the classroom, as these factors were statistically insignificant. The failure to integrate games stems from strong first-order systemic barriers, particularly institutional pressure to use traditional assessment methods, an unclear connection between game mechanics and the current curriculum, and insufficient technical infrastructure. A comparative analysis confirms that these institutional barriers are systemically homogeneous across primary and secondary education. These findings debunk myths about teachers being at fault and demonstrate that the lack of use of digital games stems from structural friction between the exploratory nature of games and the rigid, standardised school system. Educational policy must therefore shift from efforts to change teachers' attitudes toward modernising institutional frameworks for assessment and curriculum.

Keywords: First-Order Barriers, Game-Based Learning, K-12 Education, Self-Determination Theory, Structural Friction, Technology Acceptance.

1. Introduction

Game-based learning (GBL) is considered a highly effective strategy in current scientific and pedagogical discourse for increasing student engagement and developing 21st-century competencies. This is also confirmed by the latest extensive review studies from the field of secondary education (Cole et al., 2024). Theoretical frameworks, such as Self-Determination Theory (SDT), suggest that game-based environments can effectively satisfy the basic psychological needs for autonomy and competence, thereby naturally stimulating intrinsic motivation to learn (Ryan, Rigby, & Przybylski, 2006; Uysal & Yildirim, 2016). Despite their significant theoretical potential and proven cognitive and affective benefits, however, the systematic integration of educational and commercial digital games into formal K–12 education remains problematic, and their actual use in classrooms in Slovak schools is limited. Since teachers directly manage the educational process in classrooms, the literature identifies them as true *"change agents*," whose decisions and beliefs are key to the successful implementation of any technological innovation (Bourgonjon et al., 2013). This is also confirmed by the latest research, which consistently emphasises that fostering teachers' intrinsic motivation and willingness to adopt these technologies is crucial to the successful integration of both commercial and educational video games into instruction (Dramani et al., 2025). Further research on technology acceptance shows that integrating digital games is not a straightforward process but is influenced by a complex network of barriers. Although some of the literature attributes the failure to integrate GBL primarily to internal factors on the part of teachers such as personal resistance, a lack of digital skills, or a generation gap (Bingimlas, 2009; Ertmer et al., 2012; Kirschner & De Bruyckere, 2017), other authors emphasise the dominant influence of institutional, technical, and curricular constraints within the school system (De Grove et al., Bourgonjon & Van Looy, 2012). The concept of a generation gap between teachers and students is currently being critically reevaluated. It is increasingly viewed

as a myth that should not be used as an excuse for failing to implement modern approaches (Kirschner & De Bruyckere, 2017).

The actual rate of adoption of digital games in Slovak regional education remains low; this study aims to identify the underlying barriers to integrating games into K-12 education. Using a quantitative survey of a representative sample of educators in regional education in Slovakia, we analyse the adoption rate, perceived benefits, and barriers to implementing digital games. Theoretically, the research is grounded in the Technology Acceptance Model (TAM), Self-Determination Theory (SDT), and the dichotomy between first- and second-order barriers. The main research question is whether the absence of digital games in teaching stems primarily from teachers' internal reluctance and technological concerns (second-order personal barriers), or rather from an objective structural mismatch between modern game design and rigid institutional models of curriculum and assessment. (first-order systemic barriers)

2. Theoretical Background: Motivation, Technology Acceptance, and Structural Barriers in GBL

Game-based learning (GBL) is primarily valued in educational research and practice for its proven ability to stimulate student motivation and overall engagement. Self-Determination Theory (SDT), formulated by Ryan & Deci (2000), provides an ideal theoretical model for a comprehensive understanding of this phenomenon. Within SDT, a distinction is made between intrinsic motivation, in which an activity is performed for its inherent appeal and the joy it brings and extrinsic motivation, which is primarily focused on achieving an external goal or reward (Ryan & Deci, 2000; Uysal & Yildirim, 2016). In the context of educational games, intrinsic motivation plays a key role, serving as the natural driver of long-term interest and engagement in learning. A central tenet of SDT is that human motivation, healthy psychological development, and well-being are directly contingent upon the fulfilment of three universal psychological needs: autonomy, competence, and relatedness (Ryan & Deci, 2000; Ryan et al., 2006). Autonomy is defined here as a sense of freedom, self-determination, and the absence of external control during activity (Uysal & Yildirim, 2016). The need for competence reflects the human desire to overcome optimal challenges, expand one's own capabilities, and experience a sense of self-efficacy (Ryan & Deci, 2000; White, 1959). The final pillar is the need for relatedness, which pertains to a sense of meaningful connection and belonging with others (La Guardia et al., 2000). Digital games provide an environment that is exceptionally effective at satisfying these three basic needs, thereby creating a motivational drive for the player (Przybylski et al., 2010; Ryan et al., 2006). Games fulfil the need for autonomy by providing meaningful choices, flexible goals, and the freedom to decide how to play. (Przybylski et al., 2010; Uysal & Yildirim, 2016). The need for competence is systematically supported in games through progressively challenging tasks, such as quests that are continually balanced to the player's skills, as well as through clear, immediate feedback upon task completion. (Ryan et al., 2006). Competence and autonomy are the most critical factors for strengthening intrinsic motivation not only in commercial gaming but also in educational contexts (Uysal & Yildirim, 2016). Furthermore, games foster a sense of connectedness through social elements and real-time interactions, thereby integrating the student into a broader educational community (Przybylski et al., 2010).

The successful integration of educational digital games depends not only on their inherent pedagogical potential but, above all, on teachers' willingness to embrace and actively use these technologies (Bourgonjon et al., 2013). In the school setting, educational digital games represent a significant innovation whose adoption can be conceptualised through Rogers' (2003) theory of the diffusion of innovations. According to this theoretical framework, the extent and ultimate success of adoption depend directly on how potential users and educators evaluate key perceived attributes. These include, above all, the relative advantage over existing practices, the technology's complexity, and its compatibility with institutional norms. For a detailed, quantifiable analysis of this decision-making process, the literature employs technology acceptance models directly based on Rogers' assumptions. The TAM model (Davis, 1989) elaborates on the concepts of relative advantage and complexity into two key determinants: perceived usefulness (the extent to which an educator believes the technology will enhance pedagogical effectiveness) and perceived ease *of use* (the extent to which an educator believes using the system does not require excessive effort). This theoretical foundation was later integrated into the more comprehensive UTAUT model (Venkatesh et al., 2003), which combines usefulness within the *performance expectancy dimension* and introduces a critical determinant in the institutional environment of schools, specifically, *facilitating conditions*. Facilitating conditions reflect the extent to which an individual believes that adequate organisational and technical infrastructure exists to enable the smooth use of an innovative system (Venkatesh et al., 2003). Although these theoretical models were developed at the turn of the millennium, the

latest literature reviews confirm that TAM and UTAUT remain an exceptionally stable and predictive framework for studying innovation adoption (Marikyan & Papagiannidis, 2026).

In the context of educational games, perceived usefulness and expected performance are directly linked to the teacher's belief that the game offers real learning opportunities and contributes to the achievement of curricular goals (De Grove et al., 2012). Research confirms that teachers incorporate digital games into their practice precisely when they see a clear pedagogical benefit in them (Bourgonjon et al., 2013). The integration of any innovative technology into the educational environment faces a complex web of pitfalls and obstacles; research most frequently employs a dichotomous model of barriers to theoretically conceptualise these, distinguishing between first- and second-order barriers (Ertmer, 1999; Ertmer et al., 2012). First-order barriers, also referred to as extrinsic barriers, represent external and institutional constraints over which educators have minimal control, such as a lack of time, insufficient technical support, a lack of equipment, or rigid curriculum and assessment methods (Ertmer, 1999). In contrast, second-order barriers - that is, intrinsic obstacles - are internal and deeply rooted within the teacher themselves (Ertmer, 1999; Ertmer et al., 2012). These include personal attitudes, beliefs about learning styles, the level of self-confidence when working with technology, and any resistance to pedagogical changes. In the past, researchers often believed that second-order barriers represented the most fundamental and hardest-to-overcome problem in technology integration, since simply providing the infrastructure does not automatically lead to changes in pedagogical practices. The examination of these barriers, with a specific focus on educational digital games, remains a highly relevant research topic, as even recent studies continue to highlight significant barriers to classroom implementation (Kaimara et al., 2021).

The theoretical framework of this study integrates three complementary perspectives that collectively explain the complex process of adopting educational digital games (GBL) in K-12 school settings. The first pillar is Self-Determination Theory (SDT), which explains why games are pedagogically valuable, particularly because of their nonlinear and interactive design, which naturally satisfies the fundamental psychological needs for autonomy and competence, thereby stimulating students' intrinsic motivation (Ryan & Deci, 2000; Ryan et al., 2006). This motivational potential is directly reflected in the second pillar, which consists of technology acceptance models, specifically TAM and UTAUT. In the context of these models, the game's ability to motivate students is its key perceived *usefulness*, a fundamental prerequisite for a teacher to form the intention to adopt a given innovation (Davis, 1989; Venkatesh et al., 2003). However, as the third pillar - the dichotomous model of barriers (Ertmer, 1999) - points out, the mere presence of perceived usefulness does not lead to automatic implementation. Obstacles often hinder the adoption process. While it was previously assumed that the failure to integrate technology stemmed from second-order attitudinal barriers among educators themselves (Ertmer et al., 2012), the current reality of education increasingly points to a critical lack of *facilitating* conditions, namely first-order institutional barriers (Venkatesh et al., 2003).

3. Methodology

The IPSOS research agency conducted data collection. The research sample comprised 105 teachers in the regional education system of the Slovak Republic. The selection of participants was representative; quotas reflected the distribution across 8 regions, school types, lengths of teaching experience, and teachers' subject specialisations. Data collection took place from October 22 to 31, 2025. Of the total number of respondents surveyed, users who actively integrate digital games into their teaching constituted a minority (n=45). At the same time, more than half of the teachers were non-users (n=60). Data collection was conducted using a combined methodology that utilised computer-assisted personal interviewing (CAPI) and *computer-assisted web interviewing* (CAWI). This approach ensured a high degree of reliability and standardisation in obtaining responses from respondents from various demographic and institutional backgrounds. After data collection was completed, the data underwent statistical analysis. Data analysis was conducted using frequency tables and testing the significance of deviations between observed and expected frequencies via standardized residuals (Z-scores) as an integral part of contingency table (χ^2) analysis.

The results presented are part of a broader research project aimed at identifying regional educators' perceptions and attitudes toward the use of digital games in formal education. For this study, we specifically focused on a) identifying barriers to the adoption of digital games in formal education by teachers who do not use digital games in their teaching; b) identifying the perceived advantages and disadvantages of using digital games by teachers in regional schools. Based on the above, we pose the following broader research questions:

> **RQ1:** What are the reasons for the low adoption of digital games in teaching? Does this absence stem primarily from the teachers' own internal reluctance and technological concerns (second-order

personal barriers), or is it rather the result of an objective structural mismatch between modern game design and rigid institutional models of curriculum and assessment (first-order systemic barriers)?

RQ 2: What are the perceived advantages and disadvantages of using digital games by educators in regional schools?

4. Results

4.1 Identification of Barriers to the Adoption of Digital Games in Formal Education by Teachers who do not use Digital Games in Their Teaching

The subject of the statistical analysis was question Q6b, which read as follows: *"You stated that you do not use digital games in your teaching. What are your main reasons?"* Question Q6b in the questionnaire was directed only at respondents who indicated that they do not use digital games in their teaching (n=60); the question type allowed for multiple responses (multi). The survey aimed to identify the main barriers to implementing game-based methods in teaching practice and to determine which factors most influence teachers' reluctance to use game-based tools. The data reveal a multi-layered set of obstacles - ranging from personal and pedagogical to technical and institutional.

Table 1: Identification of Reasons for Teachers' Non-Use of Digital Games in K–12 Formal Education

Factor (Order 1 / Order 2)	Frequency	Expected frequency	Z-value	Statistical significance
Fear of losing control of the class **(2)**	8	9.82	-0.58	Not significant
I do not see any benefit in them (unclear connection to learning objectives) **(2)**	19	9.82	2.93	Significant
I prefer traditional assessment **(2)**	25	9.82	4.84	Significant
Insufficient technical equipment at the school **(1)**	16	9.82	1.97	Significant
Missing software and licenses **(1)**	11	9.82	0.38	Not significant
Technical support (concern about technical problems) **(1)**	6	9.82	-1.22	Not significant
Administrative constraints **(1)**	6	9.82	-1.22	Not significant
Lack of time for preparation **(2)**	10	9.82	0.06	Not significant
Short class periods **(1)**	14	9.82	1.33	Not significant
Lack of support and training (lack of training sessions) **(1)**	6	9.82	-1.22	Not significant
Lack of motivation on the part of school administration **(2)**	7	9.82	-0.9	Not significant
Traditionally oriented school system **(1)**	17	9.82	2.29	Significant
Low digital literacy **(2)**	4	9.82	-1.86	Not significant
Negative Prejudices Toward Games **(2)**	5	9.82	-1.54	Not significant
Fear of failure or loss of authority **(2)**	1	9.82	-2.82	Significant
Difficult to apply in our specific case	1	9.82	-2.82	Significant

4.2 Identification of the Perceived Advantages and Disadvantages of Using Digital Games by Teachers in Regional Education

The subject of the statistical analysis was Question Q7, which read as follows: *"In your opinion*, *what are the main benefits of using digital games during instruction?"* Question Q7 was directed at all respondents (n=105), and the question type allowed for multiple responses. The results show that teachers perceive digital games primarily as a motivational, developmental, and modernising element of instruction**.** Affective-motivational and creative-digital benefits dominate, while cognitive and organisational benefits are reflected to a lesser extent. From the perspective of research on pedagogical innovations, these data suggest that teachers are open to game-based forms of learning, provided they are clearly linked to learning objectives and do not compromise the time or assessment frameworks.

Table 2: Identification of Perceived Benefits of Using Digital Games by Educators in K–12 Formal Education

Factor	Frequency	Expected frequency	Z-value	Statistical significance
Improvement in motivation and interest in learning	57	29.2	5.14	Significant
Support for the development of cognitive skills (critical thinking, logic, problem-solving, etc.)	31	29.2	0.33	Not significant
Development of social and communication skills	29	29.2	-0.04	Not significant
Immediate Feedback	24	29.2	-0.96	Not significant
Development of digital skills	42	29.2	2.37	Significant
Development of creative thinking	43	29.2	2.55	Significant
Positive attitude toward learning and school	38	29.2	1.63	Not significant
They enable individualised instruction	21	29.2	-1.52	Not significant
At a school like ours, this would probably not be beneficial	1	29.2	-5.22	Significant
None of the above	6	29.2	-4.29	Significant

The subject of the statistical analysis was Question Q8, which read as follows*:* "In your opinion, what are the main disadvantages of using digital games during instruction?" Question Q8 was posed to all respondents (n=105), and the question type allowed for multiple responses. The results show that teachers perceive the disadvantages of digital games primarily from a practical and organisational standpoint, rather than as a rejection of the concept of game-based learning itself. The most frequently cited barriers, namely technical, time-related, and financial, highlight the need for systemic support for the digitisation of education. These are classic external barriers that hinder the implementation of innovations even among motivated teachers. *Internal barriers*, such as concerns about an entertaining effect without educational value or high demands on teachers, are secondary but crucial for the long-term sustainability of changes.

Table 3: Identification of Perceived Barriers to the Use of Digital Games by Educators in K–12 Formal Education

Factor	Frequency	Expected Frequency	Z-score	Statistical Significance
Time required	37	29.71	1.34	Not significant
Technical and organisational problems	44	29.71	2.62	Significant
Risk of misuse (merely for entertainment without an educational effect)	31	29.71	0.24	Insignificant
Demands on the teacher	31	29.71	0.24	Not significant
Inequality among students	21	29.71	-1.6	Not significant
Financial constraints	33	29.71	0.6	Insignificant
None of the above	11	29.71	-3.43	Significant

5. Discussion and Conclusion

This research study aimed to examine the extent to which educational digital games have been adopted in K-12 education and to identify the barriers preventing their wider integration into teaching practice. The results of the quantitative analysis provide important empirical evidence that refutes several traditional assumptions about teachers' resistance to innovation and highlights deep systemic shortcomings in current formal education.

The first key finding of our study addresses RQ1 and confirms that the main determinant of the perceived usefulness of games is their immense motivational potential. In line with Self-Determination Theory (SDT), it appears that teachers are fully aware of the gaming environment's ability to satisfy students' basic psychological needs for autonomy and competence. As many as 57 respondents identified increased motivation as the most significant benefit, which, together with the perceived development of creative thinking, confirms that teachers do not consider digital games to be pedagogically ineffective. In the context of technology acceptance models, this means that the *perceived usefulness parameter* is met among educators and, in theory, should lead to a high

rate of adoption. Reality, however, shows the exact opposite: the adoption rate is low, and more than half of the sample (57.1%) consists of non-users. An analysis of barriers indicated that intrinsic factors do not cause the failure to integrate games; second-order barriers such as personal resistance, fear of technology, or concern about losing control in the classroom were found to be statistically marginal or insignificant. Our data thus support contemporary critical discourse that rejects the blame of teachers and debunks myths about their incompetence or the so-called generation gap between them and their students. On the contrary, the absence of games in teaching is determined by massive first-order institutional barriers, namely the pressure of traditional assessment methods and the unclear connection between games and the rigid curriculum. This phenomenon represents *a structural friction* between the innovative, exploratory design of games and the standardised, test-oriented environment of today's schools.

A third significant finding is the systemic homogeneity of these barriers. Since we found no statistically significant differences between primary and secondary school teachers, it is clear that the identified institutional barriers are not specific to a particular age group of students but are deeply rooted in the very architecture of the K-12 education system as a whole.

These empirical findings have fundamental implications for education policymakers and school administrators. If we want to harness the potential of game-based learning fully, we must stop focusing interventions primarily on changing teachers' attitudes. Instead, it is essential to implement systemic changes that ensure adequate *facilitating conditions* for implementation.

First and foremost, it is necessary to innovate assessment frameworks in schools so that they are more flexible and capable of evaluating complex competencies acquired in nonlinear game environments, such as critical thinking and problem-solving, which traditional summative testing fails to capture. Second, educational game developers, in collaboration with instructional designers, should place much greater emphasis on explicitly linking game mechanics to applicable curriculum objectives. If this curricular connection is immediately apparent to teachers, the perceived institutional barrier to adoption will be significantly reduced (De Grove et al., 2012). Finally, we must not overlook the need for massive investments in schools' technological infrastructure, as material constraints continue to pose a significant first-order obstacle.

Despite its clear conclusions, this study has certain methodological limitations. It is a cross-sectional quantitative study based on teachers' *self-reports*, which may, to some extent, distort the actual state of their classroom practices. Although the sample size is sufficient to identify major trends and test for statistical significance, future research should supplement this quantitative framework with qualitative observations directly within the educational process. It would also be beneficial to conduct longitudinal studies that measure how adoption rates change following targeted changes in institutional conditions, for example, after the introduction of a new, more flexible national curriculum.

The study's concluding message is clear: teachers are not the enemies of educational digital games. They fully understand their enormous motivational potential and cognitive benefits for their students. The failure to systematically integrate games into formal K-12 education is primarily the result of an objective systemic failure at the level of institutional structures. A successful transformation of teaching, therefore, does not primarily require a change in teachers' attitudes but rather a restructuring of the very environment in which these teachers work every day.

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Ethics Declaration

This study involved collecting primary data from educators through a questionnaire survey. All research participants were informed in advance about the study's objectives and the nature of data processing, and they provided informed consent before the survey began. Participation in the survey was entirely voluntary, and all collected data were anonymised and processed in strict compliance with applicable data protection regulations.

AI Declaration

In preparing and conducting this study, the authors used Google *NotebookLM*, an artificial intelligence tool, to support academic writing. The tool was specifically used for linguistic stylisation, logical structuring of arguments, and text formatting in accordance with required citation and academic standards. Additionally, the AI translation tool DeepL was utilised to translate the manuscript into English. The artificial intelligence worked exclusively with primary empirical data and theoretical sources provided directly to it by the authors. No data or major research findings were generated by artificial intelligence. The authors thoroughly reviewed, verified, and edited all text outputs produced by these tools and bear sole and full responsibility for the final scientific content, accuracy, and originality of this article.

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