

RESEARCH ARTICLE

Educational benefits of digital game-based learning: K-12 teachers' perspectives and attitudes

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Abstract: This study aims to examine K-12 teachers' perspectives and attitudes toward the benefits of adopting and integrating digital game-based learning in education. The study involves 158 teachers of primary education and secondary education who filled in a 37-question questionnaire. Overall, teachers had significantly positive perspectives and attitudes. In contrast to their age and level of education in which they taught, teachers' educational background, gender, and teaching experience were correlated with their responses. Based on the results, most teachers were familiar with digital games and their use in educational settings and had previous experience in adopting digital game-based learning in their classrooms. The lack of equipment, digital skills, and training emerged as the primary challenges that they face. Concerning its general benefits in education, digital game-based learning emerged as an effective educational approach that can be applied in various subjects and offer interactive and student-centered learning environments. Regarding the benefits it can yield for teachers, digital game-based learning emerged as a useful educational approach that can facilitate and enrich the teaching process as it improves teachers' communication and digital skills and enables them to create motivational virtual learning environments that would consciously engage and encourage students to actively participate in educational activities and that would promote collaborative learning. In terms of the educational benefits that it can yield for students, digital game-based learning was evaluated as a valuable pedagogical approach that can enhance students' cognitive and social-emotional development, enhance their digital competencies, improve their learning motivation, engagement, and achievements, and increase their joy, autonomy, critical thinking, creativity, and imagination. Finally, digital game-based learning emerged as an effective educational approach that can be used at all educational levels and in both face-to-face and online learning to meet the new educational requirements, provide benefits for teachers and students, and improve the overall quality of education.

Keywords: digital game-based learning, DGBL, digital games, serious games, educational games, virtual learning environments, primary education, secondary education, K-12 education

1 Introduction

As students grow up surrounded by technological advances, their habits, preferences, views, and needs have drastically changed. Additionally, students can easily handle digital technologies, pursue to be actively involved and participate in educational activities, and seek for meaningful learning (Anastasiadis et al., 2018; Leadbeater, 2008). The current students are no longer characterized by the same traits of those that our education system was designed to teach and as a result, students' demands for effective learning cannot be satisfactorily met (Widodo et al. 2023; Prensky, 2001). Simultaneously, the need to cultivate higher-order thinking and 21st century skills through active learning while promoting students learning motivation and engagement is becoming more evident (Lampropoulos et al., 2022; Scott, 2015).

Play has a vital role in one's life throughout the different developmental stages as it affects one's learning, socialization, and overall development (Troulinaki, 2023; Tsai et al., 2012). Hence, play has a long tradition in education as it can support and enrich learning in both formal and informal learning environments (Anastasiadis et al., 2018). Nowadays, play mostly takes place through digital devices in the form of digital games which have become an integral part of culture and society (Erhel & Jamet, 2013; Papastergiou, 2009). In education, digital games are mostly applied in the form of serious games while following the digital game-based learning pedagogical approach which combines serious learning with interactive entertainment through digital games (Anastasiadis et al., 2018; Papadakis et al., 2022). By combining interactive media with educational content this approach aims to create student-centered environments

that focus more on primary purposes than pure entertainment to enhance and enrich teaching and learning and promote students' motivation and engagement (Lampropoulos et al., 2019; Papastergiou, 2009; Prensky, 2001). Moreover, digital game-based learning is an effective teaching and learning approach (Leadbeater, 2008), through which interactive and student-centered learning environments that gradually convey concepts, enable students to explore different game aspects, and allow them to reach a specific end goal, are created (Erhel & Jamet, 2013; Lampropoulos et al., 2023; Spires, 2015). This approach can yield educational benefits and improved learning outcomes in an enjoyable, exciting, and engaging way by combining education with entertainment (Gee, 2003). Hence, it has the potentials to enrich and transform the existing educational domain to meet the new educational needs and requirements (Leadbeater, 2008; Prensky, 2001) and provide effective and student-centered learning in both face-to-face and virtual learning environments (Pozo-Sánchez et al., 2022).

Despite the fact that digital game-based learning becoming more popular as a research topic, there is a clear need for more empirical studies to be conducted to understand both students' and teachers' perspectives and readiness to adopt and integrate it in educational settings (Papadakis & Kalogiannakis, 2020). Consequently, this study aims to examine K-12 teachers' attitudes and perspectives on the benefits of adopting and integrating digital game-based learning in education. Hence, the main research question set is if the use of digital game-based learning can yield educational benefits for teachers and students and enrich the educational process based on K-12 teachers' perspectives. The correlations among the various factors (e.g., teachers' age, gender, educational background, teaching experience, and level of education in which they teach, etc.) are also taken into account and examined.

2 Related work

Several studies have examined teachers' viewpoints regarding the digital game-based learning due to the potential benefits it can yield in education. Particularly, Sandford et al. (2006) examined the use of digital games in primary and secondary schools in England. Their research followed a quantitative approach and included two questionnaires, one on the views of 924 teachers and the other on the views of 2,334 students from 5 schools, as well as a case study containing 10 approaches adopted by teachers on the use of digital games for educational purposes. The technical specifications of school units, the potentials of digital games to meet the educational requirements, teachers' personal experience and training, as well as students' expectations and familiarity with digital games, are important influencing factors for teachers' views on the implementation of digital games in schools. Although teachers and students have been positive and enthusiastic about using digital games, the aforementioned factors need to be seriously considered by education leadership and digital game developers before their potentials can be fully utilized. Klemetti et al. (2009) explored the views and experiences of Finnish K-12 teachers regarding the use of educational digital games. In their research, in which 400 teachers participated, quantitative and qualitative methods were used through the use of three questionnaires and interviews. In particular, their study focused on the use of digital games in schools, the willingness and readiness of teachers to use them, as well as their views on promoting learning motivation (Papadakis & Kalogiannakis, 2022). The majority of teachers stated that they are familiar with the use of educational software and digital games and that they already apply them in their classrooms. Teachers' view regarding using educational games as a motivational tool is positive. However, it is emphasized that there are many factors that need to be taken into account when designing and developing educational games.

Furthermore, Razak et al. (2012) studied the views and motivations of primary school teachers about the use of digital game-based learning and game development tools in the Scottish curriculum. 62 teachers from 38 schools participated in quantitative studies through the use of questionnaires and in qualitative studies through interviews. Although the majority of teachers described this type of learning as promising, since it enhances collaborative learning and promotes student motivation and engagement, the results of the study showed that the application of this approach is still limited and more studies are required to assist in its being more effectively applied in primary education. To analyze teachers' views on the benefits and drawbacks of digital game-based learning and the relationship between games, schools and learning, Beavis et al. (2014) conducted a study involving K-12 teachers from ten Australian schools who taught to a total of more than 400 students. They followed a qualitative research method by interviewing teachers. According to teachers, digital games are educational tools that can provide many inherent motivations and inspire students while also improving their active participation and learning outcomes (Tzagaraki et al., 2022). Most teachers regarded that digital games contribute to the development of skills and abilities that go beyond the boundaries of traditional education, such as critical thinking, problem solving, collaboration, etc. (Sutrisni et

al., 2022). To explore the experiences and comprehend the views of primary school teachers about the use of digital games, Allsop and Jessel (2015) conducted a study in primary schools in England and Italy. In the context of this study, both quantitative research methods through questionnaires (89 participants) and qualitative methods through interviews (5 teachers from each country) were used. Based on their results, it appears that there are significant changes between the design and implementation plan of the games and their actual implementation within the classroom. In addition, teachers acknowledged that their role has now changed due to the integration of new technologies in education and highlighted the need for their active participation in the design of educational games to achieve optimal results (Xezonaki, 2022).

Moreover, Ucus (2015) examined the factors that encourage or discourage teachers to integrate digital games in their classrooms. Particularly, they followed a qualitative approach and interviewed 24 primary education Turkish teachers. Their results revealed that most teachers were positive about the use of digital games as they could affect several aspects of the educational process and they could connect lessons with social life while providing meaningful learning. Additionally, it was highlighted that digital games, when used as an educational means, could improve students' involvement and collaboration as well as increase their joy, interest, and curiosity. Rocha et al. (2018) explored K-12 teachers' perspectives regarding the advantages and barriers of using digital game-based learning in education. In total, 714 teachers from primary and secondary education from 34 countries participated in this study which adopted a quantitative approach and used a questionnaire. Based on their findings, the role of digital games as an effective educational tool emerged. Additionally, the teachers pointed out that digital games, when used in educational settings, could increase the interaction and communication among students, and improve their learning commitment and motivation which, in turn, can lead to improved learning outcomes and the achievement of specific learning goals.

Table 1 presents the details of the related studies examined. Based on their results, it was evident that due to their motivational characteristics, the inherent motivation they develop, the ease of use and flexibility they offer, as well as their direct relationship to emotional response, digital games can be effectively integrated into education and influence organizational and functional culture of educational units (Beavis et al., 2014; Klemetti et al., 2009; Ucus, 2015). Additionally, digital games have many positive social aspects (Prensky, 2001), make education more attractive and enjoyable (Razak et al., 2012) and can effectively meet new educational needs (Ucus, 2015). Their ability to increase students' learning motivation, active involvement and social interactions, to promote collaborative learning, and to enhance students' creativity, critical thinking, and soft skills arose as some of the main benefits of digital games in education (Allsop & Jessel, 2015; Beavis et al., 2014; Klemetti et al., 2009; Rocha et al., 2018; Sandford et al., 2006). Table 2 presents the benefits of adopting and integrating digital game-based learning according to teachers.

Table 1 Collection information

Article	Country	Participants	Research tool	Research method	Educational level
Sandford et al. (2006)	England	924 teachers and 2,334 students from 5 schools	2 questionnaires	Quantitative	K-12 education
Klemetti et al. (2009)	Finland	400 teachers	3 questionnaires and interviews	Mixed	K-12 education
Razak et al. (2012)	Scotland	62 teachers from 38 schools	Questionnaire and interviews	Mixed	Primary education
Beavis et al. (2014)	Australia	Teachers from 10 schools and over 400 students	Interviews	Qualitative	K-12 education
Allsop & Jessel (2015)	England and Italy	89 teachers	Questionnaire and interviews	Mixed	Primary education
Ucus (2015)	Turkey	24 teachers	Interviews	Qualitative	Primary education
Rocha et al. (2018)	34 countries	714 teachers	Questionnaire	Quantitative	K-12 education

3 Methods

This study adopted a quantitative research method. Specifically, it involves the creation and use of a questionnaire which contains both closed-ended and Likert scale questions. The Likert scale questions use a 0-4 scale (e.g., Strongly disagree = 0 ... Strongly agree = 4). In total, 158 teachers from Thessaloniki, Greece, participated in this study in the first two weeks of May 2023. The teachers had an average age of 44 years old and an average working experience as a teacher of 16.7 years. From the participants, 103 were female (65.2%) and 55 were male (34.8%). Additionally, 113 teachers taught in primary education (71.5%) and 45 in secondary education (28.5%). In terms of the teachers' level of education, 81 teachers had a bachelor degree (51.3%), 74 had a Master degree (46.8%), and 3 had a Doctoral degree (1.90%).

Besides the demographic questions, the questionnaire was divided into 5 sections and involved a total of 37 questions. Specifically, the sections and questions are categorized into:

(1) Familiarity with digital games: It involves 5 closed-ended questions about teachers' overall familiarity with digital games.

Table 2 Collection information

Article	Digital game-based learning benefits according to teachers
Sandford et al. (2006)	It provides significant learning incentives for active student participation. It offers a comprehensive and interactive way to engage students. It meets students' educational needs to a greater extent.
Klemetti et al. (2009)	It motivates students to participate actively. It brings a welcome change to traditional school study, as students prefer to use computers. It offers flexibility, challenge, and interactivity. It can include some positive social aspects. It is increasingly impacting the organizational culture of schools, due to its ability to increase students' learning motivation.
Razak et al. (2012)	It turns the educational process into a more fun, motivating, and engaging experience. It offers opportunities for collaboration and promotes problem-solving and critical thinking skills.
Beavis et al. (2014)	It is exciting, motivating, and fun. It is associated with students' emotional responses. It offers intrinsic motivation that helps the educational process and enhances students' engagement and knowledge retention. It helps students' cognitive development and 21st century skills cultivation. It promotes diversity. It offers the possibility of cooperation inside and outside the school environment.
Allsop & Jessel (2015)	It encourages creativity and provides opportunities for collaborative work. It is directly related to the educational process. It provides incentives to help improve learning and to develop problem-solving and critical thinking skills. It allows learning to happen in the background, without it being immediately perceived. It makes the role of teachers more active, participatory, and interactive. It can change students' views and attitudes for learning.
Ucus (2015)	It applies to many aspects of the educational process. It enhances active student participation and collaborative learning. It stimulates students' interest and increases their joy and curiosity. It connects the lessons with social life and promotes meaningful learning.
Rocha et al. (2018)	It enhances students' learning motivation and commitment. It contributes to the achievement of learning goals. It increases the interaction among students.

(2) General perspectives regarding digital game-based learning: It consists of 4 closed-ended questions and 9 Likert Scale questions and refers to teachers' general perspectives and attitudes toward digital game-based learning.

(3) Impact on teachers: It involves 6 Likert scale questions about the impact that the adoption and integration of digital games into education can have on teachers' work.

(4) Impact on students: It comprises 9 Likert scale questions regarding the influence that the adoption and integration of digital games into education can have on students' learning and development.

(5) Future perspectives: It consists of 4 closed-ended questions concerning the teachers' viewpoints about the use of digital game-based learning in education in the near future.

The questionnaire was confidential, anonymous, and did not pose any physical or psychological risks to the participants. Completing the questionnaire was voluntary and the participants could withdraw at any time. The questionnaire did not contain any information that could help identify the participants' identity. Additionally, following Bryman (2016) guidelines, prior to the distribution of the questionnaire, it was first evaluated and tested by two experienced teachers who belong to the research population but who did not participate in the study.

4 Results and discussion

In this section, the results of this study are presented and analyzed. To present them more clearly, the results are divided into six categories.

4.1 Familiarity with digital games

Initially, teachers' familiarity with digital games in the context of digital game-based learning was assessed. Particularly, the questions involved their prior experiences, their average time spent playing digital games, and the devices they mostly use both in general and in their classrooms.

When asked if they had any personal experience in using digital games, most teachers responded that they had a little (freq.: 74, perc.: 46.8%) or moderate (freq.: 58, perc.: 36.7%) experience with 12 (7.6%) teachers stating that they had a lot of experience and 14 (8.9%) that they had no prior experience with digital games (Figure 1). Therefore, it can be inferred that the vast majority (91.13%) of teachers had prior experience with digital games. Regarding the frequency in which they play digital games, most teachers answered rarely (freq.: 86, perc.: 54.4%), followed by often (freq.: 52, perc.: 32.9%). Only 2 (1.3%) teachers mentioned that they play very often and 18 (11.4%) that they never play digital games any more (Figure 2).

This fact highlights the importance of entertainment in the form of digital games as despite their hectic schedules, educators can still find some time to engage themselves in such activities.

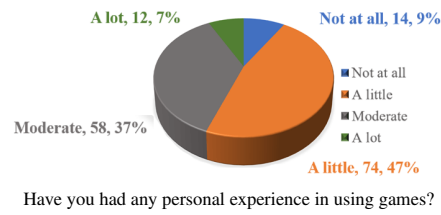


Figure 1 Teachers' personal experience in using digital games

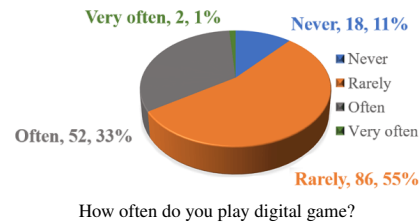


Figure 2 Teachers' frequency of playing digital games

On the contrary, when asked how much time on average they spend playing digital games, the vast majority (freq.: 82, perc.: 51.9%) stated that they dedicate less than 30 minutes per day, followed by 44 teachers (27.8%) who stated that they do not dedicate time to playing on a daily basis (Figure 3). It can be inferred that although playing digital games even for a short period of time might not be a daily occurrence, it is still evident that they seek to engage themselves in digital game related activities in their leisure time. Most teachers use either their mobile (freq.: 70, perc.: 44.3%) or laptop (freq.: 52, perc.: 32.9%) to play digital games on, which further justifies the fact that most teachers play digital games for short time periods (Figure 4).



Figure 3 Teachers' average time spent on playing digital games daily

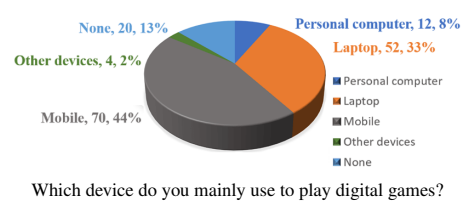


Figure 4 Teachers' most commonly used device to play digital games

It is also important to mention that most teachers (84.81%) had some previous experience in using educational digital games. Most teachers had a little (freq.: 82, perc.: 51.9%) to moderate (freq.: 38, perc.: 24.1%) experience in adopting and integrating digital games in their classrooms with 14 (8.9%) teachers stating that they had a lot of experience. Only 24 (15.2%) teachers stated that they did not have any prior experience in using digital games in educational settings (Figure 5).

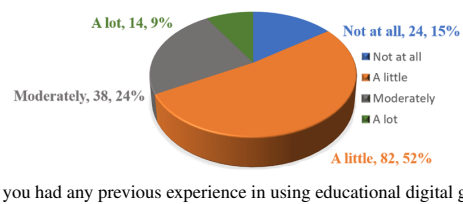


Figure 5 Teachers' prior experience in using digital games in educational settings

4.2 General perspectives regarding digital game-based learning

Regarding teachers' general perspectives on digital game-based learning, the vast majority of them had a positive attitude and expressed positive viewpoints. The overwhelming majority of teachers agreed (freq.: 74, perc.: 46.8%) or strongly agreed (freq.: 72, perc.: 45.6%) with the fact that entertainment is an important component of education and a prerequisite of effective learning. Only 2 (1.3%) teachers disagreed with this statement and 10 (6.3%) had a neutral opinion (Figure 6).

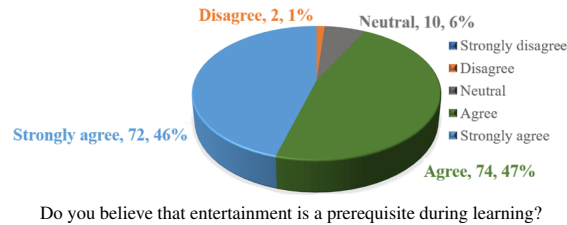


Figure 6 Teachers' perspectives on the important of entertainment in learning

When teachers were asked how often digital games should be used as a teaching means the overwhelming majority stated that they should be used moderately (freq.: 108, perc.: 68.4%), followed by a little (freq.: 44, perc.: 27.8%) (Figure 7). However, when asked how often they integrate digital games in their own classrooms, most of them responded with a little (freq.: 94, perc.: 59.5%), followed by moderately (freq.: 34, perc.: 21.5%) and not at all (freq.: 22, perc.: 13.9%) (Figure 8).

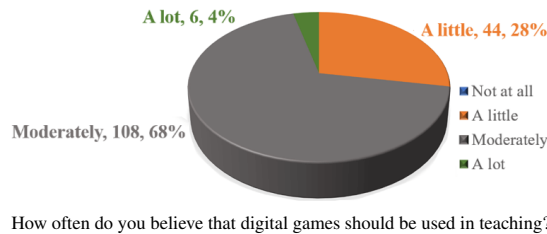


Figure 7 Teachers' beliefs on how often digital games should be used to teach

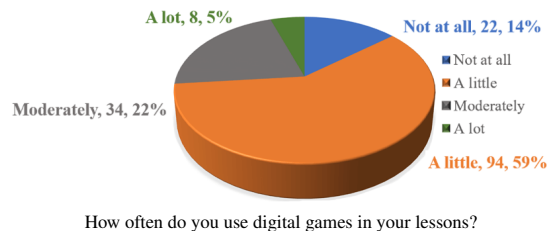
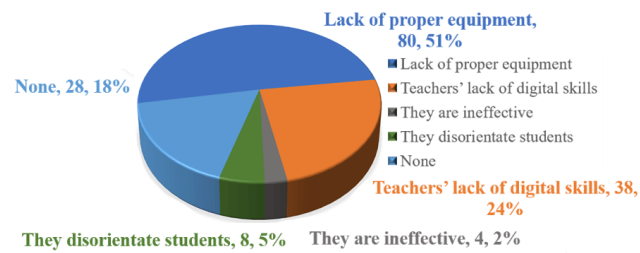


Figure 8 Teachers' use of digital games in their own lessons

Although teachers acknowledge the benefits of digital game-based learning, there are still barriers to overcome for them to be more widely and often used. Teachers stated that most obstacles are related to the lack of proper equipment (freq.: 80, perc.: 50.6%) and their lack of digital skills (freq.: 38, perc.: 24.1%). Few teachers regarded digital games as a means that disorients students (freq.: 8, perc.: 5.1%) or as an ineffective teaching tool (freq.: 4, perc.: 2.5%). Nonetheless, 28 (17.7%) teachers stated that they do not find any barriers or obstacles to effectively integrate digital games in their classrooms (Figure 9).

Furthermore, teachers assessed that the use of digital game-based learning can enhance and enrich the learning process (freq.: 140, perc.: 88.60%), can be applied in various subjects (freq.: 144, perc.: 91.14%), and facilitate the comprehension of the concepts taught (freq.: 132, perc.: 83.54%). Teachers had mixed opinions on whether the use of digital games could create a competitive atmosphere in the classroom with 58 (36.7%) teachers being neutral, 62 (39.24%) having a positive opinion, and 38 (24.05%) having a negative one. Additionally, teachers regarded that through the use of digital game-based learning, student-centered environments (freq.: 108, perc.: 68.35%) that offer interactive experiences (freq.: 146, perc.: 92.40%) and can make the learning and teaching process more enjoyable and entertaining (freq.: 148, perc.: 93.67%) can be created. Lastly, teachers had mainly a negative response when asked if using this approach would be a waste of time and resources (freq.: 128, perc.: 81.01%) and if it could only offer entertainment and not be an effective educational tool (freq.: 106, perc.: 67.09%). It can be inferred that teachers overall regard digital game-based learning as an effective educational



Which reason do you consider as the most important for not using digital games in the educational process?

Figure 9 Teachers' main obstacles in integrating digital games in their teaching

approach that can enrich and improve the teaching and learning processes by creating interactive and engaging experiences that lead to better learning outcomes. Figure 10 and Table 3 present the related information in detail.

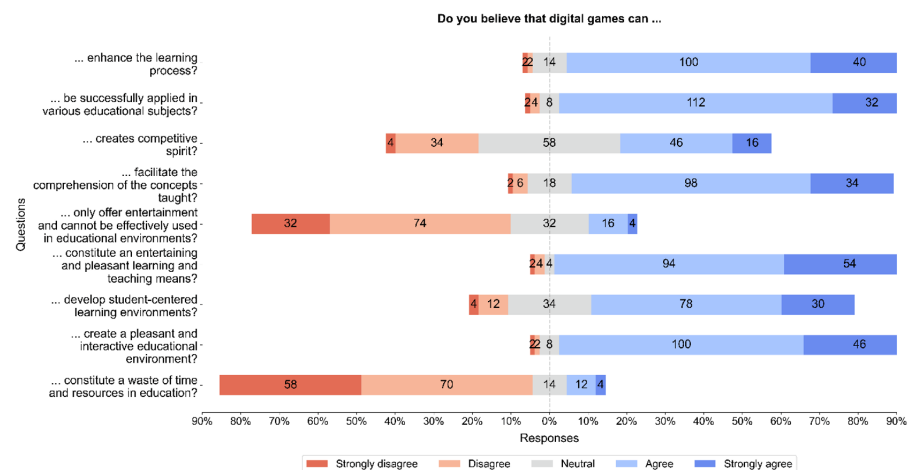


Figure 10 Teachers' general perspectives on the use of digital game-based learning in education

Table 3 Teachers' general perspectives on the use of digital game-based learning in education

Do you believe that digital games can ...	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	SD
... enhance the learning process?	2 (1.27%)	2 (1.27%)	14 (8.86%)	100 (63.29%)	49 (25.31%)	3.10	0.71
... be successfully applied in various educational subjects?	2 (1.27%)	4 (2.53%)	8 (5.06%)	112 (70.89%)	32 (20.25%)	3.06	0.68
... create competitive spirit?	4 (2.53%)	34 (21.52%)	58 (36.71%)	46 (29.11%)	16 (10.13%)	2.23	0.98
... facilitate the comprehension of the concepts taught?	2 (1.27%)	6 (3.80%)	18 (11.39%)	98 (62.03%)	34 (21.52%)	2.99	0.77
... only offer entertainment and cannot be effectively used in educational environments?	32 (20.25%)	74 (46.84%)	32 (20.25%)	16 (10.13%)	4 (2.53%)	1.28	0.98
... constitute an entertaining and pleasant learning and teaching means?	2 (1.27%)	4 (2.53%)	4 (2.53%)	94 (59.49%)	54 (34.18%)	3.23	0.73
... develop student-centered learning environments?	4 (2.53%)	12 (7.59%)	34 (21.52%)	78 (49.37%)	30 (18.99%)	2.75	0.94
... create a pleasant and interactive educational environment?	2 (1.27%)	2 (1.27%)	8 (5.06%)	100 (63.29%)	46 (29.11%)	3.18	0.69
... constitute a waste of time and resources in education?	58 (36.71%)	70 (44.30%)	14 (8.86%)	12 (7.59%)	4 (2.53%)	0.95	1

4.3 Impact on teachers

As far as the potential impact that the use of digital games in education can have on teachers, the respondents have a positive attitude. In particular, they deemed that the adoption and integration of digital game-based learning would facilitate their teaching (freq.: 128, perc.: 81.01%) and it would act as a valuable and effective teaching tool (freq.: 144, perc.: 91.14%) through which they could create motivating learning environments (freq.: 138, perc.: 87.34%) and activities to actively and consciously engage students to participate (freq.: 130, perc.: 82.28%). By using digital games in their practices, teachers stated that their digital skills would be improved (freq.: 136, perc.: 86.08%) and as they become more familiar with digital game-based learning approach, they will be able to promote teachers' and students' interaction and communication (freq.: 130, perc.: 82.28%). Based on the above, it can be inferred that teachers regarded digital games as an effective educational tool that could support and enrich their activities. In addition, it would enable them to improve their digital skills and create interactive, motivating, and engaging learning environments and experiences. The related responses are presented in Figure 11 and Table 4.

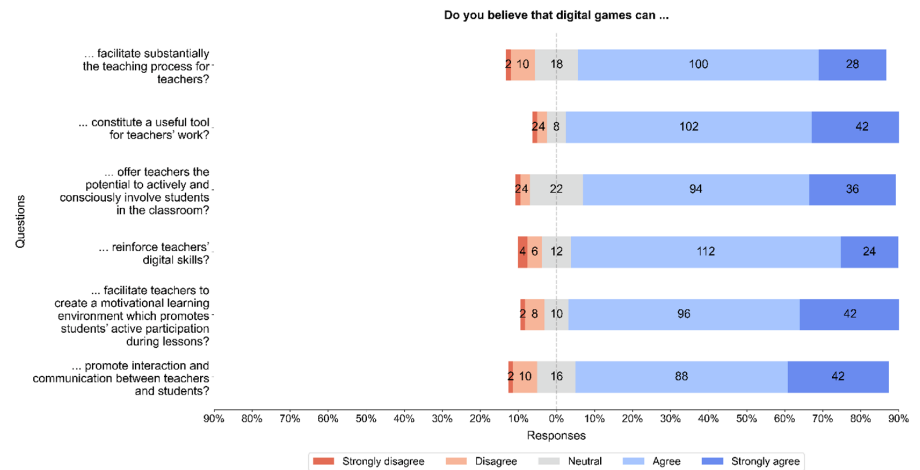


Figure 11 Teachers' perspectives on the impact that the integration of digital games in education could have on them

Table 4 Impact of integrating digital games in education on teachers

Do you believe that digital games can ...	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	SD
... facilitate substantially the teaching process for teachers?	2 (1.27%)	10 (6.33%)	18 (11.39%)	100 (63.29%)	28 (17.72%)	2.9	0.81
... constitute a useful tool for teachers' work?	2 (1.27%)	4 (2.53%)	8 (5.06%)	102 (64.56%)	42 (26.58%)	3.13	0.72
... offer teachers the potential to actively and consciously involve students in the classroom?	2 (1.27%)	4 (2.53%)	22 (13.92%)	94 (59.49%)	36 (22.78%)	3	0.77
... reinforce teachers' digital skills?	4 (2.53%)	6 (3.80%)	12 (7.59%)	112 (70.89%)	24 (15.19%)	2.92	0.78
... facilitate teachers to create a motivational learning environment which promotes students' active participation during lessons?	2 (1.27%)	8 (5.06%)	10 (6.33%)	96 (60.76%)	42 (26.58%)	3.06	0.8
... promote interaction and communication between teachers and students?	2 (1.27%)	10 (6.33%)	16 (10.13%)	88 (55.70%)	42 (26.58%)	3	0.86

4.4 Impact on students

Teachers also had a positive attitude regarding the impact that the integration of digital games in education could have on students. More specifically, teachers regarded that through digital game-based learning, students' performance would increase (freq.: 126, perc.: 79.75%) and their cognitive (freq.: 126, perc.: 79.75%) and social-emotional development (freq.: 110, perc.: 69.62%) would improve. Due to the nature of digital games, teachers assessed that they will act as a mediator to improve students' critical thinking (freq.: 124, perc.: 78.48%) as well as their imagination and creativity (freq.: 136, perc.: 86.08%). Additionally, teachers stated that by integrating digital games in teaching and learning activities, students' autonomy would increase (freq.: 120, perc.: 75.95%) and more opportunities for collaborative learning would arise (freq.: 102, perc.: 64.56%). Within the interactive environments that digital games offer students active participation would increase (freq.: 140, perc.: 88.61%) and their interactions and communication with their peers (freq.: 104, perc.: 65.82%) would improve. It can be inferred that teachers assessed digital game-based learning as an effective approach that when used in a student-centered manner can improve students' learning experiences and learning achievements while helping them develop their cognitive, social-emotional, and soft skills. Teachers' responses to the related questions are presented in detail in Figure 12 and in Table 5.

Table 5 Impact of integrating digital games in education on students

Do you believe that digital games can ...	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	SD
... improve students' learning performance?	2 (1.27%)	10 (6.33%)	20 (12.66%)	94 (59.49%)	32 (20.25%)	2.91	0.83
... promote students' cognitive development?	2 (1.27%)	6 (3.80%)	24 (15.19%)	94 (59.49%)	32 (20.25%)	2.94	0.79
... promote students' social-emotional development?	2 (1.27%)	10 (6.33%)	36 (22.78%)	84 (53.16%)	26 (16.46%)	2.77	0.84
... enhance students' critical thinking?	2 (1.27%)	8 (5.06%)	24 (15.19%)	88 (55.70%)	36 (22.78%)	2.94	0.83
... develop students' imagination and creativity?	2 (1.27%)	6 (3.80%)	14 (8.86%)	78 (49.37%)	58 (36.71%)	3.16	0.84
... reinforce students' autonomy?	2 (1.27%)	4 (2.53%)	32 (20.25%)	88 (55.70%)	32 (20.25%)	2.91	0.79
... promote collaborative learning?	2 (1.27%)	20 (12.66%)	34 (21.52%)	68 (43.04%)	34 (21.52%)	2.71	0.99
... promote students' active involvement in the learning process?	2 (1.27%)	4 (2.53%)	12 (7.59%)	88 (55.70%)	52 (32.91%)	3.16	0.77
... improve interaction and communication among students?	4 (2.53%)	10 (6.33%)	40 (25.32%)	74 (46.84%)	30 (18.99%)	2.73	0.93

4.5 Future perspectives

Overall, teachers had a positive attitude regarding the future of digital game-based learning and its potentials to transform and enrich education. In particular, as it can be observed in Table

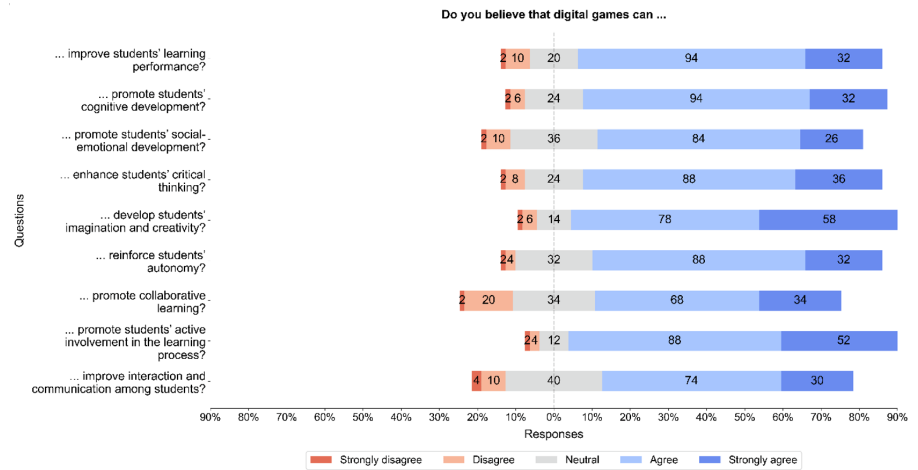


Figure 12 Teachers' perspectives on the impact that the integration of digital games in education could have on students

6, most teachers assessed that digital games will be a significant educational tool in the near future (freq.: 108, perc.: 68.35%) that could not only enhance face-to-face learning but also online learning (freq.: 126, perc.: 79.75%). Concerning the applicability of the digital game-based learning approach, the vast majority of teachers evaluated it as an effective educational approach whose use will increase in the near future (freq.: 128, perc.: 81.01%). Regarding the significance and effectiveness of integrating digital game-based learning in each educational level, teachers evaluated that it would be more impactful in primary education, followed by preschool education, secondary education, and higher education (Table 7). Hence, it can be inferred that teachers positively view digital game-based learning and they firmly believe in the potential virtues and benefits it can yield in all educational levels.

Table 6 Digital game use in education in the near future based on teachers' perspectives

Questions	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	SD
Do you believe that digital games will constitute significant educational tools in the near future?	0	0	20 (12.70%)	90 (57%)	18 (30.40%)	3.18	0.63
Do you believe that the use of digital game-based learning methods in education will increase in the near future?	0	8 (5.10%)	24 (15.20%)	100 (63.30%)	26 (16.50%)	2.91	0.72
Do you believe that the use of digital games in the educational process can enhance online learning?	0	8 (5.10%)	22 (13.90%)	74 (46.80%)	54 (34.40%)	3.10	0.82

Table 7 Importance and effectiveness of integrating digital game-based learning in each educational level based on teachers' perspectives

Educational level	Not at all	A little	Moderately	A lot	Mean	SD
Pre-school education	12 (7.60%)	22 (13.90%)	70 (44.30%)	54 (34.20%)	2.05	0.89
Primary education	0	14 (8.90%)	80 (50.60%)	64 (40.50%)	2.32	0.63
Secondary education	2 (1.30%)	48 (30.40%)	64 (40.50%)	44 (27.80%)	1.95	0.80
Higher education	30 (19%)	60 (38%)	34 (21.50%)	34 (21.50%)	1.46	1.03

4.6 Statistical analysis

Statistical analysis was also carried out to further examine the data. Three variables that is general perspectives (GP), impact on teachers (IT), and impact on students (IS), were computed based on teachers' perspectives on digital game-based learning. Particularly, GP consisted of 9 items and showcased a mean of 2.53 and a standard deviation of 0.50, IT comprised 6 items and presented a mean of 3.00 and a standard deviation of 0.70, and IS was composed of 9 items and had a mean of 2.92 and a standard deviation of 0.70. Table 8 presents the computed variables in detail.

To assess the reliability and internal consistency, Cronbach's alpha was calculated for each of the three variables and their constructs through a reliability analysis. Particularly, Cronbach's alpha was 0.733 for GP, 0.943 for IT, and 0.940 for IS. All three cases indicated a satisfactory level of internal consistency (Table 9).

One-Sample t-Test was carried out to evaluate the three null hypotheses set. For the purposes of this study, the following null hypotheses were set:

Table 8 Description of the computed variables

Computed variables	Description	Mean	SD
GP (General perspectives)	... enhance the learning process?	2.53	0.50
	... be successfully applied in various educational subjects?		
	... create competitive spirit?		
	... facilitate the comprehension of the concepts taught?		
	... only offer entertainment and cannot be effectively used in educational environments?		
	... constitute an entertaining and pleasant learning and teaching means?		
	... develop student-centered learning environments?		
	... create a pleasant and interactive educational environment?		
IT (Impact on teachers)	... constitute a waste of time and resources in education?	3.00	0.70
	... facilitate substantially the teaching process for teachers?		
	... constitute a useful tool for teachers' work?		
	... offer teachers the potential to actively and consciously involve students in the classroom?		
	... reinforce teachers' digital skills?		
	... facilitate teachers to create a motivational learning environment which promotes students' active participation during lessons?		
IS (Impact on students)	... promote interaction and communication between teachers and students?	2.92	0.70
	... improve students' learning performance?		
	... promote students' cognitive development?		
	... promote students' social-emotional development?		
	... enhance students' critical thinking?		
	... develop students' imagination and creativity?		
	... reinforce students' autonomy?		
	... promote collaborative learning?		
... promote students' active involvement in the learning process?			
... improve interaction and communication among students?			

Table 9 Reliability statistics

Variables	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
GP (General perspectives)	0.773	0.812	9
IT (Impact on teachers)	0.943	0.944	6
IS (Impact on students)	0.940	0.941	9

- H₀₁: There is no significant difference in how teachers perceive digital game-based learning.
- H₀₂: There is no significant difference in how teachers perceive that digital game-based learning can impact teachers.
- H₀₃: There is no significant difference in how teachers perceive that digital game-based learning can impact students.

Based on the results depicted in [Table 10](#) and having set the significance level to 0.05, all three null hypotheses are rejected. Particularly, in the case of GP, the p-value is less than the significance level ($p < 0.05$) and as a result, H₀₁ is rejected. Additionally, the positive mean difference (0.52883) indicates that teachers have a more positive perspective regarding how they generally view digital game-based learning. Moreover, in the case of IT, the p-value is less than the significance level ($p < 0.05$) and as a result, H₀₂ is rejected. Based on the mean difference (1.00211), teachers expressed significantly more positive perspectives on the potential benefits that can be yielded for teachers through the integration of digital game-based learning. Finally, in the case of IS, the p-value is less than the significance level ($p < 0.05$) and as a result, H₀₃ is also rejected. The positive mean difference (0.91561) indicates that teachers have significantly more positive perspectives regarding the potential benefits that can be yielded for students through the integration of digital game-based learning. Therefore, it can be inferred that teachers highly value digital game-based learning and regard it as an effective educational tool that can yield benefits for both students and teachers.

Table 10 One-Sample t-Test, Testing Value = 2

Variables	t	df	Sig. (2-tailed)	Mean Difference	95% CI	
					Lower	Upper
GP (General perspectives)	13.250	157	0.000	0.52883	0.4500	0.6077
IT (Impact on teachers)	18.058	157	0.000	1.00211	0.8925	1.1117
IS (Impact on students)	16.525	157	0.000	0.91561	0.8062	1.0251

Furthermore, correlation analysis was conducted to identify if and to what degree the variables examined within this study are correlated. [Table 11](#) presents the correlation results while [Table 12](#) depicts the descriptive statistics of the related variables. The three computed variables (GP,

IT, and IS) were significantly and positively correlated with each other. This fact highlights that teachers, who had positive perspectives on and attitudes toward digital game-based learning and digital games, evaluated their general use in education, their impact on teachers, and their impact on students positively. A significant correlation was also observed in terms of teachers' gender and their perspectives on the impact of digital game-based learning on teachers (IT, $r = -0.254$, $p = 0.001$) and on students (IS, $r = -0.205$, $p = 0.010$). Particularly, female teachers showcased a more positive attitude in comparison to male teachers toward the potential benefits that can be yielded for both students and teachers. Teaching experience was another factor that was significantly and positively correlated with teachers' perspectives on the benefits that digital game-based learning could yield for teachers (IT, $r = 0.159$, $p = 0.046$). More specifically, teachers that had more experience expressed more positive attitudes and perspectives on the positive impact that digital game-based learning could have in their teaching. Teachers that had less than 4 years of teaching experience also expressed a positive attitude but to a slightly lesser extent. Nonetheless, the overall teachers' perspectives were overwhelmingly positive as previously shown. The most impactful variable that had a significant and negative correlation with teachers' overall perspectives was their educational background. Teachers with bachelor degrees had a more positive attitude toward digital game-based learning in general (GP, $r = -0.196$, $p = 0.014$) as well as on the impact of digital game-based learning on teachers (IT, $r = -0.161$, $p = 0.043$) and on students (IS, $r = -0.240$, $p = 0.002$) than those who had master or doctoral degrees. Finally, no correlations were found between age and currently teaching level with GP, IT, and IS. Hence, the level in which teachers taught (primary or secondary education) and their age did not affect their attitudes and perspectives on digital game-based learning.

Table 11 Correlations

Variables		GP	IT	IS
Age	Pearson Correlation	-0.017	0.063	0.001
	Sig. (2-tailed)	0.834	0.431	0.991
Gender	Pearson Correlation	-0.185*	-0.254**	-0.205**
	Sig. (2-tailed)	0.020	0.001	0.010
Level of education currently teaching at	Pearson Correlation	-0.100	-0.015	-0.074
	Sig. (2-tailed)	0.210	0.848	0.358
Teaching experience	Pearson Correlation	0.048	0.159*	0.077
	Sig. (2-tailed)	0.547	0.046	0.338
Educational background	Pearson Correlation	-0.196*	-0.161*	-0.240**
	Sig. (2-tailed)	0.014	0.043	0.002
GP (General perspectives)	Pearson Correlation	1	0.648**	0.718**
	Sig. (2-tailed)		0.000	0.000
IT (Impact on teachers)	Pearson Correlation	0.648**	1	0.798**
	Sig. (2-tailed)	0.000		0.000
IS (Impact on students)	Pearson Correlation	0.718**	0.798**	1
	Sig. (2-tailed)	0.000	0.000	

Notes: GP: General perspectives; IT: Impact on teachers; IS: Impact on students; * Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed).

Table 12 Group statistics

Group	N	GP			IT			IS		
		Mean	SD	SE	Mean	SD	SE	Mean	SD	SE
Gender										
Female	103	2.60	0.46	0.05	3.13	0.56	0.05	3.02	0.61	0.06
Male	55	2.40	0.55	0.07	2.76	0.86	0.12	2.72	0.81	0.11
Age (years)										
>= 17	80	2.50	0.45	0.05	3.02	0.58	0.06	2.91	0.62	0.07
< 17	78	2.56	0.55	0.06	2.98	0.80	0.09	2.93	0.77	0.09
Teaching experience (years)										
>= 4	128	2.56	0.41	0.04	3.07	0.56	0.05	2.94	0.63	0.06
< 4	30	2.41	0.79	0.14	2.71	1.06	0.19	2.81	0.92	0.17
Education background										
Bachelor degree	81	2.62	0.37	0.04	3.10	0.61	0.07	3.08	0.55	0.06
Master degree	74	2.45	0.61	0.07	2.91	0.78	0.09	2.75	0.80	0.09
Doctoral degree	3	2.15	0.32	0.19	2.56	0.38	0.22	2.56	0.38	0.22

Notes: GP: General perspectives; IT: Impact on teachers; IS: Impact on students; SD: Std. Deviation; SE: Std. Error Mean.

5 Conclusions

The aim of this study was to examine K-12 teachers' perspectives and attitudes toward the benefits of adopting and integrating digital game-based learning in education. A quantitative

case study was carried out in which 158 teachers of primary education and secondary education took part in by filling in a questionnaire consisting of 37 closed-ended and Likert scale questions. The results of the study further validated those of the existing literature regarding the benefits of integrating digital game-based learning in education and the positive viewpoints of teachers while also presented new results and conclusive remarks.

Based on the results, most teachers were familiar with digital games and their use in educational settings and they had previous experience in integrating digital game-based learning in their classrooms. Additionally, most teachers spend time, when possible, playing digital games even for a short time period which highlights the important role of play in human development and life. Teachers assessed that digital games should be used in the educational process but they still face barriers in effectively integrating them. Particularly, the lack of equipment, digital skills and training arose as the main obstacles.

Overall, teachers had significantly positive perspectives and attitudes toward digital games and their use in education through the digital game-based learning approach. Teachers' educational background, gender, and teaching experience were correlated with their perspectives. Their age and the level of education in which they currently taught was not a significant factor that influenced their viewpoints.

Digital game-based learning emerged as an effective educational approach that can be applied in various subjects and enhance the learning process by facilitating subject comprehension, improving interactions, offering entertainment, increasing communication, and providing student-centered and engaging learning environments. Moreover, digital games emerged as useful teaching tools that would facilitate the teaching process, improve communication, and allow teachers to improve their digital skills and create motivational learning environments that would consciously engage students and encourage them to actively participate in educational activities.

Furthermore, teachers highlighted several educational benefits that the use of digital game-based learning in education could bring about for students. Digital game-based learning was evaluated by teachers as a valuable pedagogical approach that could improve students' learning motivation, engagement, and achievements, enhance their cognitive and social-emotional development, and increase their imagination, creativity, and critical thinking. Additionally, students' autonomy can also be increased through the adoption of digital game-based learning and more opportunities for collaborative learning can be created. Teachers regarded digital game-based learning as a suitable approach to meet the new educational requirements and assessed that it will be more widely used in the future in both face-to-face and online learning environments at all educational levels due to the benefits it can yield for both teachers and students. Therefore, it can be concluded that digital game-based learning is an effective educational approach that can be used at all educational levels to offer benefits for both teachers and students and enhance the overall education quality.

Conflicts of interest

The author declares that they have no conflict of interest.

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