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Digital Game-Based Learning in Education: Bibliometric Analysis of Research Trends, Game Types, and Thematic Focus on Student Engagement

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ABSTRACT

Advances in digital technology have brought about significant changes in the world of education, one of which is the implementation of Digital Game-Based Learning (DGBL), which is believed to enhance student engagement. However, research on on DGBL still shows a diversity of focus, both in terms of publication trends, fields of study, and the types of games used. This study aims to map the development of DGBL research in relation to student engagement using a bibliometric approach. The research method consists of a bibliometric analysis using data drawn from the Scopus database for the period 2017-2026. Articles were systematically selected until 50 publications meeting the inclusion criteria were obtained. Data analysis utilized the Biblioshiny software to identify publication trends, the distribution of scientific fields, and the dominant types of games. The results indicate an increase in DGBL publications with an annual growth rate of 16.65%. The study was dominated by the sciences (74%), particularly health, engineering, and biology, while the social sciences accounted for only 26%, with a focus on business, education, and literacy. In terms of game types, serious games ranked first (54%), followed by quiz games, simulation games, role-playing games, and augmented reality. These findings underscore the significant potential of DGBL in enhancing learning engagement; however, its application remains concentrated in the sciences, necessitating broader development in the social sciences.

Key Word *Digital Game-Based Learning, Bibliometric Analysis, Student Engagement, Serious Games, Educational Technology.*

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INTRODUCTION

The 4.0 Industrial Revolution has sparked a shift in the global education paradigm, throught a shift toward learner-centered learning, and has driven the use of digital technology in the learning activities (Ishak et al., 2021; Tikhonova & Raitskaya, 2023). In this context, technology no longer serves merely as a supporting tool but as a crucial core component in both teaching practices and the formulation of learning strategies (Al-ghurbani et al., 2022). In line with this transformation, educational technology has evolved into a structured approach

that leverages technology to support the design, implementation, and evaluation of learning to make it more effective and efficient (Bushina et al., 2026).

This transformation has spurred the emergence of various innovative approaches aimed at improving the quality of the learning process. The integration of technology has proven capable of creating more interactive learning experiences while fostering active student engagement (Raave et al., 2024). This trend is reflected in the increasing number of scientific publications in the field of educational technology. Bibliometric studies indicate that research in this field is experiencing rapid growth with diverse themes, one of which is *game-based learning,* which has been extensively studied in the context of higher education and technology-based learning (Gur & Turel, 2025; Mubarok et al., 2025). Additionally, systematic reviews confirm that gamification is a key strategy in modern education because it integrates pedagogical elements, personalization, and game design to enhance student participation and learning experiences (Pratama et al., 2025).

As this theme has evolved, Digital Game-Based Learning (DGBL) has emerged as a pedagogical approach that has been extensively studied in the literature. DGBL integrates learning objectives into the design of digital games by aligning game mechanics with learning mechanics to create an interactive, challenging, and participatory learning experience (Kalmpourtzis & Romero, 2020). Characteristics such as challenges, instant feedback, points, and leaderboards are utilized to encourage active student engagement in the learning process (Cigdem et al., 2024; Hong et al., 2024). From a design perspective, narrative design elements in games can strengthen students' motivation and engagement in the learning process (Breien & Wasson, 2021). In practice, *student engagement* is a key issue reflecting cognitive, affective, and behavioral participation in the learning process (Feng, 2026).

A number of previous studies have examined the use of digital games in teaching and learning from various perspectives. Özispa & Turkistanli (2025) conducted an experimental study involving 48 students in the fields of logistics and maritime education, which demonstrated that Digital Game-Based Learning (DGBL) can improve knowledge retention, boost learning motivation, and strengthen conceptual understanding through collaborative and interactive activities, ultimately enhancing student learning outcomes; however, the relatively small sample size at a single university limits the generalizability of these findings. Tian & Umar (2025) conducted a systematic review of 17 studies on Digital Game-Based Learning (DGBL) in foreign language learning in higher education, finding that DGBL has a positive impact on foreign language vocabulary acquisition, motivation, and attitudes.

Behnamnia et al. (2024) performed a meta-analysis of 18 empirical papers on DGBL in STEM studies at the primary school level. The authors reported that DGBL interventions positively affected learning outcomes, especially in mathematics, language, and science, emphasizing that it is important to optimize game design and platform selection. Findings from a meta-analysis conducted by Huang et al. (2025) also confirm that gamification strategies clearly influence engagement, motivation, learning effectiveness, and overall user experience in the context of forest fire safety education and training, accompanied by improved learning outcomes. A bibliometric study by Pratama et al., (2025) revealed that publications related to Digital Game-Based Learning (DGBL) have increased, with a primary focus on gamification, adaptive learners, and cognitive skill development. However, studies specifically mapping the relationship between types of digital games and learner engagement remain limited, necessitating a systematic literature review.

In this context, bibliometric methods are considered relevant for systematically mapping and analysis of large volumes of scientific literature. This approach allows researchers to track developments in a field of study, identify emerging themes, and uncover intellectual structures and patterns of scientific collaboration using publishing metadata such as the number of articles, citations, keywords, and author networks (Donthu et al., 2021). This research aims to conduct a bibliometric analysis of studies on digital game-based learning during the 2017–2026 period by mapping publication trends, identifying the most frequently studied types of digital games, and analyzing the thematic focus of research related to student engagement. The uniqueness of this study lies in its mapping method, which not only tracks general publication trends but also integrates an analysis of digital game types with a focus on student engagement as the primary research focus. Thus, this study contributes to providing a complete overview of the direction and patterns of development in Digital Game-Based Learning (DGBL) research while serving as a basis for the development of future digital game-based learning research and practice.

RESEARCH METHOD

This study employed a bibliometric analysis method using data sourced from the Scopus database. Articles were retrieved using the *Advanced Search* feature with a combination of keywords representing digital game-based learning, educational contexts, and student engagement. Articles were searched using the keywords (“digital game-based learning” OR “game-based learning”) AND “education” AND (“student engagement” OR *“engagement”)* in the Title,

Abstract, and Keywords fields. The inclusion criteria for this study are: (1) articles discussing digital game-based learning in an educational context, (2) articles published between 2016 and 2026, (3) articles falling under the *Social Sciences* subject area, (4) journal articles resulting from research, (5) articles written in English, and (6) *open-access* articles.

The article selection process was conducted in stages; the initial search yielded 392 documents. Next, a screening was performed based on the publication years 2016–2026, resulting in 366 articles. The subsequent stage involved screening within the *Social Sciences* subject area, yielding 229 articles. The next exclusion criterion involved removing documents that were not research articles, resulting in 116 articles. Among these articles, those not in English were excluded, leaving 114 articles. These articles were then further narrowed down using an open-access filter, resulting in 65 articles. Subsequently, a manual review of all articles was conducted using Microsoft Excel to ensure compliance with the study's inclusion criteria. The review revealed that 9 documents were not research articles and 6 articles did not fall under the open access category. Therefore, these documents were removed from the research dataset. After completing all stages of data selection and verification, the final number of articles was 50. The entire selection process is illustrated in Figure 1.

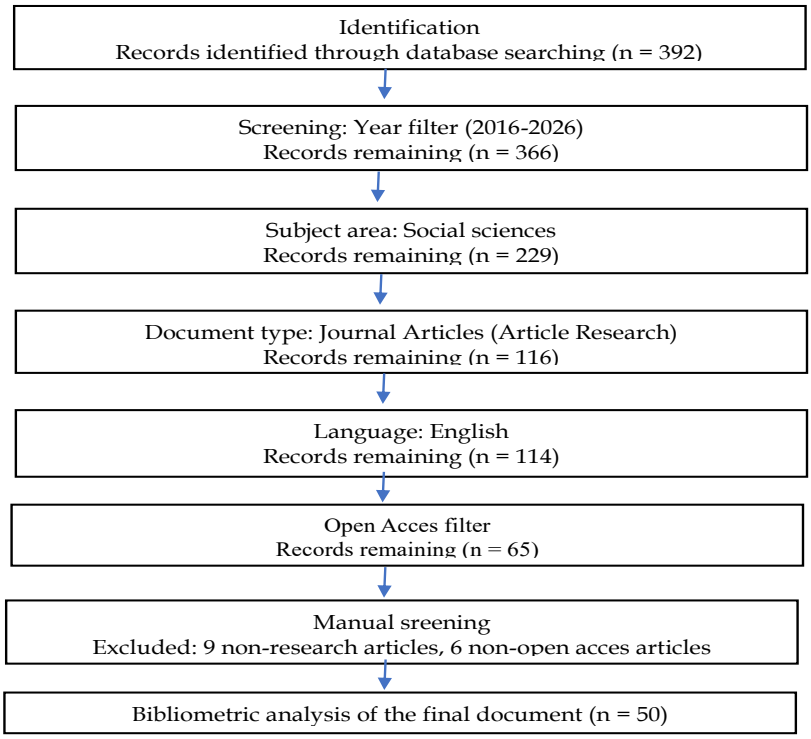

Figure 1.
Article Selection Process

After the selection stage, publications meeting the inclusion criteria were examined using a bibliometric method with the aid of the Biblioshiny software. The analysis included descriptive bibliometric analysis to track publication trends, journal source distribution, and the contributions of authors and countries. Additionally, co-occurrence analysis of keywords and author collaboration networks were conducted to identify conceptual relationships and patterns of research collaboration. A thematic analysis was also conducted to map research focuses, particularly in identifying dominant types of digital games and their relationship to the theme of student engagement. The results of the analysis are presented in the form of network mapping, trend graphs, and thematic clusters interpreted narratively to provide a comprehensive overview of the patterns and directions of research development in digital game-based learning.

RESULT AND DISCUSSION

Result

Key Information

Table 1.
Main Information of Bibliometric

Description	Results
Main Information About Data	
Timespan	2017:2026
Sources (Journals, Books, etc)	31
Documents	50
Annual Growth Rate % 16,65	
Document Average Age	2,68
Average citations per doc	9,84
References	5713
Document Contents	
Keywords Plus (ID)	91
Author's Keywords (DE)	180
Authors	
Authors	178
Authors of single-authored docs	4
Authors Collaboration	
Single-authored docs	4
Co-Authors per Doc	3,68
International co-authorships %	18
Document Types	
article	50

Table 1. presents an overview of research on digital game-based learning (DGBL) and student engagement based on Scopus data from 2017-2026. During this period, 31 publication sources produced 50 scientific documents, indicating that DGBL and student engagement are gaining growing attention in technology-based educational research. The field shows positive development, with an annual publication growth rate of 16.65%, reflecting increasing interest in using digital games to enhance student engagement. A total of 178 authors contributed to the publications with an average of 3.68 authors per document and only 4 single authored papers, demonstrating strong research collaboration, including 18% international collaboration. Inaddition, the relatively recent average publications age (2.68 years) indicates that the literature is current, while the average of 9.84 citations per document suggests a notable academic impact.

Publication Trends

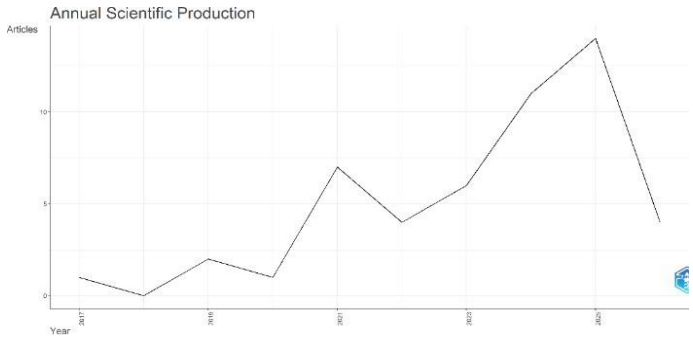

Figure 2.
Annual Scientific Production

Figure 2. ilustrates fluctuating publications trends on digital game-based learning (DGBL) and student engagement from 2017-2026. During the early period 2017–2020, publications remained low and unstable, indicating limited research development. Growth became noticeable in 2021 with 7 publications, despite a slight decline in 2022. The trend increased again in 2023 and rose sharply in 2024, reaching its peak in 2025 with more than 20 publications, reflecting growing interest in DGBL alongside advances in educational technology, particularly after the COVID-19 pandemic. The decline in 2026 is likely due to incomplete indexing of recent publications.

Of the 50 articles analyzed, most belonged to the sciences 37 articles (74%), particularly in health, engineering, environmental biology, mathematics, ICT, physics, and chemistry. Meanwhile, the social sciences accounted for 13 articles (26%), focusing on economics, social education, literacy, psychology, language, and social skills. The dominance suggests that DGBL is more widely applied in STEM fields.

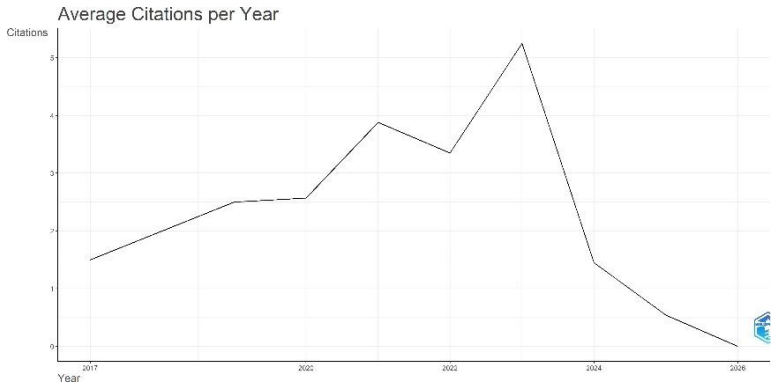

Figure 3.
Average Citations Per Year

Figure 3 shows that the average citations of studies on digital game-based learning (DGBL) and student engagement increased gradually from 2017 and peaked in 2023, indicating a strong academic impact and frequent use as references in technology-based education research. After 2023, the average citation count declined through 2026, likely because recently published articles have not had enough time to accumulate citations. In addition, the rapidly evolving nature of educational technology topics may also effect citation patterns, as researchers tend to cite the most relevant and up-to-date studies related to their research focus.

Researcher profile and title

1. Top Author

Table 2.
List of top Authors and Their Impact on Digital Game-Based Learning

Author	Articles	H-index	Total citations
KNIPPELS M-CPJ	2	2	65
BUTLER D	2	2	24
MARSHALL K	2	2	24

Table 2. Shows the ranking of authors with the most significant contributions to the topic of digital game-based learning related to student engagement. The top- ranked authors are Butler D, Knippels M-CPJ, and Marshall K, each of whom has produced 2 articles. These three authors also have an h-index of 2, indicating that their publications have been cited by other research. In terms of the number of citations, Knippels M-CPJ has the greatest scientific impact with a total of 65 citations, while Butler D and Marshall K each

received 24 citations. This indicates that the research conducted by Knippels M-CPJ has a higher influence within the literature on digital game-based learning.

2. Top Sources

Table 3.
List of top Sources and Their Impact on Digital Game-Based Learning

Source	h_index	g_index	m_index	TC	NP	PY_start
Education Sciences	4	6	0.8	45	8	2022
Sustainability (Switzerland)	4	4	0.571	98	4	2020
Frontiers In Education	3	6	0.5	51	6	2021

Table 3. shows that several journals have made significant contributions to the publication of research on Digital Game-Based Learning (DGBL) related to student engagement. Education Sciences ranks first with 8 articles, an h-index of 4, a g-index of 6, a total of 45 citations, and an m-index of 0.8 as of 2022, indicating a strong influence on the development of research in this field. Next, Sustainability (Switzerland) contributes 4 articles, an h-index of 4, a g-index of 4, and the highest total citations at 98, along with an m-index of 0.571 since 2020, indicating a substantial academic impact. Meanwhile, Frontiers in Education has published 6 articles with an h-index of 3, a g-index of 6, a total of 51 citations, and an m-index of 0.5 since 2021.

Knowledge Structure Analysis

1. Conceptual Structure

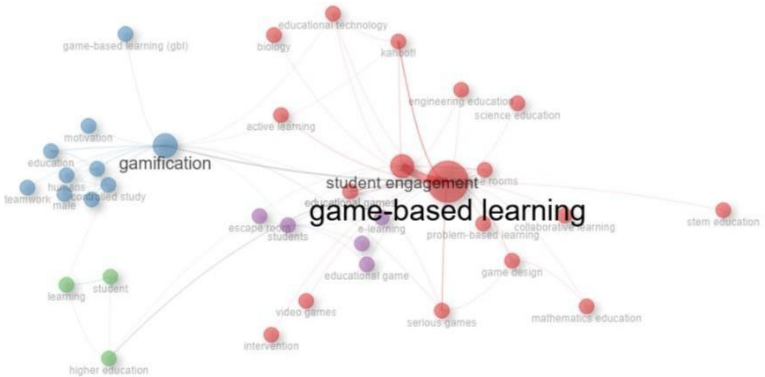

Figure 4.
Co-Occurrence Network

Figure 4. presents a co-occurrence network of keywords in digital game-based learning (DGBL) research, illustrating relationships among topics and research trends. The visualization consist of several thematic clusters. Cluster 1 (red) focuses on game-based learning, student engagement, educational

technology, and serious games, highlightting efforts to enhance engagement through digital games. Cluster 2 (blue) relates to gamification, motivation, education, and teamwork, emphasizing the role of gamification in improving motivation and interaction. Cluster 3 (green) includes learning, students, and higher education, indicating DGBL applications in higher education. Cluster 4 (purple) connects educational games, e-learning, and escape rooms in digital learning.

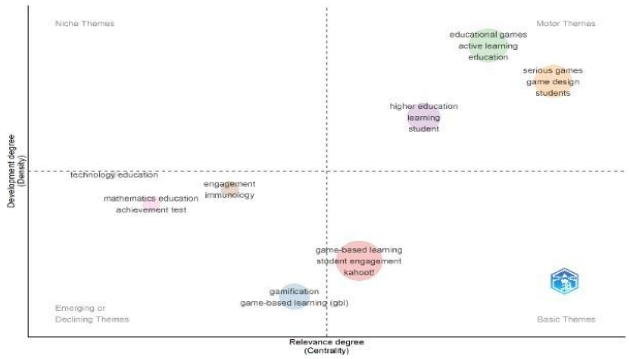

Figure 5.
Thematic Map

Figure 5. presents a thematic map illustrating the conceptual structure of digital game-based learning (DGBL) research. In this map, centrality indicates theme relevance, while density reflects the level of theme development. The "motor themes" quadrant includes educational games, active learning, education, serious games, game design, and students, showing highly developed and relevant topics that dominate research on student engagemnt. Meanwhile, the "basic themes" quadrant contains game-based learning, student engagement, and Kahoot,representing core concepts frequently applied in DGBL students. Overall, the thematic map demonstrates that DGBL research primarily focuss on innovative educational games and strategies to enhance student engagement.

2. Social Structure

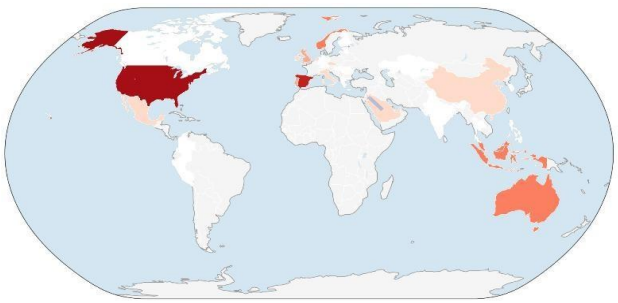

Figure 6.
Country Collaboration Map

Figure 6 shows the distribution of research publications on digital game-based learning across various countries. On the map, the United States, shown in dark red, accounts for the highest number of publications. Several European countries, such as Spain and Norway, are shown in shades of red to orange, while the United Kingdom appears in light orange. In the Asian region, China and Saudi Arabia are shown in light orange. Meanwhile, in Southeast Asia, Indonesia and Malaysia, as well as Australia in the Oceania region, appear in orange, indicating a contribution to publications in digital game-based learning research.

Dominant Game Types

Table 3.
Dominant Game Types

No.	Game Type	Number of Articles	Percentage
1.	Serious games	27	54%
2.	Quiz game	12	24%
3.	Simulation game	7	14%
4.	Role-playing game	3	6%
5.	Augmented Reality	1	2%

Table 3. Dominant game types were identified through a manual screening process using Microsoft Excel by analyzing 50 selected articles individually. The games were classified into five categories: serious games, quiz games, simulation games, role-playing games, and augmented reality. The results show that serious games were the most dominant type, appearing in 27 articles (54%). These games are specifically designed for educational purposes and often use interactive scenarios that support decision-making and problem-solving, thereby increasing student engagement and motivation. Quiz games ranked second with 12 articles (24%), commonly implemented through platforms such as Kahoot to enhance participation and learning motivation. Simulation games appeared in 7 articles (14%) and were mainly used to visualize complex concepts through virtual environments. Role-playing games were found in 3 articles (6%), while augmented reality appeared in only 1 article (2%), although it demonstrates strong potential to improve immersive learning experiences and student engagement.

Discussion

This study shows that the trend in publications, related to digital game-based learning (DGBL) continues to rise, with the field of science accounting for 74% of the total. The most commonly used type of game is serious game. These findings are consistent with previous studies confirming that DGBL is widely

applied in the STEM domain due to its ability to visualize abstract concepts and simulate complex processes. Meanwhile, the application of DGBL in the social sciences remains relatively limited. These results underscore the important role of DGBL in creating interactive learning, increasing student engagement, and supporting conceptual understanding through an experience based approach.

This bibliometric analysis can serve as a guide for future researchers in identifying key reference sources. Researchers interested in studying Digital Game-Based Learning (DGBL) are advised to consult works by influential authors and highly cited articles, such as the article "You escaped! How did you learn during gameplay?" by Knippels et al., (2022) which is one of the most inflluential publications in the field of DGBL with titcore journals such as Education Sciences can also serve as primary references because they consistently publish research related to DGBL and student engagement. By understanding these works, researchers can establish a stronger theo retical and methodological foundation for developing future research.

Research findings that publications related to digital game-based learning (DGBL) have increased significantly in recent years, with a strong dominance in the field of science at 74%. The most commonly used types of games are serious games, followed by simulation games, role-playing games (RPG), and augmented reality (AR)-based technologies, the use of which remains limited. These findings confirm that DGBL is increasingly emerging as a relevant learning approach within technology-based educational environments. This trend aligns with previous research indicating that the application of DGBL is particularly prominent in STEM fields. This is linked to the characteristics of science, which require the visualization of abstract concepts, the simulation of complex phenomena, and the representation of processes that are difficult to observe directly. In this context, simulation games have proven effective because they can represent real-world systems within a virtual environment, thereby facilitating a more concrete conceptual understanding (Pranata, 2024). Thus, the dominance of the science field in DGBL is not merely empirical but also has a strong pedagogical foundation.

Based on the bibliometric findings and student Engagement Theory proposed by Fredricks et al., (2004), this study constructs a conceptual framework illustrating how DGBL influences student engagement through various ganification elements. Different types of digital games, such as serious games, simulation gams, and quiz games, provide challanges, feedback, interaction, and narratives that support behavioral, emotional, and cognitive engagement. These engagement dimensions subsequently contribute to

meaningful learning outcomes, including motivation, participation, conceptual understanding, and critical thinking.

The inclusion of RPG in several studies indicates that DGBL supports not only cognitive development but also social and emotional skills. Through role-based scenarios, RPG encourage interaction, decision-making, empathy, collaborative skills (Crucho et al., 2025). Meanwhile, the use of AR remains limited despite its strong potential to creat immersive and contextual learning experiences. AR helps visualize objects or phenomena that are difficult to observe directly, thereby improving student engagement and understanding (Leitão et al., 2025). However, its implementation is constrained by limited technological access, infrastructure readiness, and the complexity of AR content development. Overall, the effectiveness of DGBL depends not only on the type of game used but also on its suitabilityto the learning context. Science subjects are generally more compatible with DGBL due to their systematic and visual nature, where as social sciences require more adaptive and contextual game designs grounded in real-world situations

The findings of this study also confirm that students construct knowledge through active interaction with the digital environment. In this process, student engagement is the key link between the use of digital games and conceptual understanding. Therefore, the level of student engagement determines the extent to which DGBL can produce meaningful learning. Consequently, further research is recommended to develop and test more adaptive DGBL models, particularly in the social sciences, where exploration remains limited. The integration of innovative technologies such as AR also needs to be enhanced to create a more immersive learning experience.

CONCLUSION

The bibliometric analysis highlights research trends regarding digital game-based learning and student engagement in educational contexts. The findings indicate an upward trend in the number of publications over the past few years, signaling growing interest among researchers in the use of digital games as an innovative learning approach. The results show that publications are dominated by the sciences (74%), particularly in the subfields of health, engineering, and biology, while the social sciences remain relatively limited (26%) and are dominated by business, education, and literacy.

Based on an analysis of game types, serious games are the most dominant type used in research, accounting for 54%, followed by quiz games (24%), simulation games (14%), role-playing games (6%), and augmented reality (2%). The dominance of serious games indicates that game-based learning approaches

are directly integrated with learning objectives, thereby creates a more interactive, contextual, and meaningful learning experience.

The analysis showed that research on digital game-based learning continues to develop through themes such as gamification, educational games, active learning, student engagement, and game design. Publication from the United States, Europe, Asia and Oceanic indicate the global relevance of DGBL in supporting educational innovation in the digital era. However, this study has limitations because the analysis relied only on the Scopus database, and selected articles that met specific criteria. Therefore, future research is recommended to expand data sources by incorporating additional scientific databases such as combining Scopus with Web of Science—to provide a more comprehensive overview of research developments within the field of digital game-based learning.

This study shows that digital game-based learning has great potential to increase student engagement; however, its application remains concentrated in the field of science. Therefore, further research is needed in the social sciences, particularly economics, to create a balance and expand the contribution of digital game-based learning across various disciplines. In practical terms, this research has important implications. For educators, these findings can serve as a foundation for utilizing various types of digital games, particularly serious games and quiz games, as strategies to enhance student engagement in the educational process.

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