JPPIPA 11(11) (2025)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

Trends in Educational Games to Improve Students' Learning Motivation in Science Learning: A Systematic Literature Review

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Received: July 11, 2025
Revised: September 30, 2025
Accepted: November 25, 2025
Published: November 30, 2025

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DOI: 10.29303/jppipa.v11i11.12121

Abstract: This study aims to identify research trends, dominant science topics, and technological platforms used in educational games designed to improve students' learning motivation in science learning from 2020 to 2025. A Systematic Literature Review (SLR) was conducted using the PRISMA framework. Scientific articles were retrieved from the Google Scholar database and screened using the Publish or Perish software based on predefined inclusion and exclusion criteria. Six articles met the final eligibility requirements. The results show that publication trends during this five-year period were unstable, with increases in 2021 and 2024, a decline in 2022, and an absence of publications in 2025 due to ongoing review and publication processes. Biology and environmental science were the most frequently used topics in educational game development, representing 50% of the reviewed studies, while physics appeared only once due to its abstract nature. Wordwall was the most widely used platform, followed by Educandy, QuizWhizzer, RPG Maker, and digital adaptations of the Talking Stick Game. Overall, all reviewed studies consistently reported that educational games had a positive impact on students' learning motivation. These findings highlight the pedagogical relevance of game-based learning and suggest the need for further exploration of underrepresented science topics and more diverse game development technologies.

Keywords: Educational games; Educational play; Student learning motivation

Introduction

The digitalization of learning has become inevitable in the era of Industrial Revolution 4.0, fundamentally transforming education through technology-based innovations that meet the needs of the 21st-century generation. According to UNESCO (2021), this digital transformation aims to create inclusive, flexible, and intelligent learning environments that accommodate diverse learning styles, thereby shifting the educational paradigm from passive, one-way instruction to active, collaborative, and interactive learning supported by digital media.

However, technological advancement alone is not sufficient to ensure learning success. Learning motivation remains a crucial internal factor that determines students' willingness to engage in learning activities and achieve academic goals. Uno (2014) states that motivation arises from individual needs, desires, and goals, while high motivation correlates with better learning outcomes. Sardiman (2018) also argues that high learning motivation enhances the effectiveness and efficiency of the learning process, whereas low motivation weakens achievement. The characteristics of students with strong motivation—such as persistence, diligence, and curiosity—were previously identified by Sardiman (2012). Unfortunately, Sholekah (2020) found

How to Cite:
Wali, M. A. A. G. J., Redhana, I. W., & Tika, I. N. (2025). Trends in Educational Games to Improve Students' Learning Motivation in Science Learning: A Systematic Literature Review. *Jurnal Penelitian Pendidikan IPA*, *11*(11), 34–42. https://doi.org/10.29303/jppipa.v11i11.12121

that many students exhibit low motivation, often daydreaming and showing limited engagement because classroom activities feel monotonous. This finding is supported by Amelia et al. (2021), who reported that low learning motivation negatively affects students' academic success.

Science education faces a pressing challenge: Indonesia's science performance in the 2022 PISA evaluation reached just 383, below the OECD average, revealing significant weaknesses in understanding and motivation (OECD, 2023a, 2023b). The 13-point drop from 2018 marks the lowest score in two decades. Students at the junior secondary level, according to Santrock (2012), require learning experiences that incorporate visual and interactive media to support their conceptual understanding. However, the lack of appropriate learning media.

Educational games have emerged as one solution to this issue. Prensky (2007) states that digital natives are more motivated when learning involves interactive, technology-based environments. Educational games combine rewards, challenges, feedback, and visually engaging elements to create enjoyable learning experiences that stimulate students' motivation. Empirical evidence supports this claim. Setiawati et al. (2022) reported a significant increase in students' learning motivation after using a science module integrated with educational games. Similarly, Indrawati & Hapsari (2021) demonstrated that mobile-based games successfully increased intrinsic motivation by encouraging students to complete learning missions.

The implementation of educational games is also supported by the Indonesian government through the Independent Curriculum (Kurikulum Merdeka), which encourages teachers to design learning experiences that are interest-based, contextual, and technologically integrated. Therefore, educational games are not only pedagogically relevant but also aligned with national education reforms. Considering Indonesia's declining science performance, the cognitive characteristics of learners, and the ongoing curriculum transformation, the integration of educational games into science learning is no longer merely an instructional alternative but has become an educational necessity.

Although previous studies have demonstrated that educational games can enhance students' motivation, most of these studies have focused on limited contexts, implemented single-case interventions, or examined motivation solely as an outcome variable without analyzing the characteristics of the games themselves. The novelty of this research lies in the development of a science-based educational game module specifically designed for junior secondary school students, which integrates motivational elements with curriculum-aligned content. Unlike prior studies, this research provides a systematic and pedagogically grounded design framework that connects motivational constructs, game mechanics, and scientific concepts into a unified learning experience. This approach addresses the gaps in existing research by offering a comprehensive model that can be replicated and scaled in future technology-enhanced learning innovations.

Based on the description above, this study aims to investigate several core research problems. It explores the existing research trends on the use of educational games in enhancing students' learning motivation during the 2020–2025 period, examines the types of science materials most frequently integrated into educational games to support motivation, and identifies the platforms and technologies commonly employed in the development of such educational media within the past five years.

The objectives of this study are aligned with these problems. This study seeks to describe the trends in the use of educational games to foster learning motivation in science education, determine which science materials are dominant in the development of educational games, and review the platforms and technological tools utilized in educational game development from 2020 to 2025.

Method

This study employs a Systematic Literature Review (SLR), a structured and systematic approach to collecting, evaluating, and synthesizing research on the use of educational games to support students' learning motivation in science education (Farodisa & Sari, 2023). The SLR method was selected because it enables a transparent and comprehensive analysis of existing studies, allowing the identification of patterns, thematic orientations, and technological developments within this research domain.

Table 1. Inclusion and exclusion criteria

Inclusion	Exclusion
Articles published between 2020 – 2025	Articles published before 2020 were excluded
Articles discussing the use of educational games for science learning	Articles that did not discuss the use of educational games other than science were excluded
Articles containing data on learning motivation as a variable under study	Articles that did not include data on learning motivation as a variable under study
Articles in Indonesian	Articles in foreign languages
Articles available in full text	Articles not available in full text

Data collection was conducted through a documentation study guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework. The PRISMA approach ensures a

rigorous and traceable review process, starting from the identification of potential articles to screening, eligibility verification, and the final inclusion of studies (Rachman & Sadikin, 2024). Articles were sourced from the Crossref database using the Publish or Perish application, which facilitated the retrieval of scientific publications based on relevant keywords, publication years, and journal sources. The keywords used were "educational games" and "student learning motivation," with the literature scope limited to publications issued between 2020 and 2025. The details of these criteria are presented in Table 1.

The review procedure began with the identification stage, during which titles and abstracts were examined to ensure alignment with the focus of this study. Only studies addressing the use of educational games within formal education settings, discussing motivational aspects, and integrating science learning components were retained. Articles unrelated to educational games, outside the context of science education, or focused solely on entertainment-based applications were excluded.

The process continued to the screening stage, where full-text articles that passed the initial review were assessed in greater depth. Only articles that explicitly examined educational games as part of a learning strategy and included substantial information on student motivation were selected. Studies that did not address these components were removed from the analysis.

Next, during the data extraction stage, each eligible article was systematically coded to obtain information relevant to the study's objectives. The extracted data consisted of the publication year, the science subject matter integrated into the educational games, and the platforms or technologies used in their development. These elements enabled the classification of research directions, identification of dominant science content areas, and mapping of technological ecosystems that support the integration of educational games into science education.

The extracted data were analyzed through descriptive synthesis. Publication trends were visualized to illustrate fluctuations and patterns in research growth during the 2020–2025 period. Science subject classifications were tabulated to identify dominant materials embedded in educational game designs. Meanwhile, the platforms and technologies used for educational game development were categorized to highlight technological trends and development patterns. All findings are presented in tabular and graphical formats to facilitate interpretation and to support the formulation of conclusions.

To ensure transparency, the PRISMA diagram is included as a visual representation of the article selection process. It illustrates the number of articles identified at the outset, the studies excluded during title and abstract screening, those removed after full-text evaluation, and the final set of articles included in this systematic review.

The outcome of this study is a comprehensive synthesis of research developments concerning the integration of educational games to support students' learning motivation in science education. Rather than evaluating the effectiveness of educational games, this study maps research trends, identifies science materials most frequently incorporated into educational game-based learning, and outlines the platforms and technological tools predominantly utilized over the past five years. Accordingly, the findings are expected to contribute theoretically to the development of innovative science learning media and practically to guide educators, instructional designers, and researchers in selecting content and technological platforms when integrating educational games into science instruction.

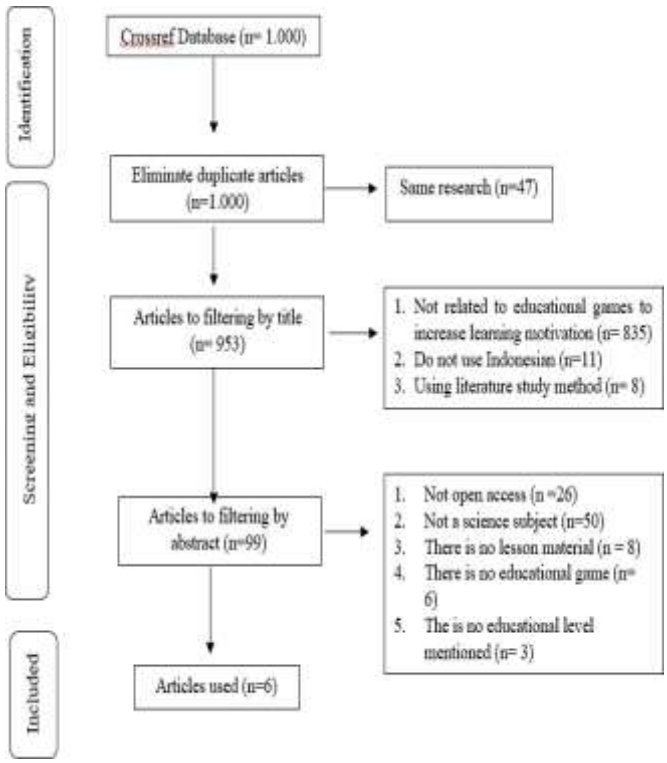

Figure 1. Prisma diagram

Result and Discussion

Table 1 presents the number of articles that met the inclusion criteria for this systematic literature review (SLR) over a six-year period. The data show that research on educational games in science learning experienced instability, with noticeable fluctuations in

publication output from year to year. The publication trend from 2020 to 2025 reflects non-linear growth, demonstrating that research interest in educational games for enhancing science learning motivation did not progress steadily but instead fluctuated depending on broader educational contexts, policy changes, and post-pandemic recovery phases.

In 2020, only one eligible article was identified. This low number aligns with the early phase of the COVID-19 pandemic, during which schools and teachers prioritized the urgent transition to online learning. The dominant focus across the educational sector was on ensuring continuity of instruction rather than innovating learning media. As a result, research on game-based learning (GBL) was limited. The number of publications rose to two in 2021, demonstrating renewed interest in GBL as educators began exploring more interactive approaches to sustain student engagement in online and hybrid environments. According to Putri et al. (2023), the rapid digitalization during the pandemic created a strong demand for engaging learning tools, including educational games. This year marks the first significant increase in research output and reflects a growing awareness of the pedagogical value of digital game-based media.

Table 2. Publication trends from 2020 to 2025

Year	Number of articles
2020	1
2021	2
2022	0
2023	1
2024	2
2025	0

No articles from 2022 met the inclusion criteria. This decline coincided with the national transition back to face-to-face instruction. Educational stakeholders primarily focused on addressing learning loss rather than designing or researching innovative technology-based learning media. Teachers tended to rely on simple e-learning tools during this transitional period, which explains the absence of publications related to educational games. In 2023, research output increased again, with one eligible article. This recovery corresponds to the stabilization of face-to-face learning and the resumption of teacher professional development programs that encouraged exploration of digital learning tools. As reported by Taswira et al. (2024), many teachers began experimenting with web-based and mobile game platforms, contributing to the gradual return of GBL-related research.

In 2024, the number of publications reached one of the highest levels observed in this review, with two articles meeting the inclusion criteria. This increase reflects a period in which educational games became more widely recognized as effective and flexible learning tools, particularly suited for students who are increasingly familiar with digital technologies. By this time, teachers and students had developed stronger competencies in utilizing and creating technology-based media, allowing game-based learning to be integrated more confidently into science instruction. Support for this development was also evident within higher education institutions, where technology-integrated coursework and research projects encouraged the exploration of digital learning innovations, including educational games. Additionally, the ongoing implementation of the Independent Curriculum played a significant role in creating a supportive environment for this type of research. With its emphasis on differentiated instruction, student-centered learning, and the encouragement of creative pedagogical approaches, the curriculum positioned educational games as a relevant and meaningful option for enhancing student motivation and engagement in science learning. As a result, 2024 represents a period in which the alignment of teacher readiness, institutional support, and curricular direction collectively contributed to an increase in research focusing on educational games. The absence of articles in 2025 should not be interpreted as a decline in research activity. Rather, it reflects the timing of data collection and the lengthy peer-review processes typical in accredited journals. Many articles submitted in late 2024 or early 2025 may still be under review.

To avoid purely qualitative interpretation, the distribution of science topics addressed in the six selected articles is presented quantitatively in Table 2. The table shows the number and percentage of articles within each topic category, providing clear evidence to support claims made in the analysis.

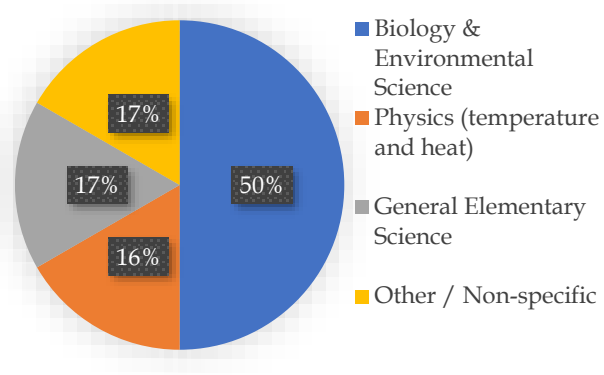

Figure 2. Distribution of science topics in the six reviewed articles

The quantitative data presented in Table 2 clearly demonstrate that topics related to biology and environmental science constitute the majority of the reviewed studies, accounting for 50% of the total. This finding strongly reinforces the earlier claim that educational game research in science learning tends to prioritize concrete and context-based content areas. Topics such as ecosystems, pollution, soil composition, sustainability, and animal locomotion are frequently chosen because they are more easily visualized and transformed into interactive representations within game-based learning formats. Their close connection to students' daily experiences and observable phenomena also makes them particularly suitable for elementary students, whose cognitive development favors concrete and familiar learning contexts.

This pattern is consistent with accessible empirical studies. Sugianto (2023) found that game-based environmental themes significantly increase student motivation because they involve visual, real-world concepts that align well with digital gameplay. Similarly, Sirjon & Solihatin (2023) demonstrated that biological concepts are among the easiest to convert into interactive learning games due to their concrete nature and the availability of relatable examples from students' surroundings. These findings support the observed dominance of biology and environmental topics in the reviewed literature.

In contrast, only one article focused on physics, reflecting a broader trend documented in previous research. Studies by Rahmawati et al. (2022) and Hasanah et al. (2022) reported that physics topics particularly abstract concepts such as heat, temperature, and force are less frequently developed into game-based learning media because they require more complex modeling, simulations, or mathematical representation. These challenges make physics materials less accessible for game developers and teachers, which aligns with the limited representation found in the dataset.

Additionally, 16 to 17% of the reviewed studies addressed general or non-specific elementary science content. Past research provides an explanation for this pattern. This choice allows educational games to target multiple competencies simultaneously, which is advantageous in elementary-level instruction. Taken together, these patterns highlight a strong tendency for existing educational game research to concentrate on content areas that are easier to visualize, contextualize, and translate into interactive learning activities. This alignment between the characteristics of game-based learning and the cognitive needs of elementary learners is also supported by Azizatunnisa et al. (2023), who found that digitally interactive science materials grounded in real-life contexts significantly improve engagement and conceptual understanding among young students. A more complete explanation is provided in Table 3, which details the science materials, research titles, and corresponding authors.

The data indicate that Wordwall is the most frequently used platform, appearing in two of the six reviewed studies. Its dominance can be attributed to several practical advantages that align with the needs of teachers and researchers. Wordwall offers free access, an intuitive interface, and a large selection of ready-made templates that allow educators to rapidly design interactive games without requiring advanced technological skills. These features make it especially appealing for teachers who may have limited experience with digital media development but still aim to incorporate engaging and interactive elements into science instruction. According to Fuad (2020) and Wafiqni & Putri (2021), wordwall games can facilitate students in understanding the material and facilitate knowing the highest to lowest scores of students, thus motivating students to get the highest scores or points in their class. Mujahidin et al. (2021) also stated several advantages of Wordwall as a tool in learning media, namely flexible and varied technology-based media, easy to use and customize, available free features, and has an attractive appearance.

Table 3. Distribution of science topics in the six reviewed articles

Researcher Name and Year	Journal	Science material
Gandasari & Pramudiani (2021)	The Influence of Wordwall Applications on Students' Science Learning Motivation in Elementary School	Science
Sandi (2024)	Development of Role Playing Game (RPG) Educational Game Learning Media to Increase Students' Learning Motivation on Environmental Pollution Materials	Environmental pollution
Resdiana et al. (2023)	The Use of Wordwall Airplane Game Media on Interaction Materials Between the Components of an Ecosystem to Increase the Learning Motivation of Grade VII Students of SMPN 8 Malang	Ecosystem
Amelia et al. (2021)	Analysis of Students' Learning Motivation Through the Application of the POE Learning Model Assisted by Educational Games Based on the Educandy Application at SMPN 25 Pekanbaru	Temperature and Heat
Suhaliah et al. (2024)	Development of Quizwhizzer Educational Games Oriented	Land and the Sustainability

Researcher Name and Year	Journal	Science material
	Towards Students' Motivation and Cognition	of Life
Taopan (2020)	Land and Life Theme Application of the Talking Stick Game Learning Model to Increase Student Motivation and Learning Outcomes in Animal Movement Organ Material Class V SD Negeri Jerdeng Academic Year 2018/2019	Animal Movement Organs

Other platforms such as Educandy and QuizWhizzer were used more selectively, each appearing in one article. Their specialized functions Educandy's puzzle-based tasks and QuizWhizzer's board-game evaluation format suggest that researchers chose them to meet specific instructional goals rather than for general use. This pattern illustrates a deliberate alignment between platform capabilities and the type of learning experience the researchers intended to design. According to Kurniyawati & Suneki (2024), Quizwhizzer has a variety of templates, offering a wide variety of games. QuizWhizzer is a learning medium that utilizes a board game system, competitions, and contests. Students may be motivated to learn, especially in the classroom, through an educational game system (Agustiningsih et al., 2022). Meanwhile, Juhaeni et al. (2023) state that QuizWhizzer is highly suitable for the learning process because it offers a variety of games and can create an engaging learning environment. QuizWhizzer has various features that allow for the creation of questions that can be packaged into games that can be played in the classroom or online. According to Larasati et al. (2024), Educandy has significant potential as an interactive learning medium because its simple game features are easy to access and operate, successfully creating a fun learning experience that can increase students' enthusiasm for learning.

One particularly noteworthy finding is the use of RPG Maker (or other RPG-style game engines) in one study. Unlike template-based platforms, RPG Maker allows the creation of more complex, narrative-driven games that embed science concepts within storylines and problem-solving quests. Its inclusion indicates that some researchers are moving beyond simple quiz-based tools toward richer forms of story-based learning, which can support deeper engagement and contextualized understanding. Qois & Sukirman (2025) state that RPG-style game-based learning can integrate storylines, challenges, and problem-solving as part of the learning process. The results of the study showed that the RPG-based approach not only attracted students' attention, but was also able to significantly increase their learning motivation.

The presence of a digital version of the Talking Stick Game in one article further shows that not all platforms were fully digital game engines; some studies adapted traditional collaborative games into digital or hybrid formats to enhance student motivation and participation. Solihah et al. (2023) stated that Talking Stick can increase student learning motivation because it requires students to be ready to answer questions in turns, thus fostering a sense of responsibility, enthusiasm, and interaction throughout the learning process. Overall, these findings align with the abstract's assertion that platforms such as Wordwall, Educandy, QuizWhizzer, the Talking Stick Game, and RPG-based tools are favored not only because they are flexible and accessible but also because they support interactive learning environments. The quantitative distribution in Table 4 strengthens this conclusion by demonstrating how frequently each platform was used and the instructional purposes they served.

Table 4. Platforms identified in the six reviewed articles

Platform	Number of Articles	Description of Use
Wordwall	2	Used for interactive quizzes and simple visual mini-games.
Educandy	1	Utilized for puzzle-based and matching activities.
QuizWhizzer	1	Applied for game board–style evaluation and competition.
RPG Maker/RPG-based Learning Game	1	Developed for story-based adventure games integrating science content.
Digital Talking Stick Game	1	Implemented as a turn-based collaborative learning activity.

An overall synthesis of the six reviewed articles reveals several interrelated patterns related to publication trends, topic distribution, platform utilization, and the effectiveness of game-based learning (GBL) in enhancing student motivation. First, publication trends from 2020 to 2025 show a clear pattern of instability. Peaks occurred in 2021 and 2024, reflecting periods of relatively strong digital learning innovation and teacher preparedness, while a decline occurred in 2022, coinciding with the national transition back to in-person learning. The absence of publications in 2025 was not due to reduced research activity, but rather to the timing of the academic review and publication process. This fluctuation underscores the influence of the external educational context and policy shifts on research productivity. The distribution of

science topics shows a significant dominance of biology and environmental science, which accounted for 50% of all studies. This concentration demonstrates researchers' preference for concrete, contextually relevant, and visually represented subject, attributes that align with the capabilities of educational games. These topics are also closely related to students' everyday experiences, making them well-suited for elementary school students who require concrete and easily visualized concepts. In contrast, the abstract topic of physics appears only once in the data set, suggesting that its less concrete nature may pose challenges for integration into interactive game-based environments.

Regarding platforms, Wordwall emerged as the most frequently used tool, reflecting its accessibility, simple interface, and the wide availability of templates that support quick game creation. Other platforms, such as Educandy, QuizWhizzer, RPG Maker, and the digital adaptation of Talking Stick Game, were selected based on their alignment with specific instructional objectives and varying levels of game complexity. This variation confirms that platform choice is influenced not only by accessibility but also by the researchers' pedagogical goals and the type of learning experience desired. Across all six articles, consistent results were found: the implementation of game-based learning positively contributed to student motivation in science learning. Whether through interactive quizzes, puzzle-based challenges, narrative-based RPG games, or collaborative digital activities, each study reported increases in student engagement, interest, or overall motivation. The positive impact demonstrates that GBL is a versatile and effective pedagogical approach to supporting active participation and fostering enthusiasm for science among elementary school students. These findings illustrate that although research findings in this area fluctuate over time, the use of educational games, particularly in topics focused on biology and the environment, remains relevant and influential in increasing student motivation. The convergence of appropriate content, practical digital platforms, and supportive learning environments underscores the continued value of game-based learning in contemporary science education.

Conclusion

Based on the systematic review of six studies published between 2020 and 2025, this research provides three main conclusions aligned with the stated research objectives. First, the analysis of publication trends demonstrates that research on educational games in science learning has experienced clear instability over the past five years. Fluctuations occurred due to shifting educational conditions, including the transition from online to face-to-face learning, post-pandemic recovery, and ongoing curriculum reforms. Peaks in 2021 and 2024 indicate periods of increased interest and technological readiness among educators, while the absence of publications in 2022 and 2025 reflects contextual and publication-cycle constraints rather than a decline in research activity. Second, the distribution of science topics shows that biology and environmental science dominate educational game development, representing 50% of the reviewed articles. These topics are favored because they provide concrete, contextual, and easily visualized content that aligns with students' cognitive characteristics and the interactive nature of game-based learning. Meanwhile, only one study focused on physics, underscoring persistent challenges in gamifying abstract scientific concepts such as heat and temperature. Third, the review identifies Wordwall as the most frequently used platform, followed by Educandy, QuizWhizzer, RPG Maker, and digital adaptations of the Talking Stick Game. Platform selection is strongly influenced by accessibility, template availability, and the alignment of game mechanics with instructional goals. Across all studies, educational games consistently demonstrated a positive impact on students' learning motivation, enhancing engagement, participation, and interest in science learning. Collectively, these findings affirm that educational games serve as a relevant and effective pedagogical approach for strengthening learning motivation within science education and that future research should explore underrepresented science topics and more diverse technological platforms.

Acknowledgments
The authors would like to express their gratitude to Universitas Pendidikan Ganesha for providing academic support throughout the completion of this study. Appreciation is also extended to the lecturers and colleagues who contributed insights during the preparation of this systematic literature review.

Author Contributions
All authors have made a real contribution in completing this manuscript.

Funding
This research received no external funding.

Conflicts of Interest
The authors declare no conflict of interest.

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