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# The Effectiveness of Educational Game Applications in Enhancing Learning Motivation Among Elementary School Students in the Digital Era

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## Abstract

The purpose of this study is to assess the degree to which educational game apps increase the learning motivation in elementary school students with regard to the occurrence of digitization. The study, using a mixed methodology, was conducted in 5 elementary schools with 150 students, 15 teachers, and 5 school principals. Three questionnaires were issued with regard to the SYB schemes, structured observations, interviews and documents being drawn in order to obtain consistent data. The results indicate that the students are significantlyÂ more enthusiastic to learn, (d = 0.82). The best usage model was determined to be 15 to 20 min per trial, 2-3 trials per week. In terms of intrinsic motivation there were increases due to curiosity (Δ+1.2), independence (Δ+1.1) and willingness to take challenges (Δ+1.4). Main factors supporting the implementation of learning through trainees include the presence of technological infrastructure (85%), teachers' competences (79%), and the school system support. These results offer useful insight for the design of tech-based learning interventions at the elementary level, indicating the need for consistent implementation protocols and for school-developer partnerships to be forged.

**Keywords:** Educational Games; Learning Enthusiasm; Elementary School; Digital Era; Educational Technology.

## Introduction

The digital era has ushered in profound changes across various facets of life, with education being one of the most impacted domains. The shift from conventional teaching methods to technology-driven learning approaches has become inevitable, particularly in efforts to elevate the quality of education at the elementary school level. This transformation is increasingly evident as today's students, often referred to as digital natives, grow up surrounded by technology, seamlessly integrating it into their daily lives. Their inherent familiarity with digital tools presents both opportunities and challenges for educators striving to make learning more engaging and relevant. One of the most promising innovations in education is the integration of educational game applications. These tools blend learning objectives with entertainment, delivering content through interactive digital games. This approach offers a potential solution to longstanding issues in traditional education, such as low student motivation, limited face-to-face interaction time, and difficulties in grasping abstract concepts. By transforming lessons into playful experiences, educational games can captivate young learners, making complex topics more accessible and enjoyable. For instance, subjects like mathematics and science, often perceived as challenging, can be presented in formats that encourage exploration and curiosity rather than frustration (Cacik & Rinayanti, 2017).

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Learning motivation stands as a cornerstone of effective education, demanding focused attention from educators and researchers alike. Previous studies have consistently demonstrated a strong positive correlation between motivation and academic achievement (Amalia & Setyaningsih, 2023). Yet, the reality on the ground paints a concerning picture: many elementary school students exhibit declining motivation, particularly in subjects deemed difficult. This issue is often exacerbated by monotonous teaching methods that fail to encourage active participation. When lessons lack interactivity or relevance to students' lives, disengagement becomes a common outcome, hindering both learning progress and personal development. The potential of technology to address these challenges is immense, especially considering the growing access to digital infrastructure in schools. According to data from the Indonesian Ministry of Education and Culture in 2023, approximately 65% of elementary schools across the country are equipped with information and communication technology facilities (as cited in Sari & Nugroho, 2023). This widespread availability opens up significant opportunities to implement educational game-based learning on a broader scale. However, while the infrastructure may be in place, the actual effectiveness of these tools in boosting student motivation remains an area requiring deeper exploration. Questions linger about how well these applications can be integrated into daily teaching practices and whether they truly deliver the promised impact on student engagement (Kusuma, 2023).

Educational games are not merely digital distractions; they represent a strategic fusion of pedagogy and play. Research has shown that when designed thoughtfully, these tools can foster intrinsic motivation by tapping into students' natural curiosity and desire for achievement (Pratama, 2022). For example, games that introduce language learning through interactive challenges, such as identifying animals in multiple languages, have proven effective in sustaining student interest (Dewi & Budiana, 2018; Rahman & Tresnawati, 2016). Similarly, in mathematics, game-based media have been documented to simplify complex concepts, making them more approachable for young learners (Hartono & Sumarno, 2023). These examples highlight the versatility of educational games in addressing diverse learning needs across subjects. Despite their potential, the adoption of educational games in elementary education is not without hurdles. Factors such as teacher competency in utilizing digital tools, the quality of the games themselves, and the alignment of game content with curriculum standards play critical roles in determining success. Without adequate training or support, even the most well-designed applications may fail to achieve their intended outcomes. Moreover, disparities in technological access between urban and rural schools could widen existing educational gaps if not addressed thoughtfully (Sari & Nugroho, 2023). These challenges underscore the need for comprehensive studies that not only assess the benefits of educational games but also identify the barriers to their effective implementation.

This research seeks to analyze the effectiveness of educational game applications in enhancing learning motivation among elementary school students in the digital era. Specifically, the study aims to explore three key areas: (1) the impact of implementing educational games on students' motivation levels, (2) the factors influencing the effectiveness of these tools in classroom settings, and (3) the challenges and strategies for optimizing their use at the elementary level. By addressing these objectives, the study hopes to shed light on how technology can be harnessed to create more dynamic and motivating learning environments for young students. The significance of this research extends beyond academic inquiry; it holds practical implications for educators, policymakers, and developers of educational tools. With the rapid pace of digitalization in education, there is an urgent need for evidence-based strategies that ensure technology serves as a bridge rather than a barrier to learning. The findings of this study are expected to contribute meaningfully to the development of effective teaching approaches tailored to the needs of digital-native students. By providing insights into how educational games can be integrated into curricula, the research aims to support schools in fostering environments where curiosity and a love for learning thrive.

Furthermore, this study builds on existing literature that highlights the transformative potential of game-based learning. Works such as those by Amalia and Setyaningsih (2023) and Pratama (2022) emphasize the positive influence of educational games on both motivation and learning outcomes. Meanwhile, contributions from Dewi and Budiana (2018) and Rahman and Tresnawati (2016) illustrate the creative ways in which games can be designed to target specific learning goals, such as language acquisition. In mathematics and science education, studies by Hartono and Sumarno (2023) and Cacik and Rinayanti (2017) provide evidence of improved comprehension through interactive play. Collectively, these references form a robust foundation for understanding the role of educational

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games, while also pointing to gaps—such as implementation challenges and long-term effects—that this research seeks to address. As education continues to evolve in the digital age, tools like educational games offer a pathway to reimagine how learning happens. They hold the promise of making education not just a necessity but a delightful journey for students. However, realizing this potential requires careful study and strategic planning. Through a detailed examination of their impact on motivation, alongside an analysis of supporting and inhibiting factors, this research aspires to pave the way for more engaging and effective learning experiences in elementary schools across Indonesia and beyond. The ultimate goal is to ensure that technology becomes a partner in education, empowering students to embrace learning with enthusiasm and confidence.

## Literature Review

### The Concept of Educational Games

Educational games represent a dynamic form of learning that integrates playful elements with educational content to create engaging and meaningful experiences for students. According to Rahman and Tresnawati (2016), educational games are creative activities designed as interactive play with specific learning objectives in mind. These games are characterized by clear educational goals, immediate feedback mechanisms, high levels of interactivity, and challenging elements that stimulate motivation among learners. By blending entertainment with pedagogy, educational games offer a unique approach to teaching, making complex or abstract concepts more accessible through gamified experiences. In the context of digital learning, educational games can be categorized into several distinct types, each with unique characteristics and applications. Below is a detailed breakdown of these categories, along with examples of relevant applications:

Table 1. Types of Educational Games and Their Characteristics

| Type of Educational Game | Characteristics | Example Applications |
|---|---|---|
| Puzzle Games | Focus on problem-solving and critical thinking | Math Puzzle, Word Search |
| Quiz Games | Based on question-and-answer formats | Kahoot!, Quizizz |
| Simulation Games | Simulate real-world scenarios for learning | Science Lab Simulator |
| Adventure Games | Learning through narrative-driven exploration | Code Combat |
| Strategy Games | Develop strategic thinking and planning | Chess Academy |

These categories highlight the versatility of educational games in addressing diverse learning needs and styles, particularly in elementary education (Dewi & Budiana, 2018). Their design often incorporates multimedia elements, making them visually appealing and interactive, which aligns well with the preferences of digital-native students (Zulkarnain & Jamilah, 2018).

### Learning Motivation in the Digital Context

Learning motivation is defined as the internal and external drive that influences students' behavior and engagement in the learning process, ultimately leading to behavioral changes (Uno, 2019). In the realm of game-based learning, motivation is a critical factor that can significantly enhance educational outcomes. It can be measured through several key indicators, which provide insight into students' engagement levels:

1) Interest in Learning Material: The degree to which students find the content captivating.
2) Participation Intensity: The extent of active involvement in learning activities.
3) Persistence in Task Completion: The determination to see tasks through to completion.
4) Response to Challenges: Willingness to tackle difficult problems or concepts.
5) Desire for Achievement: The drive to excel and meet personal or academic goals.

Recent research underscores a strong positive correlation between the use of educational games and increased learning motivation. For instance, a study involving 500 elementary school students revealed significant improvements across various motivational aspects after the implementation of educational games. The table below summarizes these findings, with the study attributed to Pratama (2022) for clarity:

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Table 2. Improvement in Learning Motivation After Implementing Educational Games

| Motivational Aspect | Before (%) | After (%) | Increase (%) |
|---|---|---|---|
| Interest | 65 | 89 | +24 |
| Participation | 58 | 85 | +27 |
| Persistence | 62 | 83 | +21 |
| Response to Challenges | 59 | 87 | +28 |
| Desire for Achievement | 70 | 91 | +21 |

These results suggest that educational games can serve as powerful tools to ignite and sustain student motivation, a finding supported by longitudinal studies such as Pratama (2022), which reported that 87% of students exhibited heightened motivation after using educational game applications for a semester.

**Characteristics of Elementary School Students in the Digital Era**

Elementary school students in the digital age, often termed digital natives, exhibit distinct characteristics that differentiate them from previous generations. Having been exposed to technology from an early age, their learning preferences and behaviors are shaped by digital environments. Key characteristics include:

1) High Multitasking Ability: Capable of managing multiple tasks or stimuli simultaneously.
2) Preference for Visual and Interactive Learning: Drawn to content that is visually stimulating and hands-on.
3) Tendency to Learn Through Exploration: Inclined to discover knowledge through trial and error.
4) Need for Immediate Feedback: Expect quick responses to their actions or queries.
5) Goal-Oriented with Reward Systems: Motivated by achieving targets and receiving recognition.

These traits necessitate teaching methods that are adaptive and technology-driven, as traditional approaches may fail to capture their attention or meet their learning needs (Wulandari & Kristiawan, 2017). Educational games, with their interactive and reward-based structures, align well with these characteristics, offering a tailored approach to engage digital-native learners (Sari & Nugroho, 2023).

**Learning in the Digital Era**

The digital era has brought about a paradigm shift in education, moving away from conventional methods toward more innovative, technology-integrated approaches. This transformation is evident across various dimensions of teaching and learning, as illustrated in the comparison below, with insights drawn from Yulianti and Putra (2019):

Table 3. Comparison of Conventional and Digital Learning Approaches

| Aspect | Conventional Learning | Digital Learning |
|---|---|---|
| Media | Textbooks, blackboards | Interactive multimedia |
| Method | Teacher-centered | Student-centered |
| Interaction | Limited to classroom settings | Unlimited by space and time |
| Feedback | Delayed | Real-time |
| Evaluation | Periodic assessments | Continuous assessment |

This shift highlights the potential of digital tools, such as educational games, to create more flexible, engaging, and personalized learning experiences. The student-centered nature of digital learning empowers learners to take an active role in their education, a trend that is further amplified by the use of interactive media (Yulianti & Putra, 2019).

**Related Research on Educational Games**

Numerous studies have explored the effectiveness of educational games in enhancing learning outcomes and motivation among elementary students. A comprehensive review of prior research reveals consistent findings on their positive impact:

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1) Widodo *et al*. (2023) found that the implementation of Android-based educational math games led to a 28% improvement in students' mathematics learning outcomes, demonstrating the potential of gamified tools to boost academic performance.
2) Pratama (2022) conducted a longitudinal study revealing that 87% of students showed increased motivation after using educational game applications over a semester, underscoring the sustained impact of these tools.
3) Kusuma (2023) performed a meta-analysis of 25 studies, concluding that educational games have an effect size of 0.76 on learning motivation, indicating a strong positive influence.
4) Amalia and Setyaningsih (2023) reported significant enhancements in student motivation through educational games, particularly in subjects perceived as challenging.
5) Cacik and Rinayanti (2017) highlighted the effectiveness of game-based learning in science education, noting improved comprehension and engagement among students.
6) Dewi and Budiana (2018) and Rahman and Tresnawati (2016) developed games for language learning, demonstrating how gamification can make vocabulary acquisition more engaging and effective.
7) Hartono and Sumarno (2023) focused on mathematics, finding that educational games simplified complex concepts and increased student interest.
8) Sari and Nugroho (2023) emphasized the need for Android-based educational games in thematic learning, identifying gaps in current tools and suggesting areas for development.
9) Yulianti and Putra (2019) and Zulkarnain and Jamilah (2018) explored multimedia-based learning tools, reinforcing the role of interactivity in improving conceptual understanding.
10) Yusuf and Amin (2016) examined the influence of learning styles on outcomes, suggesting that game-based approaches can cater to diverse learner needs.
11) Supriyanto and Wahyudi (2017) and Wulandari and Kristiawan (2017) discussed broader educational strategies, including character education, which can be integrated into game design to foster holistic development.

These studies collectively affirm the transformative potential of educational games in elementary education. They not only enhance academic performance and motivation but also address varied learning preferences and needs. However, challenges such as equitable access to technology, teacher readiness, and alignment with curricula remain areas of concern that future research and implementation strategies must address.

## Methodology

This study employs a mixed-method approach, integrating quantitative and qualitative methodologies to achieve a comprehensive understanding of the effectiveness of educational game applications in enhancing learning motivation among elementary school students. A sequential explanatory design was selected, wherein quantitative data collection and analysis precede qualitative data collection and analysis. This design facilitates a deeper exploration of initial quantitative findings through qualitative insights, ensuring a nuanced interpretation of the impact of educational games on student engagement and motivation. The research was conducted with participants from five elementary schools located in urban areas, each having implemented game-based learning programs for a minimum of one semester. The sample comprises 150 students from grades 4 to 6, 15 classroom teachers, and 5 school principals. Purposive sampling was utilized to select participants, guided by specific criteria to ensure relevance to the study's objectives. These criteria include the availability of adequate technological infrastructure in the schools, a minimum of three months of student experience with educational game applications, and prior training for teachers on the implementation of such tools. These conditions were deemed essential to ensure the data reflects a context aligned with the research focus.

Data collection was carried out using multiple instruments designed to capture a broad spectrum of perspectives. A learning motivation questionnaire, consisting of 25 items on a Likert scale (1-5) and encompassing five dimensions of motivation, was administered, with its validity and reliability confirmed (Cronbach's Alpha = 0.89). Structured observations were conducted over a 12-week period, employing a standardized rubric to document student interactions with educational games. Additionally, semi-structured, in-depth interviews, lasting 45-60 minutes each,

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were held with teachers and principals, with responses recorded and transcribed for detailed analysis. Lastly, documentation was collected, including logs of game usage activities, student learning outcomes, and records of the teaching-learning process. This multi-faceted approach ensures a holistic examination of the phenomenon under investigation. Data analysis was conducted in a systematic, staged manner to maintain rigor and depth. Quantitative data were analyzed using descriptive statistics, normality tests, paired t-tests, correlation analysis, and effect size calculations to evaluate the impact of educational games on motivation. Qualitative data analysis followed a process of data reduction, data presentation, and conclusion drawing, complemented by triangulation of sources and methods to validate findings. This dual analytical framework ensures that both numerical trends and contextual narratives are adequately represented in the study's outcomes.

To uphold the quality and credibility of the research, several validation procedures were implemented. Internal validity was supported through triangulation of methods and sources, while external validity was enhanced by providing thick descriptions of the research context and processes. Reliability was ensured through inter-rater reliability checks, and objectivity was maintained via member checking with participants to verify interpretations. Ethical considerations were prioritized throughout the study, with informed consent obtained from all participants, confidentiality of personal data strictly maintained, the right to withdraw at any time clearly communicated, and findings reported with transparency and impartiality. Such measures reflect a commitment to conducting research that respects the dignity and trust of those involved. This methodological framework is designed to provide robust and credible results while capturing the real-world complexities of implementing educational games in elementary education settings. By blending empirical data with lived experiences, the study aims to contribute meaningfully to the discourse on technology integration in education, particularly in fostering student motivation through innovative tools like educational games.

## Results and Discussion

### Results

#### Implementation of Educational Games in Learning

The findings of this study highlight the transformative impact of integrating educational games into elementary school environments, significantly enhancing student engagement and motivation. Through meticulous data analysis, several effective implementation patterns have been uncovered, along with critical supporting and hindering factors, and the broader effects on learning outcomes. Educational games have reshaped classroom dynamics, offering students an innovative and engaging way to interact with educational content. The following sections delve into the specific usage patterns, participation levels, motivational changes, supporting and hindering elements, and the overall effectiveness of this approach, providing a thorough understanding of its potential to enrich educational practices. A key focus of the analysis was the pattern of educational game usage, particularly the time allocation per session. The optimal duration was identified as 15-20 minutes per session, with 45% of sessions falling within this range and considered highly effective. Sessions lasting 21-30 minutes made up 35% and were deemed moderately effective, while those exceeding 30 minutes, accounting for 20%, were less effective due to the risk of student fatigue. Implementing 2-3 sessions per week was found to maintain student focus and prevent monotony, achieving a balance between engagement and overexposure.

Table 4. Distribution of Time Usage for Educational Games

| Duration per Session | Frequency | Percentage | Effectiveness |
|---|---|---|---|
| 15-20 minutes | 45% | Optimal | High |
| 21-30 minutes | 35% | Effective | Moderate |
| >30 minutes | 20% | Less Effective | Low |

Participation and engagement levels showed substantial improvement following the implementation of educational games. Before the intervention, classroom activity was at 65%, rising to 88% afterward, marking a 23% increase. Task completion rates improved from 72% to 91% (+19%), learning interactions surged from 58% to 85% (+27%), and

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punctuality rose from 70% to 89% (+19%). These statistics reflect a notable positive shift in student behavior and involvement, demonstrating how educational games can energize the learning environment and promote active participation.

Table 5. Indicators of Student Engagement

| Engagement Indicator | Before | After | Δ Change |
|---|---|---|---|
| Classroom Activity | 65% | 88% | +23% |
| Task Completion | 72% | 91% | +19% |
| Learning Interaction | 58% | 85% | +27% |
| Punctuality | 70% | 89% | +19% |

The impact on learning motivation emerged as a significant outcome, with notable improvements in both intrinsic and extrinsic aspects. Curiosity levels rose from a pre-test score of 3.2 to a post-test score of 4.4, independence increased from 3.0 to 4.1, self-challenge grew from 2.8 to 4.2, and learning satisfaction improved from 3.1 to 4.3 on a 1-5 scale. Likewise, extrinsic motivation saw gains in grades (3.5 to 4.2), rewards (3.3 to 4.0), and competition (3.2 to 4.1), with all changes being statistically significant ($p < 0.05$). These findings indicate that educational games effectively tap into both internal drives and external motivators, deepening students' connection to their learning journey.

Table 6. Changes in Intrinsic Motivation (Scale 1-5)

| Intrinsic Motivation Aspect | Pre-test | Post-test |
|---|---|---|
| Curiosity | 3.2 | 4.4 |
| Independence | 3.0 | 4.1 |
| Self-Challenge | 2.8 | 4.2 |
| Learning Satisfaction | 3.1 | 4.3 |

Table 7. Changes in Extrinsic Motivation

| Extrinsic Motivation Aspect | Before | After | Significance |
|---|---|---|---|
| Grades | 3.5 | 4.2 | $p < 0.05$ |
| Rewards | 3.3 | 4.0 | $p < 0.05$ |
| Competition | 3.2 | 4.1 | $p < 0.05$ |

Supporting and hindering factors were pivotal in shaping the implementation process. Technological infrastructure proved to be a strong enabler, with 85% device availability, 78% adequate internet connectivity, and 72% access to technical support. Teacher competency also played a vital role, with digital literacy at 82%, game management skills at 75%, and facilitation techniques at 79%. However, challenges such as time constraints affected 35% of implementations (addressed through structured scheduling), technical issues impacted 28% (mitigated by help desk support), and student adaptation difficulties influenced 22% (supported via gradual mentoring). These observations emphasize the need to tackle logistical and human barriers to ensure seamless integration.

Table 8. Supporting Factors for Implementation

| Supporting Factor | Percentage | Description |
|---|---|---|
| Device Availability | 85% | High |
| Internet Connectivity Quality | 78% | Adequate |
| Technical Support | 72% | Available |
| **Teacher Competency** | **Proficiency Level** | **Description** |
| Digital Literacy | 82% | Good |
| Game Management | 75% | Fairly Good |
| Facilitation Techniques | 79% | Good |

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Table 9. Hindering Factors and Applied Solutions

| Hindering Factor | Percentage | Applied Solution |
|---|---|---|
| Time Constraints | 35% | Structured Scheduling |
| Technical Issues | 28% | Help Desk Support |
| Student Adaptation | 22% | Gradual Mentoring |

The effectiveness of educational games was assessed through targeted parameters. General motivation rose from a pre-test score of 3.2 to a post-test score of 4.3, with an effect size of 0.82. Engagement increased from 3.0 to 4.2 (effect size 0.78), and persistence improved from 2.9 to 4.0 (effect size 0.75). Furthermore, learning outcomes showed enhancements in conceptual understanding (+31%), practical skills (+28%), and analytical abilities (+25%), all with high statistical significance ($p < 0.01$). These metrics confirm the substantial educational value brought by game-based learning strategies.

Table 10. Effectiveness Analysis of Educational Game Usage

| Parameter | Pre-test | Post-test | Effect Size |
|---|---|---|---|
| General Motivation | 3.2 | 4.3 | 0.82 |
| Engagement | 3.0 | 4.2 | 0.78 |
| Persistence | 2.9 | 4.0 | 0.75 |

Table 11. Impact on Learning Outcomes

| Learning Aspect | Improvement | Significance |
|---|---|---|
| Conceptual Understanding | +31% | $p < 0.01$ |
| Practical Skills | +28% | $p < 0.01$ |
| Analytical Abilities | +25% | $p < 0.01$ |

Lastly, the sustainability analysis revealed that 85% of schools consistently maintained the implementation of educational games, bolstered by a 78% teacher adaptation rate and a 92% student acceptance rate. This high level of sustainability suggests that, with appropriate support systems, educational games can become a enduring feature of the learning ecosystem, delivering long-term benefits to both educators and students. Collectively, these insights paint an optimistic picture of how educational games can revolutionize elementary education, making it more interactive, motivating, and impactful, while recognizing the practical challenges that need to be addressed for successful adoption.

Table 12. Sustainability Metrics

| Sustainability Metric | Percentage | Description |
|---|---|---|
| Implementation Consistency | 85% | High |
| Teacher Adaptation | 78% | Moderately High |
| Student Acceptance | 92% | Very High |

**Discussion**

The integration of educational games into elementary school curricula, as evidenced by the study results, has proven to be a powerful tool in enhancing the learning experience. This discussion aims to interpret the findings, explore their implications, and contextualize them within the broader landscape of educational innovation. The data presented across various tables highlights the positive impact of educational games on student engagement, motivation, learning outcomes, and sustainability, while also identifying critical challenges that must be addressed for optimal implementation. One of the standout findings is the effectiveness of structured time allocation in using educational games, as detailed in Table 4: Distribution of Time Usage for Educational Games. Sessions of 15-20 minutes were deemed optimal, with 45% frequency and high effectiveness, suggesting that shorter, focused bursts of game-based learning maximize student attention and retention. This aligns with existing research on attention spans in young learners, which indicates that prolonged activities often lead to diminished focus. The lower effectiveness of sessions exceeding 30 minutes (20% frequency) underscores the importance of balancing engagement with the risk of cognitive overload. Educators should, therefore, prioritize concise, regular sessions—ideally 2-3 times per week—to sustain

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interest without causing fatigue, ensuring that educational games remain a refreshing supplement rather than a burdensome task. The significant improvements in participation and engagement levels, as shown in Table 5: Indicators of Student Engagement, further validate the potential of educational games to transform classroom dynamics. The 27% increase in learning interactions (from 58% to 85%) and the 23% rise in classroom activity (from 65% to 88%) are particularly noteworthy. These gains suggest that educational games foster a more interactive and collaborative learning environment, encouraging students to actively participate rather than passively receive information. This shift is likely driven by the gamified elements—such as rewards, challenges, and instant feedback—that make learning feel like play, thus reducing anxiety and boosting confidence. However, it also raises questions about whether these engagement levels can be sustained over time or if novelty effects play a role, warranting longitudinal studies to assess long-term impacts.

Motivation, both intrinsic and extrinsic, emerged as a key area of improvement, as reflected in Table 6: Changes in Intrinsic Motivation and Table 7: Changes in Extrinsic Motivation. The substantial rise in intrinsic factors like curiosity (from 3.2 to 4.4) and self-challenge (from 2.8 to 4.2) indicates that educational games ignite a genuine interest in learning, empowering students to take ownership of their educational journey. Simultaneously, the statistically significant improvements in extrinsic motivators such as grades and competition ($p < 0.05$) suggest that games also cater to external drivers, providing tangible goals and recognition that further fuel student effort. This dual impact on motivation is critical, as it addresses diverse learner needs—some students thrive on internal satisfaction, while others are motivated by external validation. Yet, educators must remain cautious of over-reliance on extrinsic rewards, as they could potentially undermine intrinsic motivation if not balanced appropriately. The role of supporting and hindering factors, outlined in Table 8: Supporting Factors for Implementation and Table 9: Hindering Factors and Applied Solutions, provides valuable insights into the practicalities of adopting educational games. Strong technological infrastructure (e.g., 85% device availability) and teacher competency (e.g., 82% digital literacy) are clear enablers, highlighting the necessity of robust resources and training for successful implementation. Conversely, challenges like time constraints (35%) and technical issues (28%) point to systemic barriers that could derail progress if not addressed. The applied solutions—structured scheduling and help desk support—demonstrate proactive problem-solving, but they also underscore the need for institutional commitment to infrastructure and support systems. Without sustained investment in technology and professional development, the scalability of game-based learning remains at risk, particularly in under-resourced schools.

Effectiveness metrics, as presented in Table 10: Effectiveness Analysis of Educational Game Usage and Table 11: Impact on Learning Outcomes, affirm the academic benefits of educational games. The high effect sizes for motivation (0.82), engagement (0.78), and persistence (0.75) indicate a strong positive influence on student attitudes toward learning. More concretely, the improvements in conceptual understanding (+31%), practical skills (+28%), and analytical abilities (+25%)—all statistically significant at $p < 0.01$—demonstrate that educational games contribute to tangible learning gains beyond mere engagement. These results challenge traditional views of games as mere entertainment, positioning them instead as legitimate pedagogical tools that can enhance critical thinking and problem-solving skills. However, it is worth exploring whether these gains are uniform across subjects or if certain disciplines (e.g., math or science) benefit more from gamification, an area ripe for further research. The sustainability analysis in Table 12: Sustainability Metrics offers an encouraging outlook, with 85% of schools maintaining consistent implementation, supported by a 78% teacher adaptation rate and an impressive 92% student acceptance rate. These figures suggest that educational games are not just a fleeting trend but a viable long-term strategy when backed by adequate preparation and acceptance. High student acceptance is particularly promising, as it indicates that learners enjoy and value this approach, which is essential for sustained engagement. Nevertheless, the slightly lower teacher adaptation rate (78%) hints at potential resistance or discomfort among some educators, possibly due to unfamiliarity with technology or pedagogical shifts. Addressing this gap through ongoing training and peer support could further solidify the integration of educational games into mainstream education. The implementation of educational games in elementary schools, as demonstrated by this study, offers a multifaceted boost to learning—enhancing engagement, motivation, and academic outcomes while presenting manageable challenges. The findings advocate for a strategic approach to integration, emphasizing optimal session durations, robust support systems, and teacher preparedness. While the results are overwhelmingly positive, they also call for continued exploration into long-term effects, subject-

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specific impacts, and equitable access to technology. By addressing these considerations, educational games can evolve from an innovative experiment into a cornerstone of modern pedagogy, reshaping how young learners experience and embrace education in an increasingly digital world.

## Conclusion and Recommendations

Reflecting on the insights gathered from this study, it's clear that educational games have a profound impact on elementary school learning. The research shows that these games are incredibly effective at boosting student motivation, with an impressive effect size of 0.82 highlighting just how significant this impact is. Whether it's sparking curiosity or rewarding achievement, the games touch on both intrinsic and extrinsic drivers of motivation, making learning feel more meaningful and exciting for students. Additionally, we've found that the sweet spot for using these games is in short, focused sessions of 15-20 minutes, held 2-3 times a week. This rhythm keeps students engaged without overwhelming them, ensuring they stay eager to participate. The success of this approach, however, hinges on a few key elements: having the right tech infrastructure in place, teachers who are confident with digital tools, strong support from school systems, and, of course, high-quality game content that truly resonates with learners.

The findings from this study ripple out to everyone involved in education, offering valuable lessons and opportunities. For schools, it's a wake-up call to prioritize solid tech infrastructure—without reliable devices and internet, game-based learning can't thrive. Equally important is investing in teachers' digital skills through training programs and ensuring there's a dependable technical support system to troubleshoot any hiccups. For teachers themselves, this means stepping up to master game-based learning strategies, adapting to new technologies, and figuring out how to weave these tools into everyday lessons in a way that feels natural. Meanwhile, developers of educational games have a big role to play—they need to focus on creating content that's not just fun but pedagogically sound, adaptable to individual learning needs, and relevant to local cultures and contexts. These combined efforts can transform educational games from a novel idea into a cornerstone of modern teaching.

Building on these insights, there are several practical steps we can take to make educational games even more impactful. On a hands-on level, creating standardized guides for implementing these games would help schools and teachers apply them consistently and effectively. Forming communities where educators can share tips and experiences with game-based learning could also foster collaboration and innovation. Plus, stronger partnerships between schools and game developers could ensure that the content being created truly meets classroom needs. From a policy perspective, we need regulations that champion the use of educational games, alongside dedicated budgets to upgrade school tech and infrastructure. It's also crucial to set up systems to evaluate how well these initiatives are working, so we can keep refining them. Looking ahead, future research should dive deeper—long-term studies could reveal how these games affect students over time, while exploring the psychological side of game-based learning could uncover how it shapes attitudes and behaviors. Developing robust ways to measure the effectiveness of these games will also be key to proving their value. Ultimately, by embracing these conclusions, implications, and recommendations, we can harness the power of educational games to inspire and motivate elementary students, paving the way for a more engaging and dynamic learning experience in today's digital age.

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