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# The Influence of Game-Based Learning on Learning Motivation and Critical Thinking Skills in Elementary Science and Social Studies (IPAS)

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**Abstract:** This study aims to analyze the effect of Game-Based Learning (GBL) integrated with pop-up media on students' learning motivation and critical thinking skills in elementary IPAS learning. This study employed a quantitative approach using a pre-experimental design with a One-Group Pretest–Posttest model. The participants consisted of 19 fifth-grade students selected using a saturated sampling technique. Data were collected using a learning motivation questionnaire and a critical thinking skills test, both of which were validated and tested for reliability. Data analysis was conducted using descriptive statistics, the paired sample t-test, and effect size analysis.The results showed that there was a significant increase in both learning motivation and critical thinking skills after the implementation of Game-Based Learning. The paired sample t-test revealed a significance value of $p < 0.001$, indicating a statistically significant difference between pretest and posttest scores. Furthermore, the effect size analysis indicated a very high category, demonstrating that the intervention had a strong practical impact. These findings suggest that Game-Based Learning creates an engaging and interactive learning environment that promotes active participation and supports higher-order thinking processes. In conclusion, Game-Based Learning integrated with pop-up media is an effective instructional strategy for improving both learning motivation and critical thinking skills in elementary education. This approach contributes to the development of cognitive and affective competencies aligned with the demands of 21st-century learning.

**Keywords:** Critical thinking skills; Elementary education; Game-based learning; IPAS; Learning motivation

## Introduction

Education in the 21st century is oriented toward developing learners who are not only knowledgeable but also demonstrate strong learning motivation, critical thinking skills, and the ability to adapt to digital transformation. Contemporary learning paradigms emphasize student-centered approaches that foster autonomy, collaboration, and higher-order thinking skills as essential competencies in modern society (OECD, 2023; Schutz & Lanehart, 2002). In this context, learning motivation plays a central role in driving students' engagement and persistence, while critical thinking skills enable learners to analyze information, evaluate evidence, and generate reasoned solutions to complex problems (Halpern & Dunn, 2021; Jaramillo Gómez et al., 2025; Kanim & Cid, 2020). These competencies are particularly crucial at the elementary level, as they form the foundation for lifelong learning and cognitive development. However, classroom practices often fail to meet these expectations.

Learning processes in elementary schools remain predominantly teacher-centered, limiting opportunities for student participation, exploration, and inquiry. As a result, students tend to become passive recipients of information, which negatively impacts their intrinsic

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motivation and critical thinking development (Fredricks et al., 2004; Schindler et al., 2017).

Empirical observations further indicate that a significant proportion of students demonstrate low levels of motivation and limited ability to construct arguments, ask critical questions, or propose alternative solutions . This condition reflects a substantial gap between the intended goals of modern education and the actual implementation of learning practices in classrooms. Moreover, although digital technology has been increasingly integrated into educational settings, its pedagogical use remains suboptimal. The presence of technology alone does not guarantee meaningful learning; without appropriate instructional design, it may lead to superficial engagement and limited cognitive development (Bond et al., 2021; Kirschner et al., 2006).

Therefore, there is a need for innovative instructional approaches that can effectively integrate technology to foster active learning, enhance motivation, and develop higher-order thinking skills. One such approach is Game-Based Learning (GBL), which incorporates game elements such as challenges, feedback, rules, and rewards into the learning process. GBL has been widely recognized as an effective strategy for increasing students' motivation by creating engaging and enjoyable learning experiences (Wang et al., 2020). Furthermore, GBL facilitates the development of critical thinking skills by encouraging learners to engage in problem-solving, decision-making, and reflective thinking activities (Fiorella & Mayer, 2018; Halpern & Dunn, 2021).

The integration of interactive visual media also plays a significant role in enhancing students' conceptual understanding, particularly in elementary education, where abstract concepts need to be represented concretely (Bressler & Bodzin, 2013). Despite its potential, previous studies on Game-Based Learning have several limitations. Most research has focused on a single outcome variable, such as learning motivation or academic achievement, without examining the simultaneous relationship between motivation and critical thinking skills. In addition, the integration of Game-Based Learning with interactive visual media, particularly pop-up-based learning in IPAS (Integrated Science and Social Studies), remains underexplored in elementary school contexts. This indicates a significant research gap in both theoretical integration and empirical investigation. Based on these gaps, this study proposes the integration of Game-Based Learning with pop-up interactive media to examine its simultaneous effects on students' learning motivation and critical thinking skills in elementary IPAS learning. This study contributes to the literature by combining cognitive and affective dimensions within a unified instructional framework, thereby offering a more comprehensive learning model aligned with the demands of 21st-century education. Accordingly, the research seeks to answer the following questions: (1) Does Game-Based Learning influence students' learning motivation? and (2) Does Game-Based Learning influence students' critical thinking skills?

## Method

This study employed a quantitative approach using a pre-experimental design with a One-Group Pretest–Posttest model to examine the effect of Game-Based Learning (GBL) on students' learning motivation and critical thinking skills. This design enables researchers to measure changes before and after an intervention within the same group and is widely used in educational research when random assignment is not feasible (Creswell & Creswell, 2018; Schindler et al., 2017).

**Table 1.** Research Design (One Group Pretest–Posttest)

| Group | Pretest ($O_1$) | Treatment (X) | Posttest ($O_2$) |
|---|---|---|---|
| Experimental | Measurement of initial motivation and critical thinking | Game-Based Learning (GBL) with pop-up media | Measurement after treatment |

The research design is presented in Table 1. The study was conducted in an elementary school in Jember Regency during the 2025/2026 academic year, involving 19 fifth-grade students selected using a saturated sampling technique, where all members of the population were included as participants. Data were collected using two main instruments: a learning motivation questionnaire and a critical thinking skills test. The motivation instrument was developed based on self-determination theory, emphasizing intrinsic and extrinsic motivation as key drivers of student engagement and persistence (Bond et al., 2021; Ryan & Deci, 2020). Meanwhile, the critical thinking skills test was constructed based on core indicators such as interpretation, analysis, evaluation, inference, and explanation, which are essential components of higher-order thinking (Halpern & Dunn, 2021; Jaramillo Gómez et al., 2025). The development of both instruments followed established guidelines in educational research to ensure alignment with theoretical constructs and learning objectives (Ng, 2012; Radianti et al., 2020).

**Table 2.** Research Instruments Blueprint

| Variable | Indicator | Item Type | Item Number | Scale |
|---|---|---|---|---|
| Learning Motivation | Interest | Questionnaire | 1-3 | Likert |
| | Persistence | Questionnaire | 4-5 | Likert |
| | Engagement | Questionnaire | 6-7 | Likert |
| | Achievement Drive | Questionnaire | 8-10 | Likert |
| Critical Thinking | Interpretation | Essay | 1 | Rubric |
| | Analysis | Essay | 2 | Rubric |
| | Evaluation | Essay | 3 | Rubric |
| | Inference | Essay | 4 | Rubric |
| | Explanation | Essay | 5 | Rubric |

Prior to data collection, instrument validation was conducted using expert judgment to ensure content validity, followed by reliability testing using Cronbach's Alpha coefficient. A reliability coefficient above 0.70 was considered acceptable, indicating strong internal consistency among the instrument items (Taber, 2018; Gliem & Gliem, 2020). These procedures are essential to ensure the accuracy and consistency of measurements in quantitative educational research (de Winter, 2013).

The data collection process consisted of three stages: pretest, treatment, and posttest. In the pretest phase, students completed both instruments to establish baseline data. The treatment phase involved the implementation of Game-Based Learning integrated with pop-up interactive media, designed to enhance engagement through challenges, feedback mechanisms, and collaborative problem-solving activities (Fiorella & Mayer, 2018; Plass et al., 2015; Wang et al., 2020). This approach allows students to actively participate in the learning process, thereby fostering both motivation and critical thinking skills (Bressler & Bodzin, 2013; Radianti et al., 2020). After the intervention, a posttest was administered using the same instruments to measure learning gains. Data analysis was performed using SPSS version 30.

The normality of the data was tested using the Shapiro–Wilk test, which is appropriate for small sample sizes and widely recommended in educational research (Ghasemi & Zahediasl, 2012). Hypothesis testing was conducted using the Paired Sample t-test to determine whether there were statistically significant differences between pretest and posttest scores (de Winter, 2013). In addition, effect size was calculated using Cohen's d to evaluate the magnitude of the treatment effect, where values greater than 0.80 indicate a large effect (Fritz et al., 2012).

These statistical procedures provide a comprehensive analysis of both the significance and practical impact of the intervention (Bond et al., 2021). Throughout the research process, ethical considerations were maintained by ensuring voluntary participation, informed consent, and confidentiality of participants' data. Adhering to ethical standards is essential in educational research to protect participants and ensure the credibility of the findings (Hanson et al., 2005).

## Result and Discussion

This study aims to examine the effect of Game-Based Learning (GBL) integrated with pop-up media on students' learning motivation and critical thinking skills. The data were obtained through pretest and posttest and analyzed using descriptive statistics, paired sample t-test, and effect size.

*Learning Motivation*

The descriptive statistics of students' learning motivation are presented in Table 3.

**Table 3.** Descriptive Statistics of Learning Motivation

| Measurement | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| Pretest | 19 | 62.63 | 6.18 | 1.42 |
| Posttest | 19 | 88.36 | 6.19 | 1.42 |

Based on Table 3, the average score of students' learning motivation increased significantly from 62.63 (pretest) to 88.36 (posttest). This indicates a substantial improvement after the implementation of Game-Based Learning. The results of the paired sample t-test are presented in Table 4.

**Table 4.** Paired Sample t-Test for Learning Motivation

| Variable | Mean Difference | t | df | Sig. (2-tailed |
|---|---|---|---|---|
| Pretest-Posttest | -25.73 | -27.586 | 18 | 0.000 |

The significance value ($p < 0.001$) indicates that there is a statistically significant difference between pretest and posttest scores. The effect size of the intervention is shown in Table 5.

**Table 5.** Effect Size of Learning Motivation

| Variable | Cohen's d | Category |
|---|---|---|
| Learning Motivation | 4.07 | Very High |

The Cohen's d value of 4.07 indicates a very large effect size, suggesting that Game-Based Learning has a

strong practical impact on increasing students' learning motivation.

*Critical Thinking Skills*

The descriptive statistics of students' critical thinking skills are presented in Table 6.

**Table 6.** Descriptive Statistics of Critical Thinking Skills

| Measurement | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| Pretest | 19 | 59.47 | 8.29 | 1.90 |
| Posttest | 19 | 81.94 | 6.67 | 1.53 |

Table 6 shows that the average score increased from 59.47 to 81.94, indicating a significant improvement in students' critical thinking skills. The results of the paired sample t-test are shown in Table 7.

**Table 7.** Paired Sample t-Test for Critical Thinking Skills

| Variable | Mean Difference | t | df | Sig. (2-tailed |
|---|---|---|---|---|
| Pretest-Posttest | -22.47 | -30.745 | 18 | 0.000 |

The significance value ($p < 0.001$) indicates a statistically significant difference. The effect size is presented in Table 8. The Cohen's d value of 3.19 indicates a very strong effect of Game-Based Learning on students' critical thinking skills.

**Table 8.** Effect Size of Critical Thinking Skills

| Variable | Cohen's d | Category |
|---|---|---|
| Critical Thinking Skills | 3.19 | Very High |

*Discussion*

The findings of this study demonstrate that the implementation of Game-Based Learning (GBL) significantly improves both students' learning motivation and critical thinking skills. These results provide compelling evidence that GBL constitutes an effective and meaningful instructional approach in the context of elementary education, offering substantial benefits across both cognitive and affective learning dimensions.

First, the notable increase in learning motivation can be primarily attributed to the inherently interactive and engaging nature of Game-Based Learning. The deliberate use of challenges, rewards, and immediate feedback mechanisms collectively creates a dynamic learning environment that effectively stimulates students' intrinsic motivation and actively encourages sustained participation. This finding is consistent with recent empirical studies indicating that game-based learning environments enhance motivation by promoting deeper engagement and a genuine sense of enjoyment throughout the learning process (Ryan & Deci, 2020; Wang et al., 2020). Furthermore, digital and interactive learning environments have been consistently shown to increase students' persistence, focus, and attentiveness during learning activities, thereby reducing cognitive disengagement (Bond et al., 2021).

Second, the marked improvement in critical thinking skills is closely and directly related to the problem-solving characteristics inherently embedded within GBL. Throughout gameplay, students are continuously required to analyze complex situations, evaluate competing options, and make strategic decisions under varying conditions — cognitive demands that directly support the development of higher-order thinking skills. This aligns with converging findings from recent studies that highlight the effectiveness of game-based learning in fostering both analytical reasoning and evaluative thinking among learners (Gogolin & Krüger, 2018; Jaramillo Gómez et al., 2025).

Additionally, the deliberate integration of interactive media further supports deeper conceptual understanding by providing concrete, tangible representations of otherwise abstract concepts, thereby bridging the gap between theoretical knowledge and practical application (Radianti et al., 2020). Moreover, the large effect size observed in this study strongly indicates that the overall impact of GBL is not only statistically significant but also practically and educationally meaningful in real classroom settings. This further supports a growing body of previous research demonstrating that game-based learning exerts a powerful and lasting influence on both cognitive and affective learning outcomes (Fiorella & Mayer, 2018; Plass et al., 2015). The purposeful combination of gameplay elements and rich visual media simultaneously enhances both student engagement and conceptual comprehension, ultimately rendering the learning experience more effective, immersive, and personally meaningful.

From a broader pedagogical perspective, this study underscores the critical importance of deliberately shifting from traditional teacher-centered to more inclusive student-centered learning approaches. Conventional instructional methods frequently limit meaningful student participation and restrict opportunities for autonomous exploration, whereas GBL inherently encourages active learning, collaborative problem-solving, and independent inquiry. This pedagogical shift is firmly in line with contemporary educational frameworks that consistently prioritize sustained student engagement, autonomy, and the cultivation of higher-order thinking skills as essential competencies for 21st-century learners (Lakens, 2022).

## Conclusion

This study concludes that the implementation of Game-Based Learning (GBL) integrated with pop-up media has a significant positive effect on students' learning motivation and critical thinking skills in elementary IPAS learning. The statistical analysis results indicate a significant difference between pretest and posttest scores for both variables ($p < 0.001$), confirming the effectiveness of the intervention. Furthermore, the effect size analysis shows that the impact of GBL falls into the very high category, indicating strong practical significance. The improvement in learning motivation demonstrates that GBL is capable of creating an engaging, interactive, and student-centered learning environment that encourages active participation and persistence in learning. At the same time, the enhancement of critical thinking skills indicates that GBL effectively facilitates higher-order thinking processes through problem-solving, decision-making, and reflective activities embedded in gameplay. Overall, the findings highlight that Game-Based Learning not only improves cognitive outcomes but also strengthens affective aspects of learning. Therefore, GBL integrated with interactive media can be considered an effective instructional strategy for supporting 21st-century learning in elementary education.

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**Author Contributions**
A.A.: Conceptualization, writing the original draft, methodology; S.P.; conceptualization, methodology, writing, review and editing; H.: curation, writing the original draft; S.P.; methodology; F.A.: formal analysis; H.: validation.

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**Conflicts of Interest**
The authors declare no conflict of interest.

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