



The Influence of *MarvelAPP* Educational Game Learning Media on the Learning Achievement of IPAS Students in Grade 5 Elementary School

Lely Melan Mega Auliya¹, Dya Ayu Agustiana Putri¹, Frita Devi Asriyanti¹

¹ Department of Elementary School Teacher Education, Universitas Bhinneka PGRI, Indonesia

Correspondence: lelyauliya@icloud.com

Article Info

Article history:

Received Apr 12th, 2026

Revised Jun 5th, 2026

Accepted Jun 25th, 2026

How to cite this article:

Auliya, L. M. M., Putri, D. A. A., & Asriyanti, F. D. (2026). The influence of *MarvelAPP* educational game learning media on the learning achievement of IPAS students in grade 5 elementary school. *Primary Education Insight*, 2 (1), 66-78. <https://doi.org/10.65779/pedi.v2i1.80>

ABSTRACT

Students' IPAS learning achievement at the elementary school level remains relatively low due to the limited use of interactive and engaging learning media in classroom instruction. Conventional teaching methods often reduce students' participation and make it difficult for them to understand abstract concepts. Therefore, innovative digital learning media are needed to create more meaningful learning experiences. This study aimed to examine the effect of *MarvelApp* educational game learning media on the IPAS learning achievement of Grade 5 elementary school students. The study employed a quantitative approach using a quasi-experimental method with a nonequivalent control group design. The participants consisted of 90 Grade 5 students, including 44 students in the experimental group and 46 students in the control group. The experimental group received instruction using *MarvelApp* educational game learning media, whereas the control group received conventional instruction. Data were collected using a 20-item IPAS learning achievement test administered as both a pretest and posttest. The instrument demonstrated excellent internal consistency (Cronbach's Alpha = 0.972) and acceptable construct validity. Data were analyzed using descriptive statistics, assumption tests, and an independent samples t-test. The findings revealed no significant difference between the two groups before the intervention, whereas a significant difference was observed after the intervention, with the experimental group achieving higher IPAS learning achievement than the control group ($p < .001$). These findings indicate that *MarvelApp* educational game learning media effectively enhances students' learning achievement by promoting active engagement and meaningful learning experiences.

Keywords:

educational game, *MarvelApp*, IPAS learning achievement, elementary school, quasi-experimental study



© 2026 The Authors. Published by Creative Smart Visionary. This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>)

INTRODUCTION

Education plays a fundamental role in developing human resources and improving the quality of life. In Indonesia, education is increasingly viewed as a process that develops students' knowledge, competencies, character, and lifelong learning capacities to prepare them for active participation in society, aligning with the national educational transformation toward competency-based and character-oriented learning (OECD, 2023). At the elementary school level, education provides the foundation for children's cognitive, social, and emotional development while equipping them with essential competencies for lifelong learning and successful progression to higher levels of education (Cristóvão et al., 2020; Darling-Hammond et al., 2020; Seprie et al., 2025). Achieving these educational goals requires learning environments that actively engage students in meaningful learning experiences. Research has shown that instructional practices promoting active participation, critical thinking, collaboration, and student engagement contribute significantly to academic achievement and holistic development (Darling-Hammond et al., 2020; UNESCO, 2021).

The rapid advancement of digital technology has created new opportunities to develop learning environments that are more interactive and student-centered. Among these innovations, digital learning media have become an important instructional resource because they facilitate information delivery,

sustain students' attention, support conceptual understanding, and improve learning effectiveness when integrated with appropriate pedagogical strategies (Lubis et al., 2025; Mayer, 2020). Interactive digital media, particularly educational games, combine visual, auditory, and interactive elements that correspond to elementary school students' developmental characteristics and encourage active participation throughout the learning process (Clark & Mayer, 2016). Consequently, technology-supported learning media have become a promising approach for enhancing students' motivation, engagement, and academic achievement (Clark & Mayer, 2016; OECD, 2023; Prastiyo et al., 2026).

Despite these developments, classroom instruction in many Indonesian elementary schools continues to rely primarily on teacher-centered approaches, textbooks, and lectures. Such practices often limit students' active participation, particularly in IPAS (*Ilmu Pengetahuan Alam dan Sosial*), where abstract concepts require contextual understanding, inquiry, and meaningful learning experiences. Recent studies have reported that the limited use of interactive learning media is associated with lower student engagement and weaker conceptual understanding in elementary IPAS learning (Prayoga et al., 2025). As a result, many students perceive IPAS as difficult and uninteresting, leading to low participation and unsatisfactory learning achievement (Fharhah & Widiyono, 2026; Hastuti et al., 2026). These conditions highlight the need for innovative instructional media that can foster students' engagement while facilitating deeper conceptual understanding.

Previous studies consistently demonstrate that digital game-based learning positively influences elementary students' learning. Educational games have been shown to increase students' motivation, classroom participation, conceptual understanding, and academic achievement across various subjects (Fauzi et al., 2024; Kusuma et al., 2024; Qomaria et al., 2024). Similar findings have been reported for platforms such as *Wordwall*, *Educaplay*, *Quizizz*, and *Baamboozle*, which create more engaging learning environments and improve students' learning outcomes (Chamelia et al., 2025; Fadilah et al., 2025; Ge'e & Dahlan, 2025). Collectively, these studies indicate that educational game-based learning media represent an effective strategy for improving learning quality in elementary education.

Nevertheless, several gaps remain in the existing literature. Previous studies have primarily examined widely used educational game platforms, whereas empirical evidence regarding *MarvelApp* as an educational game development platform remains limited, particularly in elementary IPAS instruction. In addition, many studies have focused on students' learning motivation or general learning outcomes rather than specifically examining IPAS learning achievement among Grade 5 students using a quasi-experimental design. Consequently, further empirical evidence is needed to determine the effectiveness of *MarvelApp* educational game learning media in improving students' learning achievement in authentic elementary classroom settings.

To address these gaps, this study investigates the effect of *MarvelApp* educational game learning media on the IPAS learning achievement of Grade 5 elementary school students. The novelty of this study lies in the implementation of *MarvelApp* as an interactive educational game platform for IPAS instruction and the evaluation of its effectiveness using a quasi-experimental nonequivalent control group design. The findings are expected to enrich the literature on technology-enhanced learning, provide empirical evidence regarding the educational potential of *MarvelApp* in elementary education, and offer practical insights for teachers seeking to integrate interactive digital learning media into classroom instruction.

LITERATURE REVIEW

Digital Learning Media

Learning media refer to all instructional resources that facilitate communication between teachers and students during the learning process. Beyond transmitting information, learning media help students construct knowledge by presenting learning materials in ways that are easier to understand and remember (Lubis et al., 2025; Mayer, 2020). Effective learning media also reduce the abstractness of concepts through visual representations, audio, animations, and interactive activities. As a result, students demonstrate better comprehension, retention, and knowledge transfer in new learning situations (Clark & Mayer, 2016; Mayer, 2020). In elementary education, well-designed digital learning media have been associated with higher levels of engagement because they accommodate students' developmental characteristics and diverse learning preferences (Prayoga et al., 2025).

The instructional functions of learning media have been widely discussed in educational literature. According to Levie and Lentz (1982), visual learning media perform four essential functions: attracting students' attention, stimulating positive learning attitudes, supporting cognitive processing, and compensating for learning difficulties by presenting information in more accessible forms. These functions are particularly important in elementary education because children learn more effectively through concrete experiences, visual representations, and interactive activities (Darling-Hammond et al., 2020; Mayer, 2020; UNESCO, 2021). This perspective is consistent with multimedia learning theory, which states that meaningful learning occurs when verbal and visual information are integrated effectively. Such integration reduces cognitive load and facilitates knowledge construction (Clark & Mayer, 2016; Mayer, 2020). Consequently, selecting learning media that match students' cognitive characteristics contributes to more meaningful learning experiences and improved academic performance (Safira et al., 2025; UNESCO, 2021).

Recent advances in educational technology have expanded opportunities to integrate digital learning media into classroom instruction. Digital media enable teachers to present learning materials through multiple formats while providing immediate feedback, adaptive learning opportunities, and flexible access to learning resources (Clark & Mayer, 2016). Compared with conventional instructional tools, digital media also encourage greater student participation and collaboration. These environments promote student-centered learning and support the development of higher-order thinking skills (Evitasari & Putri, 2025; OECD, 2023). Furthermore, recent literature reviews in Indonesian primary education indicate that interactive digital media consistently improve students' engagement, motivation, and learning outcomes when implemented with appropriate pedagogical strategies (Prayoga et al., 2025). Therefore, technology-supported learning media have become an essential component of innovative instructional practices in elementary schools.

Educational Games in Learning

Educational games are instructional media that combine educational objectives with game mechanics to create enjoyable and meaningful learning experiences. Unlike conventional learning activities, educational games require students to solve problems, complete challenges, and make decisions throughout the learning process. This active participation promotes knowledge construction, strengthens interaction, and helps maintain students' interest and concentration during learning (Sulaiman et al., 2025).

Game-based learning is particularly appropriate for elementary school students because it aligns with their developmental characteristics, which emphasize exploration, play, and active interaction. Educational games integrate visual elements, animations, sound, and immediate feedback to sustain students' engagement during instruction. These features also support self-regulated learning by encouraging students to monitor their own progress (Chen et al., 2026; Clark & Mayer, 2016). Moreover, repeated practice within game environments reinforces conceptual understanding, strengthens knowledge retention, and reduces students' anxiety toward difficult learning materials (Ramdhani et al., 2026).

Previous studies consistently demonstrate that educational games positively influence both cognitive and motivational outcomes. Students who learn through educational games generally exhibit higher motivation, greater classroom participation, stronger conceptual understanding, and better learning achievement than those taught through conventional instructional approaches (Fauzi et al., 2024; Rahmawati et al., 2026). Systematic reviews further indicate that game-based learning is particularly effective in elementary education when game mechanics are aligned with instructional objectives and supported by appropriate teacher guidance (Ningrum et al., 2025; Ramdhani et al., 2026). Collectively, these findings suggest that educational games represent an effective instructional strategy for improving learning achievement in elementary education.

***MarvelApp* as an Educational Game Platform**

MarvelApp is a cloud-based digital prototyping platform that can be adapted to develop interactive learning media for educational purposes. As a prototyping tool, *MarvelApp* enables educators to design interactive user interfaces and learning prototypes without requiring advanced programming skills. This capability makes the platform suitable for developing educational applications and game-based learning media through rapid prototyping approaches (Lewis & Sturdee, 2022). In

elementary education, *MarvelApp* has also been used to develop mobile learning applications that integrate interactive navigation and multimedia content to support mathematics instruction (Naufal et al., 2025). These capabilities provide flexibility for designing instructional media that align with students' learning needs and curriculum objectives.

MarvelApp supports the integration of images, animations, videos, hyperlinks, and interactive navigation within a single learning environment. These features enable teachers to organize learning materials into structured and interactive learning sequences (Naufal et al., 2025). Students therefore interact directly with instructional content rather than receiving information passively. Consistent with multimedia learning theory, integrating verbal and visual information with meaningful learner interaction promotes deeper cognitive processing and improves conceptual understanding (Mayer, 2020). Furthermore, interactive digital environments that provide immediate feedback have been shown to increase students' engagement and active participation during classroom instruction (Clark & Mayer, 2016).

The platform is compatible with multiple digital devices, allowing learning media developed through interactive prototyping to be accessed across different learning environments. Its intuitive interface facilitates the rapid development and iterative refinement of educational games and interactive learning applications. Consequently, teachers can implement learner-centered instructional media more efficiently (Lewis & Sturdee, 2022; Naufal et al., 2025). These characteristics indicate that *MarvelApp* has considerable potential to support technology-enhanced learning by facilitating the development of engaging, interactive, and student-centered educational games that align with established principles of game-based learning (Plass et al., 2020).

IPAS Learning Achievement

Learning achievement refers to the level of knowledge, understanding, and skills acquired by students after participating in instructional activities (Schunk & DiBenedetto, 2020). It is commonly measured through standardized assessments or teacher-developed tests that evaluate students' mastery of predetermined learning objectives and expected competencies (Brookhart & McMillan, 2020). Therefore, learning achievement reflects not only students' cognitive development but also the effectiveness of instructional strategies, assessment practices, and learning environments that support meaningful learning (Darling-Hammond et al., 2020). As a result, learning achievement is widely used as an important indicator for evaluating the quality and effectiveness of classroom instruction.

In elementary schools, IPAS integrates concepts from natural and social sciences to help students understand the relationships among humans, society, and the natural environment. The subject requires students to understand scientific concepts, analyze everyday phenomena, and apply knowledge to authentic situations through inquiry-oriented learning approaches (Wulandari et al., 2025). However, many IPAS topics involve abstract concepts that are difficult for elementary school students to visualize. Consequently, students often experience learning difficulties when instruction relies primarily on verbal explanations and textbook-based activities without adequate visual and interactive support (Annetta et al., 2024; Prayoga et al., 2025). Previous studies have shown that visual and interactive learning media help students understand abstract concepts more effectively and improve their achievement in science-related subjects (Priliani et al., 2026).

Learning achievement in IPAS is influenced by both internal and external factors. Internal factors include students' motivation, prior knowledge, and learning readiness, whereas external factors include instructional methods, classroom environments, and learning media (Schunk & DiBenedetto, 2020). Appropriate learning media help students visualize abstract concepts, participate actively in learning activities, and receive immediate feedback that supports conceptual understanding and long-term knowledge retention (Mayer, 2020). Recent studies further demonstrate that interactive digital media and game-based learning significantly improve students' conceptual understanding, motivation, and IPAS learning achievement by providing engaging and meaningful learning experiences (Haq et al., 2026). These findings reinforce the importance of integrating well-designed digital learning media into elementary IPAS instruction to improve students' learning achievement.

Relevant Research

Previous empirical studies consistently demonstrate the effectiveness of educational game-based learning in elementary education. Fadilah et al. (2025) reported that interactive digital media

significantly improved elementary students' IPAS learning outcomes by increasing their engagement and conceptual understanding. Similarly, Chamelia et al. (2025) found that educational games implemented through *Baamboozle* positively influenced Grade 5 students' IPAS achievement by creating more interactive classroom experiences. Ge'e and Dahlan (2025) also reported that *Educaplay*-based interactive media significantly enhanced students' science learning outcomes compared with conventional instruction.

Other studies have reached similar conclusions using different educational game platforms. Kusuma et al. (2024) demonstrated that *Wordwall*-based educational games improved elementary students' science achievement by increasing learning motivation and classroom participation. Likewise, Qomaria et al. (2024) found that *Wordwall* facilitated greater conceptual understanding and higher academic performance in IPAS learning. These findings collectively indicate that interactive educational games consistently produce positive educational outcomes across various instructional contexts.

Although previous research confirms the effectiveness of educational game-based learning, most studies have focused on platforms such as *Wordwall*, *Educaplay*, *Quizizz*, and *Baamboozle*. Empirical evidence regarding the implementation of *MarvelApp* as an educational game platform in elementary IPAS learning remains limited. Therefore, investigating the effectiveness of *MarvelApp* in improving Grade 5 students' IPAS learning achievement is expected to extend the current body of knowledge and provide additional evidence regarding the educational potential of interactive game-based learning media.

METHODOLOGY

Research Design

This study employed a quantitative approach using a quasi-experimental method with a nonequivalent control group design. This study employed a quasi-experimental nonequivalent control group design because the existing classroom groups could not be randomly assigned while still allowing meaningful comparisons between the experimental and control groups (Creswell & Creswell, 2023). Both groups completed a pretest before the intervention and a posttest after the intervention. The experimental group received instruction using *MarvelApp* educational game learning media, whereas the control group received conventional classroom instruction. The research design is illustrated in Figure 1.

Experimental Group	<i>pretest</i>	<i>treatment</i>	<i>posttest</i>
	O1	X1	O2
Control Group	<i>pretest</i>	<i>treatment</i>	<i>posttest</i>
	O3	-	O4

Figure 1. Nonequivalent Control Group Research Design (Adapted from Sugiyono, 2021)

The participants were 90 fifth-grade students from two public elementary schools. The experimental class consisted of 44 students from SDN 5 Bago, while the control class consisted of 46 students from SDN 3 Kepatihan. Because the participants were drawn from intact classrooms, purposive sampling was employed. The schools were selected based on comparable academic characteristics, implementation of the same Merdeka Curriculum, similar student backgrounds, and teachers' willingness to participate in the study.

As illustrated in Figure 1, both the experimental and control groups completed a pretest before the intervention to establish their initial level of IPAS learning achievement. The experimental group then received instruction using *MarvelApp* educational game media (X_1), whereas the control group was taught through conventional instructional methods without the intervention. Following the instructional period, both groups completed the same posttest to assess changes in learning achievement and to determine the effect of the *MarvelApp* educational game on students' IPAS learning achievement.

Instruments and Data Collection

The primary research instrument was an IPAS learning achievement test consisting of 20 multiple-choice items developed according to the Grade 5 curriculum, particularly the topic How We Live and Grow. The instrument was administered as both a pretest and a posttest to measure students' learning achievement before and after the intervention. Prior to the main study, the instrument was piloted with 90 Grade 5 students to evaluate its psychometric properties.

Instrument quality was examined through construct validity and internal consistency reliability. Construct validity was assessed using Exploratory Factor Analysis (EFA), while reliability was evaluated using Cronbach's Alpha in JAMOMI version 2.7.12. Following the recommendation of Taber (2018), a Cronbach's alpha coefficient of at least 0.70 was considered indicative of acceptable reliability. The interpretation of Cronbach's Alpha used in this study is presented in Table 1.

Table 1. Values and Interpretations of Cronbach's Alpha

Cronbach's Alpha	Interpretation
$\leq 0,90$	Excellent
0,80 – 0,89	Good
0,70 – 0,79	Acceptable
0,60 – 0,69	Questionable
0,50 – 0,59	Poor
< 0.50	Unreliable

Adapted from DeVellis (2017) and Taber (2018)

Data collection was conducted during the second semester of the 2024/2025 academic year. The procedure began with administering the pretest to both groups, followed by the implementation of the instructional intervention. The experimental group learned using *MarvelApp* educational game media, whereas the control group received conventional instruction. After completing the learning sessions, both groups completed the posttest using the same instrument to measure changes in learning achievement.

Data Analysis

The collected data were analyzed using JAMOMI version 2.7.12. Before testing the research hypothesis, the quality of the research instrument was evaluated through reliability analysis using Cronbach's Alpha and construct validity analysis using Exploratory Factor Analysis (EFA). Cronbach's alpha values of 0.70 or higher indicated acceptable internal consistency (Taber, 2018).

Prior to hypothesis testing, the assumptions of normality and homogeneity were examined. Normality was assessed using the Shapiro–Wilk test, whereas homogeneity of variance was evaluated using Levene's test. For both tests, a significance value greater than 0.05 indicated that the assumptions were met (Field, 2018; Kim, 2013).

After the assumptions were met, an independent samples t-test was conducted to compare the posttest scores of the experimental and control groups at a significance level of $\alpha = 0.05$. The hypotheses were formulated as follows:

H₀: There is no significant difference in IPAS learning achievement between students taught using *MarvelApp* educational game media and those taught using conventional instruction ($\mu_1 = \mu_2$).

H₁: There is a significant difference in IPAS learning achievement between students taught using *MarvelApp* educational game media and those taught using conventional instruction ($\mu_1 \neq \mu_2$).

Ethical Statement

This study involved human participants, so ethical principles were carefully considered throughout the research process. Permission to conduct the study was obtained from the participating schools before data collection began. Teachers, students, and parents or legal guardians were informed about the purpose and procedures of the study, and participation was voluntary. Students were assured

that their participation would not affect their academic evaluation and that they could withdraw from the study at any stage without penalty.

All collected data were treated confidentially and analyzed anonymously. Students' identities were replaced with numerical codes to protect their privacy, and the research findings are reported only in aggregate form. The intervention was conducted as part of regular classroom instruction without exposing participants to any physical or psychological risks.

RESULTS

The results of this study present the psychometric properties of the learning achievement instrument and examine the effect of *MarvelApp* educational game learning media on the IPAS learning achievement of Grade 5 elementary school students. The findings include the results of instrument reliability and validity testing, assumption testing, and hypothesis testing. These analyses provide empirical evidence regarding the effectiveness of the proposed learning media.

Instruments Test

This study employed a learning achievement test consisting of 20 multiple-choice items administered as both a pretest and a posttest. The instrument was piloted with 90 Grade 5 elementary school students to evaluate its reliability and construct validity before the main experiment. The results of the instrument analysis using JAMOVI are presented in Table 2.

Table 2. Scale Reliability Statistics

Mean	Cronbach's α
0.787	0.972

Source: Jamovi, 2025

Based on Table 2, the learning achievement instrument obtained a Cronbach's Alpha coefficient of 0.972, indicating excellent internal consistency according to the criteria proposed by Adapted from DeVellis (2017) and Taber (2018). This value exceeds the minimum acceptable threshold of 0.70 recommended by Taber (2018), demonstrating that the instrument is highly reliable. In addition, the mean value of 0.787 indicates that the test items were well understood by the participants and consistently measured students' learning achievement. Therefore, the instrument was considered appropriate for measuring Grade 5 students' IPAS learning achievement.

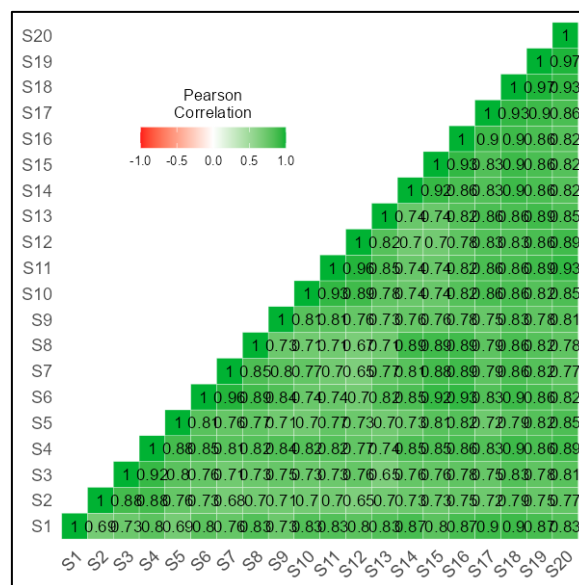


Figure 2. Correlation Heatmap of the Learning Achievement Instrument (Jamovi, 2025)

The reliability findings are further supported by the correlation heatmap presented in Figure 2. Most cells are displayed in green, indicating positive correlations among the test items. This consistent

positive relationship suggests that all items measure the same underlying construct of learning achievement. Consequently, the heatmap provides additional evidence that the instrument possesses strong internal consistency and a coherent measurement structure.

Table 3. Bartlett's Test of Sphericity

χ^2	df	p
6506	190	<.001

Source: Jamovi, 2025

The construct validity analysis presented in Table 3 produced a Bartlett's Test of Sphericity value of $\chi^2 = 6506$, $df = 190$, and $p < .001$. This significant result indicates that the correlation matrix is suitable for factor analysis because the relationships among the test items are sufficiently strong. Therefore, the instrument satisfies the statistical requirements for Exploratory Factor Analysis (EFA), providing evidence of acceptable construct validity.

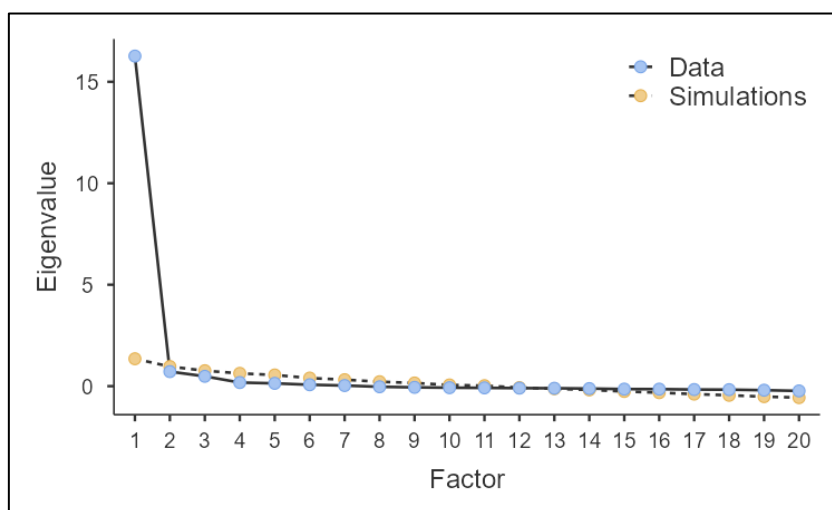


Figure 3. Scree Plot of the Exploratory Factor Analysis

The scree plot shown in Figure 3 further supports the construct validity results. A clear elbow appears after the first factor, indicating that one dominant factor explains most of the variance in the instrument. This finding suggests that the instrument is unidimensional and consistently measures a single construct, namely students' learning achievement. Together, the Bartlett's test and scree plot confirm the strong internal structure of the instrument.

To evaluate the effectiveness of *MarvelApp* educational game learning media, a quasi-experimental design with pretest and posttest measurements was implemented. The study involved 90 Grade 5 students, comprising 46 students in the control group and 44 students in the experimental group. The control group was drawn from SDN 3 Kepatihan, whereas the experimental group was selected from SDN 5 Bago.

Assumption Test

Before hypothesis testing, the assumptions of normality and homogeneity were examined using the validated learning achievement scores. Both the pretest and posttest data from the experimental and control groups were analyzed using JAMOVI version 2.7.12. These prerequisite analyses ensured that the data satisfied the assumptions required for parametric statistical testing.

Table 4. Shapiro–Wilk Normality Test

	W	p
Pretest	0.979	0.590
Posttest	0.971	0.303

Source: Jamovi, 2025

As shown in Table 4, the Shapiro–Wilk test produced significance values of 0.590 for the pretest and 0.303 for the posttest, both of which exceeded the significance level of 0.05. These findings indicate that the data are normally distributed. Therefore, the assumption of normality was satisfied for both measurement occasions.

Table 5. Homogeneity of Variance Test (Levene's Test)

	W	p
Pretest	0.979	0.590
Posttest	0.971	0.303

Source: Jamovi, 2025

The homogeneity test results presented in Table 5 also showed significance values greater than 0.05 for both the pretest and posttest. These findings indicate that the variances of the two groups are homogeneous. Because both the normality and homogeneity assumptions were satisfied, the data were considered appropriate for further analysis using an independent samples t-test.

Hypothesis Test

Table 6. Independent Samples t-Test

		Statistic	df	p
Pretest	Student's t	0.105	43.0	0.917
Post test	Student's t	3.539	43.0	<.001

Source: Jamovi, 2025

Table 6 presents the results of the independent samples t-test. For the pretest, the analysis yielded $t = 0.105$, $df = 43.0$, and $p = 0.917$, indicating no significant difference between the experimental and control groups before the intervention. This result confirms that both groups had comparable baseline learning achievement.

For the posttest, the analysis produced $t = 3.539$, $df = 43.0$, and $p < .001$, indicating a statistically significant difference between the two groups after the intervention. The higher posttest t-value demonstrates that students who learned using *MarvelApp* educational game media achieved significantly better learning outcomes than those who received conventional instruction. These findings indicate that the observed improvement in learning achievement can be attributed to the instructional intervention rather than to differences in the groups' initial abilities. Therefore, *MarvelApp* educational game learning media was found to have a significant positive effect on Grade 5 students' IPAS learning achievement.

DISCUSSION

This study examined the effect of *MarvelApp* educational game learning media on the IPAS learning achievement of Grade 5 elementary school students using a quasi-experimental pretest-posttest control group design. The findings demonstrated that students in the experimental group achieved higher posttest scores than those in the control group, indicating that the intervention positively influenced learning achievement. These results suggest that integrating educational game media into IPAS instruction provides a more effective learning experience than conventional teaching approaches. The findings also support the view that interactive digital learning environments are better suited to the learning characteristics of elementary school students, who benefit from visual, engaging, and activity-based instruction (Clark & Mayer, 2016; OECD, 2023; Darling-Hammond et al., 2020).

The positive effect of *MarvelApp* can be explained by its ability to transform abstract IPAS concepts into interactive learning experiences. The platform allows teachers to integrate multimedia elements, including images, animations, quizzes, and game-based activities, which encourage students to participate actively throughout the learning process. Rather than receiving information passively,

students interact directly with the instructional content and receive immediate feedback on their performance. Such learning experiences promote deeper conceptual understanding, increase students' attention, and facilitate knowledge retention (Kusuma et al, 2024; Mayer, 2021; Clark & Mayer, 2023). Consequently, students become more engaged and demonstrate greater confidence in understanding the topic *How We Live and Grow*.

The findings are consistent with cognitive learning theory, which emphasizes that meaningful visual and interactive experiences facilitate information processing and strengthen long-term memory. They also support constructivist learning theory, which argues that knowledge is developed through active participation and direct experience rather than passive reception of information. In the present study, students interacted with learning materials through quizzes, simulations, and problem-solving activities that required continuous engagement. These activities encouraged students to think critically, evaluate their responses, and improve their understanding through immediate corrective feedback. This interpretation is consistent with previous studies reporting that educational game-based learning enhances conceptual understanding, learning motivation, and classroom engagement (Fauzi et al., 2022; Rahmawati et al., 2026; Ramdhani et al., 2026).

The present findings are also in agreement with previous empirical studies on digital game-based learning in elementary education. Fadilah et al. (2025), Chamelia et al. (2025), and Ge'e and Dahlan (2025) reported that interactive educational media significantly improved students' IPAS learning outcomes compared with conventional instruction. Similarly, Kusuma et al. (2024), and Qomaria et al. (2024) found that educational games increased students' participation, conceptual understanding, and academic achievement by creating enjoyable and student-centered learning environments. The consistency between the present findings and previous research strengthens the evidence that educational game-based learning media can effectively improve learning achievement in elementary education. This study extends the existing literature by providing empirical evidence for the effectiveness of *MarvelApp*, which has received relatively limited attention compared with more widely studied platforms such as *Wordwall*, *Quizizz*, and *Educaplay*.

From the instructional perspective, *MarvelApp* provides teachers with a flexible platform for designing more engaging and interactive IPAS learning activities. Teachers can organize learning materials through multimedia presentations, interactive quizzes, and game-based assessments that encourage students to participate actively throughout the lesson. These features help reduce students' boredom while creating opportunities for continuous practice and immediate feedback, both of which contribute to improved learning achievement (Clark & Mayer, 2016; Lewis & Sturdee, 2022; Naufal et al., 2025). Therefore, *MarvelApp* represents a practical alternative for teachers seeking to implement student-centered learning supported by digital technology.

The findings of this study have several important implications for educational research and practice. From a theoretical perspective, the results provide additional empirical evidence supporting cognitive learning theory and constructivist learning theory, demonstrating that interactive educational game media can facilitate meaningful learning and improve students' learning achievement (Mayer, 2021; Clark & Mayer, 2023). From a practical perspective, the findings suggest that integrating game-based digital media into IPAS instruction can enhance classroom engagement while helping students understand abstract concepts more effectively. Furthermore, this study contributes to the growing body of literature on technology-enhanced learning by providing empirical evidence of the effectiveness of *MarvelApp*, a platform that has received limited attention in previous educational research. These findings may serve as a reference for educators, curriculum developers, and future researchers seeking to design and evaluate innovative digital learning media for elementary education.

CONCLUSION

This study demonstrates that *MarvelApp* educational game learning media significantly improves the IPAS learning achievement of Grade 5 elementary school students. Students who learned through *MarvelApp* achieved higher learning achievement than those who received conventional instruction, indicating that integrating interactive educational games into classroom learning provides a more effective learning experience. These findings confirm that game-based digital media can support students' conceptual understanding by promoting active participation, sustained attention, and meaningful engagement throughout the learning process.

The findings also indicate that *MarvelApp* has considerable potential as an innovative learning medium for elementary IPAS instruction, particularly for topics that require students to understand abstract concepts through visual and interactive learning experiences. By combining multimedia elements, interactive activities, and immediate feedback, the platform creates a more engaging learning environment that supports student-centered instruction. Therefore, *MarvelApp* may serve as a practical alternative for teachers seeking to integrate digital technology into elementary classroom learning while enhancing students' learning achievement.

This study has several limitations. First, the research was conducted with a relatively small sample drawn from only two elementary schools, which may limit the generalizability of the findings to other educational contexts. Second, the intervention was implemented only for the IPAS topic How We Live and Grow, so the effectiveness of *MarvelApp* for other subjects or learning materials remains uncertain. Future research is therefore recommended to involve larger and more diverse samples, examine longer intervention periods, and investigate the effectiveness of *MarvelApp* across different subjects, grade levels, and educational settings.

Acknowledgement

The authors would like to express their sincere gratitude to Universitas Bhinneka PGRI for its support in facilitating this research and encouraging the publication of scientific work by students. The authors also extend their deepest appreciation to their academic supervisor for the invaluable guidance, constructive feedback, and continuous encouragement throughout every stage of this research. In addition, the authors are grateful to the principals, teachers, and Grade 5 students of SDN 3 Kapatihan and SDN 5 Bago for their cooperation, participation, and support during the data collection process. Their contributions were essential to the successful completion of this study.

REFERENCES

- Annetta, L., Johnson, A., Newton, M. H., & Franco, Y. (2024). Immersive spatial computing: how technology can improve science content reading and vocabulary in elementary schools. *Education Sciences*, 14(12), 1355. <https://doi.org/10.3390/educsci14121355>
- Brookhart, S. M., & McMillan, J. H. (2020). *Classroom Assessment and Educational Measurement*. Routledge. <https://doi.org/10.4324/9780429507533>
- Chamelia, N., Murjainah, M., & Oktavia, M. (2025). Pengaruh media edugame baamboozle terhadap hasil belajar IPAS kelas V di SD Negeri 195 Palembang. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, 11, 156–165. <https://doi.org/10.23969/jp.v10i02.27931>
- Chen, D.-Y., Huang, S.-Y., & Lin, C.-J. (2026). Concept map-facilitated game-based learning in the mobile era: a systematic review of journal publications from 2009 to 2024. *Int. J. Mob. Learn. Organ.*, 20(2), 208–234. <https://doi.org/10.1504/ijmlo.2026.152815>
- Clark, R. C., & Mayer, R. E. (2016). *E-Learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning (5th ed.)*. John Wiley & Sons, Inc. <https://doi.org/10.1002/9781119239086>
- Creswell, J. W., & Creswell, J. D. (2023). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (6th ed.)*. Sage.
- Cristóvão, A. M., Candeias, A. A., & Verdasca, J. L. (2020). Development of socio-emotional and creative skills in primary education: Teachers' perceptions about the Gulbenkian XXI school learning communities project. *Frontiers in Education*, 4, 160. <https://doi.org/10.3389/educ.2019.00160>
- Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, 24(2), 97–140. <https://doi.org/10.1080/10888691.2018.1537791>
- DeVellis, R. F. (2017). *Scale Development: Theory and Applications (Fourth Edition)*. SAGE Publications, Inc.
- Evitasari, P. D. A. N., & Putri, D. A. A. (2025). Pengaruh game edukasi Wordwall pada materi makna sila-sila Pancasila terhadap minat belajar siswa kelas IV SD Negeri 3 Mojosari. *Jurnal Inovatif Ilmu Pendidikan*, 7(1), 27–38.

- Fadilah, N., AR, M. M., & Kuswandi, I. (2025). Pengaruh media pembelajaran interaktif Wordwall terhadap hasil belajar IPAS di sekolah dasar. *Jurnal Ilmiah Pendidikan Citra Bakti*, 12(1), 56–66. <https://doi.org/10.38048/jipcb.v12i1.4701>
- Fauzi, M. H., Mutaqin, E. J., Rusmana, A., & Taofik, D. B. I. (2024). Pengaruh media pembelajaran game edukasi terhadap minat belajar siswa dalam pembelajaran IPA. *CaXra: Jurnal Pendidikan Sekolah Dasar*, 2(2), 134–141. <https://doi.org/10.31980/caxra.v2i2.853>
- Fharhah, S. F., & Widiyono, A. (2026). The effect of discovery learning assisted by augmented reality on fourth grade elementary students' science learning outcomes. *Jurnal Ilmiah Pendidikan Citra Bakti*, 13(2), 345–356. <https://doi.org/10.38048/jipcb.v13i2.6877>
- Field, A. P. (2018). *Discovering Statistics Using IBM SPSS Statistics (5th Edition)*. Sage.
- Ge'e, R. S., & Dahlan, Z. (2025). Pengaruh media interaktif Educaplay terhadap hasil belajar IPA peserta didik kelas V sekolah dasar. *Cetta: Jurnal Ilmu Pendidikan*, 8(2), 339–349. <https://doi.org/10.37329/cetta.v8i2.4184>
- Haq, E. D., Adiningsih, S., & Mushoda, E. (2026). The use of visual learning materials to improve learning outcomes in natural and social sciences (IPAS) in elementary schools. *The Prime Journal of Islamic Elementary School*, 2(1), 89–101. <https://doi.org/10.37459/theprime.v2i1.561>
- Hastuti, R. P., Taufiqulloh, T., & Nafiati, D. A. (2026). A quantitative needs analysis of digital-based natural and social science teaching materials in elementary schools of Pemalang regency. *Journal of Innovation and Research in Primary Education*, 5(2), 4054–4063. <https://doi.org/10.56916/jirpe.v5i2.3859>
- Kim, H.-Y. (2013). Statistical notes for clinical researchers: assessing normal distribution (2) using skewness and kurtosis. *Restorative Dentistry & Endodontics*, 38(1), 52. <https://doi.org/10.5395/rde.2013.38.1.52>
- Kusuma, A., Mashari, A., Al Islam Tunas Bangsa, S., & Lampung, B. (2024). Pengaruh game edukasi Wordwall pada hasil belajar IPA siswa kelas IV SDN Galih Lunik. *Ahsanta Jurnal Pendidikan*, 10(1), 57–68. <https://doi.org/10.2503/ajp.v10i1.56>
- Levie, W. H., & Lentz, R. (1982). Effects of text illustrations: A review of research. *ECTJ*, 30(4), 195–232. <https://doi.org/10.1007/BF02765184>
- Lewis, M., & Sturdee, M. (2022). Curricula design & pedagogy for sketching within HCI & UX education. *Frontiers in Computer Science*, 4, 826445. <https://doi.org/10.3389/fcomp.2022.826445>
- Lubis, N. A., Rozi, F., Mailani, E., & Ananda, L. J. (2025). Pengembangan media pembelajaran berbasis game edukasi Wordwall untuk meningkatkan hasil belajar pada siswa kelas IV pada mata pelajaran IPAS SD negeri 100302 Pargarutan T.A 2024/2025. *Didaktik: Jurnal Ilmiah PGSD FKIP Universitas Mandiri*, 11(2), 243–252. <https://doi.org/10.36989/didaktik.v11i02.6045>
- Mayer, R. E. (2020). *Multimedia Learning (3rd ed.)*. Cambridge University Press. <https://doi.org/10.1017/9781316941355>
- Naufal, A. G. A., Jadmiko, R. S., & Satria, A. P. (2025). Pengembangan mobile learning berbantuan Marvel App pada pembelajaran matematika sekolah dasar. *Jurnal Pengabdian Masyarakat Dan Riset Pendidikan*, 4(1), 2445–2453. <https://doi.org/10.31004/jerkin.v4i1.1804>
- Ningrum, A. W., Apriza, B., Rohmani, R., Mahendra, Y., & Adelia, B. (2025). Game-based learning in improving the pedagogic competence of prospective elementary school teachers: A systematic literature review. *Journal for Lesson and Learning Studies*, 8(3), 547–558. <https://doi.org/10.23887/jlls.v8i3.103047>
- OECD. (2023). PISA 2022 results (volume I): *The state of learning and equity in education: Vol. I*. OECD Publishing. <https://doi.org/10.1787/53f23881-en>
- Plass, J. L., Mayer, R. E., & Homer, B. D. (2020). *Handbook of Game-Based Learning*. MIT Press. <https://doi.org/10.26529/cepsj.1910>
- Prastiyo, A., Wardani, S., Subali, B., & Widiati, N. (2026). Trends in the development of digital literacy-based learning media for Indonesian language instruction in elementary schools from 2020 to 2025. *Jurnal Penelitian Humaniora*, 31(1), 43–55. <https://doi.org/10.21831/hum.v31i1.92307>
- Prayoga, B. G., Wardani, S., Harniangsih, H., Subali, B., & Widiati, N. (2025). Literature review on the application of interactive media in science learning in elementary schools for the period 2020-2025. *Journal of Educational Sciences*, 9(4), 2085–2100. <https://doi.org/10.31258/jes.6.3.p.444-458>

- Priliani, N., Suminar, T., Widiarti, N., & Widiyatmoko, A. (2026). The effectiveness of interactive flipbooks in IPAS learning in elementary schools: A systematic literature review. *Journal of Innovation and Research in Primary Education*, 5(2), 3161–3172. <https://doi.org/10.56916/jirpe.v5i2.3189>
- Qomaria, E., Sumarno, S., Roshayanti, F., & Utami, S. (2024). Pengaruh penggunaan game edukasi berbasis Wordwall dalam pembelajaran IPAS terhadap hasil belajar siswa. *Ainara Journal (Jurnal Penelitian Dan PKM Bidang Ilmu Pendidikan)*, 5(4), 544–552. <https://doi.org/10.54371/ainj.v5i4.664>
- Rahmawati, R., Hidayati, W., Widiarti, N., & Avrilianda, D. (2026). Educational games, gamification, and teacher roles in supporting primary students' cognitive development: A systematic literature review. *Diniyah: Jurnal Pendidikan Dasar*, 7(1), 51–70. <https://doi.org/10.31332/dy.v7i1.14299>
- Ramdhani, I., Samsudin, A., Saepuzaman, D., Risnatati, R., & Musyadad, M. (2026). The impact of game-based learning on cognitive and affective outcomes in science education: A systematic review. *Jurnal Pendidikan Fisika Dan Teknologi (JPFT)*, 12(1), 221–239. <https://doi.org/10.29303/jpft.v12i1.11085>
- Safira, S., Lamada, M. S., & Rais, M. (2025). Pengaruh media pembelajaran berbasis game terhadap minat belajar siswa kelas 4 pada mata pelajaran bahasa Indonesia di SD Negeri Manjalling. *Journal of Computers, Informatics, and Vocational Education*, 2(3), 25–30. <https://journal.unm.ac.id/index.php/CIVE/article/view/10150>
- Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology*, 60, 101832. <https://doi.org/10.1016/j.cedpsych.2019.101832>
- Seprie, S., Wuryandani, W., & Muthmainah, M. (2025). Transforming primary education: Balancing social skills and academic achievement through global inquiry-based learning models. *Frontiers in Education*, 10, 1512274. <https://doi.org/10.3389/feduc.2025.1512274>
- Sulaiman, N. S., Zulkifli, N. S. A., & Kadir, T. A. A. (2025). Enhancing education through game-based learning: Benefits and future directions. *2025 IEEE International Conference on Industrial Technology & Computer Engineering (ICITCE)*, 99–104. <https://doi.org/10.1109/ICITCE65255.2025.11210766>
- Taber, K. S. (2018). The use of Cronbach's Alpha when developing and reporting research instruments in science education. *Research in Science Education*, 48, 1273–1296. <https://doi.org/10.1007/s11165-016-9602-2>
- UNESCO. (2021). *Reimagining our futures together: A new social contract for education*. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000379707>
- Wulandari, H., Nurulpaik, I., Sopandi, W., & Triwahyuni, I. (2025). The effectiveness of augmented reality-based learning media on students' conceptual understanding of science and social studies in the solar system topic at SDN Sanding 2. *International Conference on Elementary Education Volume*, 8(1), 582–594. <https://proceedings.upi.edu/icee/article/view/558>