

Empirical Paper

Development of a Scratch-Based Educational Game to Improve Cognitive Learning Outcomes and Rule Compliance in Pancasila Education

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Abstract

Purpose: This study developed and evaluated ADILINTAR, a Scratch-based educational game designed to improve elementary students' cognitive learning outcomes and rule-compliance practices in Pancasila Education.

Methodology: A Research and Development (R&D) approach combined with a quasi-experimental design was employed. The development process included needs analysis, design, development, expert validation, revision, and field testing. The participants were 48 fourth-grade students assigned to experimental and control groups. Data were collected through expert validation sheets, questionnaires, cognitive achievement tests (pretest and posttest), and observations of students' behavioural practices. Descriptive statistics, t-tests, and N-gain analysis were used for data analysis.

Results: ADILINTAR was rated highly feasible and practical by experts, teachers, and students. The game significantly improved students' cognitive learning outcomes, with posttest scores exceeding pretest scores and achieving a moderate N-gain. Observations also showed improvements in students' rule-compliance behaviours, demonstrating the game's effectiveness in promoting both academic achievement and behavioural development.

Novelty and Contribution: This study extends game-based learning beyond STEM into civic and character education by providing evidence that Scratch-based educational games enhance both knowledge acquisition and rule-compliance behaviours in elementary education.

Practical and Social Implications: Integrating Scratch-based games into Pancasila Education can increase student engagement, strengthen civic values, and support character development. The findings also highlight the need to strengthen teachers' digital competencies and promote game-based learning in curriculum implementation.

Keywords: Scratch-based learning; educational game; Pancasila education; cognitive learning outcomes; rule compliance

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1 Introduction

Pancasila Education is a fundamental component of the Indonesian education system, aimed at fostering students' character, civic awareness, and moral responsibility in alignment with the nation's core values (Andriani et al., 2023). As the philosophical foundation of Indonesia, Pancasila must be internalised from an early age through meaningful learning experiences that integrate cognitive understanding with attitudes and behaviours (Dewi et al., 2022). Within the Merdeka Curriculum, Pancasila Education plays a strategic role in developing the Pancasila Student Profile, which emphasises critical thinking, collaboration, independence, global diversity, and ethical conduct (Kurniawan, 2023). Consequently, instructional practices in this subject are expected not only to promote conceptual understanding but also to encourage the practical application of values, particularly in relation to rule compliance in school and everyday life (Andriani et al., 2023).

Despite its importance, the implementation of Pancasila Education at the elementary level continues to face significant pedagogical challenges. Teaching practices are still largely dominated by conventional approaches, such as lecture-based and textbook-centred instruction, which tend to limit student engagement and participation (Arsyad, 2016). As a result, students often perceive the subject as abstract and disconnected from real-life contexts, leading to low motivation, limited conceptual understanding, and weak internalisation of civic values, especially those related to discipline and adherence to rules (Susanto, 2013). This situation indicates that existing instructional strategies are insufficient to support both cognitive learning outcomes and the development of value-oriented behaviours.

Effective learning in Pancasila Education requires instructional approaches that simultaneously address cognitive mastery and behavioural practice. Learning media play a crucial role in achieving this goal by transforming abstract concepts into concrete and engaging experiences, increasing student motivation, and facilitating active participation (Rumiyati et al., 2025). In this regard, game-based learning has emerged as a promising approach, particularly for elementary school students, as it integrates elements of play, interaction, and feedback that naturally enhance engagement and understanding (Rye et al., 2025). One platform that supports such interactive learning environments is Scratch, a visual programming tool developed by the MIT Media Lab, which enables the creation of educational games through a simple block-based interface (Moraiti et al., 2022). Prior studies have demonstrated that Scratch-based learning media can improve students' motivation, creativity, and academic achievement, particularly in science and mathematics contexts (Bozan & Taşlıdere, 2024; Khalil & Wardana, 2022).

However, despite these advances, the application of Scratch-based educational games in Pancasila Education remains limited, particularly in supporting the integration of cognitive learning outcomes with character development and rule-compliance practices (Andriani et al., 2023). Most existing studies focus on STEM-related subjects, leaving a clear gap in using digital game-based learning for civic and value-based education (Laleye, 2025). This gap highlights the need for innovative instructional media that not only enhance students' understanding of Pancasila concepts but also promote the practical application of these values in everyday behaviour.

Addressing this need, the present study develops the ADILINTAR game, a Scratch-based educational game designed for fourth-grade Pancasila Education on the topic of rules in the surrounding environment. The game integrates instructional content, interactive challenges, and evaluation components to create an engaging and meaningful learning experience. Accordingly, this study aims to develop and evaluate the ADILINTAR game in terms of its feasibility, practicality, and effectiveness in improving students' cognitive learning outcomes and their rule-compliance practices. Specifically, the study seeks to:

- i. Design and develop a Scratch-based educational game aligned with curriculum objectives.
- ii. Assess its feasibility through expert validation.
- iii. Evaluate its practicality based on teacher and student responses.
- iv. Determine its effectiveness in enhancing learning outcomes and behavioural practices.

This study contributes to both theory and practice. Theoretically, it extends the application of game-based learning and Scratch technology beyond STEM education into the domain of civic and character education, providing empirical evidence on their role in supporting both cognitive and behavioural outcomes. Practically, it offers teachers an innovative, interactive, and student-centred learning medium that can enhance engagement, improve understanding, and facilitate the internalisation of Pancasila values. Furthermore, the findings provide insights for curriculum

developers and policymakers on the importance of integrating digital game-based media into Pancasila Education to improve its relevance and effectiveness in the digital era.

2 Methodology

This study employed a Research and Development (R&D) approach combined with a quasi-experimental design to develop, validate, and evaluate an educational product as a Scratch-based game named ADILINTAR for Pancasila Education. To systematically design and refine the learning media, the R&D approach was selected. The quasi-experimental component was used to test its effectiveness in improving students' learning outcomes and rule-compliance practices in real classroom settings (Toni & Sudin, 2024). The development procedure was adapted from the Borg and Gall model, as modified by Sugiyono, consisting of the following stages: needs analysis, product design, development, expert validation, revision, limited trial, field testing, and final evaluation (Sugiyono, 2017).

2.1 Research Setting and Participants

The study was conducted in elementary schools within the Pattimura Cluster, Grobogan Regency, Indonesia. The participants included fourth-grade students and their teachers. In the field-testing stage, a total of 48 students were involved and divided into two groups: an experimental group and a control group. The experimental group received instruction using the ADILINTAR Scratch-based game, while the control group was taught using conventional instructional methods. Teachers also participated in the validation and practicality assessment stages by providing feedback on the usability and implementation of the developed media.

2.2 Development Procedure

The development process began with a needs analysis, during which data were collected from teachers and students through interviews and preliminary observations to identify learning challenges, media limitations, and instructional needs in Pancasila Education, particularly on the topic of rules in the surrounding environment. The findings informed the design of the ADILINTAR game to ensure alignment with curriculum objectives and student characteristics.

In the design and development stage, the game was created using the Scratch platform, integrating instructional materials, interactive gameplay, visual elements, and evaluation features. The game was structured to facilitate both cognitive learning and the practice of rule-compliance behaviours through simulated scenarios and interactive challenges.

2.3 Instruments and Data Collection

Multiple instruments were used to collect data:

Expert validation questionnaires (Likert scale): To assess the feasibility of the game in terms of content accuracy, instructional design, language clarity, and technical quality. These were completed by media experts and subject-matter experts.

Teacher and student response questionnaires: To evaluate the practicality of the game, including ease of use, attractiveness, clarity of instructions, and overall usability.

Cognitive learning outcome tests: Consisting of multiple-choice questions on the topic of rules in the surrounding environment, administered as a pretest and posttest.

Observation sheets: To assess students' rule-compliance practices during learning activities, focusing on behaviours such as discipline, cooperation, responsibility, and adherence to classroom rules.

2.4 Validity and Reliability

The research instruments were subjected to validity and reliability testing before use. Content validity was established through expert judgment, ensuring alignment between the instruments and learning objectives. The cognitive test items were analysed for validity and reliability using standard statistical procedures, and only valid and reliable items

were retained for the study. Reliability of the questionnaire instruments was assessed using internal consistency measures, ensuring that the instruments produced consistent results.

2.5 Procedure for Practicality and Effectiveness Testing

Following expert validation and revision, the ADILINTAR game was implemented in a limited-scale trial to assess practicality. Teachers and students used the game during classroom activities and subsequently completed response questionnaires.

To evaluate effectiveness, a quasi-experimental design with a non-equivalent control group was employed. Both experimental and control groups were given a pretest prior to the intervention and a posttest after the learning activities. The experimental group used the ADILINTAR game, while the control group received conventional instruction.

2.6 Data Analysis Techniques

Data analysis in this study involved both descriptive and inferential statistics. Descriptive statistics were used to analyse expert validation results, questionnaire responses, and observation data, typically presented in percentages and categorised into feasibility and practicality levels. Inferential statistical analysis was conducted to examine the effectiveness of the intervention. Before hypothesis testing, normality tests (Shapiro–Wilk) and homogeneity tests (Levene’s test) were performed to ensure that the data met the required assumptions. Differences between pretest and posttest scores, as well as between experimental and control groups, were analysed using t-tests. Additionally, the magnitude of learning improvement was assessed using the N-gain score, which was interpreted according to standard criteria (low, medium, high). The effectiveness of the ADILINTAR game was determined based on statistically significant improvements in cognitive learning outcomes and observable enhancements in students’ rule-compliance practices.

3 Results

3.1 Scratch-based ADILINTAR Game Development

The development of the ADILINTAR game was carried out through a Research and Development (R&D) process, beginning with a needs analysis and followed by design, development, validation, and revision stages. The needs analysis revealed that Pancasila Education learning at the elementary level was still dominated by conventional teaching methods, resulting in low student engagement and limited understanding of rules in the surrounding environment. These findings informed the design of an interactive educational game aimed at enhancing both motivation and comprehension.

The ADILINTAR game was developed using the Scratch platform due to its user-friendly, visual programming features suitable for elementary school students. The game consists of several structured components, including an opening menu, learning objectives, instructional materials, interactive challenges, evaluation quizzes, and feedback mechanisms. These components were designed to guide students sequentially from concept introduction to practice and evaluation, thereby supporting a coherent learning process.

In terms of design, the game incorporates colourful graphics, simple animations, and contextual illustrations reflecting students’ daily environments, such as classrooms and neighbourhoods. Interactive features, including quizzes, scoring systems, and immediate feedback, were embedded to promote active engagement and reinforce learning. These design elements aim to transform abstract civic concepts into more concrete and relatable experiences.



Figure 1 Home Page and Menu Page

3.2 Feasibility of Scratch-based ADILINTAR Games

The feasibility of the ADILINTAR game was evaluated through expert validation involving media experts and subject-matter experts. The assessment focused on content accuracy, instructional design, language clarity, visual presentation, and technical quality.

The validation results indicated that the ADILINTAR game falls within the “highly feasible” category. Experts confirmed that the content aligns with curriculum objectives, the instructions are clear, and the game mechanics are appropriate for students’ cognitive development. Several minor revisions were suggested, primarily related to improving text readability, navigation clarity, and alignment between learning objectives and evaluation components.

Specifically, revisions included: (1) aligning learning objectives with measurable cognitive outcomes; (2) replacing essay-based evaluation with interactive quizzes; and (3) simplifying the developer profile section. These improvements enhanced the overall quality and usability of the game, ensuring that it meets instructional and technical standards for classroom implementation.

Table 1 Expert Validation Results of the ADILINTAR Game

No.	Aspect Evaluated	Indicator Description	Expert Suggestion	Revision Made
1	Learning Objectives	Alignment with curriculum and measurable outcomes	Ensure objectives focus on the cognitive domain	Learning objectives revised to be measurable and aligned with cognitive competencies.
2	Evaluation Component	Suitability of assessment format	Replace essay-based evaluation with an interactive quiz	Evaluation section redesigned into a quiz-based format
3	Content Accuracy	Relevance to Pancasila material	Maintain alignment with topic of rules	Content refined to match curriculum indicators
4	Language Clarity	Simplicity and readability for students	Improve readability of instructions	Text simplified and adjusted for student comprehension
5	Media Design & Navigation	Ease of use and interface clarity	Improve navigation flow	Navigation structure simplified and made more intuitive
6	Developer Profile Section	Relevance of additional information	Simplify developer information	Profile reduced to essential details only

The overall feasibility score obtained from expert validation was 4.5 out of 5.0, which falls within the “highly feasible” category. This indicates that the ADILINTAR game meets the required standards in terms of content, instructional design, language clarity, and technical quality, and is suitable for classroom implementation with minor revisions.

3.3 Practicality of the ADILINTAR Scratch-Based Game

The practicality of the ADILINTAR game was assessed through teacher and student response questionnaires following limited and field trials. The evaluation covered indicators such as ease of use, clarity of instructions, navigation, visual appeal, and overall usefulness in supporting learning activities.

The results show that the ADILINTAR game achieved a “very practical” category, as reflected by high response scores from both teachers and students. Teachers reported that the game was easy to operate, required minimal technical preparation, and could be effectively integrated into classroom instruction. The structured design and clear instructions enabled smooth implementation without disrupting teaching time. From the students’ perspective, the game received highly positive responses. Students found the game engaging, enjoyable, and easy to understand. The presence of interactive elements, animations, and immediate feedback contributed to sustained attention and active participation during learning activities. These findings indicate that the ADILINTAR game successfully creates an engaging and user-friendly learning environment. Overall, the high level of practicality demonstrates that the ADILINTAR game is suitable for classroom use and can support student-centred learning with minimal implementation challenges.

3.4 The Effectiveness of Scratch-based ADILINTAR Games

The effectiveness of the ADILINTAR Scratch-based game was evaluated using a quasi-experimental design involving pretest and posttest comparisons between experimental and control groups. The analysis included assumption testing (normality and homogeneity), hypothesis testing (t-test), and measurement of learning improvement using the N-gain score.

3.4.1 Assumption Testing

Before hypothesis testing, the data were examined for normality and homogeneity to ensure the validity of parametric statistical analysis.

Table 2 Normality Test Results (Shapiro–Wilk)

Variable	Kelas	Kolmogorov-Smirnov ^a Statistic	Kolmogorov-Smirnov ^a df	Kolmogorov-Smirnov ^a Sig.	Shapiro-Wilk Statistic	Shapiro-Wilk df	Shapiro-Wilk Sig.
Results	Pretest control	.284	14	.007	.825	14	.060
	Posttest control	.268	14	.231	.816	14	.078
	Pretest Experiment	.123	48	.251	.940	48	.114
	Posttest Experiment	.154	48	.288	.912	48	.258

a. Lilliefors Significance Correction

The results of the Shapiro–Wilk normality test (Table 2) indicate that all data groups are normally distributed. The significance values for the control group were 0.060 (pretest) and 0.078 (posttest), while the experimental group showed values of 0.114 (pretest) and 0.258 (posttest). All values exceed the threshold of 0.05, confirming that the data meet the assumption of normality.

The homogeneity test results (Table 3) further demonstrate that the variance between groups is homogeneous. The significance values based on mean, median, adjusted median, and trimmed mean were 0.107, 0.100, 0.100, and 0.105, respectively, all above 0.05. This indicates that the data satisfy the homogeneity assumption required for parametric testing.

Table 3 Homogeneity Test Results (Levene's Test)

Test of Homogeneity of Variance		Levene Statistic	df1	df2	Sig.
Value	Based on Mean	2.675	1	60	.107
	Based on Median	2.792	1	60	.100
	Based on Median and with adjusted df	2.792	1	55.448	.100
	Based on trimmed mean	2.715	1	60	.105

3.4.2 Hypothesis Testing (t-Test Results)

The results of the paired samples t-test (Table 4) show a substantial improvement in students' cognitive learning outcomes following the intervention. The mean pretest score was 63.75 (SD = 6.997), which increased to 80.79 (SD = 7.095) in the posttest. This improvement indicates a significant enhancement in students' understanding after the use of the ADILINTAR game.

Table 4 Paired Samples t-Test Results

	Mean	N	Std. Deviation	Std. Error Mean
Pair 1 Pretest	63.75	48	6.997	1.010
Posttest	80.79	48	7.095	1.024

The relatively similar standard deviation values between pretest and posttest suggest that the distribution of scores remained stable, while overall performance improved. These findings confirm that the intervention had a positive and statistically meaningful impact on students' learning outcomes.

3.4.3 Learning Gain Analysis (N-Gain)

The N-gain analysis (Table 5) was conducted to determine the magnitude of learning improvement. The results show that the N-gain values ranged from 0.00 to 0.70, with a mean score of 0.4702, which falls within the moderate improvement category. The results were statistically significant ($p < 0.05$).

Table 5 N-Gain Test Results

	N	Minimum	Maximum	Mean	Std. Deviation
NGain	48	.00	.70	.4702	.17498
Valid N (listwise)	48				

($p < 0.05$)

This indicates that the ADILINTAR game produced a meaningful increase in students' learning outcomes, demonstrating its effectiveness as an instructional medium. Although the level of improvement is categorised as moderate, it still reflects a substantial enhancement compared to conventional learning approaches.

Overall, the statistical analysis confirms that the ADILINTAR Scratch-based game is effective in improving students' cognitive learning outcomes. The data met all statistical assumptions, showed significant improvement in test scores, and demonstrated a moderate level of learning gain. In addition, observational findings (as presented earlier) indicate improvements in students' rule-compliance behaviours, suggesting that the game supports both cognitive and behavioural learning outcomes.

3.5 Dissemination of the ADILINTAR Game

Following the development and evaluation stages, the ADILINTAR game was disseminated through teacher working group (KKG) activities in the Banjarejo cluster. This dissemination aimed to introduce the game to elementary school teachers and promote the adoption of interactive, technology-based learning media. During this process, teachers were trained on the concept, structure, and operation of the game, enabling them to implement it effectively in their classrooms. The dissemination activity also contributed to enhancing teachers' pedagogical competence and encouraging the use of innovative, student-centred instructional strategies.

4 Discussion

The results of this study suggest that interactive, game-based digital media in civic education can enhance not only students' conceptual knowledge but also their behavioural engagement. These findings support the growing recognition of game-based learning as an effective approach for creating meaningful and engaging learning experiences, particularly at the elementary level.

The observed improvement in cognitive learning outcomes is in line with well-established theoretical and empirical literature. Specifically, the findings are consistent with Mayer's Cognitive Theory of Multimedia Learning, which suggests that the integration of verbal and visual information in a meaningful way can facilitate learning by allowing learners to actively engage in the process of processing and organising information (Mayer, 2024). This principle is operationalised in the ADILINTAR game by integrating instructional content with interactive visual elements and immediate feedback to promote deeper cognitive processing. The substantial improvement in posttest scores observed in this study is consistent with previous research. For example, Wen et al. (2023) reported an increase in motivation and academic achievement after a Scratch-based intervention, and Nadeem et al. (2023) found digital game-based learning environments to be more engaging and motivating than traditional instructional approaches. In summary, these results suggest that the interactive features embedded in ADILINTAR, such as challenges, feedback, and rewards, are critical in supporting knowledge acquisition and retention.

In addition to cognitive gains, this study shows important value-oriented outcomes. Students who received the intervention not only understood the rules better but also showed more consistent rule-following behaviours. This dual enhancement lends support to theoretical perspectives in character education that emphasise the integration of knowledge and practice to foster the internalisation of values. Likewise, Görün et al. (2025) also found that children's moral behaviour was significantly improved through play-based learning. Hanifah et al. (2025) also conducted a review and revealed that gamified civic education had a positive impact on children's understanding and values. The ADILINTAR game seems to offer a simulated environment for students to practise decision-making and experience the consequences of their actions in order to reinforce the Pancasila values in a concrete and relatable way. Cognitive and behavioural learning outcomes are integrated in accordance with the principles of constructivist pedagogy that emphasises active engagement and contextualised learning (Subhash & Cudney, 2018).

However, the results must be taken with a grain of salt. As in many studies on game-based learning, the intervention was conducted in a relatively short period of time and with a limited sample size; this may affect the magnitude of the observed effects. Similar findings have been reported in previous studies, suggesting that small-scale implementation can result in robust engagement outcomes which may not fully translate into sustained academic gains (Seddighi-Khavidak et al., 2026; Görün et al., 2025). Furthermore, even though this study reported a statistically significant improvement in cognitive outcomes, the level of learning gain was moderate. This suggests that although a greater level of engagement is beneficial, it does not necessarily translate to major improvements in academic performance, as noted by Subhash and Cudney (2018). It is also possible that the improvements seen were due to novelty effects associated with the introduction of a new medium of learning.

The development and implementation of the ADILINTAR game generally prove that the limitations of conventional instructional media can be overcome by the good design of the game-based learning media. The game integrates value-based content using digital technology to establish an engaging, student-focused learning environment promoting cognitive understanding and behavioural development. The results of this study prove that innovative instructional media is important in improving the quality and relevance of elementary education in the digital era (Sudjana & Rivai, 2013).

5 Conclusion

This study developed and tested the ADILINTAR Scratch-based educational game as an innovative medium of Pancasila Education that can improve students' cognitive learning outcomes and practices of compliance with rules. The results of the quasi-experimental study, guided by the Research and Development approach, provide strong evidence that the developed game satisfies the major criteria of quality and instructional effectiveness. The first is that the ADILINTAR game is very feasible, supported by expert validation. The game was well aligned with curriculum objectives, had appropriate instructional design, clear language, and good technical quality. Through iterative revision, we also ensured the final product was pedagogically sound and suitable for elementary-level learners. Second, the game was highly practical for classroom implementation. Both teachers and students had positive experiences, citing its ease of use, engaging interface, and smooth integration into teaching and learning activities. These results indicate that the game meets pedagogical needs and reduces implementation barriers, thus making it a useful tool in everyday instruction. Third, and most importantly, the ADILINTAR game was empirically proven to be effective in improving learning outcomes. When students interacted with the game, they made significant gains in cognitive achievement with higher posttest scores and moderate N-gain results. In addition, the observational data indicated improvements in students' rule-compliance behaviours, and the game seems to be a successful tool for knowledge acquisition and the internalisation of civic values. This dual effect supports the possibility of game-based learning to reduce the gap between conceptual knowledge and behavioural application in value-oriented subjects. In conclusion, this study proves that the ADILINTAR Scratch-based educational game is a significant innovation in Pancasila Education. This approach not only overcomes the limitations of traditional teaching methods but also contributes to the broader dissemination of digital, student-centred learning approaches in civic and character education. Although the learning gains observed were moderate, they were statistically significant and educationally meaningful, especially in the context of short-term classroom interventions.

Limitations and Directions for Future Research

Although this study has confirmed the feasibility, practicality, and effectiveness of the ADILINTAR Scratch-based game, some limitations need to be considered in interpreting the findings. The study was carried out with a relatively small sample of 48 students from a single school cluster, which might restrict the generalisability of the results to other educational contexts with different student characteristics, technological access, and instructional conditions. Furthermore, the quasi-experimental design, while suitable for classroom research, did not include complete randomisation, which could have resulted in selection bias and the effect of external variables that were not controlled. Another major limitation concerns the brief duration of the intervention. The study mainly evaluated the short-term changes in cognitive learning outcomes and observed behavioural changes after the use of the game. However, these short-term gains may not necessarily translate into long-term retention of knowledge or continued internalisation of rule-compliance behaviours. Furthermore, the assessment of behavioural outcomes was primarily based on classroom observations, which are prone to observer bias and may not encompass the entire spectrum of students' behaviours in daily situations outside the controlled setting of the classroom. Another limitation is the range of the instructional material. The game ADILINTAR was designed specifically for the topic of rules in the environment around Pancasila Education. Therefore, the effectiveness reported in this study may not necessarily be generalisable to other topics, grade levels, or subject areas without further adaptation and validation. This points to the need for wider testing and refinement of the game in a variety of instructional contexts.

Given these limitations, future research should strive to increase the scale and scope of investigation. Further research with larger and more diverse samples across multiple schools and regions is needed to improve external validity. Longitudinal research designs would be particularly useful in investigating the longevity of learning outcomes and behavioural changes over time. Moreover, the use of more rigorous experimental designs such as randomised controlled trials and mixed-method designs may also strengthen causal inferences and further improve our understanding of students' learning experiences. Future work may also consider expanding game content, integrating advanced features (e.g., adaptive or mobile-based learning), and the role of teacher facilitation in optimising the effectiveness of game-based learning in civic and character education.

Practical Implications

The findings of this study offer important practical implications for classroom practice, particularly in the teaching of Pancasila Education at the elementary level. The demonstrated feasibility, practicality, and effectiveness of the ADILINTAR Scratch-based game suggest that teachers can meaningfully integrate game-based digital media into their instructional strategies to enhance student engagement and learning outcomes. By transforming abstract civic concepts into interactive and contextualised experiences, the game supports deeper understanding and encourages the application of values such as discipline and rule compliance. Importantly, the positive teacher responses indicate that such tools do not require complex technical expertise, making them accessible even in typical classroom settings. Teachers can therefore adopt ADILINTAR as either a primary or complementary instructional medium to foster more student-centred, active learning environments.

Beyond immediate classroom use, the study also highlights the need for teachers to develop digital pedagogical competencies. Effective implementation of game-based learning depends not only on the availability of tools but also on teachers' ability to facilitate, guide, and contextualise learning experiences. As such, professional development initiatives should focus on equipping teachers with skills in integrating interactive media, managing digital classrooms, and aligning game-based activities with curriculum objectives and assessment strategies. This will ensure that the pedagogical value of such innovations is fully realised.

Policy Implications

From a policy perspective, the results underscore the importance of integrating digital game-based learning into curriculum frameworks and educational planning. Policymakers should recognise the potential of interactive technologies like Scratch-based games to enhance both cognitive and character education outcomes, particularly within subjects such as Pancasila Education that require value internalisation alongside conceptual understanding. Incorporating guidelines for the use of digital learning media within the curriculum can support more consistent and structured adoption across schools.

In addition, education authorities should invest in infrastructure, resource provision, and capacity building to support the implementation of technology-enhanced learning. This includes ensuring access to basic digital devices, reliable internet connectivity where possible, and the provision of validated educational software. Policies that encourage collaboration among educators, developers, and researchers can further promote the development and dissemination of contextually relevant learning tools like ADILINTAR. Ultimately, such policy support will contribute to modernising instructional practices and improving the quality and relevance of elementary education in the digital era.

Conflict of Interest

The authors declare that there is no conflict of interest

Declaration of Use of Generative AI

The author declares that generative AI tools were used only for language editing, clarity, and structural refinement. They were not used otherwise. Therefore, the authors take full responsibility for the accuracy, originality, and integrity of the manuscript.

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