



Enhancing Javanese script reading using the Javanese script smart board

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ABSTRACT

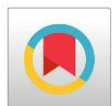
Purpose: improve fourth-grade students' Javanese script reading ability through the implementation of the Javanese script smart board.

Method: classroom action research was used based on the Kemmis and McTaggart model, conducted in two cycles. The participants were 22 fourth-grade students at SD Al Islam Pengkol, Jepara. Data were collected through observations, interviews, tests, and documentation, and analyzed descriptively using quantitative and qualitative approaches.

Findings: the implementation of the Javanese script smart board improved students' Javanese script reading ability. The students' mean score increased from 70.45 in the pre-intervention stage to 81.14 in cycle I and 84.09 in cycle II. The percentage of students achieving the minimum mastery criterion also increased from 50.00% to 81.82% and 86.36%, respectively. These findings indicate that the Javanese script smart board effectively supported students' reading skills and engagement in learning Javanese script.

Implications: the Javanese script smart board can be implemented as an effective and practical instructional medium to enhance students' engagement and reading competence in Javanese script learning at the elementary school level.

Originality: lies in implementing the Javanese script smart board as an interactive instructional medium within classroom action research to improve elementary students' Javanese script reading ability.



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Introduction

Javanese is one of Indonesia's major regional languages and represents an essential component of the nation's cultural heritage (Bashori, 2026). Beyond functioning as a means of communication, the Javanese language embodies philosophical values, local wisdom, and historical identity that should be preserved across generations (Rohmadi et al., 2025). Consequently, Javanese is taught as a local content subject in elementary schools to develop students' linguistic competence while

fostering cultural awareness and appreciation (Nugraheni & Hasan, 2026). One of the fundamental competencies expected from elementary school students is the ability to read Javanese script (*aksara jawa*), as this skill enables learners to recognize script characters, understand orthographic rules, interpret the use of *sandhangan* (diacritical marks), and read Javanese words and sentences accurately. Mastery of Javanese script reading therefore plays a significant role not only in achieving curriculum objectives but also in sustaining regional cultural heritage in the era of globalization and rapid technological development (Asrianti & Fauziah, 2023; Nuraseh et al., 2023).

Despite its importance, learning to read Javanese script remains challenging for many elementary school students. Unlike the Latin alphabet, Javanese script consists of unique character forms accompanied by various orthographic features, including *sandhangan* and paired characters, which require students to develop strong visual discrimination and decoding skills. Many students experience difficulties distinguishing similar-looking characters and applying orthographic rules correctly during reading activities. These challenges often reduce students' motivation and participation, particularly when instruction relies predominantly on conventional teaching methods. Therefore, effective learning requires instructional media capable of transforming abstract script forms into meaningful and engaging learning experiences. Educational media serve not only as instructional aids but also as tools that increase students' motivation, participation, and conceptual understanding by presenting learning materials in more concrete and interactive ways (Febrianingrum & Wiranti, 2023; Hartono et al., 2025; Nurrita, 2018; Supratman & Tundreng, 2025).

This issue was also identified in grade IV at SD Al Islam Pengkol Jepara. Preliminary classroom observations and interviews with the classroom teacher revealed that students' ability to read Javanese script had not yet reached the expected level. Many students encountered difficulties recognizing *carakan* characters, differentiating visually similar letters, and accurately reading words containing *sandhangan*. Furthermore, classroom instruction was primarily conducted using textbooks, worksheets, and teacher explanations, providing limited opportunities for students to engage with interactive instructional media. As a result, students' classroom participation remained relatively low, and their learning outcomes were unsatisfactory. The preliminary assessment showed an average reading score of 70.45, while only 11 of the 22 students (50.00%) achieved the school's minimum mastery criterion (MMC) of 70. These findings indicate that improvements in instructional practice are needed through the implementation of learning media capable of increasing both students' engagement and their Javanese script reading proficiency.

From a learning-theory perspective, instructional media play an important role in facilitating meaningful learning by providing concrete representations of abstract concepts. According to constructivist learning theory, students develop knowledge more effectively when they actively interact with learning materials rather than passively receiving information from teachers. Likewise, Dale's Cone of experience suggests that learning becomes more meaningful when students are involved in direct and interactive experiences. Interactive learning media therefore provide opportunities for students to manipulate learning materials, receive immediate feedback, and actively construct their understanding, ultimately improving both learning processes and outcomes (Huang, 2005; Kustandi & Darmawan, 2020; Nurrita, 2018; Tuma, 2021). Within the context of Javanese script instruction, such media are expected to reduce students' cognitive difficulties while simultaneously increasing learning motivation and classroom participation.

Previous studies consistently demonstrate that appropriate instructional media contribute positively to students' learning achievement and engagement. Puzzle media have been reported to improve elementary students' achievement in learning Javanese script by increasing their interest and facilitating character recognition (Febrianingrum & Wiranti, 2023). Game-based learning media, including quartet games (Nuraseh et al., 2023), *jenga aksara jawa* (Rinata et al., 2023), flora-fauna cards (Dewi et al., 2022), *monopoli aksara jawa* (Widodo & Hanifah, 2020), and *perdasawa* (Wulandari et al., 2018), have similarly shown positive effects on students' motivation and learning outcomes. More recent innovations include *dia raja audiovisual media* (Tanwuijaya & Airlanda, 2023), android-based applications (Rosyidah & Subrata, 2021), augmented reality media (Hanif & Avianto, 2024), *palangraja* (Andani & Sukardi, 2024), *utr-aksara jawa* (Putri et al., 2026), and *papitaja* smart board (Mutmainnah et al., 2025). Collectively, these studies confirm that innovative instructional media have substantial potential to improve students' understanding of Javanese script while creating more engaging learning environments.

Nevertheless, the existing literature reveals several limitations. First, most previous studies have focused on developing and validating instructional media rather than examining how such media improve classroom learning through continuous instructional intervention. Second, many studies have evaluated media effectiveness using experimental or research-and-development approaches. In contrast, relatively few have investigated their implementation within classroom action research (CAR), which emphasizes iterative cycles of planning, action, observation, and reflection to solve authentic classroom problems. Third, previous classroom action studies addressing Javanese script learning primarily employed cooperative learning strategies such as make a match (Fitriani et al., 2022; Kurniawati et al., 2024) without exploring the instructional potential of an interactive smart board specifically designed for reading Javanese script.

Consequently, empirical evidence regarding the effectiveness of smart board-based instructional media in systematically improving students' Javanese script reading ability through classroom action research remains limited. To address these gaps, this study implements the Javanese script smart board as an interactive instructional medium in grade IV Javanese language learning at SD Al Islam Pengkol Jepara using a two-cycle classroom action research design. Unlike previous studies that mainly focused on media development, this research emphasizes the practical implementation of the smart board as an instructional intervention aimed at improving both the learning process and students' reading performance. The novelty of this study lies in integrating an interactive smart board with iterative classroom action cycles to promote students' active participation while enhancing their ability to recognize, interpret, and read Javanese script accurately.

Accordingly, this study aims to improve fourth-grade students' Javanese script reading ability through the implementation of the Javanese script smart board. The study is considered important because preserving local languages requires effective instructional practices that enable young learners to acquire essential literacy skills while maintaining cultural identity. Moreover, the findings are expected to provide practical evidence for teachers regarding the effective integration of interactive instructional media into Javanese language classrooms. From a theoretical perspective, this study contributes to the growing body of knowledge concerning media-assisted learning and constructivist language instruction. Practically, it offers an alternative instructional strategy that can enhance students' engagement, improve reading

achievement, and support the preservation of Javanese cultural heritage through more meaningful and student-centered learning experiences.

Metode

This study employed classroom action research (CAR) based on the model proposed by Kemmis & McTaggart (1988), which consists of iterative cycles of planning, action, observation, and reflection. This design was selected because it is appropriate for addressing practical classroom problems through continuous instructional improvement. The research was conducted collaboratively between the researcher and the grade IV classroom teacher at SD Al Islam Pengkol, Jepara regency, Indonesia. Prior to the intervention, a preliminary observation and semi-structured interview with the classroom teacher were conducted to identify students' difficulties in reading Javanese script and to determine appropriate instructional strategies. The findings from this preliminary stage served as the basis for designing the intervention using the Javanese script smart board.

The study was implemented over two action cycles, with each cycle comprising four stages: planning, action, observation, and reflection. During the planning stage, instructional materials and research instruments were prepared, including lesson plans, the Javanese script smart board, observation sheets, interview guidelines, and reading achievement tests. The action stage involved implementing the planned learning activities using the smart board as the primary instructional medium. Throughout the learning process, both the researcher and the classroom teacher observed students' learning activities and recorded the implementation of the instructional procedures. At the end of each cycle, students completed a Javanese script reading test to evaluate their learning achievement. The reflection stage involved analyzing the results of observations and assessments to identify strengths and weaknesses of the intervention and to formulate improvements for the subsequent cycle.

The participants consisted of 22 fourth-grade students enrolled at SD Al Islam Pengkol, Jepara, including 10 boys and 12 girls, together with their classroom teacher. The participants were selected because preliminary assessments indicated that many students had not yet achieved the expected level of competence in reading Javanese script. In this study, the independent variable was the implementation of the Javanese script smart board, whereas the dependent variable was students' ability to read Javanese script. Data were collected using observations, interviews, tests, and documentation to obtain both qualitative and quantitative evidence of the intervention's effectiveness. Classroom observations were conducted during every learning session to examine the implementation of instructional activities and students' participation. Semi-structured interviews with the classroom teacher were conducted before the intervention and after each cycle to obtain information regarding students' learning difficulties and the effectiveness of the implemented actions. Students' Javanese script reading ability was measured through achievement tests administered during the pre-action stage, cycle I, and cycle II. Documentation, including lesson plans, students' worksheets, assessment results, field notes, and photographs of classroom activities, was collected to support and verify the research findings.

The research instruments consisted of observation sheets, interview protocols, Javanese script reading tests, and documentation checklists. The observation sheets were designed to evaluate the implementation of learning activities and students' classroom engagement. At the same time, the interview protocol explored the teacher's perceptions of students' learning progress and instructional challenges. The reading

tests assessed students' ability to recognize Javanese characters, distinguish visually similar characters, interpret the use of *sandhangan* (diacritical marks), and read Javanese words and sentences accurately. To ensure the trustworthiness of the findings, the study employed methodological triangulation and source triangulation. Methodological triangulation was achieved by comparing information obtained from observations, interviews, tests, and documentation, whereas source triangulation involved comparing data collected from the classroom teacher, students, and supporting research documents. Integrating multiple data sources and collection methods enhanced the credibility and validity of the research findings.

Quantitative data were analyzed descriptively by calculating students' mean scores and the percentage of learning mastery at the pre-action stage, cycle I, and cycle II. Learning mastery was determined based on the school's minimum mastery criterion (MMC) of 70. Improvements in students' reading achievement across the research cycles were used to evaluate the effectiveness of the intervention. Qualitative data obtained from observations, interviews, and documentation were analyzed using the interactive model of data reduction, data display, and conclusion drawing. Finally, the quantitative and qualitative findings were integrated to provide a comprehensive interpretation of changes in students' Javanese script reading ability and classroom learning engagement following the implementation of the Javanese script smart board.

Results and discussion

Baseline condition (pre-intervention)

The baseline condition was established to identify students' initial ability to read Javanese script before implementing the Javanese script smart board. Data were collected through classroom observations, interviews with the grade IV teacher, and a pre-intervention reading assessment conducted on April 25, 2026. The findings from these preliminary activities provided the basis for planning the classroom action and determining the instructional improvements required in subsequent cycles. Classroom observations indicated that the teaching of Javanese script was predominantly teacher-centered. Learning activities relied mainly on teacher explanations and students' worksheets, with limited use of interactive instructional media. As a result, students had few opportunities to engage with the learning materials actively. During classroom activities, many students experienced difficulty recognizing the basic *carakan* characters, distinguishing visually similar letter forms, and accurately reading Javanese words containing *sandhangan* (diacritical marks). These difficulties reduced students' confidence when reading aloud and limited their participation during classroom discussions.

The interview with the classroom teacher further confirmed these observations. According to the teacher, many students frequently confused several *carakan* characters because of their similar visual appearance and encountered persistent difficulties when reading words containing *sandhangan*. The teacher also explained that the lack of attractive and interactive learning media made it challenging to maintain students' attention throughout the lesson. Consequently, many students tended to memorize individual characters without fully understanding their pronunciation or orthographic functions, resulting in relatively low reading performance. To obtain quantitative evidence of students' initial reading ability, a pre-intervention achievement test was administered to all 22 students. The distribution of students' scores is presented in Table 1.

Table 1 frequency distribution of pre-intervention reading achievement

Score interval	Frequency (f)	Percentage (%)
0-59	1	4.55
60-69	10	45.45
70-79	5	22.73
80-89	3	13.64
90-100	3	13.64
Total	22	100.00

Source: primary data, processed

As shown in Table 1, the largest proportion of students (45.45%) obtained scores within the 60–69 interval, indicating that nearly half of the class had not yet achieved the expected level of reading proficiency. Only six students (27.28%) scored 80 or above, whereas one student (4.55%) scored below 60. Overall, the score distribution suggests that students' reading ability was concentrated in the lower performance categories, demonstrating the need for instructional improvement. A summary of the students' pre-intervention achievement is presented in Table 2.

Table 2 summary of pre-intervention reading achievement

Indicator	Result
Number of students	22
Highest score	100
Lowest score	50
Mean score	70.45
Students achieving mastery	11
Students not achieving mastery	11
Learning mastery	50.00%

Source: primary data, processed

As presented in Table 2, the class achieved a mean score of 70.45, with scores ranging from 50 to 100. Although the average score slightly exceeded the school's minimum mastery criterion (MMC) of 70, only 11 of the 22 students (50.00%) successfully achieved the required level of mastery. The remaining eleven students failed to meet the criterion, indicating that only half of the class demonstrated satisfactory reading competence. Consequently, the predetermined research success criterion, that at least 80% of students achieve the MMC, had not yet been attained.

The qualitative and quantitative findings consistently demonstrated that students experienced substantial difficulties in mastering Javanese script reading prior to the intervention. Their challenges were particularly evident in recognizing carakan characters, differentiating visually similar letters, and applying *sandhangan* correctly during reading activities. These learning difficulties were accompanied by relatively low classroom participation, largely because the instructional process provided limited opportunities for interactive learning experiences. Therefore, an instructional intervention was considered necessary to improve both students' engagement and their reading achievement. Based on these baseline findings, the Javanese script smart board was introduced in cycle I as an instructional strategy to create a more interactive learning environment, enhance students' participation, and improve their ability to read Javanese script.

Cycle I results

Cycle I was conducted on May 21, 2026, involving all 22 fourth-grade students of SD Al Islam Pengkol, comprising 10 boys and 12 girls. The instructional intervention was

designed based on the findings of the pre-intervention stage, which revealed that students' Javanese script reading ability had not yet met the predetermined success criterion. During this cycle, the Javanese script smart board was implemented as the primary instructional medium and integrated with the cooperative learning model using the Make a Match technique. This combination was intended to encourage active participation while providing students with repeated opportunities to recognize, match, and read Javanese script in a collaborative learning environment.

The lesson began with an apperception activity in which the teacher reviewed students' prior knowledge of carakan characters and introduced the lesson objectives. The teacher subsequently demonstrated how the Javanese script smart board would be used to recognize, arrange, and pronounce Javanese characters. Students were then engaged in a series of cooperative learning activities. Working in small groups, they searched for matching pairs of Javanese script cards and their corresponding Latin transliterations, discussed the correct answers with their peers, and used the smart board to arrange Javanese characters into meaningful words. Throughout the lesson, students were encouraged to read the completed words aloud, receive feedback from both the teacher and classmates, and revise their responses whenever errors occurred. The learning session concluded with an individual reading achievement test to evaluate students' mastery after the implementation of the instructional intervention.

Classroom observations indicated a noticeable improvement in students' engagement compared with the baseline condition. Most students participated enthusiastically in the matching activities, actively discussed their answers within their groups, and demonstrated greater confidence when reading Javanese script aloud. The interactive nature of the smart board encouraged students to manipulate the learning materials directly rather than merely observing the teacher's explanation. In addition, collaborative learning promoted peer interaction, allowing students to support one another in identifying Javanese characters and correcting pronunciation errors.

Despite these positive developments, classroom observations also identified several challenges that remained during cycle I. Several students continued to confuse carakan characters with similar visual structures, particularly when reading more complex combinations of characters. Difficulties were also observed in interpreting the correct pronunciation of words containing sandhangan (diacritical marks). Consequently, several students still required guidance from the teacher during reading activities and were not yet able to read Javanese script independently with consistent accuracy. The distribution of students' achievement scores obtained at the end of cycle I is presented in Table 3.

Table 3 frequency distribution of cycle I reading achievement

Score interval	Frequency (f)	Percentage (%)
0-59	1	4.55
60-69	3	13.64
70-79	4	18.18
80-89	4	18.18
90-100	10	45.45
Total	22	100.00

Source: primary data, processed

As presented in Table 3, students' achievement shifted considerably toward the higher score categories. Nearly half of the class (45.45%) obtained scores between 90 and 100, while only one student (4.55%) remained in the lowest score interval. Four

students (18.18%) achieved scores within the 70–79 range, and another four students (18.18%) obtained scores between 80 and 89. Compared with the baseline condition, the overall score distribution clearly demonstrates an improvement in students' reading performance after the implementation of the Javanese script smart board. A summary of students' achievement in cycle I is presented in Table 4.

Table 4 summary of cycle I reading achievement

Indicator	Result
Number of students	22
Highest score	95
Lowest score	45
Mean score	81.14
Students achieving mastery	18
Students not achieving mastery	4
Learning mastery	81.82%

Source: primary data, processed

As shown in Table 4, the class achieved a mean score of 81.14, representing an improvement of 10.69 points compared with the pre-intervention mean score (70.45). Furthermore, 18 out of 22 students (81.82%) successfully achieved the school's minimum mastery criterion (MMC), whereas only four students (18.18%) remained below the required standard. This finding indicates an increase of 31.82 percentage points in learning mastery compared with the baseline condition, where only 50.00% of students met the criterion.

The improvement observed in cycle I suggests that integrating the Javanese script smart board with cooperative learning successfully enhanced students' participation and reading achievement. The interactive features of the smart board enabled students to recognize characters more easily, while the Make a Match activities encouraged repeated practice and collaborative problem-solving. Frequent interaction with the instructional media appeared to strengthen students' familiarity with Javanese script and increase their confidence during oral reading activities.

Although the quantitative findings indicated that the predetermined success criterion of at least 80% learning mastery had been achieved, the qualitative findings revealed that several instructional issues still required attention. Classroom observations showed that a small group of students continued to experience difficulty distinguishing visually similar carakan characters and accurately interpreting *sandhangan*. These students also required more intensive teacher guidance than their classmates and occasionally hesitated when reading unfamiliar words.

Accordingly, the reflection stage concluded that further instructional refinement was necessary to consolidate students' reading competence. For cycle II, several improvements were planned. First, explicit teacher demonstrations would be provided using the direct instruction model to reinforce students' understanding of confusing character forms. Second, students would receive more structured and repetitive guided reading practice with immediate corrective feedback. Third, individualized assistance would be provided to students who had not yet achieved mastery. Finally, the use of the Javanese script smart board would be further optimized to provide additional opportunities for independent practice, enabling students to develop greater accuracy and fluency in reading Javanese script.

Cycle II results

Cycle II was conducted on May 25, 2026, involving the same 22 fourth-grade students who participated in cycle I. The instructional activities implemented during this cycle were developed based on the reflections from cycle I, which indicated that although the predetermined criterion for learning mastery had been achieved, several students continued to experience difficulties distinguishing visually similar carakan characters and accurately reading words containing *sandhangan* (diacritical marks). Therefore, the second cycle focused on strengthening students' conceptual understanding through more explicit instruction, intensive guided practice, and individualized support while continuing to utilize the Javanese script smart board as the primary instructional medium.

Unlike cycle I, which integrated the smart board with the cooperative learning make-a-match strategy, cycle II adopted the direct instruction model. This instructional approach was selected to provide more systematic teacher guidance and immediate corrective feedback, particularly for students who had not yet achieved the expected level of reading proficiency. The lesson began with a review of the concepts learned in the previous cycle, followed by the presentation of the learning objectives. The teacher then demonstrated the correct pronunciation and reading procedures for Javanese script using the smart board, emphasizing the identification of visually similar carakan characters and the application of *sandhangan*.

Following the demonstration, students participated in a sequence of guided practice activities. They individually arranged Javanese script characters on the smart board, read the completed words aloud, and received immediate feedback from the teacher regarding pronunciation accuracy and character recognition. Students were encouraged to repeat reading exercises until they demonstrated greater fluency and confidence. Additional scaffolding was provided to students who had encountered difficulties during cycle I, enabling them to practice at an appropriate pace while receiving individualized assistance. The instructional session concluded with an individual achievement test designed to assess students' Javanese script reading ability following the revised instructional intervention.

Classroom observations revealed further improvements in students' learning engagement and reading performance compared with cycle I. Most students demonstrated greater confidence when reading Javanese script aloud and participated more actively throughout the lesson. Students appeared more attentive during teacher explanations and were able to follow the step-by-step demonstrations effectively. Repeated guided practice using the smart board also encouraged students to identify character patterns more accurately and to correct their own reading errors with minimal teacher assistance.

Furthermore, students showed noticeable progress in differentiating carakan characters with similar visual forms and applying *sandhangan* correctly when reading words and short sentences. Compared with the previous cycle, fewer students hesitated during oral reading activities, and classroom discussions became more interactive as students increasingly volunteered to demonstrate their reading in front of their classmates. Nevertheless, classroom observations indicated that a small number of students still required occasional teacher guidance, particularly when reading unfamiliar combinations of characters involving multiple *sandhangan*. The distribution of students' achievement scores at the end of cycle II is presented in Table 5.

Table 5 frequency distribution of cycle II reading achievement

Score interval	Frequency (f)	Percentage (%)
0–59	0	0.00
60–69	3	13.64
70–79	5	22.73
80–89	2	9.09
90–100	12	54.55
Total	22	100.00

Source: primary data, processed

As shown in Table 5, students' achievement continued to shift toward the highest performance category. More than half of the students (54.55%) obtained scores between 90 and 100, representing an increase compared with cycle I. Five students (22.73%) achieved scores between 70 and 79, while only three students (13.64%) remained in the 60–69 interval. Importantly, no student scored below 60, indicating that the lowest level of achievement observed during the previous stages had been eliminated. Overall, the distribution demonstrates a continued improvement in students' reading performance following the instructional refinements implemented during cycle II. A summary of students' learning achievement in cycle II is presented in Table 6.

Table 6 summary of cycle II reading achievement

Indicator	Result
Number of students	22
Highest score	100
Lowest score	60
Mean score	84.09
Students achieving mastery	19
Students not achieving mastery	3
Learning mastery	86.36%

Source: primary data, processed

As presented in Table 6, the class achieved a mean score of 84.09, increasing from 81.14 in cycle I and 70.45 during the pre-intervention stage. The highest score improved to 100, while the lowest score increased from 45 in cycle I to 60, indicating that lower-performing students also benefited from the revised instructional strategy. Of the 22 students, 19 (86.36%) achieved the school's minimum mastery criterion (MMC), whereas only three (13.64%) remained below the required standard. Compared with cycle I, the learning mastery rate increased from 81.82% to 86.36%, reflecting a continuous improvement in students' reading achievement.

The quantitative findings were consistent with the qualitative evidence obtained from classroom observations. Observable improvements in classroom participation, confidence, and reading fluency accompanied increases in students' mean scores and mastery levels. Students became more proficient in recognizing carakan characters, distinguishing visually similar letters, and applying *sandhangan* appropriately during reading activities. The combination of explicit teacher demonstration, repeated guided practice, individualized feedback, and continuous use of the Javanese script smart board appeared to facilitate a deeper understanding of Javanese orthographic conventions while strengthening students' reading accuracy.

The end-of-cycle II reflection concluded that the instructional objectives had been successfully achieved. The predetermined research success criterion, a minimum of 80% of students achieving the minimum mastery criterion, was exceeded, with 86.36% of students reaching the expected level of achievement. In addition, classroom

observations indicated substantial improvements in students' engagement, confidence, and active participation throughout the learning process. Because both the quantitative and qualitative indicators demonstrated satisfactory outcomes, no further action cycle was considered necessary, and the study proceeded to the overall analysis and interpretation of findings.

Summary of improvement across cycles

The implementation of the Javanese script smart board throughout the two classroom action research cycles resulted in consistent improvements in students' Javanese script reading ability. The quantitative findings demonstrated progressive increases in students' learning achievement, while qualitative evidence from classroom observations indicated positive changes in students' learning engagement, participation, confidence, and reading performance. These findings suggest that the instructional intervention contributed not only to improved academic outcomes but also to a more interactive and student-centered learning environment. A comparison of students' reading achievement across the pre-intervention stage, cycle I, and cycle II is presented in Table 7.

Table 7 summary of students' Javanese script reading achievement across research cycles

Indicator	Pre-intervention	Cycle I	Cycle II
Number of students	22	22	22
Highest score	100	95	100
Lowest score	50	45	60
Mean score	70.45	81.14	84.09
Students achieving mastery	11	18	19
Students not achieving mastery	11	4	3
Learning mastery (%)	50.00	81.82	86.36

Source: primary data, processed

As shown in Table 7, students' reading achievement improved continuously throughout the study. The class mean score increased from 70.45 during the pre-intervention stage to 81.14 in cycle I and further increased to 84.09 in cycle II. Overall, this represents an improvement of 13.64 points from the baseline condition to the completion of the intervention. Similarly, the percentage of students achieving the school's minimum mastery criterion (MMC) increased substantially from 50.00% before the intervention to 81.82% after cycle I and 86.36% after cycle II. The number of students achieving mastery increased from 11 to 18 and finally to 19 students, while the number of students who had not yet achieved mastery declined from 11 to 4, and ultimately to 3 students.

Qualitative changes in classroom learning also accompanied the improvement in students' achievement. During the pre-intervention stage, students generally relied on teacher explanations and showed limited participation during reading activities. Many students struggled to recognize carakan characters, distinguish visually similar letters, and correctly interpret *sandhangan*. Following the implementation of the Javanese script smart board in cycle I, students became more actively involved in classroom activities, particularly during collaborative learning sessions in which they matched, arranged, and read Javanese script using the interactive media. Although several students still required additional guidance, their willingness to participate and confidence in reading aloud increased noticeably.

Further instructional refinement in cycle II produced additional improvements in both learning behavior and reading performance. The use of direct instruction, combined with repeated guided practice and individualized feedback through the smart board, enabled students to strengthen their understanding of character recognition and pronunciation. Classroom observations indicated that students became more independent during reading activities, demonstrated greater accuracy in distinguishing similar characters, and applied *sandhangan* more appropriately when reading Javanese words and sentences. Consequently, students exhibited greater fluency and confidence than in the previous cycle, while teacher assistance was required less frequently. The progressive improvement in students' learning outcomes is illustrated in Figure 1, which shows a consistent upward trend in both the class mean score and the percentage of students achieving learning mastery across the three stages of the research.

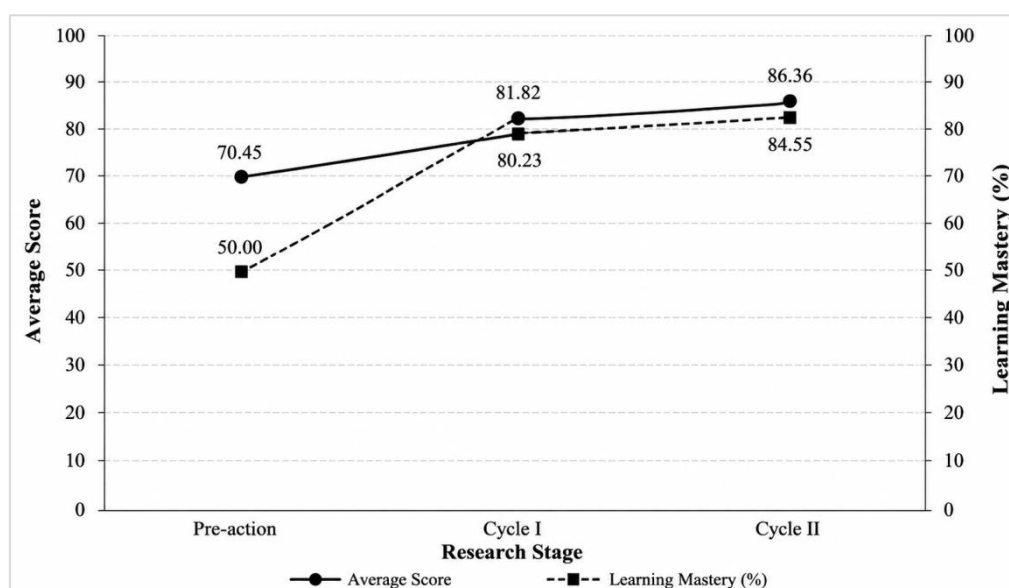


Figure 1 improvement in students' Javanese script reading achievement across the research cycles

Source: primary data, processed

As illustrated in Figure 1, the most substantial improvement occurred between the pre-intervention stage and cycle I, indicating that the initial implementation of the Javanese script smart board had an immediate positive impact on students' reading performance. Although the increase from cycle I to cycle II was comparatively smaller, the upward trend demonstrates that the instructional refinements implemented after reflection successfully consolidated students' understanding and further improved their reading proficiency. This pattern is consistent with the cyclical nature of classroom action research, in which each reflection informs subsequent instructional improvements, resulting in continuous enhancement of the learning process.

Overall, the findings indicate that implementing the Javanese script smart board effectively improved students' Javanese script reading ability. The intervention not only increased students' academic achievement, as reflected in higher mean scores and learning mastery rates, but also promoted more active classroom participation, greater learning confidence, and improved reading accuracy. Because the predetermined success criterion, at least 80% of students achieving the minimum mastery criterion, was exceeded in cycle II, the classroom action was considered successful and was concluded after the second cycle. These findings provide empirical evidence that integrating interactive instructional media into Javanese language instruction can

effectively support elementary students in developing Javanese script reading proficiency while simultaneously creating a more engaging and meaningful learning experience.

Discussion

The findings of this study demonstrate that implementing the Javanese script smart board improved students' ability to read Javanese script. Rather than merely indicating an increase in learning achievement, the findings suggest that interactive learning experiences can effectively facilitate students' acquisition of complex orthographic knowledge. Reading Javanese script requires learners not only to memorize character forms but also to distinguish visually similar carakan characters and accurately interpret the function of *sandhangan* (diacritical marks). These cognitive demands require instructional approaches that provide repeated exposure, active engagement, and immediate feedback. The present study indicates that these learning conditions were successfully facilitated through the integration of the smart board into classroom instruction.

From a theoretical perspective, the findings can be explained through constructivist learning theory, which posits that knowledge is actively constructed through learners' interaction with their environment rather than passively transmitted by the teacher. During the intervention, students directly manipulated Javanese characters, arranged words, identified matching symbols, and practiced reading repeatedly using the smart board. Such learning activities encouraged students to actively construct their understanding of Javanese orthographic patterns instead of relying solely on teacher explanations. This finding supports the view that meaningful learning occurs when students participate actively in the learning process and engage directly with instructional materials (Kustandi & Darmawan, 2020).

The effectiveness of the intervention is also consistent with Dale's Cone of Experience, which emphasizes that learning becomes more meaningful when students participate in direct and purposeful experiences. Conventional instruction in Javanese script often relies heavily on verbal explanation and textbook exercises, limiting students' opportunities to interact with the script itself. In contrast, the smart board transformed abstract character recognition into concrete learning experiences by allowing students to manipulate script components physically, receive immediate feedback, and repeatedly practice reading. Such multisensory learning experiences are likely to reduce students' cognitive load during character recognition while strengthening long-term memory of letter forms and pronunciation.

Another theoretical explanation can be derived from the cognitive theory of multimedia learning (Mayer, 2002), which suggests that learning improves when information is presented through multiple complementary representations. Although the Javanese script smart board is not a digital multimedia application, it incorporates several multimedia learning principles by integrating visual representations of Javanese characters, physical manipulation of instructional components, oral reading practice, and teacher feedback within a single learning activity. The combination of visual, kinesthetic, and verbal learning experiences enables students to process information through multiple cognitive pathways, thereby facilitating deeper understanding of Javanese script.

The improvement observed in this study also appears to be influenced by the instructional strategy employed across the two action cycles. Rather than relying on a single teaching approach, the intervention combined different pedagogical models

according to students' learning needs identified during reflection. In cycle I, the cooperative learning make-a-match model promoted collaborative learning, peer interaction, and active participation. Through matching activities and group discussions, students repeatedly identified and compared Javanese characters, allowing them to strengthen visual discrimination while learning from their peers. Cooperative learning has long been recognized for promoting social interaction and knowledge construction through shared problem-solving activities, particularly in elementary classrooms.

Following reflection, the instructional strategy was refined in cycle II by implementing direct instruction. This modification provided more explicit demonstrations, systematic explanations, guided practice, and immediate corrective feedback for students who continued to experience reading difficulties. The combination of collaborative learning during the initial phase and explicit instruction during the subsequent phase appears to have produced complementary learning benefits. While cooperative learning increased motivation and engagement, direct instruction provided the structured scaffolding necessary to master complex orthographic concepts. This finding supports the principle of adaptive instruction, which emphasizes that instructional strategies should be adjusted according to learners' developmental needs rather than relying on a single pedagogical approach.

The findings further reinforce the important role of instructional media in elementary language learning. According to Nurrita (2018), instructional media function as learning facilitators that transform abstract concepts into concrete experiences, thereby improving students' understanding and learning outcomes. Similarly, Sholeh et al., (2024) argue that instructional media facilitate the delivery of learning materials by making information more accessible and easier for students to comprehend. The present study extends these theoretical perspectives by demonstrating that interactive instructional media contribute not only to conceptual understanding but also to students' active participation, confidence, and willingness to engage in repeated reading practice. Consequently, the smart board functioned not merely as a teaching aid but as an instructional environment that encouraged students to construct knowledge through continuous interaction.

These findings are consistent with previous studies investigating instructional media for Javanese script learning. Febrianingrum & Wiranti (2023) reported that puzzle-based instructional media significantly improved elementary students' achievement in learning Javanese script by increasing motivation and facilitating character recognition. Likewise, Azzahra & Sukardi (2024) found that the Karawa media supported students' reading development by encouraging active participation through educational games. Similar findings were also reported by Tanwuijaya & Airlanda (2023), who demonstrated that the *dia raja audiovisual media* enhanced classroom engagement and improved learning outcomes. Collectively, these studies suggest that active interaction with instructional media consistently contributes to better learning outcomes in Javanese language instruction.

The present findings also corroborate previous research on technology-assisted and game-based learning media. Rosyidah & Subrata (2021) demonstrated that the android-based *si raja application* successfully improved students' Javanese script reading skills by providing interactive digital exercises. Likewise, Hanif & Avianto (2024) showed that augmented reality media increased students' motivation and understanding through immersive visualization of Javanese characters. More recently, Putri et al. (2026) reported positive effects of UTR-Aksara Jawa, while Mutmainnah et al. (2025) found that Papitaja effectively enhanced students' understanding of Javanese

script. Although these studies employed different instructional media, they consistently indicate that interactive learning environments promote greater student engagement and improved literacy outcomes.

Nevertheless, the present study contributes several important perspectives that distinguish it from previous investigations. Most earlier studies primarily focused on developing instructional media or evaluating their effectiveness through research-and-development or experimental designs. In contrast, the present study emphasizes the classroom implementation of instructional media within the framework of classroom action research. This approach provides evidence not only regarding the effectiveness of the media itself but also concerning how continuous reflection, instructional modification, and iterative improvement contribute to enhanced learning outcomes. Consequently, this study demonstrates that successful instructional innovation depends not only on the characteristics of the learning media but also on teachers' ability to refine instructional practices based on ongoing classroom evaluation.

Another distinctive contribution of this study lies in the practicality of the Javanese script smart board. Unlike digital learning applications requiring computers, tablets, smartphones, or stable internet connectivity, the smart board can be implemented using relatively simple instructional materials and is therefore accessible to schools with limited technological infrastructure. This characteristic is particularly relevant for many Indonesian elementary schools, where disparities in technological resources remain a significant challenge. The smart board therefore represents an affordable, sustainable, and contextually appropriate instructional alternative for improving Javanese script literacy without increasing schools' dependence on digital technologies.

Despite these promising findings, several limitations should be acknowledged. The study was conducted in a single elementary school with a relatively small number of participants and involved only two classroom action research cycles. Consequently, the findings should be interpreted within the context of the participating classroom and may not be directly generalizable to other educational settings. Furthermore, the study primarily examined improvements in students' reading ability and classroom engagement without investigating long-term retention of Javanese script literacy or students' affective attitudes toward learning the script. Future studies could therefore employ larger samples, involve multiple schools, compare different instructional media experimentally, or investigate the long-term effectiveness of smart board-based instruction in developing broader aspects of Javanese literacy.

Overall, the present study provides empirical evidence that integrating the Javanese script smart board into elementary language instruction constitutes an effective pedagogical strategy for improving Javanese script reading proficiency. The findings suggest that instructional media are most effective when they are integrated with appropriate pedagogical approaches, opportunities for active learning, continuous formative feedback, and reflective instructional improvement. Accordingly, this study contributes both theoretically and practically to the growing body of research on culturally responsive language instruction by demonstrating how interactive, low-cost instructional media can simultaneously enhance literacy development and support the preservation of Indonesia's regional linguistic heritage.

Conclusions

This study demonstrates that implementing the Javanese script smart board effectively improved fourth-grade students' reading ability in Javanese script at SD Al

Islam Pengkol, Jepara. The improvement was evident not only in students' reading achievement but also in their classroom engagement, confidence, and participation throughout the learning process. The iterative implementation of classroom action research enabled instructional practices to be continuously refined, resulting in more effective learning experiences across the two action cycles. The findings indicate that integrating the Javanese script smart board with appropriate instructional models, cooperative learning (make a match) in cycle I and direct instruction in cycle II, provided meaningful opportunities for students to recognize Javanese characters, distinguish visually similar carakan letters, interpret sandhangan accurately, and develop greater reading fluency.

The findings contribute both theoretically and practically to the field of elementary language education. Theoretically, this study provides empirical support for constructivist learning theory by demonstrating that active interaction with instructional media facilitates students' understanding of complex orthographic concepts. It also extends the existing literature on Javanese script instruction by emphasizing the importance of implementing instructional media through iterative classroom improvement rather than focusing solely on media development. Practically, the Javanese script smart board offers teachers an affordable, interactive, and easily implemented instructional alternative that does not require digital infrastructure, making it particularly suitable for elementary schools with limited technological resources. Nevertheless, this study has several limitations. It was conducted in a single classroom with a relatively small sample of participants and involved only two action research cycles. In addition, the study focused primarily on students' reading achievement and classroom engagement without examining the long-term retention of Javanese script literacy or comparing the effectiveness of the smart board with other instructional media.

Based on these limitations, future research should involve larger, more diverse samples from multiple schools to improve the generalizability of the findings. Comparative studies employing quasi-experimental or mixed-methods designs could further examine the relative effectiveness of the Javanese script smart board against digital, game-based, or augmented reality learning media. Future investigations should also explore the long-term impact of smart board-assisted instruction on students' retention, motivation, higher-order literacy skills, and cultural appreciation of Javanese script. Such studies would provide a more comprehensive understanding of how interactive instructional media can contribute to sustainable regional language preservation while enhancing literacy learning in elementary education.

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