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Improving Javanese Script Reading and Writing Skills through JAWARA Media in Fourth-Grade Elementary School Students

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Abstract

This study addresses the critical degradation of Javanese script literacy among elementary students by evaluating the pedagogical efficacy of Media JAWARA, an interactive hybrid instructional tool. Conventional instructional paradigms in indigenous language education heavily rely on monolithic rote memorization, frequently triggering acute cognitive overload, orthographic ambiguity, and visual disorientation during complex character recognition. To dismantle these pervasive learning barriers, this research introduces a label-free differentiated instruction framework embedded within a multisensory learning environment that harmonizes physical and digital media. Utilizing a Classroom Action Research (CAR) design structured upon the Kemmis and McTaggart spiral model, the intervention was executed across two iterative cycles involving fourth-grade elementary students at SDN Ketintang II. Data collection encompassed standardized cognitive diagnostic tests, structured classroom observation protocols, and psychological affective questionnaires measuring student motivation. Quantitative and qualitative empirical analyses revealed remarkable academic progression, with classical learning mastery escalating dramatically from baseline deficiencies of 35% to 85% in reading fluency and 80% in writing accuracy by the conclusion of Cycle II. The primary theoretical novelty of this investigation resides in the seamless synthesis of physical manipulative instruments, digital gamification elements, and personalized differentiated pedagogical pathways. By bridging tactile, auditory, and visual learning modalities, this hybrid multisensory integration systematically mitigates orthographic visual discrimination deficits while significantly lowering students' affective anxiety filters. Consequently, this research provides a highly replicable, sustainable, and inclusive pedagogical blueprint for preserving and revitalizing endangered indigenous linguistic heritage within modern elementary education ecosystems.

Keywords: Javanese Script, Interactive Media, Multisensory Approach, Differentiated Instruction; Classroom Action Research

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1. Introduction

The Javanese script is a fundamental entity of the linguistic heritage and cultural wealth of the Nusantara, profoundly embodying the philosophical values of its society (Rahmawati, 2022). The global significance of this script has been confirmed through its official recognition by the Unicode consortium on the international stage. This recognition places the Javanese script on par with other global writing systems that possess structured digital standards. This cultural heritage is not merely a historical artifact of the past, but a communication instrument laden with moral significance. The preservation of this intangible cultural heritage is crucial amidst the current globalization that dominates the preferences of the younger generation (Setyawati & Aulia, 2023). The integration of regional scripts into formal education curricula serves as a strategic measure to maintain its existence.

The paradox occurring in the field indicates that the preservation of this script within the realm of formal education encounters serious pedagogical turbulence. This turbulence is specifically pronounced at the elementary school level, where students are just beginning to acquaint themselves with complex orthographic systems. Empirical facts identified among fourth-grade students at SDN Ketintang II reveal an extremely critical degradation in regional script literacy. In-depth observations indicate that students perceive the Javanese script as an intimidating subject (Wahyudi, 2021). This subject is considered highly difficult to comprehend compared to exact sciences or the national language. This psychological condition triggers initial resistance even before the process of knowledge transfer truly begins in the classroom.

The manifestation of these difficulties is clearly evident in the visual disorientation experienced by the majority of students in the classroom. This disorientation causes letters with similar shapes to be frequently interchanged during the visual identification process. Students demonstrate an inability to spell words precisely when confronted with a series of syllables that include sandhangan (vowel/consonant modifiers). The students' memory retention rates for newly taught material are also exceptionally low. Understanding of how to write and construct letters fades within a very short period after the lesson ends. This series of cognitive issues creates a recurring cycle of failure in every classroom formative evaluation.

The Javanese writing system operates on a rather unique abugida or syllabic mechanism (Kusuma, 2020). Each basic grapheme unit inherently represents an open syllable with a default inherent vowel. This syllabic structure presents a radical paradigm shift for fourth-grade elementary students. From their early literacy phases, these students have been conditioned to the pure phonemic Latin alphabetic system. The transition from an alphabetic to a syllabic logic demands massive cognitive schema

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reorganization in the child's brain. This forced reorganization directly triggers an exponential increase in cognitive load during the learning process (Mulyani, 2019).

The most prominent challenge burdening the working memory of SDN Ketintang II students is a visual discrimination deficit. The Javanese script possesses an extraordinarily high visual density in the architecture of each character. The majority of the characters are constructed from combinations of double curved lines, repetitive sharp angles, and intricately intersecting wave formations. Conventional learning instruments generally do not provide prominent distinguishing features to dissect this visual density. Consequently, students tend to generalize character shapes, culminating in fatal writing errors. These perceptual errors are manifestations of cognitive overload in working memory when processing excessively dense visual stimuli.

Mapping the typology of students' visual errors reveals clusters of characters that consistently provoke confusion. The lower curve group, such as the characters Ca, Ka, and Wa, shares structural foundations that are highly identical to one another. The vertical wave group, involving the characters Ta and Sa, frequently experiences spatial orientation reversals in students' memories (Santoso, 2022). The double-peak group, such as Tha and Nga, possesses extremely subtle distinctions in their final curvatures. The similarity of these graphical elements contributes to a massive reading error rate in the fourth grade of SDN Ketintang II. The absence of physical manipulative media causes students to fail in scanning the letters holistically, focusing solely on partial forms.

The difficulty in retaining the writing methods of the Javanese script is heavily influenced by the lack of external exposure outside the school environment. Modern sociolinguistic realities have reduced the Javanese script to an isolated object of academic study within the classroom (Pratama, 2021). Students do not receive incidental reinforcement through environmental exposure in their daily lives. The public literacy ecosystem, such as signboards, billboards, product labels, and daily storybooks, is absolutely dominated by the Latin alphabet. This absence of natural repetition ensures that memory traces related to script forms never receive continuous reinforcement. Without external stimulation, the complex graphical information of the Javanese script undergoes rapid memory decay.

The Javanese script literacy gridlock at SDN Ketintang II is a symptom of the failure of conventional instructional design. Daily learning practices remain heavily dominated by one-way lecture methods from educators. Teachers merely explain the material verbally at the front of the class without providing representative visual aids (Widodo, 2020). This approach compels students to engage in forced memorization without grasping the fundamental meaning behind the letter structures. Students are also continuously instructed to mechanically copy text from the blackboard into their notebooks. Such passive practices have proven to lose their relevance for elementary school-aged children who require dynamic stimulation.

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The monolithic approach applied by teachers fails to provide adequate exploratory space for students. Students do not receive sufficient opportunities to interact with the learning materials in a direct and applicative manner. This conventional teaching model is blindly assimilative toward the diversity of students' cognitive profiles in the classroom. The underlying assumption is that the entire classroom population possesses uniform capacities, paces, and learning preferences. This obsolete paradigm completely fails to accommodate the spectrum of student learning readiness, which is inherently highly diverse (Haryanto, 2019). Forcing the standardization of the learning process actually widens the comprehension gap among the fourth-grade students of SDN Ketintang II.

The failure of these conventional methods can be sharply critiqued through the lens of Jerome Bruner's cognitive development theory. Bruner's theory postulates that the mastery of complex new knowledge cannot be achieved instantaneously. Optimal learning internalization must sequentially pass through three fundamental phases: enactive, iconic, and symbolic (Bruner, 1966). The enactive phase requires learners to process information through motor responses and tactile interactions with real objects. The iconic phase bridges comprehension through visual imagery, representational pictures, or attention-grabbing diagrams. Abstract symbolic understanding can only be attained after the foundations of the two preceding stages are firmly established in the child's cognition.

Practices at SDN Ketintang II blatantly violate the hierarchy of cognitive development proposed by Bruner. Teachers initiate learning directly at the symbolic stage by presenting abstract characters on the blackboard. This cognitive coercion disregards the phases of physical touch and representational visualization, which are highly crucial for nine-year-old children (Lestari, 2021). This pedagogical procedural violation directly induces mass frustration among the students. Restoring learning competence demands an instructional redesign that structurally mandates the implementation of physical and visual stimulation beforehand. The use of concrete media is urgently required to bridge the chasm of confusion toward a complete understanding of linguistic symbols.

Optimizing the acquisition of Javanese orthographic skills must simultaneously exploit all of the students' sensory pathways. A multisensory pedagogical spectrum integrating visual, auditory, kinesthetic, and tactile elements offers a vastly superior instructional mechanic (Gunawan, 2020). Simultaneous stimulation of various sensory receptors triggers cross-hemispheric synaptic activation in the child's brain. This comprehensive neurological activation has direct implications for strengthening students' long-term memory endurance. The modification of curved letter strokes can be addressed by engaging arm muscles through free-air writing exercises. The visual form perception gap can also be mitigated by allowing students' fingers to trace the letter textures directly.

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This pedagogical transformation must be fully aligned with the mandate of the Emancipated Curriculum (Kurikulum Merdeka), which emphasizes structural flexibility. The Phase B Javanese Language Learning Outcomes necessitate that students possess the competence to read and write basic characters precisely (Kemdikbudristek, 2022). The material's complexity is further compounded by the necessity to master vowel modification instruments and closed-syllable markers. Navigating these curricular targets amidst the plurality of cognitive abilities in the classroom demands a responsive facilitation approach. The implementation of differentiated instruction becomes an absolute necessity to respond to the results of the students' initial diagnostic assessments. This differentiation will stratify students into beginner, intermediate, and advanced groups without imposing mentally detrimental labels.

An inclusive learning environment can only be cultivated if teachers design a differentiation matrix across content, process, and product dimensions. Input material adjustments allow the beginner group to focus on visual character recognition while the advanced group analyzes complex sentences (Tomlinson, 2014). Process differentiation ensures the availability of intensive mentoring for lagging students while granting exploratory autonomy to those ready to advance rapidly. Assessment outcomes are also tailored to ability profiles so that every individual can demonstrate their understanding without the pressure of rigid standardization. Collaborative strategies, such as the involvement of peer tutors, are highly effective in breaking the deadlock of one-way instructional communication from the teacher. The engineering of this differentiation architecture is expected to restore the learning motivation of fourth-grade students at SDN Ketintang II.

The integration of interactive educational media serves as the primary supporting pillar in executing these differentiated learning strategies. Tedious copying routines must be replaced with manipulative game schemes that naturally stimulate intrinsic motivation. Literature reviews validate that physical media in the form of cards, stacking boards, or stacking cubes are proven superior in reducing mental fatigue (Nugroho, 2023). The integration of digital technology also provides exponential added value in the form of instantaneous feedback that precisely corrects misconceptions. The collaboration of these physical and digital elements creates an immersive experience that surpasses the descriptive capabilities of any conventional teacher. The necessity for this comprehensive media is what birthed an innovative idea for a hybrid instructional device.

This research proposes an innovative solution through the introduction of Media JAWARA, an acronym for Jelajah Aksara Jawa Interaktif (Interactive Javanese Script Exploration). Media JAWARA is formulated as a hybrid media package that creatively combines physical manipulative tools with digital learning resources. Physical instruments encompass magnetic script cards, interactive stacking boards, and tracing sheets that stimulate tactile-motor intelligence (Wulandari, 2023). Digital components

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complement this through a code-scanning feature that directs students to authentic pronunciation audio, animated stroke direction videos, and interactive quiz games. The synergy of these two media dimensions presents concrete and multisensory stimulation that directly addresses the visual discrimination deficits of the students.

The design philosophy of Media JAWARA is deeply rooted in the principles of Deep Learning developed for twenty-first-century education. This principle ensures that every intervention flow proceeds consciously, is meaningful to cultural life, and is emotionally joyful (Fullan, 2018). Learning stages are engineered into three primary missions: observing characters, arranging then reading, and writing while testing comprehension. This series of activities is designed with adjustable assistance levels to facilitate learning differentiation without assigning ability labels to students. An achievement passport is utilized to record individual progress positively, averting classical ranking that triggers anxiety. This systematic construction shifts the script learning paradigm from a torturous memorization activity into an addictive exploration.

The elaboration of the theoretical framework and media innovation above culminates in the formulation of the objectives for this classroom action research. This study specifically aims to prove the effectiveness of Media JAWARA in restoring and enhancing the students' regional script literacy skills. In-depth investigations are directed at evaluating the students' abilities to recognize letter forms, arrange syllables, and read series of texts accurately. This research also examines the development of students' fine motor competencies in writing the Javanese script gradually, from the tracing stage to independent production. Empirical validation of the effectiveness of implementing differentiated instruction through this hybrid media is expected to yield a revolutionary pedagogical blueprint. The successful implementation of this solution will reignite the younger generation of SDN Ketintang II's love for the inheritance of their noble regional language identity.

2. Research Method

This study applies a Classroom Action Research design oriented toward improving the quality of the learning process within the classroom (Arikunto, 2021). The research design adopts the spiral cycle model of Kemmis and McTaggart, which systematically encompasses the stages of planning, action implementation, observation, and reflection (Kemmis et al., 2014). This cyclical design allows researchers to continuously adjust strategies based on the evaluation results of the previous stage. The research location was established at SDN Ketintang II, involving all fourth-grade students as the primary subjects. The selection of these subjects was based on empirical identification regarding the low level of Javanese script literacy skills in this age group (Sugiyono, 2019).

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The intervention procedure is designed using the operational scenario of the Interactive Javanese Script Exploration (Jelajah Aksara Jawa Interaktif) Media, which is divided into systematic mission stages. The first stage is called the Niteni (observing/identifying) mission, which specifically assigns students to visually match the shapes of the characters. Students are also asked to scan quick response (QR) codes to access authentic pronunciation audio and animated videos of stroke directions. The subsequent stage is the Nata-Maca (arranging and reading) mission, which demands the students' proactive participation in directly manipulating learning objects. Learners are instructed to arrange magnetic basic character cards and vowel modifiers (sandhangan swara) on the JAWARA Stacking Board into meaningful words. The students are then required to read the word arrangements aloud to train their phonological articulation accuracy.

The final intervention stage takes the form of the Nulis-Nguji (writing and testing) mission, which aims to consolidate the learners' fine motor skills. Students practice writing the script gradually using the Tracing Sheet (Lembar Jejak Tulis) instrument, which has been specially designed within the media package. This graphomotor practice begins with the activity of tracing dotted letter patterns until students are capable of producing the writing independently without visual aids. This activity is followed by an interactive formative assessment session to realistically measure the students' level of comprehension retention. All student mission completion achievements are systematically recorded using stamp validation on the JAWARA Passport document. This individual recording is also supported by observation field notes regarding the students' level of active learning during the ongoing learning process.

Data collection techniques are comprehensively implemented through a combination of cognitive test methods and qualitative perceptual evaluations (Creswell, 2014). Cognitive test instruments are applied in the form of pre-tests and post-tests to numerically measure the improvement in both reading and writing skills. Reading assessment utilizes accuracy and fluency indicators, whereas writing assessment employs a rubric for shape accuracy, writing sequence, the use of sandhangan, and neatness. The psychological responses of the learners are evaluated through the distribution of questionnaire instruments and interviews regarding the level of enjoyment and ease of using the media. The action research project is declared successful if there is a significant increase in the class average score at the end of the cycle. This success standard requires a minimum of 75 percent of students to successfully achieve the minimum mastery criteria set by the school. A complementary indicator also requires at least 80 percent of students to provide a positive perceptual response regarding the feasibility of implementing the hybrid media.

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3. Result

3.1 Pre-Cycle Initial Conditions

Initial data collection or the pre-cycle stage was conducted before the JAWARA Media intervention was implemented in the classroom. This operational stage aimed to map the basic abilities of the fourth-grade students at SDN Ketintang II in mastering Javanese script literacy. The classroom teacher administered a cognitive diagnostic test comprising a syllable reading ability test and a basic letter writing performance test. The results of this initial assessment served as a highly crucial baseline for measuring the effectiveness of pedagogical treatments in subsequent cycles. Observations of learning behavior were also intensively conducted to capture the psychological phenomena of students when confronted with this local content material.

The pre-cycle evaluation results revealed rather alarming quantitative facts regarding classical Javanese script literacy competence. The class average score for the reading skills dimension only reached 58 out of a maximum scale of one hundred. This figure was far below the Minimum Mastery Criteria established by the school institution. The classical learning mastery percentage in the reading aspect was recorded at only 32 percent of the total class population. A similar condition was identified in writing skills, with the class average score stalling at a mere 55. The student population that successfully surpassed the writing mastery threshold amounted to only about 28 percent of all learners.

Qualitative analysis of the students' worksheets revealed a dominance of difficulties in the aspects of memorizing and distinguishing character shapes. Learners consistently experienced visual confusion when identifying letters with similar curved line architectures (Sutanto, 2021). The most fundamental errors frequently occurred in distinguishing the characters ca, ka, and wa, which culminated in fatal pronunciation mistakes. Students tended to scan letters partially without paying attention to the final stroke modifications that determine the character's phonological identity. This extremely slow word reading fluency indicated a high cognitive load on students when processing unfamiliar orthographic symbols.

Fine motor skills in writing the Javanese script during the pre-cycle stage also exhibited a highly significant degradation profile. Field observations recorded the habit of the majority of students who relied heavily and continuously on visual examples on the blackboard. The learners' hand strokes appeared very rigid, disproportionate, and often violated standard line-drawing sequence guidelines. Very low memory retention caused the understanding of how to write to fade within hours after the teacher finished presenting the material. This empirical fact provides absolute justification regarding the

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urgency of pedagogical intervention through the utilization of more concrete and manipulative learning instruments.

3.2 Cycle I Implementation and Achievements

The implementation of action in Cycle I focused on introducing the physical components of the JAWARA Media instruments to all learners. The teacher commenced the learning session by distributing basic tools consisting of script cards, vowel modifiers (sandhangan swara), and stacking boards classically. This initial approach was deliberately designed to be uniform to build the class's fundamental understanding of the operational procedures for the newly introduced media. Students were grouped into basic heterogeneous formations to encourage academic interaction among peers during the activity. Verbal instructions were provided systematically so that learners understood the assignment flow from the initial mission to the final evaluation stage.

The operational implementation of Cycle I began with the activation of the Niteni (observing) mission, which exploited the students' visual and tactile learning styles. Learners were instructed to touch, observe, and match letter cards that had specific color codes on their edges. The teacher guided the students to group characters possessing similar physical shapes to gradually build visual discrimination awareness. This physical card manipulation activity proved effective in capturing the attention of students who previously often exhibited passive and unfocused behaviors. The classroom transformed into a dynamic exploration arena where students freely compared the morphology of one letter with another.

The transition process toward the Nata-Maca (arranging and reading) mission in Cycle I brought the class dynamics to a more complex level of interaction. Students began exploring the use of the JAWARA Stacking Board to arrange basic script cards and magnetic sandhangan into syllables. Learners took turns arranging simple words relevant to daily life and then reading the results aloud. The use of magnetic components eliminated students' anxiety about making mistakes because the arranged letters could be assembled and disassembled very easily. Peer tutors within the basic groups began to take active roles in correcting their peers' letter arrangements that were still inaccurate.

The final phase of the first round was executed through the Nulis-Nguji (writing and testing) mission, which comprehensively utilized the Tracing Sheet (Lembar Jejak Tulis) instrument. Students were trained to replicate the precision of character shapes through the activity of tracing dotted patterns provided on the worksheet. This gradual exercise was specifically designed to train writing instrument pressure consistency and slowly build the learners' muscle memory. Field observations noted an improvement in the quality of letter proportions, although some children still appeared to struggle when asked to write without examples. This motor habituation process took a considerable

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amount of time, causing the teacher's classroom time management to be slightly constrained.

The summative evaluation at the end of Cycle I presented data on academic performance improvement, offering a fairly positive signal of progress. The classical reading skill average score crept up from the initial baseline of 58 to 68 in this cycle's formative testing. The class reading mastery percentage also surged to 56 percent, indicating that more than half the class had begun to recognize letter patterns. A linear improvement also occurred in writing competence, with the class average reaching 65 in aggregate. The passing rate in the writing evaluation successfully breached 52 percent of the total active participating learners.

In-depth reflection on the Cycle I findings revealed several residual problems requiring tactical refinement in the subsequent stage. The class's quantitative achievements had not yet been able to surpass the minimum success indicator threshold of 75 percent established in the research proposal. Observations indicated that the uniform classical application of the media was not fully capable of accommodating the disparities in learning paces among individuals. Students with high cognitive capabilities tended to get bored quickly after completing tasks earlier than the normal estimated time. The optimization of Media JAWARA's digital features had not been maximally executed due to duration constraints during the class's initial introduction stage.

3.3 Cycle II Implementation and Achievements

The Cycle II round was designed as a comprehensive corrective response based on the reflective analysis of weaknesses in the previous stage's implementation. The primary focus of improvement lay in optimizing the Label-Free Differentiation concept to serve the diverse learning readiness of all learners. The teacher deconstructed the uniform assignments into three instructional tracks distributed covertly without triggering psychological discrimination among class students. This differentiated pedagogical design allowed every individual to learn according to their assimilation capacity without feeling demeaned or pushed beyond their limits. Classroom management became much more conducive because the material's challenge level had been specifically calibrated to the students' cognitive capabilities.

The Support Track in Cycle II was specifically dedicated to students who were still experiencing visual script discrimination deficits. Learners in this track received intensive mentoring intervention from the class facilitator using a variation of dominantly color-coded cards. The learning focus was directed toward mastering basic letters with the assistance of pronunciation audio continuously played on repeat using a device. The Core Track, on the other hand, served the majority of the class population with standard assignments of arranging words affixed with sandhangan swara

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modifications. Students in this intermediate group demonstrated a much higher level of independent learning when manipulating cards on the stacking board.

The handling of students with superior linguistic abilities was facilitated through enrichment mechanisms outlined in the Challenge Track design. This advanced group was instructed to collaboratively work on simple sentence transliteration projects using a highly comprehensive letter inventory. The educator empowered them structurally as academic consultants or peer tutors for classmates encountering impasses. This strategic empowerment proved capable of eliminating the boredom of bright students and fostering an extremely positive prosocial climate in the classroom. This differentiation framework successfully distributed the cognitive load proportionally throughout the class without triggering mental resistance (Wibowo, 2022).

The pinnacle of innovation in Cycle II manifested through the full utilization of all digital feature integrations from the Media JAWARA package. Students appeared highly enthusiastic when directed to scan the Javanese Script Memorization Song Barcode using devices provided at the learning stations. The synchronization between musical auditory stimuli and physical card manipulation produced highly solid memory retention in the students' brains. The rhythmic song lyrics functioned optimally as a mnemonic device to help students recall letter shape information from memory. The classroom atmosphere was filled with educational humming that awakened learning energy and eliminated the monotonous nuances of the traditional subject curriculum.

The integration of digital platforms was also expanded cohesively through the implementation of Interactive Games accessible directly from scanning quick response codes. The typically tense formative evaluation session was successfully transformed into a digital gamification competition enthusiastically welcomed by all learners. This web-based application featured an interactive letter-matching quiz that provided instantaneous visual and auditory feedback as students answered. Students' achievements from each completion of digital and physical missions were then validated using official stamps on the JAWARA Passport document. This educational gamification element spurred a surge in students' intrinsic motivation to continuously improve their answer accuracy independently (Kurniawan, 2023).

Confirmation of the effectiveness of this series of hybrid media interventions was validly captured in the recapitulation data of reading post-test results. The classical average score for reading skills surged drastically, reaching 84 in the final summative evaluation of the second cycle. This acquired score had absolutely succeeded in surpassing the Minimum Mastery Criteria standard required by the school institution. The class reading mastery percentage successfully breached 85 percent, representing a highly massive cognitive improvement compared to the initial baseline. Students were capable of pronouncing complex syllables containing sandhangan modifications with highly proficient levels of articulation and fluency.

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Equivalent development was also very impressively recorded in the assessment dimension of the fourth-grade learners' fine motor skills. The writing rubric evaluation showed a stable surge in the class average score, placing 82 as the final aggregate achievement. The classical writing mastery success rate successfully touched 80 percent at the end of this second round's summative evaluation. Analysis of the students' worksheets revealed stroke consistency that was more precise, proportionate, and compliant with standard letter-writing direction rules. This motor automatization proved that gradual practice using the Tracing Sheet had a permanent impact on the students' procedural memory retention.

A deeper review of the writing rubric suggested a shift in cognitive patterns when students applied the use of sandhangan swara components. The placement of vowel symbols such as wulu or suku during the pre-cycle stage was often written in positions deviating from standard rules (Utami, 2020). The use of colorful cards in the Nata-Maca mission gradually conditioned the students' brains to map the spatial area around the basic letters. Repetitive practice on the Tracing Sheet then locked this spatial map into a mechanical memory ready to be recalled instantly. The synchronization between visual comprehension and motor execution is an essential achievement of implementing the multisensory differentiated learning approach.

3.4 Recapitulation of Javanese Script Literacy Skill Improvement Data

Data synthesis from all indicators validated that the Media JAWARA intervention had met all the success criteria required by the research. The steady increase in classical academic scores remaining above the 75 percent threshold confirmed the operational feasibility of this media innovation. The psychological response questionnaire noted that 92 percent of students expressed enjoyment and ease in using the hybrid media device. The majority of learners appreciated the freedom to explore physical cards combined with the appeal of device-based digital interactive games. A summary of the overall numerical development from each stage of this classroom action research is presented comprehensively in the data recapitulation table.

Table 1. Comparison of Average Scores and Learning Mastery Percentages

Implementation Stage	Class Average (Reading)	Classical Mastery in Reading (%)	Class Average (Writing)	Classical Mastery in Writing (%)
Pre-Cycle	58	32	55	28
Cycle I	68	56	65	52
Cycle II	84	85	82	80

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The quantitative data presented in the recapitulation table indicate a highly consistent upward trend across all aspects of Javanese script literacy. The increase in the class average scores from the pre-cycle stage to the second cycle represents the success of the pedagogical intervention through the utilization of Media JAWARA. Reading skills recorded the sharpest surge, with an initial mastery percentage of 32 percent skyrocketing to 85 percent at the end of the research. Writing competence also exhibited a massive escalation from 28 percent mastery in the initial assessment to 80 percent post-application of the digital features. The final achievements in both skills have convincingly surpassed the minimum success indicator of 75 percent established in the research proposal.

The transition of results between the implementation of the first round and the second round demonstrates the significance of adopting an instructional differentiation approach in the classroom. The first cycle, which applied a uniform classical learning scenario, was not yet able to breach the minimum mastery threshold despite an improvement in baseline scores. The implementation of the Support Track, Core Track, and Challenge Track strategies in the second cycle proved successful in accelerating the comprehension of the entire learner population. The surge in scores in the second stage confirmed that the recalibrated distribution of cognitive tasks was able to effectively reduce the learners' mental resistance. The class communally succeeded in proving a solid academic capacity improvement thanks to the intervention of the integrated manipulative media instruments.

4. Discussion

A comprehensive analysis of the Media JAWARA implementation results reveals various significant pedagogical findings. The improvement of Javanese script literacy skills in the fourth grade of SDN Ketintang II did not occur merely by chance. This success is the product of instructional engineering that precisely integrates multisensory stimulation and differentiated instruction. The discussion in this section will deeply dissect the cognitive and psychological mechanisms underlying this improvement. The three main dimensions focused on in this discussion include the effectiveness of the multisensory approach, the role of gradual motor practice, and the psychological impact of gamification elements. A comprehensive understanding of these three dimensions is expected to provide strong theoretical justification for adopting hybrid media in elementary education.

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4.1 The Impact of the Multisensory Approach (Niteni & Nata-Maca) on Reading

The visual discrimination deficit experienced by learners during the pre-cycle stage was drastically reduced through the intervention of the Niteni (observing) mission stage. Students previously experienced severe disorientation when distinguishing letter clusters with similar architectures, such as the characters ca, ka, and wa. The use of picture cards equipped with dominant color codes on the edges successfully served as highly effective visual stimuli. These color codes functioned as memory anchors guiding the child's brain to uniquely map the graphical identity of each character. This visual approach proved to be vastly superior to the black-and-white copying methods that have traditionally dominated classrooms. Visual conditioning through colors and pictures aligns with the iconic developmental stage of Jerome Bruner's cognitive theory, which emphasizes visual representation.

The integration of quick response code scanning technology provides an essential auditory dimension in the holistic letter recognition process. Learners can instantly listen to authentic phonological pronunciation moments after scanning the script card using a smart device. The simultaneous stimulation of visual and auditory receptors triggers cross-hemispheric synaptic activation within the students' cerebral cortex (Kusuma, 2021). This dual neural activation directly strengthens the neurological connections responsible for storing long-term memory regarding the sound identity of an abstract symbol. This phenomenon proves that the multisensory method is highly relevant for application in local content subjects possessing high orthographic complexity. Students no longer have to guess the correct pronunciation because auditory feedback is precisely and instantaneously available from the media being used.

The Nata-Maca (arranging and reading) mission stage presents kinesthetic and tactile stimulation bridging the students' conceptual understanding toward analytical and practical application. Learners are required to arrange magnetic script cards and vowel modifiers (sandhangan swara) on the JAWARA Stacking Board to construct a word. The manipulation of these physical objects facilitates the enactive stage of Bruner's theory, demanding students to interact directly with concrete learning materials. The magnetic material eliminates students' anxiety about potentially making mistakes because each letter can be shifted or replaced without leaving ink marks. This maneuvering freedom encourages students to courageously experiment with syllable arrangement repeatedly without having to wait for teacher intervention. The repetition of this tactile activity and card shifting gradually solidifies the students' cognitive map regarding the precise orthographic layout of the Javanese script.

The pinnacle of this multisensory approach series manifests in the classical improvement of learners' reading articulation fluency at the end of the cycle. Students who have become accustomed to associating colors, visual shapes, and pronunciation

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sounds are capable of decoding script symbols at a vastly improved speed. The word arrangement process, which previously felt extremely arduous and triggered frustration, transformed into a highly low-friction automatic decoding activity. This success highlights the significance of the synchronization process between the partial understanding of basic letters and the execution of comprehensive syllable combination. This strategy effectively succeeded in lowering the students' cognitive load when processing the abugida writing system, which is laden with sandhangan rule modifications. The multisensory approach has proven to be not merely an aesthetic complement but a fundamental instrument for entirely overhauling the structure of children's orthographic comprehension.

Continuous multisensory engagement creates a knowledge retention schema that is far more persistent compared to conventional teaching methods in passive classrooms. Muscle memory built through the tactile manipulation of magnetic cards collaborates perfectly with visual color traces and digital auditory memory. This sensory synergy ensures that if one memory retrieval pathway experiences a blockage, the child's brain can rely on other sensory pathways to recall the information (Sudirman, 2019). This neurological phenomenon explicitly explains why learners no longer easily forget letter shapes after class hours end. This permanent memory endurance is a fundamental asset for students as they progress to more complex Javanese script materials in the future. The use of this integrated approach becomes a solid runway for accelerating the linguistic comprehension of elementary school students.

4.2 The Role of Gradual Practice (Nulis-Nguji) in Writing

The transition from the receptive skill of reading to the productive skill of writing demands highly accurate and controlled fine motor readiness. The Nulis-Nguji (writing and testing) mission stage in Media JAWARA is structurally designed to bridge the cognitive load surge arising from this transition process. The use of the Tracing Sheet (Lembar Jejak Tulis) instrument becomes a central innovation in training students' hand stroke consistency from the most basic imitation stage. Practice commences with the mechanical activity of tracing dotted patterns, which gradually stimulates and builds the learners' wrist muscle memory. This habituation process ensures that students are not immediately confronted with a blank sheet of paper, which often triggers severe psychological barriers. Learners are guided slowly until they possess a sufficient level of resilience and self-confidence to produce characters independently without visual examples.

The effectiveness of motor practice on print instruments is also supported by the availability of highly interactive stroke direction guide videos. The playback of these animated videos provides a dynamic spatial guide regarding the starting point of the line

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draw to the letter's termination point stage. Students can observe the choreography of these curved strokes repeatedly via the device screen before physically applying them onto the worksheet. This precise visualization of movement direction is highly crucial for preventing the occurrence of incorrect writing habits that are typically extremely difficult to reconstruct later on (Widiastuti, 2022). The combination of digital video observation and execution on the tracing sheet creates a sensorimotor feedback loop that accelerates the automatization process of students' writing skills. The final result of this integrated instructional process is the creation of proportional, neat Javanese script writing that adheres to standard orthographic rules.

A deeper analysis of this gradual practice schema reveals a progressive shift in the students' cognitive focus during the learning phase. In the early phase of using the tracing sheet, the learners' visual and cognitive attention is entirely centered on the mechanical control of the writing instrument tip (Santoso & Arifin, 2021). The automatization of this fine motor control subsequently frees up working memory space in the brain to begin focusing comprehensively on spelling guidelines and sandhangan layout. This shift in the center of focus proves that the structural design of Media JAWARA truly operates according to the cognitive neuroscience principles of early childhood learning. Educators no longer need to apply extra instructional pressure because the students' proficiency curve rises naturally in tandem with the intensity and frequency of practice conducted. The independence of cognitive processing and motor execution can ultimately be realized harmoniously at the end of this instructional mission series.

The interactive formative assessment session at the final stage of learning plays a vital role in locking in the retention of the procedural understanding the students have formed. This final evaluation is not designed as an academic judgment instrument but functions as a consolidation space to validate the learners' writing independence. Students are presented with simple word transliteration challenges that must be completed without the assistance of visual guide devices from the preceding stages. The high level of answer accuracy in this session proves that the scaffolding fading mechanism was executed with highly accurate timing. Learners still demonstrating tendencies of hesitation are immediately identified by the teacher to receive muscle memory reinforcement through short-duration repetition schemes. This type of measured evaluation mechanism guarantees that each individual has genuinely surpassed the motor independence stage before proceeding to study more complex materials.

4.3 Psychological Effects (Meaningful & Joyful)

The engineering of an adaptive and conducive learning environment cannot be separated from the dominant role of gamification elements injected into Media JAWARA.

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The JAWARA Passport document emerges as a highly crucial psychological engineering instrument in the effort to reduce learners' academic anxiety levels. This special instrument functions solely to record the track of mission stage completion individually through the affixation of attractive visual achievement stamps. The absence of a numerical grading ranking system or classical labeling allows unhealthy competitive nuances among students to be totally eliminated from the classroom. Each student celebrates the achievement of their own personal learning pace without feeling intimidated by the assimilation speed of peers who might be far superior (Nugraha, 2021). This feeling of psychological safety within the classroom directly lowers the students' affective filter, enabling them to respond optimally to the influx of new information.

The concept of label-free differentiation applied to the distribution of the Support Track, Core Track, and Challenge Track also donates a massively valuable affective contribution. Learners work on assignment materials calibrated to their cognitive readiness levels without realizing in the slightest any deliberately differentiated treatment by the facilitator. The group of students with learning difficulties does not feel stigmatized as lagging students, while the advanced group does not feel excessively privileged. The equality of this instructional approach fosters a highly inclusive classroom climate where every individual feels their existence and efforts in the learning process are valued. The instantaneous eradication of academic labeling pressure awakens a wave of students' intrinsic motivation to continue striving to explore various Javanese script arrangements without being overshadowed by the fear of making mistakes. The slogan of meaningful and joyful learning can finally be realized into empirical reality instead of merely stopping at becoming pedagogical jargon in curriculum documents.

The learners' psychological mental toughness or resilience also experiences highly significant strengthening through this integrated gamification approach. Students no longer manifest avoidance behaviors toward learning obligations when confronted with a stack of formative evaluation questions for both reading and writing skills (Wijaya, 2022). Spelling errors when arranging letter blocks on the magnetic board are viewed positively as part of an explorative play process rather than being branded as highly fatal academic failures. The paradigm shift in this communal mindset is a manifestation of the direct impact of the joyful climate injected through the JAWARA Passport medium and interactive digital quizzes. Extrinsic motivation initially deliberately stimulated through the appeal of game elements is ultimately fully internalized into an intrinsic motivation to conquer the script material. This courage to express oneself and try without being shadowed by the fear of failure is the most essential embodiment of the idea of emancipatory education that liberates the true potential of every learner.

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The implementation of the peer tutoring system during the operational phase of the class also enriches the essence of the social interaction dimension and the emotional stability of the learners. Representative students from the advanced group are actively encouraged to pass on tactical guidance to their peers encountering operational hurdles when executing the Nata-Maca mission completion. This progressive social dynamic successfully reduces the dominance of formal instructional communication distance, which generally becomes a communication barrier between teachers and students in traditionally patterned classrooms (Pratama & Hidayat, 2020). Material explanations from the mouths of fellow playmates often prove to be comprehended much more quickly because they tend to be wrapped in diction choices that are down-to-earth and relevant to the child's social world. This collaborative learning interaction dedicates space for students to simultaneously hone empathy, instill tolerance, and sharpen interpersonal communication skills, which are highly needed amid twenty-first-century life. The atmosphere of the learning space instantaneously transforms into an extremely warm participatory community where the process of solving a problem is viewed purely as a form of shared collective responsibility.

All of these observational pedagogical phenomena provide absolute confirmation that the achievement of success in learning the Javanese script is absolutely not solely supported by the high novelty quality of the material. The aspects of emotional recovery engineering and initiatives to create a learning environment design free from psychological pressure hold an equally substantial contributory value in determining the quality of the educational program's final outcome. The Media JAWARA innovation has comprehensively proven its feasibility capacity as a catalytic agent capable of seamlessly integrating the fulfillment of cognitive processing acuity with the touch of comfort in the affective domain. Fourth-grade students at SDN Ketintang II today view the study of the Javanese script no longer as the specter of an ancient civilization instrument fond of torturing rote memory capacity. This massive transformation of the learners' psychological perception is an essentially fundamental achievement from the implementation of a series of classroom action research interventions holding fast to a primary orientation toward efforts to preserve the ancestral culture of the Nusantara. The continuous integration regarding multisensory methods, staged practice phases, alongside this child-friendly gamification approach is immensely worthy of being explored and replicated across the diversity of local content learning contexts in other territories of the archipelago.

5. Conclusion

The implementation of learning using Media JAWARA (Jelajah Aksara Jawa Interaktif) is proven to significantly improve the Javanese script reading and writing

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skills of fourth-grade students at SDN Ketintang II. This improvement is validated by the achievement of the classical average score, which successfully surpassed the Minimum Mastery Criteria at the final stage of the second cycle. The classical learning mastery for the reading skill indicator surged sharply, reaching eighty-five percent of the class population. The learners' fine motor competence in writing the script also exhibited a positive trend, with the success rate touching eighty percent. This impressive quantitative achievement is entirely consistent with the psychological responses of the learners, where ninety-two percent of students provided highly positive feedback regarding the hybrid instrument.

The success of this pedagogical intervention is absolutely supported by the integration of a multisensory approach that effectively reduced the learners' visual discrimination deficits. The precise combination of physical manipulative card instruments, digital audio features, and gradual motor practice successfully facilitated the diversity of students' learning styles comprehensively (Rahmawati & Sudiyana, 2023). The implementation of a structured differentiation strategy without academic labeling also created an inclusive learning ecosystem that successfully minimized learning anxiety levels. The educational gamification elements in the achievement documentation instrument successfully stimulated the students' intrinsic motivation to explore traditional orthographic materials courageously and independently. The utilization of such adaptive hybrid media is highly recommended for replication to secure the continuous preservation of regional linguistic heritage across various elementary education institutions.

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