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DESIGNING AN INTERACTIVE LEARNING GAME INTEGRATING LOCAL CULTURAL VALUES TO ENHANCE JAVANESE SCRIPT LITERACY

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ABSTRACT
Interactive Learning Games are one of the learning media used to measure the achievement of student learning objectives. This development research aims to test the feasibility of a product in the form of Interactive Learning Games to improve Javanese literacy. Validation testing was conducted by material experts, media experts, peer review, as well as testing on students with three types of tests including individual tests, small group trials, and large group trials. The Interactive Learning Games were created using Canva without requiring coding skills. The type of research is Research and Development using the ADDIE development model. The research target was grade V students at SDN Urangagung Sidoarjo. Based on the validation results from the media experts, the Interactive Learning Games received an average score of 92.6%, while the validation results from material experts received an average score of 90%. The product test results from peer review received an average score of 90.4% with some improvements, while individual trial tests obtained an average score of 91%, small group trials achieved an average of 87%, and large group trials reached 88%. Based on validation tests from experts, peer reviews, and trials conducted with students, the use of this Interactive Learning Game is feasible for use in the learning process and can also be used as independent assignments.

I. INTRODUCTION

Conceptually, literacy is defined as an individual's ability to access, comprehend, evaluate, and produce information in various forms both textual and visualalongside the capacity for critical thinking within modern life contexts [1]. One crucial dimension of literacy is cultural literacy, which refers to the competence to understand, appreciate, and preserve local cultural elements as an integral part of national identity.

Javanese script literacy serves as a tangible form of cultural literacy because it involves the ability to read, write, and interpret the symbolic meanings embedded in traditional Javanese writing. This literacy plays a vital role in preserving Indonesia's cultural heritage and fostering a sense of pride in national identity and cultural diversity. Through Javanese script literacy, students gain not only technical skills but also an appreciation for cultural values that reinforce their connection to national identity.

According to [2], Javanese script literacy encompasses the ability to read, write, comprehend, and utilize the script in functional and creative ways across cultural, social, and technological contexts. [3] emphasize that Javanese script literacy goes beyond merely recognizing or writing charactersit includes understanding meaning, applying the script appropriately, and preserving cultural identity through the integration of digital media, making it relevant to today's digital generation.

Furthermore, [4] identify three core components of Javanese script literacy: the accuracy of transliteration between Latin and Javanese scripts, the proficiency in writing the script correctly, and the comprehension of the

cultural context inherent in its use. Hence, Javanese script literacy underscores the importance of developing holistic competencies that integrate technical proficiency, cultural preservation, and technological application in the learning process.

The teaching of Javanese script literacy at the elementary education level plays a vital role in preserving cultural heritage and strengthening local identity, which are increasingly eroded by modernization and the digitalization of Latin-based learning systems [5]. Research on Javanese script literacy within the field of elementary education aims to reinforce students' foundational skills while cultivating patriotism and appreciation for local wisdom as part of Indonesia's intellectual and cultural wealth.

Moreover, such studies contribute to enriching contextual education that aligns with the needs and values of local communities [6]. Therefore, incorporating Javanese script literacy into elementary education is essential for maintaining cultural values that embody the nation's identity. The Javanese script serves not only as a tool for communication but also as a medium through which students can explore local culture and develop a sense of national pride.

Furthermore, Javanese script literacy can be effectively enhanced to foster students' interest, motivation, and skills in responding to the challenges of globalization and educational digitalization. This can be achieved through innovative and context-based learning approaches, such as the Montessori method and the integration of interactive learning media. Hence, the development and implementation of Javanese script literacy must be carried out systematically and sustainably, given its essential role in shaping character and reinforcing cultural identitynot merely as a technical or linguistic skill.

Previous studies on the development of Javanese script literacy at the elementary school level have utilized a wide range of approaches and instructional innovations. These include the development of digital media such as Rajagita, the implementation of educational games based on Javanese script literacy, Montessori-based training, the use of the Teams Games Tournament (TGT) model, as well as the creation of local-culture-based learning modules and e-comic media (PRAJA) designed to enhance students' motivation and comprehension [7].

Other strategies involve transliteration techniques, the use of interactive books, and the development of web- and mobile-based educational games that aim to foster students' contextual engagement in learning. Overall, the findings indicate that digital media and interactive methods have significantly improved students' learning outcomes, concentration, and motivation, while simultaneously deepening their understanding of local culture.

Nevertheless, certain theoretical and methodological limitations remain. Conceptually, many studies have yet to fully integrate local wisdom values or emphasize the cultural dimensions of Javanese literacy. Pedagogically, instructional practices still tend to be teacher-centered, and innovation in digital tools, student interaction, and equitable access to technology remain limited [8].

These complexities highlight the need to optimize Javanese script literacy instruction through innovative, adaptive, and integrated approaches within the elementary education ecosystem. Such efforts are essential to achieving a sustainable balance between technological advancement and cultural preservation.

Although prior research has yielded positive outcomes, several constraints persist. Theoretically, most studies have focused primarily on general literacy and numeracy, while exploration of Javanese script literacy within the framework of foundational literacy pedagogy remains scarce [9]. Methodologically, many works conclude at the validation stage without employing experimental or quasi-experimental designs to assess media effectiveness quantitatively [10]. Practically, few learning media have been developed with attention to local cultural contexts and the psychopedagogical characteristics of elementary learners [11].

This condition reveals a clear research gap in the development of interactive educational game media, particularly concerning the optimization of Javanese script literacy through local wisdom-based approaches, digital media innovation integrating cultural values, and technology utilization that promotes active and participatory learning in primary education settings [12].

Most fifth-grade elementary school students still struggle to read and write Javanese script fluently, particularly in using sandhangan (vowel diacritics) and pasangan (consonant ligatures). These difficulties arise from the similar shapes of the characters, complex pronunciation rules, and the intricate structure of the script [13]. Furthermore, Javanese script instruction is generally conducted using traditional teaching methods without the support of engaging learning media, which contributes to students' low literacy levels in the subject [14].

In addition, the availability of learning media for Javanese language instruction remains limited compared to other subjects. The materials commonly usedsuch as Javanese script posters, pepak reference books, and textbooksare less effective in stimulating students' engagement and enthusiasm for learning.

According to [15], motivation serves as the foundation for students to achieve optimal learning outcomes, which subsequently become the basis for assessing their competency attainment. Therefore, the selection and use of interactive learning media are expected to enhance students' interest and motivation, thereby improving their literacy skills in Javanese script [16]. Hence, there is an urgent need for innovative learning media development

that can effectively support students in mastering Javanese script literacy in a more engaging and interactive way.

In the context of elementary education, educational game media has proven effective in enhancing students' literacy, numeracy, and social skills. The use of game-based learning media not only captures students' attention but also facilitates the process of learning to read and write Javanese script, which is often considered complex.

The strength of this study lies in the application of a research and development (R&D) approach to produce a learning medium that is valid, practical, and effective [17]. Moreover, this research integrates local wisdom values directly into the learning media design. Consequently, students are not only able to strengthen their Javanese script literacy skills but also internalize cultural values and local identity as part of their character development [18].

This study focuses on developing adaptive learning technology that enables students to learn independently with appropriate visual support. The media is designed to accommodate diverse learning styles while optimizing the use of digital technology to enrich students' overall understanding of Javanese script.

Digital and interactive-based learning has proven to be highly effective in enhancing students' motivation and learning outcomes [19]. Educational games represent a pedagogical strategy that integrates game elements with instructional objectives, creating an engaging and meaningful learning experience for students.

This research also provides a relevant solution to challenges in primary education, particularly regarding the lack of innovative learning media, limited interactivity, and the absence of local wisdom integration in Javanese language learning. Therefore, this study contributes significantly, both theoretically and practically, to the advancement of educational practices by developing innovative, culturally grounded learning media aligned with contemporary educational needs [20].

Although various learning innovations such as the Rajagita digital media, the *Teams Games Tournament* (TGT) learning model, and local culture-based e-comics (PRAJA) have made positive contributions to improving students' motivation and understanding [21], these approaches still exhibit significant limitations. The Rajagita media tends to emphasize the technical aspects of script recognition without deeply integrating cultural values into the learning flow [22]. The TGT model primarily focuses on group competition and the improvement of cognitive learning outcomes [23], yet it is not specifically designed to internalize local wisdom and the cultural character of elementary school students [24]. Meanwhile, although visually engaging, the PRAJA e-comic remains largely one-directional and provides limited interactive and adaptive learning experiences that align with the psychopedagogical characteristics of elementary learners, who require exploratory learning, immediate feedback, and active engagement [25]. In addition, many existing media have not fully integrated visual, kinesthetic, and auditory elements within a unified digital learning ecosystem [26]. Therefore, the development of an *Interactive Learning Game* based on local cultural values emerges as the most innovative and urgent solution, as it holistically integrates cultural, pedagogical, and technological dimensions [27] while addressing students' needs for engaging, adaptive, participatory, and culturally meaningful learning [28].

The novelty of this research lies in the integration of local wisdom and digital technology within a unified game-based learning design specifically developed to enhance Javanese script literacy at the elementary school level. The results of this study are expected to strengthen the scientific foundation of basic education, promote the preservation of national cultural values, and present innovative learning strategies relevant to the demands of the digital.

II. RESEARCH METHODOLOGY

The type of research employed in this study is Research and Development (R&D). This study aims to develop an interactive learning medium based on educational games integrated with local wisdom to optimize the Javanese script literacy skills of elementary school students. The ADDIE model comprising Analysis, Design, Development, Implementation, and Evaluation was adopted as the development framework [29]. The ADDIE model was selected due to its systematic structure and ease of application, making it suitable for instructional media development. Furthermore, the model offers a straightforward process that leads to the creation of effective instructional or training designs, emphasizing learning outcomes while addressing user needs and ensuring the sustainability of the development process [30]. The subjects of this study were grade V students at SDN Urangagung, located in Sidoarjo District, Sidoarjo Regency. A total of 24 students from the fifth grade participated as research subjects.

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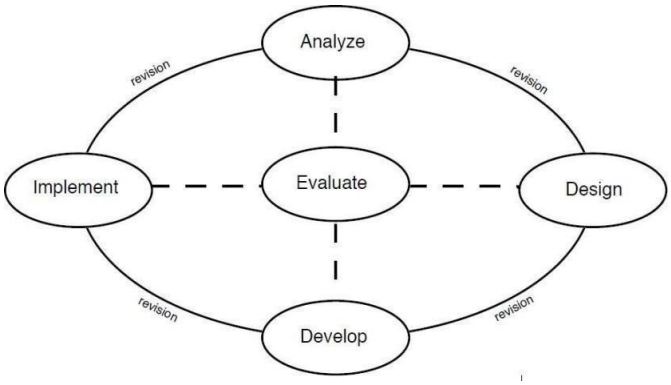

Figure 1 ADDIE Model Development Stage

The stages of the ADDIE method in developing an interactive learning media based on educational games integrated with local wisdom to optimize Javanese script literacy skills.

The development process of the interactive learning media based on educational games integrated with local wisdom to optimize Javanese script literacy skills follows the ADDIE model, which consists of five systematic stages [31]. The Analysis stage involves evaluating various aspects such as learning needs, curriculum alignment, student characteristics, available resources, learning models, and the conceptual design of the product to be developed [32]. The Design stage focuses on formulating strategies for creating interactive educational game–based learning media derived from the previous analysis and aligned with the established learning objectives. In the Development stage, the interactive learning media is produced and refined, followed by expert validation to ensure its quality, feasibility, and relevance [33]. The Implementation stage includes testing the developed media in fifth grade elementary school classes, conducted on both small and large scales to measure its practicality and effectiveness in real classroom settings. Finally, the Evaluation stage assesses the impact of the developed media on improving students' Javanese script literacy skills, ensuring that the learning objectives are achieved and that the media contributes meaningfully to the learning process [34].

The ADDIE model was selected because it provides a systematic, flexible, and instruction-oriented development framework, making it more suitable for developing educational games based on local cultural values compared to other models such as the *Game Development Life Cycle* (GDLC), which primarily emphasizes technical programming aspects and user experience [35]. ADDIE enables the structured integration of local wisdom values starting from the needs analysis stage through to the evaluation stage, rather than limiting cultural integration to visual design or gameplay flow alone [36]. Furthermore, ADDIE ensures strong alignment between pedagogical principles, students' psychological development, and cultural content, as each stage is interconnected and anchored in clear instructional objectives [37]. This makes ADDIE superior for educational game development at the elementary level, which demands not only visual attractiveness and interactivity but also content accuracy, cognitive appropriateness, and the meaningful and sustainable internalization of cultural values.

A student is considered to have achieved learning mastery if they meet the Minimum Mastery Criteria (KKM) of 75%, categorized at least as good [38]. Meanwhile, classical mastery is achieved when at least 85% of the total students in the class reach the predetermined level of competence. Once these criteria are fulfilled, the developed learning media is deemed feasible and effective for educational use. The validity of the test results is assessed using a percentage scale presented in Table 1, while the effectiveness and practicality criteria are shown in Table 2 and Table 3, respectively.

TABLE I.
VALIDITY CRITERIA

Creteria	Validity Level
75 - 100%	Very Valid
50 - 75%	Valid
25 - 50%	Loss Valid
0 - 25%	Not Valid

TABLE II.
EFFECTIVENESS CRITERIA

Average Value (%)	Description
76-100	Highly effective
51-75	Effective
26-50	Less Effective
0-25	Very Less Effective

TABLE III

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PRACTICALITY CRITERIA

Criteria	Validity Level
75%-100%	Very practical
50%-75%	Practical
25%-50%	Less practical
0%-25%	Impractical

III. RESULT AND DISCUSSION

Results

The product developed in this research is an online-accessible Javanese script educational game with link https://s.id/gameedukasiaksarajawa To access the game, users need a stable internet connection and can use any digital device at any time and from any location. The game consists of several main components, including user name input, scoring system, and learning materials.

Regarding the usage procedure, students begin by opening the provided URL link to access the game. They then enter their names and proceed to answer a series of multiple-choice questions. Once all questions have been answered, students click the "Finish" button, and their scores are automatically displayed on the screen, providing immediate feedback on their performance. The interface of the game is illustrated in the figure below.

Figure 1. First Page

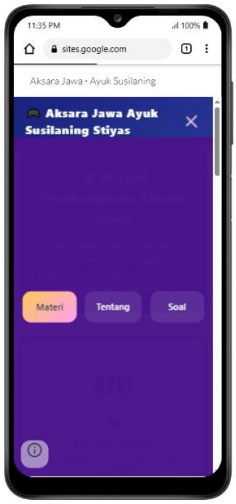

Figure 2. Menu Game

Figure 3. Created Game

Figure 4. Quiz

Figure 5.Level game

Figure 6.Quiz False

The media expert validation test in this study covered three main aspects comprising 19 assessment indicators, including appearance (10 items), usability (6 items), and utility (3 items). Each aspect was rated using a five-point Likert scale. The results of the media expert validation are presented in Table 4 below:

TABLE IV

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MEDIA EXPERT FEASIBILITY TEST

Validation Test	Aspect	Percentage (%)
	Display	90
	Usability	96
	Utilization	92
Media Expert (Average)		**92.6**

Based on the results, the appearance aspect obtained a score of 90%, the usability aspect achieved 96%, and the utility aspect reached 92%, resulting in an overall average of 92.6%. The media expert suggested applying brighter color schemes to make the visual interface more comfortable and less fatiguing for students. According to the feasibility criteria in Table 1, the validation results are classified as "highly feasible."

Following this stage, a material expert validation test was conducted, which included five aspects with a total of 21 indicators. These aspects comprised identity (3 items), content (3 items), learning objectives (10 items), scoring (2 items), and assignments (3 items). Each aspect was evaluated using a five-point Likert scale. The results are shown in Table 5 below:

TABLE V.
MATERIAL EXPERT FEASIBILITY TEST

Validation Test	Aspect	Percentage (%)
	Identity	90
	Content	94
	Learning Objectives	88
	Scoring	94
	Assignment	94
Material Expert (Average)		**92**

The results revealed that the identity aspect scored 90%, content scored 94%, learning objectives scored 88%, scoring scored 94%, and assignments scored 94%, yielding an average of 92%, which falls under the "highly feasible" category. The material expert also provided feedback emphasizing the need to include explicit learning objectives and achievement indicators to serve as clear benchmarks for students' mastery of the material. The validation results from the material expert revealed that the identity aspect obtained a percentage of 90%, the content aspect 94%, the learning objectives aspect 88%, the scoring aspect 94%, and the assignment aspect 94%.

Overall, the average validation result reached 92%, which falls into the *highly feasible* category. During the validation process, the material expert suggested that the learning section should include clear objectives and achievement indicators as the main focus and learning targets that each student is expected to master. Furthermore, peer evaluation in this study employed five assessment aspects consisting of 16 items, namely the introduction aspect (2 items), content aspect (3 items), learning aspect (8 items), summary aspect (2 items), and assignment aspect (1 item). Each aspect was assessed using a five-point Likert scale.

The peer review was conducted with the participation of the fifth-grade teacher as the evaluator. The scoring results from the peer validation are presented in Table 6 below:

Table VI. Peer Review Test Results

Tes	Aspect					Persentase
	Intro	Content	Learning	Summary	Test	
Peer Reviewer	86	94	94	90	88	90,4

Based on Table 4, the scoring results of the peer review test show that the introduction aspect obtained a score of 86%, the content aspect 94%, the learning aspect 94%, the summary aspect 90%, and the assignment aspect 88%. Overall, the total percentage score was 90.4%, which can be categorized as *highly feasible*. However, revisions are needed to improve the image resolution quality to make the visuals clearer and more attractive for students to read.

The individual test was conducted after validation by media experts, material experts, and peer reviewers. This individual test was carried out with fifth-grade students of SDN Urangagung, Sidoarjo Regency. It consisted of five aspects with sixteen indicators, including the identity aspect (2 indicators), content aspect (3 indicators), learning objective achievement aspect (8 indicators), evaluation aspect (2 indicators), and scoring aspect (1 indicator). The results are presented in Table 7 below.

Table VII. One-on-One Test Results

No	Trial Participant	Aspect					Total
		1	2	3	4	5	
1	Student 1	90%	89%	86%	90%	90%	89%
2	Student 2	93%	90%	87%	90%	93%	91%
3	Student 3	94%	90%	90%	93%	94%	92%
4	Student 4	89%	93%	90%	94%	89%	91%
5	Student 5	93%	90%	87%	90%	93%	91%
6	Student 6	94%	90%	90%	93%	94%	92%
7	Student 7	90%	89%	94%	88%	90%	90%
8	Student 8	92%	94%	93%	89%	92%	92%
9	Student 9	90%	89%	94%	88%	90%	90%
10	Student 10	92%	85%	89%	89%	92%	89%
Average Percentage		**92%**	**90%**	**90%**	**90%**	**92%**	**91%**

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The results of the individual trial showed that: (1) the identity aspect achieved a score of 92%, (2) the content aspect obtained 90%, (3) the learning objectives attainment aspect reached 90%, (4) the evaluation aspect received 90%, and (5) the scoring aspect achieved 92%. The overall average score was 91%, which falls into the "very feasible" category. Although each aspect received highly positive feedback, a revision was suggested for the URL link used in the media so that it could be shortened, making it easier for students to memorize and access.

After completing the individual trial, a small group trial was conducted involving 25 fifth-grade students of SDN Urangagung, Sidoarjo District, Sidoarjo Regency. This stage included five assessment aspects with sixteen indicators, consisting of: (1) the identity aspect, (2 indicators), (3) the content aspect, (3 indicators), (3) the learning objectives attainment aspect (8 indicators), (4) the evaluation aspect (2 indicators), and (5) the scoring aspect (1 indicator). The detailed results are presented in Table 8 below.

Table VIII. Small Group Trial Results

No	Participant	Aspect					Total
		1	2	3	4	5	
1	Student 1	90%	89%	86%	90%	89%	89%
2	Student 2	88%	85%	81%	88%	86%	86%
3	Student 3	91%	85%	80%	83%	84%	85%
4	Student 4	86%	88%	82%	83%	90%	86%
5	Student 5	88%	85%	83%	83%	88%	85%
6	Student 6	90%	89%	94%	88%	90%	90%
7	Student 7	92%	85%	89%	89%	89%	89%
8	Student 8	82%	88%	85%	85%	82%	84%
9	Student 9	83%	88%	85%	88%	86%	86%
10	Student 10	90%	89%	94%	88%	90%	90%
11	Student 11	92%	85%	89%	89%	89%	89%
12	Student 12	94%	90%	90%	93%	92%	92%
13	Student 13	89%	93%	90%	94%	92%	92%
14	Student 14	85%	81%	81%	88%	81%	83%
15	Student 15	85%	88%	81%	85%	90%	86%
Average Percentage		**88%**	**87%**	**86%**	**88%**	**88%**	**87%**

Based on the small group trial, the developed product in the form of a Student Worksheet (Lembar Kerja Peserta Didik) was declared highly feasible for use in the learning process, with a total percentage score of 88%. Specifically, the results showed that: (1) the identity aspect achieved 89%, (2) the content aspect 88%, (3) the learning objectives attainment aspect 87%, (4) the evaluation aspect 88%, and (5) the scoring aspect 89%. The students' responses in this small group trial were generally very positive, and their feedback served as valuable input for further improvement of each aspect of the product.

Following the small group trial, a large group trial was conducted involving 24 fifth-grade students. This stage included five assessment aspects with sixteen indicators, consisting of: (1) the identity aspect (2 indicators), (2) the content aspect (3 indicators), (3) the learning objectives attainment aspect (8 indicators), (4) the evaluation aspect (2 indicators), and (5) the scoring aspect (1 indicator). The scoring results from the large group trial are presented in Table 9 below.

Table IX. Large Group Trial Results

No	Participant	Aspect					Total
		1	2	3	4	5	
1	student 1	90%	89%	86%	90%	89%	89%
2	student 2	88%	85%	81%	88%	86%	86%
3	student 3	91%	85%	80%	83%	84%	85%
4	student 4	86%	88%	82%	83%	90%	86%
5	student 5	88%	85%	83%	83%	88%	85%
6	student 6	90%	89%	94%	88%	90%	90%
7	student 7	92%	85%	89%	89%	89%	89%
8	student 8	82%	88%	85%	85%	82%	84%
9	student 9	83%	88%	85%	88%	86%	86%
10	student 10	91%	90%	90%	90%	89%	90%
11	student 11	93%	90%	87%	90%	90%	90%
12	student 12	94%	90%	90%	93%	92%	92%
13	student 13	89%	93%	90%	94%	92%	92%
14	student 14	92%	94%	93%	89%	92%	92%
15	student 15	85%	81%	81%	88%	81%	83%
16	student 16	85%	88%	81%	85%	90%	86%
17	student 17	88%	83%	81%	85%	91%	86%
18	student 18	85%	87%	90%	90%	90%	88%
19	student 19	89%	90%	88%	92%	88%	89%
20	student 20	85%	90%	91%	92%	83%	88%
21	student 21	81%	85%	92%	92%	90%	88%
22	student 22	90%	85%	81%	85%	90%	86%
23	student 23	90%	88%	91%	85%	92%	89%
24	student 24	85%	87%	90%	90%	90%	88%
Average Percentage		**88%**	**88%**	**87%**	**88%**	**89%**	**88%**

Based on the large group trial, the development of the Javanese Script Educational Game was declared highly feasible for use in the learning process, achieving a total percentage of 90%, showing an improvement of 2% from the small group trial results. The identity aspect obtained 89%, the content aspect achieved 90%, the learning objectives aspect scored 88%, the evaluation aspect received 91%, and the scoring aspect also achieved 91%. The students' responses in this large group trial were generally positive, indicating that the product was engaging and effective. Some students suggested adding background colors to certain displays to make the game more visually appealing.

Discussion

The research utilized the ADDIE development model, which consists of sequential stages that involve feedback from students and peers to ensure a structured and well-directed thinking process aligned with learning objectives. The use of this model is considered highly appropriate for developing teaching materials and student worksheets because of its instructional, systematic, and organized characteristics [39].

The development of the Javanese Script Educational Game for students integrates various components such as materials and exercises presented in an engaging and interactive format to motivate students' interest in reading and understanding the Javanese language [40]. This model focuses on creating a gamified worksheet for fifth-grade students with the aim of improving learning quality in line with technological advancements.

The results of this study are in line with the findings of [41], who stated that the implementation of game-based learning can enhance students' motivation and engagement in learning regional languages. Additionally, [42] found that interactive game-based learning media can significantly improve students' reading and writing skills in Javanese script. [43] confirmed that digital learning innovations, such as educational games, can foster students' interest in learning and create a more enjoyable and contextual learning experience.

Moreover, research by [44] revealed that the use of technology-based educational media can enhance students' creativity and memory in understanding local cultural materials. [45] also emphasized that educational games not only improve cognitive skills but also cultivate positive attitudes toward the preservation of regional culture. [46] demonstrated that game-based learning facilitates collaborative learning, encouraging students to actively discuss and support each other in understanding regional language and script materials.

The Javanese Script Educational Game offers several advantages compared to traditional worksheets. It can be accessed anytime and anywhere for 24 hours, provides a variety of complete and diverse content, and is compatible with digital devices such as smartphones, which suits the current era of digital learning [47]. The game helps enhance students' understanding as each session focuses on a single topic, and its design ensures efficient access and presentation. Since learning the Javanese script requires repeated practice and demonstration, this game facilitates such activities by including interactive question-based content [48]. Additionally, it is accessible across all digital platforms, lightweight with fast loading, easy to design by teachers, and simple to develop further.

The specifications of the Javanese Script Educational Game include full-color, modern, and elegant visuals that are highly attractive to students. The images and content are clear and high-resolution, making them easy to read and engaging. This game can be independently developed using Canva and Google Sites [49]. During implementation, it is shared online through WhatsApp so that all students can access it simultaneously at any time, with continuous 24-hour availability.

However, this product also has certain limitations. It can only be accessed online, and its current development has not yet measured students' learning outcomes [50]. Therefore, further research is needed to evaluate its effectiveness in improving students' academic performance and engagement.

Furthermore, the integration of local cultural values particularly the philosophical meanings embedded in Javanese script functions as a mediating factor in improving students' motivation, conceptual understanding, and technical performance. The symbolic nature of Javanese characters, which embodies values of harmony, balance, and moral conduct, activates students' affective engagement through the formation of cultural identity, emotional attachment, and pride in local heritage [51]. These affective responses strengthen intrinsic motivation, which directly influences students' attention, persistence, and active participation in learning activities [52]. Cognitively, culturally meaningful game elements facilitate schema activation, enabling students to link new knowledge with their prior cultural experiences, thereby enhancing memory retention and conceptual comprehension [53]. The use of visual symbols, contextual narratives, and culturally based challenges also activates *dual coding* processes (verbal and visual), resulting in more effective information processing [54]. From a psychomotor pespective, repeated interactive practices within culturally familiar contexts have been shown to improve students' technical accuracy in writing and transliterating the Javanese script [55]. Thus, culturally grounded educational game design does not merely serve an aesthetic function but operates as a cognitive–affective bridge that simultaneously strengthens learning depth, technical mastery, and character development [56].

IV. CONCLUSION

The conclusion of this study, based on the research objectives as well as the results of data analysis and several validation tests, indicates that the use of the Javanese Script Educational Game is highly feasible and serves as an effective innovation in the learning process. The implementation of the ADDIE development model in this research was carried out systematically in accordance with each stage of the game development process.

The results of the material expert validation show that the Javanese Script Educational Game, as an innovation in online learning, is highly suitable for use by students. Meanwhile, the peer evaluation also received very positive responses, categorizing the game as highly feasible. Furthermore, the results from individual, small group, and large group trials consistently demonstrate that the Javanese Script Educational Game is highly appropriate for use as a learning innovation.

This educational innovation, in the form of an online Javanese Script Educational Game, offers an engaging and easily accessible learning experience for students, thereby enhancing both motivation and participation in the learning process.

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