

THE DEVELOPMENT OF DIANDA: ANDROID-BASED EDUCATIONAL GAME FOR SUNDANESE SCRIPT LEARNING IN JUNIOR HIGH SCHOOL LEVEL

Rian Aryandani, Abdul Arif

Program Studi Teknologi Pendidikan, Fakultas Ilmu Pendidikan dan Psikologi, UNNES
rian.aryandani19@gmail.com

Article History

Received: 16 March 2026, Accepted: 18 April 2026, Published: 10 May 2026

Abstrak

Kemampuan literasi aksara Sunda siswa yang rendah akibat metode pembelajaran konvensional dan minimnya media digital interaktif berdampak pada kurang optimalnya pemahaman siswa. Penelitian ini bertujuan untuk mengembangkan dan menganalisis kelayakan gim edukasi berbasis Android bernama DIANDA dari hasil penilaian para ahli yang menyatakan bahwa media tersebut valid dan praktis untuk digunakan dalam proses pembelajaran. Jenis penelitian ini adalah penelitian dan pengembangan yang terdiri dari empat tahap yakni pendefinisian perancangan pengembangan dan penyebarluasan. Validitas gim edukasi dilakukan oleh para ahli media dan ahli materi. Subjek penelitian yang digunakan untuk melihat kepraktisan gim edukasi ini adalah guru dan siswa kelas delapan SMP. Hasil penelitian menunjukkan pertama tingkat kelayakan media berdasarkan penilaian ahli materi dan ahli media tergolong kategori sangat layak. Kedua kepraktisan media berdasarkan respons guru dan siswa tergolong kategori sangat praktis. Berdasarkan hasil penelitian dapat disimpulkan bahwa gim edukasi yang dikembangkan memiliki kualitas yang baik dan memenuhi standar kelayakan sehingga dapat meningkatkan pemahaman siswa mengenai aksara Sunda. Implikasi penelitian mengenai pengembangan gim edukasi menggunakan mesin Unity ini memiliki potensi yang signifikan sebagai solusi inovatif untuk melestarikan aksara daerah bagi generasi digital.

Kata Kunci: Gim Edukasi; Model Four-D; Aksara Sunda; Unity Engine; Gim Android

Abstract

Students' low Sundanese literacy skills due to conventional learning methods and the lack of interactive digital media have an impact on students' suboptimal understanding. This study aims to develop and analyze the feasibility of an Android-based educational game called DIANDA from the results of expert assessments that state that the media is valid and practical to be used in the learning process. This type of research is research and development which consists of four stages, namely definition, design, development, and dissemination. The validity of educational games is carried out by media experts and material experts. The research subjects used to see the practicality of this educational game were teachers and eighth grade students of Junior High School. The results of the study show that first, the level of media feasibility based on the assessment of material experts and media experts is classified as a very feasible category. Second, the practicality of media based on teacher and student responses is classified as very practical. Based on the results of the research, it can be concluded that the educational games developed have good quality and meet feasibility standards so that they can improve students' understanding of Sundanese script. The implications of research regarding the development of educational games using the Unity engine have significant potential as an innovative solution to preserve regional scripts for the digital generation.

Keyword: Educational Game; Four-D Model; Sundanese Script; Unity Engine; Android Game

To cite this article:

Aryandani, R., & Arif, A. (2026). The Development Of Dianda: android-based educational game for sundanese script learning in junior high school level. *JKTP: Jurnal Kajian Teknologi Pendidikan*, 9(2), 192–204. doi: [10.17977/um038v9i22026p192-204](https://doi.org/10.17977/um038v9i22026p192-204)

INTRODUCTION

Indonesia as an archipelagic nation with thousands of ethnic groups possesses extraordinary cultural wealth including indigenous scripts that have been passed down through generations. One of the legacies most affected by the tides of modernization and the rapid development of digital technology is the Sundanese script. This traditional writing system records linguistic tracks along with aesthetic values and the philosophy of the Sundanese people since the Tarumanagara Kingdom era around the 5th century AD (Balai Bahasa Provinsi Jawa Barat, 2021). Its preservation is considered vital as a part of strengthening regional cultural identity and it also represents an urgent collective responsibility because the digital era can actually serve as a strategic opportunity to revitalize the Sundanese script through technology-based learning platforms (Ridwan & Nugraha, 2024).

The Sundanese language holds a significant position as a regional language with a large number of speakers, although widespread oral use does not correlate with proficiency in its script as a writing system. This phenomenon is evident in educational environments, where the ability of students to read and write Sundanese script tends to be much weaker than their oral language skills (Pebriyani et al., 2023). This condition is further compounded by the fact that Sundanese script is widely perceived as difficult to learn and rarely implemented consistently in schools, partly due to limited teacher competency in its instruction (Nurfadhillah et al., 2024), leaving a growing gap between oral language use and script literacy that puts this heritage writing system at risk.

The West Java Provincial Government has mandated the teaching of Sundanese script in schools through Regional Regulation Number 5 of 2003 (Balai Bahasa Provinsi Jawa Barat, 2021), yet this policy alone has not resolved the problem on the ground. Learning still largely depends on conventional methods without digital media support, which contributes to declining student engagement (Rahmawati et al., 2025). As today's junior high school students have grown up immersed in digital devices, they naturally gravitate toward visual, interactive, and fast-feedback learning experiences, making technology integration in the classroom not merely an option but a genuine necessity. The growing prevalence of smartphones has opened a clear pathway for mobile learning, with research showing that mobile-based instruction improves student engagement and learning outcomes (Amalia et al., 2025). This has been demonstrated concretely in the Indonesian context, where Android-based mobile learning applications have been validated as feasible and effective media across various subjects (Ilman et al., 2022).

Various efforts to develop digital-based learning media for Sundanese script have been conducted (Vitianingsih et al., 2023), yet several limitations remain. For example, the educational game *KASADA* shows high feasibility, with average scores ranging from 4.46 to 4.82 on a 5-point scale, indicating strong user acceptance in terms of usability, visual design, and content relevance (Rudini et al., 2023). However, the development of *KASADA* employs the Multimedia Development Life Cycle (MDLC), a software development approach introduced by Luther, which focuses on technical stages such as concept, design, material collecting, assembly, testing, and distribution, rather than on instructional design validation. As a result, the study emphasizes technical feasibility without providing comprehensive empirical evidence of learning effectiveness. Similarly, MDLC-based applications for elementary-level learners have been proven interactive but lack pedagogical validation and context-specific empirical testing (Sujana, 2023). In contrast, the *KAGANGA* application, which applies the ADDIE instructional design model, has demonstrated high feasibility of 90.1% through expert validation and field trials; however, it is limited to fifth-grade elementary students and does not address the cognitive characteristics of junior high school learners (Mutammimah et al., 2024). Meanwhile, Augmented Reality based learning media for seventh-grade students achieved a high approval rate of 93.6%, yet the study did not include direct empirical

implementation in schools nor a systematic application of instructional design stages (Hidayat et al., 2022). These findings indicate that prior studies tend to emphasize either technical development or limited pedagogical validation, without integrating both aspects comprehensively at the junior high school level.

Based on these limitations, this study offers several key contributions as its scientific novelty. First, it develops a Sundanese script educational game using the Unity Engine, which is selected for its high performance, flexible scripting capabilities, and cross-platform scalability in creating interactive and visually rich Android-based learning environments (Khaerudin et al., 2021). Second, this research specifically targets eighth-grade junior high school students, with a design approach that aligns with their cognitive development and digital learning preferences. Third, unlike previous studies that rely on MDLC or limited instructional validation, this study adopts the Four-D (4D) development model, consisting of Define, Design, Develop, and Disseminate (Thiagarajan et al., 1974), to ensure a systematic process that integrates needs analysis, instructional design, product development, and empirical validation. Therefore, this research not only bridges the gap between technical development and pedagogical effectiveness but also provides a more comprehensive and contextually relevant solution for Sundanese script learning at the junior high school level.

This issue is also concretely found at SMPN 2 Ujungjaya in Sumedang Regency which conducts Sundanese language as a local content subject. Based on preliminary observations the learning of Sundanese script in this school still uses conventional methods with a lack of interactive learning media while students who are part of the digital generation require a more innovative approach. The low interest of students toward the Sundanese script at this school is clear evidence that a learning media solution is needed to bridge local cultural heritage with the learning preferences of the digital generation.

Based on the description above this research aims to analyze the needs of Sundanese script learning at SMPN 2 Ujungjaya as a basis for development and to develop the Android based educational game "DIANDA" which stands for *Diajar Aksara Sunda* using Unity for 8th grade students and to identify the feasibility of the educational game based on validation from material experts and media experts and user responses.

METHOD

This research employs the Research and Development (R&D) method, a systematic process to develop and validate educational products through the study of related research findings, product development, field testing, and revision (Gall et al., 2007). A mixed methods approach is applied: qualitative methods analyze learning needs through in-depth interviews, while quantitative methods measure product feasibility and practicality through structured questionnaires (Sugiyono, 2022).

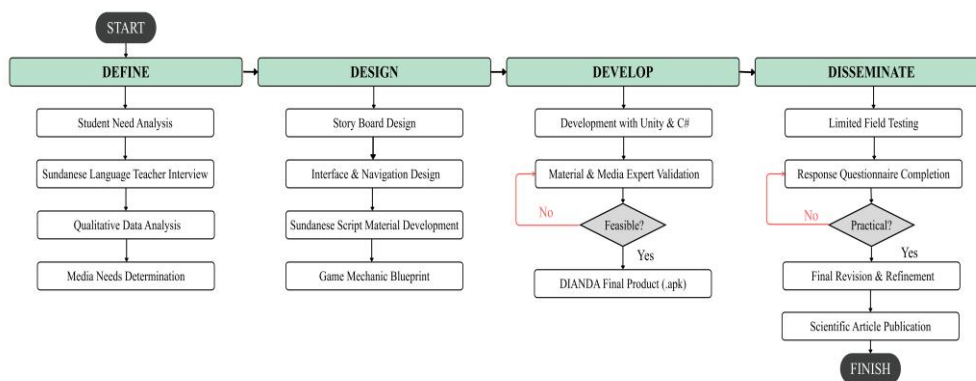


Figure 1. DIANDA Development Flowchart Using the 4D Model

The development model adopted is the Four-D model, which consists of four main stages: Define, Design, Develop, and Disseminate (Thiagarajan et al., 1974). This model was selected for its clear systematics, straightforward stages, and suitability for developing learning tools (Johan et al., 2023). The Define stage involved a literature study and needs analysis through semi-structured interviews with the Bahasa Sunda teacher at SMPN 2 Ujungjaya, covering six aspects: Sundanese script learning conditions, student ability characteristics, supporting facilities, content and curriculum, learning media needs, and suggestions. Data were analyzed qualitatively through reduction, display, and conclusion drawing. The Design stage encompassed interface design, navigation flow, and Sundanese script material including *aksara swara*, *aksara ngalagena*, and *rarangkén* alongside a game mechanic blueprint. Systematic planning aligned with pedagogical objectives and learner characteristics is essential for effective interactive media (Rakasiwi & Muhtadi, 2021). The Develop stage translated the blueprint into a functional product using Unity Engine, supporting C# scripting, 2D/3D rendering, physics, audio integration, and Android deployment (Khaerudin et al., 2021), followed by expert validation and iterative revisions. The Disseminate stage involved limited product trials with 8th-grade students at SMPN 2 Ujungjaya and publication via scientific articles.

The object of this research is the Android-based educational game "DIANDA". The research subjects consist of two expert validators, namely a learning media expert who is a specialist in educational media development and a Sundanese language material expert who is a specialist in Sundanese language and script, both selected based on criteria determined by the researcher. In addition, the research subjects also include teachers and 8th-grade students selected through purposive sampling with the criteria of being registered as active students, possessing an Android device with the required minimum specifications, and being willing to participate in the trials. The research was conducted in the even semester of the 2025/2026 academic year.

Instruments include semi-structured interview guidelines, validation sheets, and teacher and student response questionnaires, all using a four-point Likert scale (1 = strongly disagree to 4 = strongly agree) without a neutral option to reduce central tendency bias (Kusmaryono et al., 2022). Content feasibility validation covers objectivity, instructional program, program target, and language readability (Prayoga et al., 2025). Media quality validation examines visual design, language, animation, and ease of use (Kusumawardani, 2023). Teacher and student responses assess usability, appeal, content clarity, and learning support (Marliani, 2024).

Feasibility data were analyzed by calculating the percentage of scores obtained against the maximum score. The product is declared feasible if expert validators award a minimum score of 61%, indicating that the media can be used with minor revisions, while a score of 81% or above places it in the Very Feasible category, meaning it can be used without revision. Practicality was measured through teacher and student response questionnaires, referring to ease, comfort, and usefulness in real learning conditions. Similarly, a minimum response score of 61% indicates the product is practical, while a score of 81% or above is categorized as Very Practical. Aspects falling below the 61% threshold require revision before the product proceeds to user trials (Akbar, 2013).

RESULT

The Define stage was carried out through semi-structured interviews with the Bahasa Sunda teacher at SMPN 2 Ujungjay. Findings revealed that instruction relies entirely on lectures and manual writing without digital media. Students struggle most with the 18 visually similar *aksara ngalagena* characters and the *rarangkén* diacritical system. Motivation is low, though technology proficiency is high given regular smartphone use. The school has adequate WiFi and permits supervised

smartphone use, establishing the need for a visual, interactive Android-based game covering *aksara swara*, *aksara ngalagena*, and *rarangkén*.

The Design stage produced the game architecture of "DIANDA" (*Diajar Aksara Sunda*), covering interface layout, navigation flow, Sundanese script material, and the game mechanic blueprint. The interface features a main menu, material section, and gameplay screen with clearly labeled navigation. The game integrates a material presentation feature displaying all Sundanese script characters with audio pronunciation, and an endless runner gameplay where the player navigates a scrolling environment with Sundanese script obstacles requiring real-time character identification. This trains script recognition speed and cognitive accuracy through repeated practice, consistent with findings that endless runner gameplay significantly enhances cognitive outcomes and student engagement (Marlina & Aswandi, 2026).

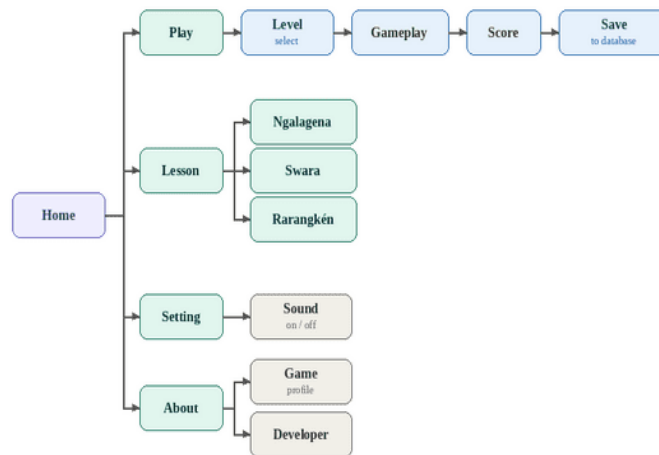


Figure 3. DIANDA Game Application Flowchart

The development stage was carried out after the design phase was fully completed. This stage successfully produced the final educational game application built utilizing the Unity Engine and its designated programming language. Subsequently, the product underwent expert validations and iterative revisions, with its final interface presented in figure 4.



Figure 4. DIANDA Game Application Interface

The feasibility of the educational game material was rigorously evaluated by content experts to ensure its pedagogical accuracy. Based on this comprehensive review, necessary adjustments were implemented to align the materials with the intended learning objectives. The detailed outcomes of this content expert validation are systematically presented in Table 1.

Table 1. Content Expert Validation Results

No	Assessment Aspect	Score	Max Score	Percentage
1	Accuracy and Authenticity of Content	4	4	100%
2	Alignment with Curriculum	7	8	87.5%
3	Content Relevance	3	4	75%
4	Instructional Structure	7	8	87.5%
5	Depth of Content	7	8	87.5%
6	Suitability for Learners' Developmental Level	7	8	87.5%
7	Language Use and Readability	10	12	83,3%
Total / Average		45	52	86,54%

Table 2. Media Expert Validation Results

No	Assessment Aspect	Score	Max Score	Percentage
1	Visual Design	39	44	88,64%
2	Language	10	12	83,33%
3	Animation	9	12	75,00%
4	Ease of Use	25	28	89,29%
Total / Average		83	96	86,46%

Based on Tables 1 and 2, content validation yielded 86.54% categorized as Very Feasible and media validation obtained 86.46% also categorized as Very Feasible. Revisions were made iteratively based on validator feedback until the product was confirmed ready for user trials. The Dissemination stage was executed after the development and revision phases were thoroughly completed. This final step involved a large group trial comprising eighth grade students and language teachers at the observed school. The documentation of this comprehensive trial process is clearly presented in figure 5.



Figure 5. Student and Teacher Trial Activity

Teacher responses were collected using a structured questionnaire covering seven indicators related to instructional usability, visual design, content organization, and overall effectiveness. The results of the teacher response evaluation are presented in Table 3.

Table 3. Teacher Response Results

No	Indicator	Item No.	Score	Max Score	Percentage
1	Instructions for using "DIANDA" are clear and easy to understand	1	39	48	81,25%
2	Alignment of learning objectives with the curriculum	2	41	48	85,42%
3	Attractiveness of the visual design	3, 4	83	96	86,46%
4	Readability of text (typography and font size)	5	38	48	79,17%
5	Systematic organization and relevance of Sundanese script content	6, 7	80	96	83,33%
6	Interactive features are engaging and support learning	8, 9	83	96	86,46%
7	"DIANDA" helps students learn Sundanese script more easily	10	45	48	93,75%
Total / Average			409	480	85,21%

Student responses were gathered from 20 eighth-grade students using a questionnaire consisting of ten items across seven indicators, assessing aspects such as clarity of instructions, ease of content delivery, visual appeal, audio effectiveness, and overall usability of the DIANDA game. The complete student response evaluation results are summarized in Table 4.

Table 4. Student Response Results

No	Indicator	Item No.	Score	Max Score	Percentage
1	Clarity of game usage instructions	1	65	80	81,25%
2	Ease of understanding Sundanese script content delivery	2, 3	132	160	82,50%
3	Visuals, animations, and on-screen text are clear and attractive	4, 5	119	160	74,38%
4	Effectiveness of audio in creating an engaging learning atmosphere	6	68	80	85,00%
5	Learning objectives for Sundanese script are clearly presented in the game	7	63	80	78,75%
6	Game menu and navigation are attractive and easy to use	8, 9	133	160	83,13%
7	"DIANDA" helps me learn Sundanese script more easily and enjoyably	10	74	80	92,50%
Total / Average			654	800	81,75%

Based on Tables 3 and 4, teacher responses yielded an overall score of 85.21% and student responses yielded 81.75%, both categorized as Very Practical. The highest score from both groups was consistently found on the indicator regarding DIANDA's effectiveness in helping students learn Sundanese script more easily and enjoyably, with 93.75% from teachers and 92.50% from students.

Table 5. Summary of Expert Validation and Product Trial Results

No	Assessment	Score (%)	Category
1	Content Expert Validation	86.54%	Very Feasible
2	Media Expert Validation	86.46%	Very Feasible
3	Teacher Response	85.21%	Very Practical
4	Student Response	81.75%	Very Practical

Based on Tabel 5, the content expert validation scored 86.54% and media expert validation scored 86.46%, both categorized as Very Feasible, while teacher and student responses scored 85.21% and 81.75% respectively, both categorized as Very Practical. These results indicate that DIANDA is declared feasible and practical as a Sundanese script learning medium for eighth-grade students.

DISCUSSION

The findings from the Define stage confirm a concrete and systemic learning problem. Interviews with the Bahasa Sunda teacher at SMPN 2 Ujungjaya revealed that instruction relies entirely on conventional lecture and manual writing methods with no digital media support, a condition that contributes to low student engagement when applied without variation over time (Rahmawati et al., 2025). The students' greatest difficulty lies in distinguishing the 18 visually similar *aksara ngalagena* characters and the *rarangkén* diacritical system, as students' ability to read and write Sundanese script tends to be much weaker than their oral language skills (Pebriyani et al., 2023). Students further regard Sundanese script as difficult and irrelevant in the context of modern communication (Nurfadhillah et al., 2024). At the same time, the school's adequate WiFi infrastructure and students' high familiarity with smartphones and mobile games indicate that the conditions for a technology-based solution are already in place.

The Design stage produced a game blueprint that directly responds to the identified learning needs. Learning media function as intermediary tools that convey educational content effectively when aligned with instructional objectives and learner characteristics (Rumiyati et al., 2025; Sasmita & Wahzudik, 2025) DIANDA was designed with two core components, namely a structured material presentation feature displaying all Sundanese script characters with responsive audio, and an endless runner gameplay mechanic that trains character recognition speed and cognitive response accuracy through repeated contextual practice. The endless runner genre was selected due to its fast-paced structure that requires rapid recall and provides immediate feedback in a low-consequence environment, enabling repeated reinforcement of learning content. This characteristic aligns with findings that endless runner-based learning can support repeated exposure and improve cognitive processing speed (Johnson et al., 2020). In addition, previous studies confirm that Android-based endless runner learning media can significantly improve student learning outcomes, engagement, and interest, supporting its effectiveness as an instructional medium (Marlina & Aswandi, 2026)

The Develop stage translated the design into a functional product through iterative production and expert validation. Content expert validation resulted in a score of 86.54 percent in the Very Feasible category, indicating that the material is accurate, curriculum-aligned, and appropriate for junior high school students, with the highest score in accuracy and authenticity at 100 percent and a lower score in content relevance at 75 percent, suggesting opportunities for further contextual enrichment. Media expert validation yielded 86.46 percent in the Very Feasible category, with the highest scores in ease of use at 89.29 percent and visual design at 88.64 percent, while the animation aspect obtained 75 percent in the Feasible category, indicating the need for improvement in animation smoothness. Revisions were implemented prior to dissemination, demonstrating responsiveness to expert feedback during the iterative development process. Furthermore, iterative testing ensured system stability, usability consistency, and compatibility across Android devices, supporting optimal user experience and minimizing technical barriers during classroom implementation. These findings reinforce that interactive media integrating visual, audio, and animation elements can enhance student engagement and learning interest, particularly among digital-native learners (Rambe et al., 2024; Zulfikasari et al., 2024)

The limited dissemination stage involved classroom implementation with teachers and students, from which practical response data were collected. Teacher response data yielded 85.21% in the Very Practical category, indicating that the game is directly usable in the Sundanese language classroom with minimal modification. The highest teacher rating was for the indicator "DIANDA helps students learn Sundanese script more easily" at 93.75%, a figure reinforced by open-ended comments in which teachers described the game as engaging and practical, and noted that students are naturally drawn to hands-on practice with a medium they encounter in daily life. Teachers specifically highlighted that the combination of color selection, illustrations, typography, audio, and animation effectively fosters student interest in learning Sundanese script, stating that these elements contributed strongly to motivating engagement with the material, central components of quality instructional media design (Firdaus et al., 2020). Several teachers also recommended broader dissemination and suggested that the game be further developed for publication through collaboration with the MGMP Bahasa Sunda teachers' forum, underscoring its perceived potential beyond the immediate research context. Teachers also affirmed the instructional value of the visual content, noting that the illustrations of Sundanese script characters within the game meaningfully help students understand each character's form. The only quantitative indicator below the Very Practical threshold was Readability of Text at 79.17%, corresponding to comments noting that color contrast in certain screens was perceived as insufficiently vivid, reinforcing visual refinement as the primary direction for the next development cycle.

Student response data yielded 81.75% in the Very Practical category, with the highest score of 92.50% for "DIANDA helps me learn Sundanese script more easily and enjoyably." Open-ended responses were predominantly enthusiastic: students described the game as enjoyable and engaging, praised the animated character as fun and appealing, and noted that the game genuinely supports their understanding of Sundanese script. A number of students specifically mentioned that the illustrations of script characters within the game help them recognize and remember each character's form more effectively, validating the instructional function of the game's visual design. Navigation and usability scored 83.13% (Very Practical) and audio effectiveness reached 85.00%, confirming that the responsive audio pronunciation feature is well-received. The most consistent student feedback across open-ended responses was a request to extend the gameplay duration per level, with many noting that the timer moved too quickly to allow comfortable script identification, a finding aligned with the media expert's earlier recommendation and partially addressed through pre-trial revision. Requests for higher-resolution graphics and additional character variety also emerged and are noted as priorities for future development. These findings confirm that educational games combining interactive elements with sequential cognitive challenges strengthen knowledge retention and problem-solving skills (Widyani & Widyaningsih, 2025), and that game-based learning can transform students' perception of difficult subjects (Wiryaningtyas et al., 2023).

Compared with related prior studies, DIANDA's overall average of 85.49% is consistent with and in some respects extends the findings of its predecessors. The KASADA game (Rudini et al., 2023) obtained a feasibility rating between 4.46 and 4.82 without detailed empirical evaluation or a systematically validated development model. The Augmented Reality Sundanese script media (Hidayat et al., 2022), earned 93.6% respondent agreement yet was not developed specifically for the junior high school level and did not apply the Four-D development model with its structured needs analysis and iterative validation logic. Game-based learning more broadly has been shown to improve student motivation and learning outcomes across subjects (Amanda & Prihatin, 2025). This motivational effect is particularly evident in game-based media developed for elementary-level mathematics, where game mechanics consistently strengthened students' learning motivation

(Sabrina et al., 2021), and DIANDA contributes a jenj-specific, pedagogically grounded instance of this approach focused on Sundanese script, an underserved area in the existing literature.

Overall, the feasibility and practicality data, supported by rich qualitative evidence from both teachers and students, confirm that DIANDA constitutes a valid and practical Sundanese script learning medium for eighth-grade students. Effective learning media must be adapted to both the subject matter and student characteristics in order to facilitate the learning process, enhance learning interest, and improve learning effectiveness (Mutiarra et al., 2025). DIANDA meets these criteria: its content is grounded in the Sundanese Language curriculum and affirmed by the content expert as appropriate for the target age group; its design is calibrated to the visual and interactive preferences of digital-native teenagers; and its game-based mechanics provide the kind of engaging, repeated practice essential for mastering the complex forms of Sundanese script (Pebriyani et al., 2023; Rambe et al., 2024). The qualitative feedback from teachers and students further reveals a clear appetite for continued development and broader publication, a direction that aligns with the preservation mandate of Regional Regulation Number 5 of 2003 and the broader imperative to revitalize Sundanese script through adaptive technology-based platforms (Balai Bahasa Provinsi Jawa Barat, 2021; Ridwan & Nugraha, 2024). Having established that DIANDA meets the criteria of both feasibility and practicality, this study lays a solid empirical foundation upon which future research can build. The validated and practically proven status of DIANDA makes it a strong candidate for subsequent effectiveness testing, and future studies are therefore encouraged to examine its impact on students' mastery of Sundanese script through quasi-experimental designs using pre-test and post-test instruments. In conducting such studies, it is important to consider potential biases such as differences in initial group ability, testing effects, and participant reactivity to ensure the validity of the findings. This direction is supported by methodological approaches that employ experimental evaluation of gamified mobile learning outcomes (Kao et al., 2023) and further reinforced by findings that understanding the full instructional impact of game-based learning programs remains an important frontier in the field (Alotaibi, 2024), particularly in strengthening internal validity, improving research design rigor, and ensuring more generalizable and reliable educational outcomes across different learning contexts.

CONCLUSION

This study developed and evaluated DIANDA (*Diajar Aksara Sunda*), an Android-based educational game for learning Sundanese script at the junior high school level using the Four-D development model. The Define stage identified the lack of interactive digital media and students' difficulties in understanding aksara ngalagena, swara, and rarangkén. The Design stage integrated instructional materials with game-based mechanics through an endless runner concept that supports rapid recognition, immediate feedback, and repeated exposure. The Develop stage produced a functional application using Unity and C#, followed by expert validation and iterative revision, while the Disseminate stage involved limited trials with teachers and students. The findings indicate that DIANDA is feasible and practical, as shown by content expert (86.54%) and media expert (86.46%) validations categorized as Very Feasible, and teacher (85.21%) and student (81.75%) responses categorized as Very Practical. The endless runner mechanics enhance engagement, cognitive processing speed, and repeated practice for mastering complex script characters. This study contributes an empirically validated and scalable model for integrating local cultural content into mobile game-based learning, although further research is needed to examine effectiveness, scalability, and long-term impact.

ACKNOWLEDGMENT

The author would like to express sincere gratitude to the Headmaster of SMPN 2 Ujungjaya for granting permission and full support in conducting this research. Special appreciation is extended to the Sundanese language teacher of SMPN 2 Ujungjaya for their valuable assistance, insights, and collaboration throughout the research process. The author also gratefully acknowledges the contributions of the Sundanese language content expert and the learning media expert for their constructive feedback and professional validation, which significantly improved the quality and feasibility of the developed product.

REFERENCES

- Akbar, S. (2013). *Instrumen perangkat pembelajaran*. Remaja Rosdakarya.
- Alotaibi, M. S. (2024). Game-based learning in early childhood education: A systematic review and meta-analysis. *Frontiers in Psychology*, 15. <https://doi.org/10.3389/fpsyg.2024.1307881>
- Amalia, A. R., Wedi, A., & Setyosari, P. (2025). The implementation of mobile learning in primary schools in Indonesia. *Italian Journal of Educational Technology*, 33(2), 17–32. <https://doi.org/10.17471/2499-4324/1428>
- Amanda, A. D., & Prihatin, T. (2025). Pengembangan multimedia interaktif berbasis game edukasi “Math Adventure” untuk meningkatkan motivasi belajar siswa sekolah dasar. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, 10(02), 540–553. <https://doi.org/10.23969/jp.v10i02.26916>
- Balai Bahasa Provinsi Jawa Barat. (2021). *Modul: Membaca dan menulis aksara Sunda*. Balai Bahasa Provinsi Jawa Barat. https://sirungbasa.kemendikdasmen.go.id/modul/BA_aksara.pdf
- Firdaus, M. I., Mariani, C., & Adityayoga. (2020). Perancangan huruf dan media pembelajaran aksara Sunda. *Jurnal SeniRupa Warna*, 8(2), 157–173. <https://doi.org/10.36806/.v8i2.87>
- Gall, M., Gall, J., & Borg, W. (2007). *Educational research: An introduction (8th ed.)*. Pearson Education.
- Hidayat, A. A., Sutedi, A., Gunadhi, E., & Heryanto, D. (2022). Media pembelajaran aksara Sunda menggunakan augmented reality berbasis Android. *Jurnal Algoritma*. <https://jurnal.itg.ac.id/index.php/algoritma/article/view/1135>
- Ilman, A., Sulthoni, S., & Wedi, A. (2022). Pengembangan mobile learning berbasis Android materi recount text kelas X bahasa. *JKTP: Jurnal Kajian Teknologi Pendidikan*, 5(1), 32–41. <https://doi.org/10.17977/um038v5i12022p032>
- Johnson, E. K., Giroux, A. L., Merritt, D., Vitanova, G., & Sousa, S. (2020). (PDF) Assessing the Impact of Game Modalities in Second Language Acquisition: ELLE the EndLess LEarner. <https://doi.org/10.3897/jucs.2020.048>
- Kao, M.-C., Yuan, Y.-H., & Wang, Y.-X. (2023). The study on designed gamified mobile learning model to assess students’ learning outcome of accounting education. *Heliyon*, 9(2). <https://doi.org/10.1016/j.heliyon.2023.e13409>
- Khaerudin, M., Srisulistiowati, D. B., & Warta, J. (2021). Game edukasi dengan menggunakan Unity 3D untuk menunjang proses pembelajaran. *JSI (Jurnal Sistem Informasi) Universitas Suryadarma*, 8(2), 263–272. <https://doi.org/10.35968/jsi.v8i2.741>
- Kusmaryono, I., Wijayanti, D., & Maharani, H. R. (2022). Number of response options, reliability, validity, and potential bias in the use of the Likert scale education and social science research: A literature review. *International Journal of Educational Methodology*, 8(4), 625–637. <https://doi.org/10.12973/ijem.8.4.625>
- Kusumawardani, S. A. (2023). *Pengembangan aplikasi mobile learning “LaBu” berbasis Android pada materi lapisan bumi mata pelajaran IPA kelas VII di SMP Negeri 39 Semarang*. Universitas Negeri Semarang.

- Marliani, L. S. (2024). *Pengembangan media “LISMART” berbasis digital dalam keterampilan membaca aksara Sunda di sekolah dasar* [Universitas Pendidikan Indonesia]. <https://repository.upi.edu/>
- Marlina, L., & Aswandi, A. (2026). Android-based endless runner game learning media innovations to improve students' mathematical literacy. *Jurnal Eduscience*, 13(1), 128–140. <https://doi.org/10.36987/jes.v13i1.7513>
- Mutammimah, F. S., Aeni, A. N., & Nugraha, R. G. (2024). Pengembangan aplikasi KAGANGA berbasis Android untuk mengenalkan aksara Sunda di sekolah dasar. *Ideguru: Jurnal Karya Ilmiah Guru*, 9(2), 613–621. <https://doi.org/10.51169/ideguru.v9i2.858>
- Mutiara, M., Safitri, E. R., Raharjo, M., & Hamzah, M. (2025). Developing interactive game-based learning media to enhance conceptual understanding of the human digestive system in elementary education. *Jurnal Pendidikan MIPA*, 26(4), 2191–2208. <https://doi.org/10.23960/jpmipa.v26i4.pp2191-2208>
- Nurfadhillah, N., Julia, J., & Sunaengsih, C. (2024). Kompetensi Guru dalam mengajar: Sebuah studi kasus pembelajaran aksara Sunda di sekolah dasar. *Jurnal Educatio FKIP UNMA*, 10(1), 266–273. <https://doi.org/10.31949/educatio.v10i1.7944>
- Pebriyani, D., Sutisnawati, A., & Hamdani, L. (2023). Peningkatan keterampilan menulis aksara Sunda dengan menggunakan media flashcard pada siswa sekolah dasar. *Jurnal Educatio FKIP UNMA*, 9(3), 1369–1377. <https://doi.org/10.31949/educatio.v9i3.5748>
- Prayoga, Y. A., Respati, R., & Alia, D. (2025). Pengembangan media card match dalam pembelajaran mengenal aksara Sunda pada siswa kelas V SD [Other, Universitas Pendidikan Indonesia]. <https://repository.upi.edu>
- Rahmawati, I., Ruhaliah, & Kosasih, D. (2025). Media flipcard dalam aplikasi Carda Akusara untuk pembelajaran menulis aksara Sunda (eksperimen terhadap siswa kelas VII SMP Pasundan 9 Bandung tahun ajaran 2024/2025). *Fon: Jurnal Pendidikan Bahasa dan Sastra Indonesia*, 21(2), 480–494. <https://doi.org/10.25134/1syj2397>
- Rakasiwi, C. W., & Muhtadi, A. (2021). Developing educational games for mathematics learning to improve learning motivation and outcomes. *JTP - Jurnal Teknologi Pendidikan*, 23(1), 49–57. <https://doi.org/10.21009/jtp.v23i1.18356>
- Rambe, A., Parapat, H. F., Hadinata, R., & Hasratuddin. (2024). Elementary school learning transformation: Using game-based media to enhance student activities interactively. *ELSE (Elementary School Education Journal): Jurnal Pendidikan dan Pembelajaran Sekolah Dasar*, 8(3). <https://doi.org/10.30651/else.v8i3.24251>
- Ridwan, F. M., & Nugraha, H. S. (2024). Keefektifan media digital dalam pembelajaran Aksara Sunda. *IBERS: Jurnal Pendidikan Indonesia Bermutu*, 3(2), 105–114. <https://doi.org/10.61648/ibers.v3i2.112>
- Rudini, D., Bastian, A., & Zaliluddin, D. (2023). Perancangan game KASADA aksara dan bahasa Sunda sebagai media edukasi menggunakan Unity berbasis Android. *J-ENSITEC (Journal of Engineering and Sustainable Technology)*, 9(02), 825–834. <https://doi.org/10.31949/jensitec.v9i02.4069>
- Rumiyati, Lestari, A. P., & Juanda, J. (2025). The role of learning media in enhancing the effectiveness and activeness of the learning process. *Journal Didaskalia*, 8(2), 114–127. <https://doi.org/10.33856/didaskalia.v8i2.614>
- Sabrina, F. G., Adi, E. P., & Praherdhiono, H. (2021). Pengembangan game ketepatan dadu matematika sebagai penguat motivasi belajar siswa kelas 2 sekolah dasar. *JKTP: Jurnal Kajian Teknologi Pendidikan*, 4(1), 60–69. <https://doi.org/10.17977/um038v4i12021p060>

- Sasmita, R. N. K., & Wahzudik, N. (2025). Pengembangan media pembelajaran pencegahan dan penanganan kekerasan berbasis aplikasi Android di sekolah inklusi. *Epistema*, 5(2), 105–125. <https://doi.org/10.21831/ep.v5i2.78702>
- Sugiyono. (2022). *Metode penelitian kuantitatif, kualitatif, dan R&D (2nd ed.)*. Alfabeta.
- Sujana, I. (2023). Pengembangan aplikasi pengenalan aksara Sunda berbasis Android menggunakan metode MDLC. *Jurnal Informatika dan Teknik Elektro Terapan*, 11(3). <https://doi.org/10.23960/jitet.v11i3.3203>
- Thiagarajan, S., Semmel, Dorothy S., & Semmel, Melvyn I. (1974). *Instructional development for training teachers of exceptional children: A sourcebook*. Indiana University, Center for Innovation in Teaching the Handicapped.
- Vitianingsih, A. V., Firmansyah, A., Maukar, A. L., Choiron, A., & Cahyono, D. (2023). Pengembangan aplikasi game edukasi sejarah Sunan Kalijaga berbasis Android. *JKTP: Jurnal Kajian Teknologi Pendidikan*, 6(1), 001–013. <https://doi.org/10.17977/um038v6i12023p001>
- Widyani, D. O., & Widyaningsih, O. (2025). Educational game “Algo Fun” to improve learning outcomes in algorithm material in informatics subject class VII. *Jurnal Ilmiah Pendidikan Profesi Guru*, 8(1), 150–162. <https://doi.org/10.23887/jippg.v8i1.94212>
- Wiryaningtyas, R. K., Adamura, F., & Astuti, I. P. (2023). Pengembangan game edukasi sebagai media pembelajaran berbasis Android pada materi bangun ruang kelas VII SMP Negeri 1 Geger. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 7(3), 3192–3204. <https://doi.org/10.31004/cendekia.v7i3.2815>
- Zulfikasari, S., Sulistio, B., & Agry, F. P. (2024). Pengembangan multimedia pembelajaran pola hidup sehat untuk siswa sekolah dasar. *Journal on Teacher Education*, 6(2), 94–103. <https://doi.org/10.31004/jote.v6i2.39980>