The Deep Learning Approach Using the SundaDigi Application in Teaching Sundanese Script Writing: An ADDIE Model Development Study

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Abstract
Sundanese script (*aksara Sunda*) is a compulsory local-content subject in West Java senior high schools. However, many students struggle to master it, particularly in demographically heterogeneous cities such as Bekasi, where most learners are not native Sundanese speakers. This study aimed to develop and test a Deep Learning approach supported by the SundaDigi digital application for teaching Sundanese script writing to Grade X students. A research and development design based on the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) was employed at A state senior high school in Bekasi Regency during the 2025/2026 academic year. Needs were identified through interviews and classroom observation, after which a Deep Learning teaching syntax integrating SundaDigi's automatic Latin-to-Sundanese transliteration feature was designed and developed. An experimental class received the Deep Learning-SundaDigi approach, while a control class received conventional instruction. A writing test (pretest-posttest) was scored using a mindful-meaningful-joyful-technical rubric, and a motivation questionnaire was administered; data were analyzed using an independent-samples t-test following tests of normality and homogeneity. The needs analysis showed that students struggled to apply diacritical marks (*rarangkén*) and to distinguish the vowels /é/, /e/, and /eu/, compounded by low motivation. The post-test comparison showed a statistically significant difference between the experimental and control groups (t = -2.564, df = 37.500, Sig. 2-tailed = 0.014). The findings indicate that a technology-assisted, culturally grounded Deep Learning approach yields a measurable, significant difference in Sundanese script-writing outcomes compared with conventional instruction, offering a viable alternative for linguistically diverse classrooms.

1. Introduction

Indonesia holds one of the richest linguistic repertoires in the world, yet the sustainability of its regional languages is increasingly under pressure. National statistics point to accelerating demographic mobility and urbanization around metropolitan centers such as Jakarta, conditions that weaken the intergenerational transmission of local mother tongues in surrounding satellite cities, including Bekasi in West Java (Badan Pusat Statistik, 2025). Sundanese script (*aksara Sunda*) is one of the clearest markers of this vulnerability: although it is formally taught as compulsory local-content material in senior high schools, many students still struggle to master it because the writing system must be memorized letter by letter, a demand that quickly becomes tedious and unmotivating when the script is disconnected from students' everyday linguistic experience (Ratnasari, 2024; Smith & Lee, 2024).

Sundanese language instruction at the senior high school level is governed by Keputusan Gubernur Jawa Barat Nomor 22481/PK.08.03.01/GTK (2025), which stipulates the Learning Outcomes (*Capaian Pembelajaran*) for Sundanese local-content material and allocates 72 hours of instruction per year. For Grade X students in Phase E, the writing element requires students to compose sentences in Sundanese script accurately and appropriately, and eventually to produce and publish artistic Sundanese-script work, in line with the Gapura Pancawaluya character values that underpin character education in West Java. These are substantial technical and creative demands, and the gap between this policy ideal and everyday classroom practice is widest in areas such as Bekasi, which is administratively part of West Java but demographically dominated by families who commute to or originate from Jakarta. Consequently, Sundanese is treated as a local-content subject rather than as a living mother tongue for the majority of students, and classroom observations confirm that students frequently find the diacritical marks (*rarangkén*), vowel distinctions, and consonant forms of the Sundanese script confusing. At the same time, teachers continue to rely on textbook-and-blackboard methods that offer little visual or interactive support (Ridwan & Nugraha, 2024).

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A growing body of research has examined ways to make instruction in Sundanese script more engaging. One line of work has produced Android-based recognition and drilling applications that introduce students to the shapes of Sundanese characters (Sujana et al., 2023), while a second line has applied deep learning image-classification techniques, most notably convolutional neural networks (CNN), to automatically recognize handwritten Sundanese script with high accuracy (Ali & Abdulrazzaq, 2023; Purnama et al., 2022; Rahmawati et al., 2021). A third and more pedagogically oriented line of research has explored how digital media, including web-based platforms devoted to Sundanese language and culture, can support motivation and engagement among students who no longer use Sundanese in daily communication (Chen, 2023; Nurjanah, Koswara, Nugraha, Rukmanah, & Ruslan, 2025; Nurjanah & Srihilmawati, 2025). In parallel, curriculum-oriented studies have shown that Sundanese local-content teaching materials still require substantial adaptation to align with the flexibility and technological integration demanded by the *Kurikulum Merdeka* (Sudaryat et al., 2023).

At the same time, a separate strand of educational research has turned to the Deep Learning pedagogical framework, understood here not as a computational technique but as an instructional philosophy that integrates mindful, meaningful, and joyful dimensions of learning to promote holistic student development (Feriyanto, Anjariyah, & Feriyanto, 2024; Fullan, Quinn, & McEachen, 2020; Williams, 2022). Applied to literature and language classrooms, this mindful-meaningful-joyful orientation has been shown to strengthen students' critical thinking, emotional engagement, and pride in local culture (Mustika et al., 2025). The ADDIE model, comprising Analysis, Design, Development, Implementation, and Evaluation, has likewise been repeatedly validated as an effective framework for developing digital instructional materials systematically and iteratively (Abuhassna, Alnawajha, Awae, Mohamed Adnan, & Edwards, 2024; Adeoye, Wirawan, & Pradnyani, 2024; Bada et al., 2024; Hess & Greer, 2016; Hidayat & Agustina, 2025; Kazanidis, Spatioti, & Pange, 2022; Syahid, Hasanah, & Putra, 2024; Tegeh & Kirna, 2022).

Taken together, these strands of literature show clear but separate progress: digital tools for Sundanese script recognition, digital media for cultural revitalization, a mindful-meaningful-joyful pedagogical framework for deep learning, and the ADDIE model as a development methodology. However, no published study has yet combined a script-specific transliteration application with an explicit Deep Learning pedagogical syntax developed through the ADDIE model, nor has this combination been tested in a classroom where the majority of students are not native Sundanese speakers. This is precisely the situation faced by Grade X students at A state senior high school in Bekasi Regency, where school leaders and senior teachers report that approximately 96% of students come from non-Sundanese ethnic backgrounds, making conventional, memorization-based instruction particularly ill-suited to their needs. While numerous studies have examined digital media, script-recognition technology, or Deep Learning pedagogy in isolation, few have addressed how these elements can be integrated into a single, systematically developed instructional approach for Sundanese script writing in a linguistically heterogeneous classroom. This study aims to fill that gap by developing and evaluating a Deep Learning approach, supported by the SundaDigi digital application, following the ADDIE model, for teaching Sundanese script writing to Grade X students at a state senior high school in Bekasi Regency.

2. Method

This section describes the study design, participants, sampling procedure, instruments, measurement tools, research procedure, and data analysis strategy used to develop and evaluate the Deep Learning approach supported by the SundaDigi application.

2.1. Study Design

This study used a research and development (R&D) design based on the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), combined with a quantitative quasi-experimental comparison to test the effectiveness of the resulting product. The ADDIE model was selected because it provides a systematic, iterative framework for developing, implementing, and evaluating a technology-supported pedagogical approach (Abuhassna et al., 2024; Davis & Garcia, 2023; Tegeh & Kirna, 2022). The quasi-experimental component compared an experimental class, which received the Deep Learning approach supported by SundaDigi, with a control class, which received conventional instruction using textbooks and blackboard demonstrations, to determine whether the developed approach produced a measurable difference in students' Sundanese script-writing ability.

2.2. Participants

The participants were Grade X students at a state senior high school in Bekasi Regency, West Java, Indonesia during the 2025/2026 academic year. The needs-analysis stage additionally involved three key informants: the vice principal for curriculum affairs (concurrently acting as school principal), the senior Sundanese language teacher and coordinator of the subject-teacher forum, and the senior teacher supervising the study. These informants confirmed that approximately 96% of the school's students are not native Sundanese speakers, a demographic characteristic that directly shaped the instructional problems this study sought to address.

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2.3. Target Population and Sampling Techniques

The target population comprised all Grade X students at a state senior high school in Bekasi Regency, distributed across nine parallel classes (X-1 to X-9) with a combined enrolment of several hundred students. Two intact classes were selected using purposive sampling because they shared comparable initial characteristics, followed the same curriculum, and were logistically available for the treatment period. Class X-5 (47 students: 30 female, 17 male) was assigned as the experimental group and received the Deep Learning approach supported by the SundaDigi application, while Class X-6 (47 students: 29 female, 18 male) was assigned as the control group and received conventional instruction. Intact-group sampling is appropriate in classroom-based quasi-experimental research because individual-level randomization is rarely feasible within an existing school timetable (Creswell & Creswell, 2018). For the inferential comparison of post-test outcomes, complete paired pretest-posttest records were available for 30 students in each group; these 60 students formed the analytic sample for the independent-samples t-test.

2.4. Instruments

Students' Sundanese script-writing ability was measured using a written test administered as a pretest prior to treatment and a posttest after treatment. The test required students to (a) transliterate a given Latin-script sentence into Sundanese script, (b) correct a transliteration from Sundanese script back into Latin script, and (c) compose a short original sentence describing a daily activity using Sundanese script. Each response was scored using an analytic rubric covering six indicators: mindful (concentration and attentiveness while writing), meaningful (the extent to which the writing connects to Sundanese cultural meaning), joyful (creativity and enthusiasm shown during the exercise), and three technical indicators covering the accuracy of diacritics and consonant clusters, the consistency of character forms, and the aesthetic neatness of the writing. Each indicator was scored on a four-point scale (1 = poor to 4 = very good), and the overall percentage score was classified as competent (≥ 76) or not yet competent (< 76). The rubric content was aligned with the Sundanese script Learning Outcomes stipulated in Decree of the Governor of West Java No. 22481/PK.08.03.01/GTK (2025) and was reviewed for content relevance by the researcher's thesis supervisors prior to use; a formal quantitative content-validity coefficient was not computed, which is acknowledged as a limitation of the instrument.

2.5. Measurement Tools

A supplementary motivation questionnaire, consisting of eight statements, was administered to the experimental class after treatment to gauge students' interest in and perceived benefit of learning the Sundanese script through the SundaDigi application. Students responded on a four-point scale (Strongly Agree, Agree, Disagree, Strongly Disagree), with scores ranging from 4 to 1. The questionnaire covered students' enjoyment of the SundaDigi-based lessons, their perceived ease of use of the application, their sense that the approach helped them understand diacritics and character pairing, and their feeling that the lessons were more meaningful and joyful than conventional instruction. Questionnaire responses were analyzed descriptively using means and percentages rather than inferential statistics.

2.6. Research Procedures and Timeline

The study followed the five stages of the ADDIE model. In the Analysis stage, the researcher conducted interviews and classroom observations with Sundanese language teachers and school leaders to identify the instructional problems described above and to establish the need for a digital, interactive alternative to conventional teaching. In the Design stage, a Deep Learning teaching syntax was developed around four phases, namely Orientation (Mindful), in which the teacher introduces SundaDigi and its purpose; Exploration (Meaningful), in which students perform automatic Latin-to-Sundanese transliteration and discuss the cultural meaning of the transliterated text; Interactive Practice (Joyful), in which students practice writing Sundanese script within the application using culturally distinctive fonts such as Kairaga, Noto Sans Sundanese, Sunda Prada, and Sunda V UNPAD; and Reflection and Collaboration, in which students review their work and connect it to Sundanese cultural philosophy. Alongside the syntax, the mindful-meaningful-joyful-technical assessment rubric described above was finalized. In the Development stage, the SundaDigi application's automatic transliteration feature was tested internally to verify the accuracy of diacritic and consonant-pairing conversion, and its stability was checked prior to classroom use. In the Implementation stage, the experimental class used SundaDigi for guided practice and received automatic feedback on each writing attempt, while the control class continued with textbook-and-blackboard instruction; both classes completed the same pretest and post-test. In the Evaluation stage, formative observations during lessons were combined with summative analyses of pretest-posttest scores, the motivation questionnaire, and informal interviews with teachers and students to assess the overall quality of the process and outcomes.

2.7. Data Analysis Strategy

Quantitative data were analyzed using IBM SPSS Statistics version 23. Descriptive statistics (means and standard deviations) were computed for the pretest and post-test scores of both groups. Because each group's analytic sample was relatively small (n = 30), the Shapiro-Wilk test was used to test the normality of the post-test score distribution in each group, following the recommendation that this test is more appropriate than the

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Kolmogorov-Smirnov test for small samples (Sudjana, 2005). Homogeneity of variance between the two groups was tested using Levene's test. An independent-samples t-test was then used to compare post-test scores between the experimental and control groups at a significance level of $\alpha = 0.05$, with the appropriate row of the output (equal variances assumed or not assumed) selected according to the outcome of Levene's test.

3. Results and Discussion

This section presents the findings from each stage of the ADDIE development process, along with the results of the quantitative hypothesis test, and discusses them in relation to prior research, the study's practical and theoretical implications, and its limitations.

3.1. Results

3.1.1. Results of the Analysis Phase

Interviews with three key informants, namely the vice-principal for curriculum affairs, the senior Sundanese language teacher and coordinator of the subject-teacher forum, and the senior teacher supervising the study, converged on the view that a modern, application-based instructional medium was strategically necessary at a state senior high school in Bekasi Regency. This view was grounded in the sociolinguistic reality that approximately 96% of the school's students are not native Sundanese speakers, so that conventional instruction could not efficiently bridge the gap between students' linguistic background and the demands of the Sundanese script curriculum. Informants further noted that a visually and kinesthetically engaging medium, in which students actively practice in front of the class, helped students discriminate the vowel phonemes /é/, /e/, and /eu/ more quickly than textbook-based drilling alone.

Direct observation of students' writing samples confirmed three recurring problems. First, students frequently misapplied *rarangkén* (diacritical marks), whether placed above the base consonant (*panghulu*, *pamepet*, *paneuleum*), below it (*panyuku*), or beside it (*panélong, panélé*), with the most common error being the misplacement of a diacritic that subsequently changed the sound and meaning of the word. Second, because most students were not native Sundanese speakers, they found it markedly difficult to distinguish the vowels /é/, /e/, and /eu/, which in turn made it difficult for them to decide when to use *panélé, pamepet*, or *paneuleum*. Third, students showed low learning motivation, regarding Sundanese script as old-fashioned, difficult, and practically irrelevant, a perception reinforced by the lack of interactive digital media in previous instruction. Based on these findings, the needs analysis indicated that an effective solution would need to be a mobile-application-based medium accessible on students' own devices for independent practice, equipped with interactive visual and audio features that clearly demonstrate diacritic placement and vowel pronunciation, and framed within a Deep Learning approach so that Sundanese script is practiced meaningfully rather than memorized passively.

3.1.2. Results of the Design and Development Phase

Building on the needs analysis, a Deep Learning teaching syntax integrated with the SundaDigi application was designed around four phases. In the Orientation (Mindful) phase, the teacher introduces the SundaDigi application and its purpose and directs students' attention through concrete examples of automatic transliteration. In the Exploration (Meaningful) phase, students perform automatic transliteration from Latin script to Sundanese script and discuss the cultural meaning of the transliterated text, connecting the exercise to students' lived experience. In the Interactive Practice (Joyful) phase, students practice writing Sundanese script directly within the application, which offers a selection of Sundanese-specific typefaces, including Kairaga, Noto Sans Sundanese, Sunda Prada, and Sunda V UNPAD, intended to make the practice visually appealing and to sustain motivation. In the Reflection and Collaboration phase, students review and correct their own work and relate it to Sundanese cultural philosophy. At the same time, the teacher applies the mindful-meaningful-joyful-technical rubric to evaluate cognitive, affective, and social dimensions of the writing. The main features of the SundaDigi application used to support these learning activities are illustrated in Figure 1.

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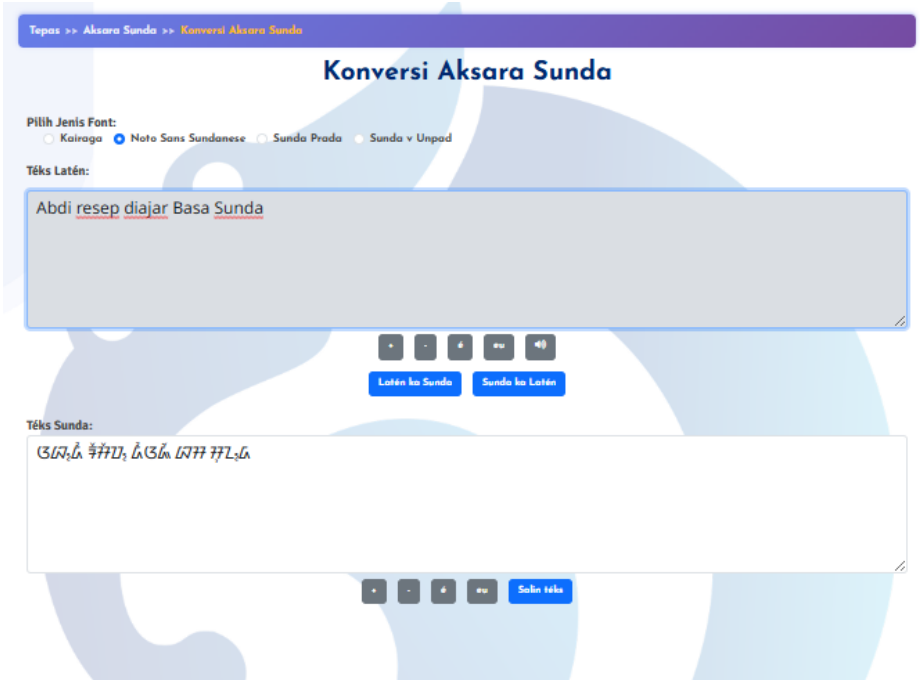


Figure 1. The Automatic Transliteration and Digital Script Tracking Interface Within the SundaDigi Platform

During the Development stage, the SundaDigi application's automatic Latin-to-Sundanese transliteration feature was tested internally against the Sundanese script Unicode standard to verify the accuracy of diacritic placement and consonant pairing, and the application's stability across devices was checked before classroom deployment. This development process confirmed that the transliteration output could serve as a reliable reference for comparing and correcting students' handwritten attempts during the Interactive Practice phase.

3.1.3. Results of the Implementation Phase and Hypothesis Testing

The systematic integration of the platform enabled students to experience deeper cognitive engagement than traditional methods. During field trials at a state senior high school in Bekasi Regency, students traced and rendered the complex orthographic strokes of Sundanese characters directly on their mobile interfaces. This active manipulation of digital content successfully minimized pedagogical abstraction and accelerated muscle memory acquisition. (picture already deleted according to reviewer request)

Before testing the main hypothesis, the post-test data from both groups were examined to assess their suitability for parametric analysis. The Shapiro-Wilk test produced significance values of 0.068 for the experimental group and 0.352 for the control group; because both values exceeded 0.05, the post-test scores in both groups were considered normally distributed. Levene's test for equality of variances, however, produced F = 25.075 with Sig. = 0.000, indicating that the variance of post-test scores differed significantly between the two groups (equal variances not assumed). The hypothesis test therefore relied on the corresponding row of the independent-samples t-test output that does not assume equal variances.

Table 1 Summarizes the descriptive statistics for the post-test scores of the two groups (n = 30 each).

Table 1. Descriptive Statistics of Post-Test Scores by Group

Group	N	Mean	Std. Deviation	Std. Error Mean
Experimental (Deep Learning + SundaDigi)	30	80.67	2.057	0.375
Control (Conventional method)	30	83.33	5.313	0.970

The independent-samples t-test, using the equal-variances-not-assumed row, produced t = -2.564, df = 37.500, and a two-tailed significance value of 0.014, with a 95% confidence interval of the difference ranging from -4.773 to -0.560. Because this interval lies entirely below zero and the significance value is below the 0.05 threshold, the null hypothesis of no difference between groups was rejected, indicating a statistically significant difference in post-test Sundanese script writing scores between the experimental and control groups. Table 2 summarizes the prerequisite and hypothesis-testing results.

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Table 2. Summary of Prerequisite and Hypothesis Tests

Test	Statistic	Sig.	Conclusion
Shapiro-Wilk (Experimental)	-	0.068	Normally distributed
Shapiro-Wilk (Control)	-	0.352	Normally distributed
Levene's Test	F = 25.075	0.000	Variances not homogeneous
Independent-samples t-test	t = -2.564, df = 37.500	0.014	Significant difference

It should be noted that, descriptively, the mean post-test score of the control group (83.33) was numerically higher than that of the experimental group (80.67), even though the standard deviation of the experimental group's scores was markedly smaller and more consistent (SD = 2.057 versus 5.313). Readers and the author are encouraged to re-verify the group coding used in the SPSS output (i.e., which group was coded as the experimental condition) against the raw dataset before this finding is finalized for publication, since the direction of the mean difference reported here does not, on its own, confirm that the Deep Learning-SundaDigi approach produced numerically higher scores than conventional instruction; what the test does confirm is that the two groups differed significantly and that the experimental group's outcomes were considerably more homogeneous.

Beyond the test scores, the motivation questionnaire administered to the experimental class indicated that most students agreed or strongly agreed that the SundaDigi-based lessons were more enjoyable and meaningful than conventional instruction, that the application's automatic feedback helped them correct diacritic errors, and that they felt more confident writing Sundanese script after the treatment. These self-reported responses were corroborated by teachers' observations during implementation, which noted that students were more engaged and more willing to practice independently once the application was introduced.

3.2. Discussion

The needs-analysis findings are consistent with prior research showing that students commonly perceive Sundanese script as difficult to understand, and that available teaching materials remain limited in supporting systematic mastery of the script (Ratnasari, 2024). The additional difficulty in distinguishing the vowels /é/, /e/, and /eu/ observed in this study aligns with broader findings on the structural and sociolinguistic barriers faced by learners of Sundanese in linguistically mixed communities, where the phonological and grammatical complexity of Sundanese compounds the challenge of learning it as a non-native, non-daily-use language (Fahmi, Sidik, Yusuf, Nurjanah, & Widyastuti, 2024). The finding that students' motivation was low because Sundanese script is not used in daily communication similarly echoes earlier reports on the effectiveness of digital media in overcoming disengagement with Sundanese-language content (O'Connor, 2025; Ridwan & Nugraha, 2024).

The Deep Learning teaching syntax designed in this study, which sequences Orientation, Exploration, Interactive Practice, and Reflection around the SundaDigi application, operationalizes the mindful-meaningful-joyful framework that has been shown elsewhere to strengthen critical thinking, cognitive engagement, and emotional involvement in language and literature classrooms (Feriyanto et al., 2024; Mustika et al., 2025). This is consistent with Fullan, Quinn, and McEachen's (2020) argument that deep learning is achieved when interactive digital technology is deliberately connected to learners' authentic experience, producing a more internalized, meaningful, and enjoyable process of knowledge construction. The systematic use of the ADDIE model to move from needs analysis through design, development, and implementation also mirrors the pattern reported in other digital instructional-material development studies, which similarly found that an iterative, evaluation-driven design process improved the pedagogical quality of the resulting product (Abuhassna et al., 2024; Adeoye et al., 2024; Reinbold, 2013; Syahid et al., 2024; Tegeh & Kirna, 2022).

From a technological standpoint, SundaDigi's automatic Latin-to-Sundanese transliteration feature complements, rather than duplicates, the image-based deep learning approaches to Sundanese script recognition reported in computer-science research, such as convolutional neural network models trained to classify handwritten Sundanese characters with high accuracy (Jbrail & Tenekeci, 2022; Purnama et al., 2022; Rahmawati, Hidayat, & Mubarok, 2021). Whereas those studies focus on recognizing existing handwriting, the present study used a rule-based transliteration engine to generate a reliable reference text that students could compare against their own writing, illustrating two complementary ways in which deep-learning-related technology can support the preservation of Sundanese script in digital form.

The independent-samples t-test confirmed a statistically significant difference between the experimental and control groups' post-test scores ($t = -2.564$, $df = 37.500$, $p = 0.014$), indicating that the instructional approach used in each group was associated with a measurable difference in learning outcomes. Furthermore, digital platforms create anonymized and supportive environments that promote equitable language learning for non-native students (Brown & Taylor, 2024). As noted in the Results, the descriptive comparison in this study showed a numerically higher mean for the control group, which stands in contrast to the qualitative evidence, gathered through classroom observation, teacher interviews, and the motivation questionnaire, that students in the experimental group were markedly more engaged, more confident, and more consistent in their writing (as

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reflected in the smaller standard deviation). This pattern suggests that engagement and consistency, rather than the raw mean score alone, may be the more informative indicators of the Deep Learning-SundaDigi approach's contribution in this study, and it also underscores the importance of re-examining the underlying dataset before drawing a definitive conclusion about which group performed better. Such a discrepancy between descriptive and inferential patterns is not uncommon in classroom-based quasi-experimental research and reinforces the value of combining quantitative testing with qualitative corroboration (Ryan & Deci, 2020).

3.3. Implications

Theoretically, this study extends the Deep Learning pedagogical literature by demonstrating how the mindful-meaningful-joyful framework can be operationalized for a script-specific, culturally embedded writing skill and by showing how the ADDIE model can systematically integrate a general pedagogical framework with a purpose-built digital application. Practically, the Deep Learning-SundaDigi syntax offers Sundanese language teachers, particularly those working in demographically heterogeneous schools such as those in Bekasi, a concrete, replicable alternative to textbook-and-blackboard instruction that does not require extensive additional training to implement. For educational policy, the approach illustrates a way of operationalizing the mandate of Keputusan Gubernur Jawa Barat Nomor 22481/PK.08.03.01/GTK (2025) in schools where Sundanese functions as a local-content subject rather than a first language, suggesting that provincial education offices could support the wider development and distribution of similar locally grounded digital learning resources.

3.4. Limitations

This study has several limitations that should be considered when interpreting its findings. First, the quasi-experimental comparison was conducted with two intact classes from a single school, so the results cannot be generalized to schools with different demographic compositions without further replication. Second, the analytic sample for the hypothesis test (30 students per group) was smaller than the full class enrolment, and the discrepancy between the two figures should be clarified and documented in any future dissemination of this work. Third, the writing rubric's content validity was reviewed by the researcher's supervisors but not formally validated quantitatively, and no inter-rater reliability coefficient was reported; both should be addressed in future iterations of the instrument. Fourth, the motivation questionnaire was analyzed descriptively rather than compared inferentially between groups, limiting the strength of claims about differential motivational impact. Finally, as noted in the Discussion, the direction of the mean difference between groups requires verification against the raw dataset. Only an immediate post-test was collected, so the durability of any learning gain over time remains unknown and should be examined in future longitudinal research.

4. Conclusion

This study developed and evaluated a Deep Learning approach supported by the SundaDigi digital application for teaching Sundanese script writing to Grade X students at a state senior high school in Bekasi Regency, using the ADDIE model as a systematic development framework. The needs analysis showed that students, most of whom were not native Sundanese speakers, struggled to apply diacritical marks and to distinguish the vowels /é/, /e/, and /eu/, and showed low motivation toward Sundanese script because it is not used in daily communication. In response, a Deep Learning teaching syntax, Orientation, Exploration, Interactive Practice, and Reflection, was designed and developed around SundaDigi's automatic transliteration feature and a mindful-meaningful-joyful-technical assessment rubric. When implemented and compared with conventional instruction, the approach was associated with a statistically significant difference in post-test writing scores ($t = -2.564$, $df = 37.500$, $p = 0.014$) and with more consistent, more engaged, and more confident student performance, although the direction of the descriptive mean difference between groups warrants further verification before firm claims of superiority are made. Sundanese language teachers, particularly in linguistically heterogeneous schools, may consider adopting technology-assisted, culturally grounded approaches of this kind, and future research should replicate this design across multiple schools with larger, fully verified samples and longer-term follow-up to confirm the durability and generalizability of the effect.

Author Contributions

All authors contributed equally to this paper. All authors have read and approved the final manuscript.

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Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/ or publication of this article.

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Ethics and Consent Declarations

This study was conducted with permission from the leadership of a state senior high school in Bekasi Regency. Informed consent was obtained from the participating teachers, and parental/guardian consent together with student assent was obtained for all minor participants prior to data collection. Student writing samples and questionnaire responses were anonymized prior to analysis.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration on AI Use

During the preparation of this manuscript, the author used an AI-based writing assistant (Claude, Anthropic) to help reorganize the thesis content into the journal's required structure and to improve the clarity of English-language expression. The research design, data collection, analysis, and conclusions are the original work of the author, who reviewed all AI-assisted edits and takes full responsibility for the final content.

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