



Development of Canva-Based Interactive E-Modules for Sundanese Script Learning in Elementary Schools

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Abstract:

This study aimed to develop and test an interactive e-module for reading and writing Sundanese script using Canva. The R&D method integrated Borg and Gall (10 stages) and ADDIE (5 phases) into four main stages: preliminary study, planning, development, and implementation. Subjects were 30 sixth-grade students at SDN 1 Bojongkalong, Sukabumi Regency. Data were collected through interviews, questionnaires, and tests. Results showed: (1) The e-module was successfully developed using Canva, enriched with video, audio, and Wayground for pretest/posttest; (2) Feasibility was rated highly feasible by experts (material 90%, media 93.04%, instructional design 85.6%) and users (94.83%); (3) Effectiveness was moderate (N-Gain 0.69), yet student scores improved significantly from 44.83 to 83.00. The novelty lies in integrating Borg and Gall with ADDIE, using Canva-based e-modules specifically for Sundanese script, and incorporating Wayground for interactive evaluation. The implication is that this integrated procedure can serve as an alternative model for developing digital learning media, and the e-module can be used as innovative supplementary learning material.

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Introduction (مقدمة)

The National Education System Law (Law No. 20 of 2003) affirms that the purpose of national education is to develop students' potential comprehensively, covering spiritual, personality, intelligence, noble character, and life skills needed for society. In the Qur'an, Surah Al-Mujadilah (58) verse 11 states that Allah will elevate those who believe and those who are given knowledge several degrees, indicating the importance of knowledge for Muslims. This underscores the importance of education in producing knowledgeable, faithful, morally upright, and beneficial individuals for society. Therefore, learning using interactive e-modules for reading and writing Sundanese script must be well-designed so students can achieve their potential

through meaningful learning experiences.

The West Java Provincial Government has designated Sundanese language as a compulsory local content subject at all primary and secondary education levels. The goal is to strengthen the cultural identity of the younger generation while ensuring the sustainability of regional language heritage. One of the materials in Sundanese language subjects is reading and writing Sundanese Script (Aksara Sunda). Sundanese script is not merely a writing system but a cultural heritage of ancestors that represents the identity, wisdom, and civilization of the Sundanese people. The preservation of Sundanese script is crucial as it embodies the historical records, literary works, and traditional knowledge of the Sundanese civilization that has existed for centuries. However, the declining mastery of reading and writing Sundanese script among the younger generation potentially breaks the chain of local cultural transmission.

A review of five previous studies shows that learning media are important factors in supporting student learning success. Appropriate media can help simplify complex material so it is easier to understand, interesting, and according to student characteristics. This is highly relevant in learning to read and write Sundanese script because the material contains symbols, letter shapes, sounds, and writing rules that differ from Latin letters. Therefore, learning to read and write Sundanese script requires media capable of displaying visuals clearly, providing exercises, and offering interaction space so students can more easily understand and remember the material. The abstract nature of script characters and the complexity of vocalization rules demand innovative approaches that go beyond traditional textbook-based instruction.

One form of digital learning media is interactive e-modules. Interactive e-modules are designed to facilitate independent learning by integrating multimedia and interactive exercises that can increase student engagement and learning motivation. According to the Ministry of Education and Culture, e-modules are self-instructional learning materials presented systematically in electronic format, with each learning activity connected via hyperlinks enabling students to interact more actively. Previous efforts to develop media have been carried out, but significant limitations remain. Most e-modules are still presentative and static, functioning more as information delivery tools while interactivity and facilitation of student independent learning remain minimal. Meanwhile, existing e-module development research has not been specifically designed to accommodate the learning needs of symbolic material like reading and writing Sundanese script. The lack of interactive elements in current learning media has resulted in passive learning experiences where students merely receive information without active engagement.

The research gap is specifically identified in several key areas. First, studies on Sundanese script learning media have primarily focused on augmented reality applications or Android-based educational games for junior high school levels, with limited attention to Canva-based e-modules specifically for elementary school students. Second, while Canva has been effectively used to develop interactive e-modules for subjects such as science, Indonesian literacy, and local wisdom, its application for teaching regional scripts remains underexplored. Third, recent studies have demonstrated the effectiveness of technology-assisted approaches for Sundanese script instruction, but no research has specifically integrated the comprehensive validation procedures of Borg and Gall with the instructional design framework of ADDIE for this purpose. Fourth, the integration of interactive assessment platforms such as Wayground for pretest and posttest evaluation has not been previously explored in the context of Sundanese script learning.

Based on the curriculum used at SDN 1 Bojongkalong, Nyalindung District, Sukabumi Regency, in local content subjects, Sundanese language, the learning outcomes that must be achieved by students in phase C, grade VI, for reading and writing Sundanese script material are that students are able to read and write simple words and sentences using Sundanese script. More

details are explained in the reading and viewing element that students must be able to read words and sentences in Sundanese script texts, and in the writing element, students must be able to write simple words and sentences with Sundanese script. The curriculum emphasizes the importance of mastering both receptive skills (reading) and productive skills (writing) as complementary competencies that support each other.

Contrary to the expected ideal conditions, from documentation studies conducted by researchers, facts show that the average score of daily test results in Sundanese language subject on reading and writing Sundanese script material is still relatively low. Of 30 students in grade VI at SDN 1 Bojongkalong, only 30% or 9 students achieved scores above the Learning Objective Achievement Criteria (KKTP = 65), consisting of 4 students scoring 80 and 5 students scoring 70, while the remaining 70% or 21 students have not reached the set standard: 2 students scored 30, 3 students scored 40, 9 students scored 50, and 7 students scored 60. This condition indicates problems in the learning process of reading and writing Sundanese script that need immediate attention. The distribution of scores shows that most students are clustered in the low to moderate range, suggesting systemic issues in how the material is currently being taught.

Interview results with the grade VI teacher at SDN 1 Bojongkalong revealed factors causing low student learning outcomes in Sundanese language, especially reading and writing Sundanese script material, including: (1) teachers have not optimally used digital learning media, (2) student learning motivation is low because teachers only use conventional learning media, (3) student involvement in learning is not visible because they only listen to the teacher and work on questions, (4) teachers have not optimized the use of available digital technology at school, and (5) teachers have never used interactive e-modules, especially for reading and writing Sundanese script material. These factors collectively point to a gap between the potential of digital technology and its actual implementation in classroom settings.

This research presents novelty in content specifically intended for learning to read and write Sundanese script at the elementary school level, addressing the research gap identified in previous studies. Then there is technology integration using the Canva application, which is easy to use as a visual design tool and developed creatively to create interactive exercises. Canva strongly supports education by offering free accounts with features that cater to teachers at all educational levels, including tools for developing modules and creating learning media. This interactive e-module is also enriched with Wayground integration in the pretest and posttest sections, which not only aims to assess learning outcomes but also provides an enjoyable experience and direct feedback. Other novelty in this research is the use of the development model where the researcher integrates the Borg and Gall research and development model as the foundation in research and development that focuses more on research steps so the resulting product is valid and suitable for use, with the ADDIE development model as an instructional design development model that focuses more on learning so the interactive e-module suits student characteristics in learning. This integration represents a methodological innovation that addresses both product quality and instructional effectiveness simultaneously.

Based on the background above, the research problems are formulated as follows: (1) How is the development procedure for interactive e-modules for reading and writing Sundanese script for grade VI at SDN 1 Bojongkalong? (2) How is the feasibility level of interactive e-modules for reading and writing Sundanese script for grade VI at SDN 1 Bojongkalong in learning? (3) How is the effectiveness level of interactive e-modules for reading and writing Sundanese script for grade VI at SDN 1 Bojongkalong in improving student learning outcomes?

This research aims to: (1) Describe the development procedure for interactive e-modules for reading and writing Sundanese script for grade VI at SDN 1 Bojongkalong, (2) Test the feasibility of interactive e-modules for reading and writing Sundanese script for grade VI at SDN

1 Bojongkalong for use in learning, and (3) Test the effectiveness of interactive e-modules for reading and writing Sundanese script for grade VI at SDN 1 Bojongkalong in improving student learning outcomes..

Theoretical Study

Educational Technology

The Association for Educational Communications and Technology (AECT) defines educational technology from year to year, with the latest definition in 2008 stating that educational technology is the study and ethical practice of facilitating learning and improving performance through creating, using, and managing appropriate technological processes and resources (Arief, 2024). This definition emphasizes the ethical dimension of educational technology practice, highlighting that technology implementation must always consider moral and professional standards. The essence of educational technology is not limited to the use of devices but is an integration between physical components (hardware and software) with theoretical frameworks, field practices, and scientific ethics (Nurhayati, 2023; Mundir, 2022). This integration ensures that technology serves pedagogical purposes rather than being an end in itself.

Seels and Richey (1994) identified five domains of educational technology: design, development, utilization, management, and evaluation. The design domain focuses on strategic planning processes to establish specifications and learning solution frameworks before entering the development stage. The development domain is the process of translating specifications from the planning stage into physical form or products, including developing various technologies such as print technology, audiovisual, computer-based technology, and multimedia. The utilization domain relates to the direct use of methods and learning resources in real learning situations. The management domain is a series of activities aimed at improving through planning, organizing, coordinating, and supervising resources. The evaluation domain is defined as activities aimed at reviewing and improving a product or program. These five domains are not mutually exclusive but rather interconnected, with each domain supporting and informing the others in a cyclical relationship.

Research and Development

Research and Development (R&D) in education is defined as a cyclical process aimed at producing and validating educational products. This cycle includes three main steps: (a) Reviewing relevant research findings, (b) Designing and developing products, and (c) Conducting continuous evaluation and revision, which in more rigorous implementation also includes field trials to prove product feasibility (Gall, 1983). Sugiyono (2013) states that R&D requires two types of research simultaneously: needs analysis to produce products and further research to test effectiveness. The R&D approach is particularly suitable for addressing practical educational problems where existing solutions are inadequate and new products need to be created and validated.

Borg and Gall Development Model

The Borg and Gall model consists of 10 stages: (1) Research and information collecting, (2) Planning, (3) Developing preliminary form of product, (4) Preliminary field testing, (5) Main product revision, (6) Main field testing, (7) Operational product revision, (8) Operational field testing, (9) Final product revision, and (10) Dissemination and implementation. The advantage of this model is its ability to produce products with high validation levels and encourage continuous product innovation processes. The weakness is that it requires relatively long time due to complex procedures and significant financial resources. Despite these limitations, the comprehensive nature of this model ensures that products undergo rigorous testing and

refinement before widespread implementation.

ADDIE Development Model

The ADDIE model has five main phases: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). The analysis phase defines what will be learned through needs assessment and learner analysis. The design phase creates the blueprint for instruction, specifying learning objectives, assessment strategies, and instructional approaches. The development phase realizes the design ideas into reality, producing instructional materials and media. The implementation phase is the actual step to apply the learning system in real settings. The evaluation phase examines whether the learning system being built is successful according to initial expectations. The advantage of the ADDIE model is its systematic structure that is easy to apply in various learning situations. However, the most significant weakness is the analysis phase requiring a long time and having a crucial role in determining the overall success. Poor analysis can lead to ineffective design and development, regardless of how well subsequent phases are executed.

Integration of Borg and Gall and ADDIE Models

This research integrates Borg and Gall and ADDIE models based on the need for development research oriented not only to instructional design but also to product validation and effectiveness testing. The researcher integrates both models because the resulting product is learning media, namely interactive e-modules for reading and writing Sundanese script to be used in learning. The integration produces four main stages: (1) Preliminary study combining Borg and Gall's research and information collecting with ADDIE's analysis, (2) Planning combining Borg and Gall's planning with ADDIE's design, (3) Development combining Borg and Gall's preliminary product development through final product revision with ADDIE's development, and (4) Implementation combining Borg and Gall's implementation and dissemination with ADDIE's implementation and evaluation. This integration represents a synergistic approach that leverages the strengths of both models while mitigating their individual weaknesses.

Learning Outcomes

Learning outcomes are changes in ability obtained by students after participating in the learning process. These changes are not limited to material mastery but also include attitudes and skills manifested in learning behavior. In evaluation contexts, learning outcomes can be identified through three main domains: cognitive domain (thinking ability and understanding material), affective domain (attitudes, values, and student responses), and psychomotor domain (skills or ability to perform actions) (Bhakti et al., 2022). Gagne distinguishes learning outcomes into five categories: (a) intellectual skills, (b) cognitive strategies, (c) verbal information, (d) motor skills, and (e) attitudes (Harefa et al., 2024). This comprehensive view of learning outcomes ensures that assessment captures the full range of student development resulting from instruction.

Sundanese Script

Sundanese script is the traditional script used by the Sundanese ethnic group in West Java, Indonesia. Sundanese script consists of: (1) Ngalagena script (basic consonants) consisting of 23 characters: ka, qa, ga, nga, ca, ja, za, nya, ta, da, na, pa, fa, va, ba, ma, ya, ra, la, wa, sa, xa, ha; (2) Swara script (independent vowels) consisting of 7 characters: a, i, u, é, o, e, and eu; (3) Numbers; and (4) Vocalization (Rarangkén) consisting of 13 techniques for adding vowels and consonants to basic characters. The complexity of Sundanese script lies not only in its numerous characters but also in the rules governing their combination and modification. Understanding these rules requires systematic and structured learning approaches.

Interactive E-Module

Interactive e-modules are electronic learning modules designed not only to deliver digital content but also to facilitate student engagement through interactive elements such as interactive exercises, direct feedback, and integrated multimedia, enabling more effective and contextual independent learning (Suwandi et al., 2024). Interactive e-modules are equipped with text, images, sound, video, interactive buttons, and interactive evaluation, where a module is said to be interactive because users experience interaction and behave actively (Azizah, 2022). Canva is a graphic design platform used to create various visual content, such as social media graphics, presentations, posters, and documents (Lubis, 2024). Canva's user-friendly interface and extensive template library make it an accessible tool for educators to create professional-looking learning materials without requiring advanced graphic design skills.



Method (منهج)

Research Location and Time

This research was conducted at SDN 1 Bojongkalong, located in Kampung Pangkalan Rt. 03/02, Bojongkalong Village, Nyalindung District, Sukabumi Regency, West Java Province. The research subjects were grade VI students (phase C). The research was conducted over six months from January to June 2026. The selection of this location was based on several strategic considerations: the implementation of the Merdeka Curriculum, availability of digital technology facilities such as laptops and projectors, stable internet connection, and ownership of gadgets by all grade VI students. These conditions made SDN 1 Bojongkalong an ideal location for implementing and testing the interactive e-module product.

Research Approach and Method

This research uses the Research and Development (R&D) method. Sugiyono (2015) states that R&D is a research method aimed at creating educational products and testing whether the product is feasible and effective in learning contexts. The research method used is mixed methods between qualitative and quantitative. Quantitative data were obtained through Likert scale questionnaire instruments to measure product validation by experts, measure product practicality based on student responses, and measure product effectiveness through pretest and posttest results with N-Gain formula. Qualitative data were obtained through interviews with grade VI teachers to identify initial needs. This mixed methods approach allows for comprehensive data collection that captures both numerical evidence and contextual understanding.

Product Development Procedure

The product development procedure integrates Borg and Gall's 10 stages with ADDIE's 5 phases (21 operational stages) into four main stages:

Stage 1: Preliminary Study

Combines Borg and Gall's research and information collecting with ADDIE's analysis, including: (1) validating performance gaps through interviews and documentation, (2) determining general learning objectives from curriculum review, (3) identifying student characteristics (age 11-12 years, concrete operational stage), (4) identifying available resources, (5) analyzing solutions and cost estimates, and (6) preparing project management plans. The preliminary study serves as the foundation for all subsequent development activities, ensuring that the product addresses actual needs rather than perceived ones.

Stage 2: Planning

Combines Borg and Gall's planning with ADDIE's design, including: (7) conducting learning analysis by breaking down material from simplest to most complex (swara, ngalagena, vocalization, numbers), (8) formulating specific learning objectives using ABCD format (Audience, Behavior, Condition, Degree), (9) developing learning strategies, and (10) measuring costs and benefits. The planning stage transforms analysis findings into concrete design specifications that guide development.

Stage 3: Development

Combines Borg and Gall's preliminary product development through final product revision with ADDIE's development, including: (11) producing learning content, (12) selecting/developing media through storyboard creation, (13) developing student guidelines, (14) developing teacher guidelines, (15) conducting formative evaluation and revision (expert review by material expert, instructional design expert, and media expert), and (16) conducting trials (preliminary field testing, main product revision, main field testing, operational product revision, operational field testing, final product revision). This iterative stage ensures that the product is refined based on expert feedback and user testing before widespread implementation.

Stage 4: Implementation

Combines Borg and Gall's implementation and dissemination with ADDIE's implementation and evaluation, including: (17) teacher preparation, (18) student preparation, (19) determining evaluation criteria, (20) determining evaluation instruments, and (21) conducting learning evaluation. The implementation stage brings the product into real learning contexts and assesses its effectiveness in achieving intended outcomes.

Data Collection Instruments

Data collection instruments used include: (1) Document study for curriculum, lesson plans, and student learning outcome documents; (2) Structured interviews with grade VI teachers; (3) Questionnaires for needs analysis, expert validation (material, media, instructional design), and user trials (students); and (4) Tests (pretest and posttest) consisting of 20 multiple-choice questions to measure learning outcomes. Each instrument was carefully developed and validated to ensure it captured relevant data accurately and reliably. The questionnaires for expert validation contained specific items aligned with quality criteria for each aspect being assessed.

Data Analysis Techniques

Data analysis used qualitative descriptive analysis and quantitative descriptive analysis. Qualitative data from interviews and needs analysis questionnaires were analyzed descriptively by identifying patterns, themes, and key findings from participant responses. This analysis provided rich contextual information that complemented the quantitative data. Quantitative data from expert validation and user trials were analyzed using percentage formulas:

$$\text{Percentage} = (\text{Score obtained} / \text{Maximum ideal score}) \times 100\%$$

Feasibility criteria: 81%-100% (highly feasible), 61%-80% (feasible), 41%-60% (moderately feasible), 21%-40% (not feasible), 0%-20% (highly not feasible). These criteria provide clear benchmarks for determining product quality and readiness for use. Effectiveness was measured using N-Gain formula:

$$\text{N-Gain} = (\text{Posttest Score} - \text{Pretest Score}) / (\text{Ideal Score} - \text{Pretest Score})$$

$$\text{N-Gain categories: } g > 0.7 \text{ (high), } 0.3 \leq g \leq 0.7 \text{ (moderate), } g < 0.3 \text{ (low).}$$

Percentage categories: <40% (ineffective), 40%-55% (less effective), 56%-75% (moderately effective), >76% (effective). The N-Gain analysis provides a standardized measure of learning improvement that accounts for initial differences in student ability.

Development Procedure

Result (نتائج)

The development procedure produced an interactive e-module for reading and writing Sundanese script through the integration of Borg and Gall (10 stages) and ADDIE (5 phases = 21 operational stages) into four main stages.

Stage 1: Preliminary Study

Documentation results showed that only 30% of students achieved scores above KKTP, with average score below standard. Literature review identified research gaps. Interviews and questionnaires revealed teachers had not optimally used digital learning media, student motivation was low, and there was a desire for more interesting technology-based learning media. Performance gap analysis showed significant gaps between ideal conditions and reality. General learning objectives were formulated based on curriculum review: students can read 3 simple sentences using Sundanese script with 80% accuracy and write 5 words using Sundanese script with 80% accuracy. Student characteristics identification showed age 11-12 years (concrete operational stage), preference for visual learning (60%), auditory (30%), kinesthetic (10%), and 100% had access to gadgets. Resource identification showed availability of 10 laptops, 1 interactive flat panel, 4 projectors, 50 Mbps internet, and 1,300 Kwh electricity. The solution was a web-based e-module accessible via various devices, with online mode (all features) and offline mode (PDF format). Cost estimates showed efficient development using existing facilities. Project management plans were prepared covering all stages with indicators of success.

Stage 2: Planning

Learning analysis was conducted by breaking down material from simplest to most complex: swara (vowels), ngalagena (consonants), vocalization (13 techniques), and numbers. Specific learning objectives were formulated using ABCD format. Learning strategies were developed oriented towards student activeness with three meetings. Cost-benefit analysis showed efficient development without significant costs.

Stage 3: Development

Learning content was produced covering swara (introduction, writing methods, exercises), ngalagena (introduction, memorization song, writing methods, examples, exercises), vocalization in three parts (above, below, parallel to basic characters), and numbers. The media was developed using Canva with storyboard containing cover, table of contents, instructions, objectives, pretest, material 1-4, posttest, glossary, and closing. Student guidelines were prepared with 7 steps for using the e-module. Teacher guidelines were prepared comprehensively including preparation and implementation instructions. Formative evaluation was conducted through expert reviews: material expert (90%, highly feasible), instructional design expert (62.4% first round, improved to 85.6% after revisions), media expert (93.04%, highly feasible). Expert suggestions included adding learning outcomes, roadmap, balancing reading and writing exercises, providing familiar word examples, fixing writing errors, adding achievement criteria, changing exercises to direct activities, providing answer keys, adding syllable formation pages, ensuring navigation consistency, adding "repeat material" links, using consistent titles, showing video URLs, and adding glossary. Trials were conducted in three stages: preliminary field testing (3 students, 88.89%, good), main field testing (7 students, 97.14%, highly good), and operational field testing (30 students, 98.44%, highly good). Revisions were made based on findings, especially technical aspects.

Stage 4: Implementation

Teacher preparation included meetings to explain research objectives and provide e-

module usage training. Student preparation included introduction to e-module, access methods, and usage rules. Learning evaluation through pretest and posttest showed significant improvement from average 44.83 to 83.00, with N-Gain 0.69 (moderate category) and 69% (moderately effective).

Interactive Features Supporting Reading and Writing Skills

The interactive e-module incorporates several features specifically designed to support both reading and writing skills in Sundanese script. These features work synergistically to address the cognitive and psychomotor demands of learning a symbolic writing system.

Features Supporting Reading Skills

The e-module includes multiple features that facilitate the development of reading skills in Sundanese script:

1. **Audio Pronunciation Integration.** Each Sundanese script character and syllable is accompanied by audio recordings that provide correct pronunciation. This feature enables students to hear the sound associated with each character, creating a multisensory learning experience that bridges the gap between visual symbols and auditory recognition. For example, when students click on the ngalagena character "ka" (ᮊ), they hear the correct pronunciation /ka/, which helps them develop sound-symbol correspondence. This is particularly important for Sundanese script, where certain sounds (such as é and e, or qa and ka) are phonetically similar and require auditory discrimination.
2. **Video Demonstration of Character Recognition.** Videos embedded in the e-module demonstrate how to recognize and differentiate between similar-looking characters. The videos highlight distinguishing features of each character, such as the presence of specific strokes or the positioning of elements. For instance, the characters for "qa" (ᮊ) and "ga" (ᮃ) are visually similar, and the video emphasizes their subtle differences. This visual scaffolding helps students develop the visual discrimination skills essential for fluent reading.
3. **Interactive Reading Exercises.** The e-module contains interactive exercises that require students to read Sundanese script words and sentences and select the correct Latin-script translation. These exercises present words in Sundanese script, and students must match them to the correct Latin-script equivalent from multiple options. When students make an incorrect selection, immediate feedback provides the correct answer and explains why it is correct, reinforcing learning. For example, an exercise might display the word "ᮊᮥᮒᮥᮒ" (krékék) and require students to identify its meaning from four options, with feedback explaining the correct answer.
4. **Scaffolded Reading Progression.** The reading materials are organized progressively from simple to complex. Students begin by reading single characters (swara and ngalagena), then progress to syllables, simple words, and finally simple sentences. This scaffolding ensures that students build confidence gradually, avoiding cognitive overload. Each section includes examples with familiar words from students' daily lives, such as "ᮊᮥᮒᮥᮒ" (breuk - broken) and

"ᮊᮥᮒ" (téla - cassava), making the learning more contextual and meaningful.

5. "Repeat Material" Links. Each page includes a link that allows students to revisit previous material without navigating back through the entire module. This feature supports self-paced learning, allowing students who need additional practice to review content as many times as necessary.

Features Supporting Writing Skills

The e-module includes features that facilitate the development of writing skills in Sundanese script, acknowledging the importance of psychomotor practice for script mastery:

1. Video Demonstrations of Writing Techniques. Each character is accompanied by a video that demonstrates the correct writing technique, showing the stroke order, direction, and proportion. The videos provide a step-by-step visual guide, showing how to form each character from the starting point to the final stroke. For example, the video for writing "nga" (ᮊ) shows the correct number of strokes (3 strokes), the direction of each stroke, and the relationship between strokes. This feature is particularly important for Sundanese script, where stroke order and direction significantly affect the final shape and legibility of the character.
2. Audio Guidance for Writing Practice. While students practice writing, the e-module can be used alongside audio guidance that provides verbal instructions. In classroom implementation, teachers can play the audio while students practice, providing synchronized guidance for each stroke. The audio describes the shape, direction, and positioning of each stroke, helping students internalize correct writing techniques.
3. Interactive Writing Exercises with Immediate Feedback. The e-module presents exercises where students must identify the correct Sundanese script representation of a given Latin-script word. While this does not track the physical act of writing, it requires students to recognize the correct characters, understand their arrangement, and apply vocalization rules. When students select the wrong character, immediate feedback explains why it is incorrect and shows the correct character, reinforcing learning. For example, an exercise might ask students to select the correct script for "ka" and provides immediate feedback explaining the difference between "ka" (ᮊ) and "qa" (ᮊᮥ).
4. Progressive Writing Practice. The e-module guides students through a systematic progression of writing practice. Students begin by identifying individual characters, then progress to forming syllables by combining characters with vocalization techniques (rarangkén), and finally construct complete words and simple sentences. This progression ensures that students master the basic building blocks before moving to more complex writing tasks. The material includes abundant examples of words commonly used in students' daily lives, making practice more contextual and meaningful.
5. Answer Keys for Self-Assessment. Each exercise includes an answer key that students can access after completing the exercise. This allows students to check their work independently and identify areas needing improvement. The answer keys provide the correct Sundanese script form alongside the Latin-script equivalent, enabling students to compare their answers

with the correct form.

How Interactive Features Integrate to Support Both Skills

The interactive features of the e-module are not isolated but work synergistically to support both reading and writing skills.

Table 1. Interactive features

Feature	How It Supports Reading	How It Supports Writing	Integration
Audio Pronunciation	Sound-symbol correspondence	Auditory reinforcement of writing practice	Clicking characters plays audio, reinforcing reading through sound
Writing Videos	Visual identification of characters	Stroke order and technique demonstration	Videos show character formation, supporting both recognition and reproduction
Interactive Exercises	Comprehension through word recognition	Character selection and arrangement	Same exercises require both reading and writing knowledge
Progressive Scaffolding	Building from simple to complex	Systematic skill development	Reading and writing progress together through similar stages
Immediate Feedback	Correct identification reinforcement	Error correction and learning	Feedback addresses both reading and writing errors
Repeat Material Links	Self-paced review of reading content	Additional practice opportunities	Enables students to revisit challenging content as needed

Feasibility of Interactive E-Module

Material Expert Validation resulted in 90% (highly feasible). The material expert assessed that the e-module content was appropriate to learning outcomes, supported reading and writing achievement, was appropriate to learning objectives, relevant to indicators, suitable for elementary student development level, presented Sundanese script concepts correctly, followed applicable writing rules, provided appropriate examples, was free from conceptual errors, covered swara, ngalagena, vocalization, and numbers, included examples and exercises, was arranged systematically from easy to difficult, and supported independent learning.

Media Expert Validation resulted in 93.04% (highly feasible). The media expert assessed that text size was proportional and readable, font type was appropriate and clear, text and background colors contrasted, illustrations matched Sundanese script material, image quality was clear, layout was neat and consistent, visual element composition was balanced, display was not too dense, navigation was easy to find, interactive features were provided, media encouraged student activeness, provided feedback, was easy to operate, had clear instructions, navigation worked well, could be used independently and repeatedly, helped understanding of Sundanese script concepts, supported reading and writing skills, was more interesting than conventional media, and improved learning effectiveness.

Instructional Design Expert Validation improved from 62.4% (moderately good) to 85.6% (highly feasible) after two rounds of revision. Initial assessment showed learning objectives were formulated clearly but needed achievement criteria, materials needed adjustment for elementary student ability, strategies needed improvement for student activeness and independent learning,

material presentation needed better sequencing, interactivity needed enhancement, feedback needed provision, and navigation needed consistency.

User Trials showed improvement from preliminary field testing (88.89%, good) to main field testing (97.14%, highly good) and operational field testing (98.44%, highly good). This improvement especially occurred in technical aspects, from 66.67% (moderately good) after revision to 90.48% (highly good), proving that gradual testing stages effectively identified and fixed product weaknesses before widespread use.

The effectiveness test showed that the interactive e-module was moderately effective in improving student learning outcomes. N-Gain calculation resulted in 0.69 (moderate category) with 69% effectiveness (moderately effective). This was evidenced by: 1) Average pretest score: 44.83, 2) Average posttest score: 83.00, 3) Average increase: 38.17 points (85.13% improvement), 4) Students achieving "good" category (score ≥ 70): from 3 students (10%) in pretest to 28 students (93.33%) in posttest, 5) Students scoring 90-100: from 0 in pretest to 8 students in posttest, 6) No students scored below 60 in posttest.

Compared to previous research: (1) Asmianto et al. (2022) developed Android-based interactive e-modules for trigonometry using only ADDIE without Borg and Gall, lacking dissemination stages; (2) Dewi et al. (2025) conducted systematic literature review on e-module implementation in elementary schools, concluding e-modules designed with technology support and interactive content can improve learning quality; (3) Safitri and Dafitri (2025) developed interactive e-modules for elementary students using generic R&D models without explicit integration; (4) Fatimah et al. (2023) developed gamification-based interactive e-modules for fable texts also using only ADDIE; (5) Hidayat et al. (2022) developed Sundanese script learning media using Augmented Reality for Android, reaching 93.6% user response but without separate media expert validation.

This research's novelty lies in: (1) Integration of Borg and Gall and ADDIE models for Sundanese script material; (2) Use of Canva-based e-modules specifically for reading and writing Sundanese script; (3) Integration of Wayground for interactive pretest and posttest with direct feedback; (4) Local content focus (Sundanese script) which has rarely been researched in previous e-module studies.

Several limitations in this research include: (1) Designing truly interactive e-modules with various exercises and links required considerable time, especially in searching and synchronizing video content; (2) Technical constraints occurred when several students simultaneously accessed video links causing buffering due to unstable internet; (3) Canva's interactivity features are still limited to certain links and links, not as sophisticated as special programming applications, and lacks tracking features for digital Sundanese script writing; (4) Several important features in the interactive e-module require active internet connections; (5) The e-module depends on Canva's output format, requiring redevelopment for more complex interactivity; (6) Effectiveness testing was only done with N-Gain without quasi-experimental control group.



Discussion (مناقشة)

The Preliminary Study Stage

The preliminary study stage was particularly important as it established the empirical foundation for all subsequent development activities. The finding that 70% of students were below the mastery standard highlighted the urgency of developing more effective learning media. The identification of student characteristics, especially their preference for visual learning and access to gadgets, guided design decisions about the e-module's format and features. The

resource assessment confirmed that the school had adequate infrastructure to support digital learning, including stable internet and available devices.

The Planning Stage

The planning stage translated the findings from the preliminary study into concrete design specifications. The systematic breakdown of material from simple to complex ensured that students could build their knowledge gradually, with each concept serving as a foundation for subsequent learning. The ABCD format for learning objectives ensured that each objective was specific, measurable, and observable.

The Development Stage

The development stage was the most resource-intensive phase of the research. The creation of learning content required careful attention to both accuracy and pedagogical appropriateness. The use of Canva as the primary development tool proved effective, allowing for rapid prototyping and easy revision. The storyboard served as a blueprint that guided the entire development process, ensuring consistency and completeness. Expert validation was crucial in identifying areas for improvement that might not have been apparent to the researcher. The significant improvement in instructional design expert scores from 62.4% to 85.6% after revisions demonstrates the value of iterative refinement based on expert feedback.

The Implementation Stage

The implementation stage brought the e-module into actual classroom use, providing evidence of its effectiveness in real learning conditions. The significant improvement in student scores from pretest to posttest indicates that the e-module successfully facilitated learning.

Theoretical Basis for Interactive Design

The design of these interactive features is grounded in several learning theories:

1. Multimedia Learning Theory (Mayer). The integration of visual (text, images, videos) and auditory (audio pronunciations) modalities supports dual coding theory, allowing students to process information through both visual and auditory channels, which enhances retention and understanding.
2. Cognitive Load Theory. The progressive scaffolding and self-paced navigation reduce cognitive load by presenting information in manageable chunks and allowing students to control the pace of their learning. This is particularly important for complex material like Sundanese script, where students must simultaneously process multiple elements (character shape, pronunciation, vocalization rules).
3. Constructivism. The interactive exercises require active student participation, allowing students to construct their understanding through practice and immediate feedback. The self-assessment features encourage metacognitive reflection, helping students identify their own learning needs.
4. Piaget's Cognitive Development Theory. The design accommodates students in the concrete operational stage (ages 11-12) by providing concrete representations (visual characters, audio sounds, video demonstrations) and hands-on practice opportunities, rather than relying solely on abstract explanations.

Based on student feedback, field observations, and effectiveness data, the interactive features of the e-module had a positive impact on learning.

Table 2. Positive Impact of the e-module

Aspect	Evidence
Increased Engagement	94.83% student response rate in trials indicates high interest
Improved Reading Skills	Posttest showed significant increase in reading comprehension (from 44.83 to 83.00)
Enhanced Writing Understanding	Students demonstrated improved ability to construct words and sentences in posttest
Self-Paced Learning	Students used "repeat material" links actively, indicating independent learning
Immediate Feedback Impact	Students reported that instant feedback helped them learn from mistakes quickly

The high score from the material expert indicates that the content meets professional standards for accuracy, completeness, and pedagogical appropriateness. The expert noted that the inclusion of examples familiar to students, such as words commonly used in their daily lives, helped make abstract script concepts more accessible. The media expert's high score validates the design choices made in developing the e-module, particularly the use of Canva's features to create an engaging and user-friendly interface. The expert particularly appreciated the integration of audio for script pronunciation and the interactive exercises that provide immediate feedback.

The instructional design expert's feedback was particularly valuable in improving the pedagogical structure of the e-module. The addition of achievement criteria made learning objectives more measurable, while the inclusion of "repeat material" links and consistent navigation supported independent learning. The user trials provided valuable evidence of the e-module's practicality and acceptance among the target users. The improvement in technical aspects after revision addressed navigation issues and loading times, which had been identified as barriers to effective use. Student feedback during the trials indicated that the e-module made learning Sundanese script more enjoyable and less intimidating compared to traditional methods.

The e-module provided clear script images, writing videos, pronunciation audio, and interactive exercises that helped students construct understanding gradually, suitable for concrete operational stage according to Piaget's theory. Students aged 11-12 years need visualization and concrete examples to understand abstract material like Sundanese script. The multimedia features of the e-module addressed this need by providing multiple representations of the script characters, including visual, auditory, and kinesthetic learning modalities.

The integration of audio pronunciation helps students develop sound-symbol correspondence, which is foundational for both reading and writing. When students hear the correct pronunciation of a character while seeing it written, they form stronger memory associations. The writing videos demonstrate proper stroke order and technique, which is essential for developing legible handwriting. Research has shown that video-based instruction is particularly effective for teaching psychomotor skills, as it allows students to observe the motion and timing of each stroke.

The e-module provided direct feedback through interactive exercises, increasing student engagement. This aligns with research on gamification-based e-modules reporting significant effectiveness in improving student learning outcomes. The interactive exercises in the e-module required students to actively apply their knowledge rather than passively receive information, promoting deeper learning and better retention.

When students complete reading exercises, they must actively select the correct Sundanese script characters or words, engaging with the material rather than simply viewing it. When

completing writing exercises, they must apply their knowledge of character formation and vocalization rules, reinforcing their understanding through active recall. The immediate feedback provided after each exercise serves multiple purposes: it confirms correct responses, corrects errors immediately, reduces the likelihood of practicing incorrect responses, and promotes self-regulated learning. The evaluation process became more enjoyable and did not cause anxiety in students. This aligns with the meaningful and enjoyable learning principles mandated in Permendikdasmen Number 1 of 2026. The integration of Wayground for quizzes added a game-like element to assessment, reducing test anxiety and increasing student motivation to perform well.

The Canva platform enabled the creation of visually appealing materials that capture student attention. The use of consistent colors, attractive illustrations, and clear layout contributes to a positive learning environment. Video links embedded in the e-module provide additional learning resources without overwhelming the primary content. The integration with Wayground for pretest and posttest assessment adds an element of fun and competition, motivating students to perform their best. Although the interactive e-module was declared highly feasible (material expert 90%, media expert 93.04%, instructional design expert 85.6%), its effectiveness was "moderate" (N-Gain 0.69). This disparity reflects the symbolic nature of Sundanese script material requiring manual writing practice that cannot be fully accommodated by Canva's digital features (lacking writing tracking features). This is a recognized limitation. Moreover, the intervention only lasted 3 meetings with 2 lesson hours each meeting (1 face-to-face, 2 online independent study), limiting optimal learning achievement considering Sundanese script has 23 basic characters (ngalagena), 7 vowel characters (swara), and 13 vocalization techniques (rarangkén). The complexity of the material and the limited intervention duration explain why the effectiveness, while significant, was moderate rather than high.

Additionally, the e-module supports the cognitive aspects of writing (character recognition, understanding of vocalization rules, correct character arrangement) but cannot fully address the psychomotor aspects of writing (developing muscle memory for stroke formation, mastering correct stroke order). Future development could address this limitation through integration with writing tracking applications or by providing more explicit guidance for manual practice. Reporting N-Gain 0.69 (moderate category) is a strength of this research, showing that although the interactive e-module is highly feasible, improving reading and writing Sundanese script skills still requires a long process and consistent practice. This finding strengthens the recommendation that interactive e-modules should be used as supplementary media, not as total replacements for teacher roles and manual practice. The moderate effectiveness score does not indicate product failure but rather reflects the realistic challenges of mastering complex symbolic material within a limited timeframe.

The integration of Borg and Gall and ADDIE models represents a methodological innovation that combines the strengths of both approaches. Borg and Gall's comprehensive validation stages ensure product quality, while ADDIE's systematic instructional design process ensures pedagogical effectiveness. The use of Canva as the development platform makes the e-module accessible and replicable by other educators, while the integration of Wayground adds interactive assessment features that enhance student engagement.



Conclusion (خاتمة)

Based on the research and development of interactive e-modules for reading and writing Sundanese script for grade VI at SDN 1 Bojongkalong, Sukabumi Regency, it can be concluded that the e-module was successfully developed through an integrated procedure combining Borg and Gall (10 stages) and ADDIE (5 phases) into four main stages: preliminary study, planning,

development, and implementation. The e-module is highly feasible for use in learning, as evidenced by expert validation (material expert 90%, media expert 93.04%, instructional design expert 85.6%) and user trials averaging 94.83%. Effectiveness testing showed significant improvement from pretest (44.83) to posttest (83.00), with N-Gain 0.69 (moderate category). The main contribution of this e-module is threefold: methodologically, it provides a replicable integrated development procedure for digital learning media; practically, it offers an accessible Canva-based supplementary resource enriched with video, audio, interactive exercises, and Wayground-based assessment; and culturally, it supports the preservation of Sundanese script literacy and local content education. The implication is that this integrated procedure can serve as an alternative model for developing digital learning media, and the e-module can be used as an innovative supplementary resource. Teachers are advised to use it alongside direct instruction, particularly for manual writing practice, while future researchers should conduct wider-scale testing with control groups to strengthen generalizability.

Implications

The integration of Borg and Gall (10 stages) and ADDIE (21 operational stages) models can be used as an alternative procedure for future researchers developing multimedia-based digital learning products. This integration demonstrates how systematic design and rigorous validation can be combined in a single development framework. This research theoretically proves that the five domains of educational technology according to Seels and Richey (design, development, utilization, management, and evaluation) are integrative and mutually supportive in developing digital learning media. The simultaneous application of the five domains is not rigidly linear but can be cyclical and flexible according to development needs. This finding contributes to the theoretical understanding of how educational technology domains interact in practice.

The finding that Canva-based e-modules with multimedia integration and interactive exercises are effective in improving learning outcomes strengthens Suwandi et al.'s (2024) theory that active student engagement through interactive elements and real-time feedback is a key factor in interactive e-module effectiveness. This supports the broader literature on multimedia learning and interactive instruction. Teachers at SDN 1 Bojongkalong and other schools can utilize this interactive e-module as an innovative learning tool that can be adapted. This study also encourages teachers to use the easy-to-use Canva platform to create similar media for other local content materials. The availability of this e-module provides a concrete example of how digital technology can be integrated into local content instruction. Grade VI students gain a more interesting, interactive, and not boring learning experience compared to lecture methods. The presence of video, audio, and exercise features with direct feedback facilitates students with visual, auditory, and kinesthetic learning styles. This addresses the diverse learning needs of students and promotes inclusive education. SDN 1 Bojongkalong now has a digital learning resource supporting the improvement of local content learning quality in Sundanese language. The existence of this e-module is also part of the school's efforts in integrating digital technology into the learning process. This supports the school's strategic goals of technology integration and cultural preservation.

Suggestions

Teachers are advised to use this interactive e-module as supplementary media in learning Sundanese script, not as a total replacement for teacher roles. Teacher guidance is still needed especially when students practice manual script writing. The e-module should complement rather than replace direct instruction, providing additional practice and reinforcement opportunities. Teachers should study the entire e-module content before use in class and ensure stable internet connection because some features (video, interactive quizzes) require online access. Advance preparation will help teachers anticipate and address any technical issues that

may arise during instruction.

Future researchers can test the effectiveness of this e-module on a wider scale, for example involving several schools in Nyalindung District or Sukabumi Regency, so research generalization is stronger. Larger-scale studies would provide more robust evidence of the e-module's effectiveness across different contexts and student populations. Further research is needed with stricter quasi-experimental design to compare the effectiveness of interactive e-modules with conventional media (printed books) with more convincing statistical evidence. Such research would provide stronger causal evidence of the e-module's superiority over traditional approaches.

It is recommended to hold training for upper-grade elementary school teachers in Sukabumi Regency on developing interactive e-modules with Canva and integrating them with quiz platforms like Wayground to increase student engagement. Such training would build teacher capacity in creating their own digital learning materials, promoting sustainable innovation in local content instruction.



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