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DEVELOPMENT OF A MULTIMODAL INTERACTIVE E-BOOK INTEGRATING THE SAS METHOD FOR GRADE ONE EARLY READING

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ABSTRACT
Early reading skills are essential for students' academic development in elementary education, particularly in first grade. However, learning activities may be constrained by limited interactive media that support systematic and engaging beginning reading practice. This study aimed to develop digital learning media based on the Structural Analytic Synthetic (SAS) method to support beginning reading instruction for first-grade elementary school students. The study employed a Design and Development (DnD) approach using the ADDIE model. The developed media integrates the structural, analytic, and synthetic stages of SAS into sequential digital reading activities, supported by multimedia resources and interactive Wordwall exercises for guided reading practice. Data were collected through needs analysis questionnaires, expert validation sheets, teacher and student response questionnaires, interviews, and observations. Validation by multimedia, materials, language, and pedagogy experts resulted in scores of 91.52%, 90.00%, 90.00%, and 84.17%, respectively, with an overall feasibility score of 88.88%, categorized as Very Feasible. Practicality testing with first-grade students in a public elementary school in Subang Regency resulted in an overall response score of 92.50%, categorized as Very Practical. These findings indicate that the developed SAS-based digital learning media is feasible and practical as a supporting medium for beginning reading instruction. However, the findings do not establish its effectiveness in improving students' reading skills.

Keywords: Early Reading; Elementary Education; Interactive Learning Media; Multimodal Interactive E-Book; SAS Method

1. Introduction

Early reading skills play an important role in supporting the development of children's subsequent literacy learning and participation in elementary education, particularly during the first grade. At this stage, reading instruction commonly involves developing students' ability to recognize written symbols, associate letters with their corresponding sounds, and combine these units into syllables, words, and simple sentences (Rahmawati & Handayani, 2023; Clay, 1991; Munthe & Sitinjak, 2018; National Reading Panel, 2000). These foundational skills are relevant to subsequent literacy development because persistent

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difficulties in early reading may create challenges for students when engaging with increasingly complex texts and literacy activities (Fauziah & Desiani, 2024; Porter et al., 2024). Recent research also indicates that early literacy development is influenced by the quality of instructional practices and teachers' knowledge of foundational reading skills, highlighting the importance of appropriate support during the early stages of reading instruction (Porter et al., 2024). Therefore, early reading instruction requires learning experiences that provide structured opportunities for students to develop foundational reading skills in ways that are appropriate to their developmental and instructional needs.

The preliminary study, involving classroom observations of 30 grade one students and an interview with the first-grade teacher at SDN Purwadadi 1, Subang Regency, identified several early reading difficulties. The observations and teacher interview indicated that a number of students had not yet fully mastered letter recognition and experienced difficulties in combining syllables into words. Difficulties were also observed when reading particular letter combinations, including *nyo*, *ngu*, *ang*, and *ing*. The teacher also reported that some students tended to forget words shortly after reading them and had difficulty maintaining concentration during reading activities. These initial findings provided an indication of the students' early reading needs and served as a basis for designing learning media that could provide structured and repeated opportunities to practice letter–sound recognition, syllable combination, and word reading. In addition, classroom reading activities relied predominantly on printed textbooks, providing limited opportunities for students to engage with varied and interactive reading resources (Lestari et al., 2021). These findings indicate the need for learning media that can provide systematic reading practice while presenting learning content in an engaging form appropriate to first-grade students.

One instructional approach that can be connected directly to these reading difficulties is the Structural Analytic Synthetic (SAS) method. The SAS method provides a systematic sequence that begins with recognizing language units as meaningful wholes, continues with analyzing them into smaller components, and then synthesizes the components back into meaningful forms (Madasari & Mulyani, 2016; Puspita, 2021). The structural stage allows students to recognize a complete word or sentence, the analytic stage guides them to identify its constituent components, such as words, syllables, and letters, and the synthetic stage provides opportunities to reconstruct these components into meaningful units (Hidayah & Novita, 2017). This sequence is relevant to the difficulties identified in the preliminary study because students who have difficulty recognizing letters and combining syllables require learning activities that gradually connect whole linguistic forms with their constituent elements. Thus, the use of SAS in this study is related to the specific reading difficulties identified among the target learners rather than being selected solely as a general reading method.

In addition to the instructional method, digital and multimedia-based learning media provide opportunities to enrich beginning reading activities. Young learners may engage more readily with learning experiences that combine visual, auditory, textual, and interactive elements because such resources provide multiple modes of representing information (Cerovac & Keane, 2025). Teachers are therefore encouraged to strengthen their digital literacy and integrate technology-based media into instructional practices (Porter et al., 2024). The integration of technology into face-to-face learning can also provide variation in learning activities, support motivation, present instructional information, and reduce the monotony of conventional learning activities (Amanullah, 2020; Handayani & Koeswanti, 2020; Sharma & Barrett, 2008; Willya et al., 2023). In beginning reading instruction,

however, digitalization needs to be accompanied by appropriate instructional sequencing so that technology functions as a learning support rather than merely as a presentation tool.

Previous studies have demonstrated growing efforts to develop digital media for early literacy learning. Janawati et al. developed an interactive e-book for the early reading-writing stage of first-grade elementary school students by incorporating text, images, sound, animation, and video. Other studies have explored digital audiobook media, interactive digital learning media, and e-flashcard media as alternatives for supporting early literacy instruction (Fachrurrozi et al., 2021; Oktavia et al., 2024a). Interactive multimedia has also been integrated with instructional models for early reading learning, indicating that technology-supported approaches have increasingly become part of literacy instruction in elementary schools (Nurmahanani et al., 2021). Recent literature has further shown that digital multimedia for beginning reading has been developed in various forms, including interactive e-books, educational games, augmented reality, and digital storytelling, with potential contributions to students' engagement, motivation, vocabulary development, and reading-related learning processes.

These studies establish the current state of digital learning media for beginning reading and show that interactive e-books and multimedia are not entirely new in elementary literacy education. Therefore, the research gap addressed in this study does not concern the absence of digital reading media. Rather, it concerns the specific integration of the complete operational sequence of the SAS method into a multimodal interactive e-book designed for first-grade beginning reading instruction. Previous studies have examined interactive e-books, multimedia, audiobooks, and digital cards as learning media, while the present study positions the SAS method as the instructional structure that organizes the reading activities within the digital medium. This distinction is important because the systematic progression from whole language units to their components and back to meaningful units corresponds directly to the reading difficulties identified in the preliminary study.

The novelty of this study lies in the instructional and functional integration of these elements into a multimodal interactive e-book. The developed product integrates the structural, analytic, and synthetic stages of SAS into sequential digital reading activities supported by textual, visual, auditory, and interactive components. Heyzine is used as the digital delivery environment that enables the learning material to be presented in an interactive e-book format, while Wordwall is incorporated as an interactive practice component that provides opportunities for students to respond to and practice the reading material. Therefore, the novelty does not lie simply in the use of Heyzine or Wordwall, but in how these digital affordances are functionally embedded within the SAS instructional sequence. The media are also developed based on the specific needs identified among first-grade students and designed to provide more varied reading experiences than conventional printed materials.

The development of the media is further aligned with the learning competencies of Indonesian language education at the elementary level. In Phase A, the "Reading and Viewing" element includes students' ability to engage with written, visual, and/or audiovisual texts, while foundational components include phonemes, letters, vocabulary, language structures, and meaning. This curricular orientation provides a relevant basis for integrating textual, visual, auditory, and interactive elements into beginning reading instruction. Accordingly, the multimodal design of the e-book is intended to support foundational reading competencies while maintaining a systematic instructional sequence based on the SAS method.

The curricular alignment also indicates the potential relevance of the developed media to Islamic primary education. The competencies in Phase A are applicable to both elementary schools (SD) and Islamic elementary schools (MI), particularly in developing foundational reading abilities. However, this study was conducted in a public elementary school in Subang Regency. Therefore, the relevance of the developed media to MI is limited to its potential adaptability to similar early reading competencies and should not be interpreted as empirical evidence of its feasibility or effectiveness in the MI context.

Based on the identified classroom needs, theoretical considerations, previous studies, and curricular demands, this study addresses the need for a learning medium that integrates a systematic reading method with multimodal digital interaction. The research problem concerns how a multimodal interactive e-book integrating the SAS method can be developed to support beginning reading instruction for first-grade elementary school students and whether the resulting product meets the criteria of feasibility and practicality. Accordingly, this study aims to develop a multimodal interactive e-book integrating the Structural Analytic Synthetic (SAS) method for first-grade beginning reading instruction and to examine its feasibility and practicality based on expert validation and user responses. The study focuses on product development, feasibility, and practicality; therefore, it does not claim the effectiveness of the developed media in improving students' reading skills.

2. Method

This study employed a Design and Development (D&D) approach, focusing on the systematic design and development of an educational product to address identified instructional needs (Richey & Klein, 2014). The development procedure adopted the ADDIE model, consisting of five stages: Analysis, Design, Development, Implementation, and Evaluation (Branch & Varank, 2009). In the Analysis stage, the researchers identified needs and problems related to early reading instruction through classroom observation, interviews with the first-grade teacher, and a needs analysis questionnaire. The analysis focused on students' early reading difficulties, learning characteristics, existing learning media, and the alignment of learning activities with Indonesian language learning objectives. The Design stage involved preparing the Media Program Outline (GBPM), content structure, storyboard, e-book format and navigation, and research instruments. The Development stage included producing the multimodal interactive e-book based on the SAS method and conducting expert validation. The Implementation stage involved a limited field trial with first-grade students and a teacher at SDN 1 Purwadadi, Subang, West Java, Indonesia. The Evaluation stage consisted of formative evaluation conducted throughout the development process to identify weaknesses and improve the product based on findings from each stage.

The research participants consisted of four expert validators, a first-grade teacher, and first-grade students at SDN 1 Purwadadi, Subang. The four validators assessed the product from the aspects of media design, material suitability, language, and pedagogical appropriateness. The limited field trial initially involved 30 first-grade students as the intended users of the developed product; however, two students did not complete the response questionnaire, resulting in 28 students included in the final analysis. The teacher and students participated as users to provide responses regarding the practicality of the developed multimodal interactive e-book. The product was designed to integrate the structural, analytic, and synthetic stages of the SAS method into sequential early reading activities. Heyzine was used as the digital delivery platform for the interactive e-book, while Wordwall was incorporated to provide interactive early reading practice.

The data collection instruments consisted of a classroom observation sheet, teacher interview guide, needs analysis questionnaire, expert validation questionnaire, teacher and

student response questionnaires, and learning activity observation sheets. The expert validation questionnaire assessed the feasibility of the product in terms of media, materials, language, and pedagogy. Meanwhile, the teacher and student response questionnaires were used to obtain information regarding the practicality of the developed product. Qualitative data obtained from expert comments, revision suggestions, interviews, and observations were analyzed descriptively and used as a basis for product improvement. Quantitative data obtained from expert validation and teacher and student response questionnaires were analyzed using descriptive percentage analysis. The percentage was calculated by comparing the obtained score with the maximum possible score and was subsequently interpreted according to the feasibility and practicality criteria used in the study. The analysis was limited to product feasibility and practicality; therefore, the study did not measure the effectiveness of the developed e-book in improving students' early reading skills.

3. Results and Discussions

3.1 Results

1. Analysis Stage

The analysis stage was conducted to identify the instructional needs and the gap between the existing conditions of early reading instruction and the expected learning outcomes (Branch & Varank, 2009). The analysis consisted of classroom observation, interviews with the first-grade teacher, needs analysis, and curriculum analysis. Classroom observations and teacher interviews were conducted at SDN 1 Purwadadi, Subang, West Java, Indonesia. The findings indicated that students' early reading abilities were heterogeneous. Some students were able to recognize and spell letters and syllables, whereas several students had not yet mastered the alphabet completely. Students also experienced difficulties in combining syllables into words and reading specific consonant combinations, including *nyo, ngu, ang,* and *ing*. During learning activities, some students had difficulty maintaining attention and tended to lose interest when activities relied primarily on printed textbooks. The teacher also reported that students sometimes forgot words they had just read and required repeated practice and varied learning stimuli. Although the school had a projector that could support technology-assisted instruction, its use for early reading instruction was limited because the teacher had limited time to prepare digital learning materials. These findings indicated the need for learning media that could provide structured, varied, and engaging early reading activities.

A needs analysis questionnaire was administered to 30 first-grade students and one first-grade teacher. The questionnaire examined three indicators: the need for digital learning media, the need for interactive features, and the need for practice activities. Responses were measured using a four-point Likert scale ranging from 1 to 4. The percentage score was calculated by comparing the total obtained score with the maximum possible score and multiplying the result by 100. The results showed that students obtained a percentage of 90.00%, while the teacher obtained 87.50%, resulting in an overall average of 88.75%. This percentage indicates a strong perceived need for digital media that provides interactive features and practice activities for early reading instruction. However, the result was interpreted as evidence of the respondents' perceived instructional needs rather than as proof that digital media was inherently the best solution. Therefore, the questionnaire findings were considered together with the classroom observation and teacher interview findings in determining the characteristics of the product to be developed.

Table 1. Results of the Early Reading Digital Media Needs Analysis

Respondent	Indicators	Percentage (%)	Interpretation
Students (n = 30)	Need for digital learning media, interactive features, and practice activities	90.00	Strongly Agree
Teacher (n = 1)	Need for digital learning media, interactive features, and practice activities	87.50	Strongly Agree
Average	Need for digital learning media, interactive features, and practice activities	88.75	Strongly Agree

The curriculum analysis was conducted to ensure that the content and learning activities in the developed media were aligned with grade one Indonesian language learning objectives. The selected content was based on Chapter 8, *Around the House*, with the theme *Exploring the Surrounding Environment*. The content includes familiar vocabulary, directions, and names of occupations related to students' everyday environment. These topics were selected because they provide meaningful linguistic contexts for early reading activities rather than presenting letters and syllables in isolation. The selected vocabulary was organized into activities involving letter recognition, syllable formation, word reading, and contextual reading. Thus, the selected content was connected to the targeted early reading competencies, particularly students' ability to recognize written language units, decode syllables and words, and read familiar vocabulary in simple contexts.

The analysis of students' difficulties also informed the selection of the Structural Analytic Synthetic (SAS) method. The difficulties identified in recognizing letters, combining syllables, and reading particular letter combinations indicated the need for a systematic progression from meaningful language units to their constituent parts and back to meaningful combinations. The SAS method provides this sequence through three interconnected stages: structural, analytic, and synthetic. In the structural stage, students encounter a meaningful whole word or sentence in context. In the analytic stage, the language unit is broken down into smaller components such as words, syllables, and letters. In the synthetic stage, these components are recombined into meaningful units. This sequence was therefore incorporated into the media to provide structured early reading practice corresponding to the difficulties identified during the analysis.

The identified instructional problems also informed the specific features of the proposed multimodal interactive e-book. The difficulty in maintaining students' attention was addressed through varied visual and interactive elements. The need for repeated reading practice was supported through audio components and sequential SAS activities. The limited variety of classroom reading materials was addressed by organizing the content into an interactive digital e-book format. Heyzine was used as the digital delivery environment for presenting the interactive e-book, while Wordwall was incorporated to provide additional interactive practice activities. Thus, the product was not developed merely by combining the SAS method with digital technology. Instead, the media features were selected based on the specific instructional problems, perceived needs, and curriculum requirements identified during the analysis stage. The findings from the observation, teacher interview, needs analysis, and curriculum analysis consequently provided the basis for designing a

multimodal interactive e-book that integrates the SAS sequence with curriculum-aligned early reading activities.

2. Design Stage

The design phase began with the preparation of a Media Program Outline (GBPM), which served as the instructional blueprint for developing the multimodal interactive e-book. The GBPM contained the selected learning materials, learning objectives, instructional sequence, SAS stages, learning activities, digital features, assessment indicators, and initial visual design. The design was developed based on the findings of the analysis stage, particularly the heterogeneous early reading abilities of first-grade students, their need for repeated and engaging practice, and the limited variety of digital learning resources available in the classroom. Therefore, the design did not only determine the appearance and format of the media but also established the relationship between the curriculum, learning objectives, SAS method, student activities, and assessment.

The learning content was organized into three chapters and an evaluation section. The sequence was designed to move from basic recognition skills toward the application of early reading skills through the SAS approach. Chapter 1 introduced the distinction between vowels and consonants as a foundation for recognizing the written language system. Chapter 2 introduced simple sentences through the Structural and Analytic stages of SAS, in which students encountered meaningful language units and then identified their constituent words, syllables, and letters. Chapter 3 continued with the Synthetic stage, in which students recombined the language units and applied them to reading simple sentences. The evaluation section provided short stories and interactive activities to allow students to practice and demonstrate the targeted competencies. The structure of the instructional content is presented in Table 2.

Table 2. Structure and Instructional Alignment of the Multimodal Interactive E-Book

Chapter	Subject	SAS Stage	Media Format	Cognitive Level (Bloom)	Learning Activity	Achievement Indicator
Chapter 1	Difference between vowels and consonants	Foundation	Illustrations, text, and audio	C1 (Remembering)	Students observe, listen to, identify, and differentiate vowels and consonants.	Students correctly identify and classify vowels and consonants presented in letters, syllables, or simple words.
Chapter 2	Sentence recognition Part I using the SAS method	Structural-Analytic	Illustrations, text, and audio	C2 (Understanding)	Students recognize meaningful sentences and analyze them into words, syllables, and letters.	Students read simple words and sentences related to familiar contexts, including directions and

Chapter	Subject	SAS Stage	Media Format	Cognitive Level (Bloom)	Learning Activity	Achievement Indicator
						professions, using the SAS sequence.
Chapter 3	Sentence recognition Part II using the SAS method	Synthetic	Illustrations, text, and audio	C3 (Applying)	Students recombine letters and syllables into words and apply the resulting words to read simple sentences.	Students apply the structural, analytic, and synthetic stages of the SAS method to read targeted syllables, words, and simple sentences.
Evaluation	Short stories and interactive games	Integrated SAS practice	Text, illustrations, audio, videos, and interactive games	C2–C3 (Understanding and Applying)	Students read short texts, answer reading questions, match pictures with vocabulary, and complete interactive challenges.	Students answer reading questions, match pictures with the correspondin g vocabulary, and complete the assigned interactive reading activities.

The learning activities in Table 2 were designed to accommodate differences in students' early reading abilities. Students who had not yet mastered letter recognition could begin with the foundational activities in Chapter 1, while students who had already acquired basic letter knowledge could proceed to syllable and word-level activities. The progression from whole language units to their component parts and back to meaningful units provided a structured learning path through the SAS method. Repeated exposure to letters, syllables, words, and sentences through visual, auditory, and interactive activities was intended to provide additional support for students who required more practice without changing the targeted learning objectives.

Based on the material structure in Table 2, a storyboard was developed as a visual blueprint specifying the sequence of pages, graphic layout, navigation, instructional prompts, and placement of multimedia and interactive components. Each digital feature was assigned a specific instructional function. Visual illustrations were used to provide concrete representations of vocabulary and support students in connecting images with written

language. Audio recordings were incorporated as pronunciation models to support students in associating written letters, syllables, and words with their corresponding sounds. The visual and interface design was developed using Canva (Gehred, 2020) and subsequently converted into an interactive HTML flipbook through Heyzine. Heyzine therefore functioned as the digital delivery environment that enabled students to navigate the learning sequence in an e-book format rather than serving merely as a presentation platform.

Wordwall was integrated to provide interactive practice following the presentation and analysis of letters, syllables, and words. The activities were designed as opportunities for students to apply the material through matching, identification, and other game-based tasks rather than simply presenting additional content. Previous research has also identified Wordwall as a platform that can support interactive formative learning activities (Pasaka et al., 2022). QR codes generated through ME-QR were embedded to provide direct access to selected supplementary digital resources through mobile devices. YouTube videos were used selectively as audiovisual stimuli related to the learning content, particularly vocabulary concerning professions and students' surrounding environment. Thus, audio, Heyzine, Wordwall, QR codes, and YouTube were integrated according to their respective instructional functions rather than included solely as technological components.

To support classroom implementation, a Learning Implementation Plan (RPP) or structured teaching module was also prepared (Tarumasely, 2022). The teaching plan specified the learning objectives, sequence of SAS activities, teacher and student activities, use of the multimodal interactive e-book, and assessment activities. The application of SAS was aligned with the developmental characteristics of early-grade students, who benefit from learning experiences that connect meaningful and concrete representations with smaller language units (Sari & Koeswanti, 2023). The design therefore positioned the digital media as a tool for implementing the instructional sequence rather than as a substitute for teacher guidance.

The learning materials were synthesized primarily from the grade one Indonesian language textbook *I Can!* (Dewayani, 2021) and supplemented with relevant literature (Farhurohman, 2017; Oktavia et al., 2024b; Syifa et al., 2024). Concrete visualizations were incorporated to facilitate students' semantic representation of the vocabulary being learned (Akbar et al., 2021; Rozi & Rahayu, 2022). Audio recordings provided pronunciation models corresponding to the SAS activities, while selected professional-themed educational videos from YouTube provided contextual audiovisual stimuli. Through this design, the curriculum content, early reading competencies, SAS stages, cognitive indicators, student activities, assessment, and digital features were systematically aligned before the product proceeded to the development and validation stage.

3. Development Stage

The development phase involved the technical realization of the storyboard into a multimodal interactive e-book based on the SAS method using Canva and Heyzine. The product, entitled *"Learning to Read with Fun: The SAS Method for Grade One Students,"* was developed by translating the instructional sequence, learning objectives, and media specifications established during the design stage into functional digital learning activities. The resulting product is presented in Figure 1.

The front cover and interface were designed using child-friendly illustrations and a natural green color combination to provide a visually appropriate entry point for first-grade students (Figure 1A). Navigation buttons were provided on the right side of the interface to facilitate movement between pages and learning sections. These visual and navigation elements were designed to reduce unnecessary operational demands so that students could

focus on the early reading activities. The first chapter focuses on recognizing vowels and consonants from A to Z (Figure 1B). Letter symbols were presented alongside illustrations of concrete nouns to help students connect written symbols with familiar objects. Audio buttons were incorporated to provide pronunciation models, allowing students to hear the sounds associated with the letters and words presented. This feature supported the recognition of written language units and provided auditory reinforcement during early reading activities.

The SAS sequence was systematically incorporated into Chapters 2 and 3 (Figures 1C and 1D). The learning materials were developed contextually using curriculum-related themes concerning professions and directions in the students' surrounding environment. In Chapter 2, students were introduced to meaningful sentences and subsequently guided to analyze them into smaller language units, including words, syllables, and letters. This activity represented the Structural and Analytic stages of the SAS method. In Chapter 3, the language units were recombined to form words and simple sentences, representing the Synthetic stage. Audio was provided throughout these activities as a pronunciation model, while illustrations supported the connection between vocabulary and its meaning. Thus, the multimedia components were integrated into the SAS sequence to support specific early reading competencies rather than functioning only as visual or auditory decoration.

The visual and interface components were developed using Canva and subsequently converted into an interactive HTML flipbook using Heyzine. Heyzine functioned primarily as the digital delivery environment, providing page navigation and access to the embedded and linked learning components. The interactive nature of the product was not limited to page-turning. Students were also required to interact with selected learning components by listening to audio, following the sequential SAS activities, identifying language units, and completing practice activities. In response to the media expert's feedback, the user interface and user experience (UI/UX) were refined to make the media easier to operate. Several navigation and access features were added or adjusted to facilitate movement between learning sections and to support more convenient use by first-grade students and teachers. Thus, the UI/UX revisions focused on improving the accessibility and usability of the product rather than merely its visual appearance.

Wordwall was integrated into the final learning section as an interactive practice and formative assessment component. At this stage, students encountered a short contextual story entitled *"Pak Tani di Sawah"* (*Farmer in the Rice Field*) and completed activities related to the vocabulary and language units presented in the preceding SAS activities (Figures 1E and 1F). The Wordwall activities included crossword puzzles, word completion, and profession-picture matching. These activities were designed to provide opportunities for students to practice identifying and applying letters, syllables, and familiar words. The students' responses in these activities served as formative information about their performance during the learning process; they were not interpreted as evidence of an increase in reading comprehension because the study did not employ an effectiveness test.

The learning content was also revised based on feedback from the material and pedagogical experts. The material expert emphasized that the content should be adapted to the characteristics and developmental level of first-grade elementary school students. Accordingly, the presentation of learning materials was reviewed to ensure that the vocabulary, examples, activities, and level of difficulty were appropriate for early learners. The material expert also recommended improving the use of Indonesian and reducing typographical errors. These suggestions were addressed by reviewing the wording of the content, correcting language errors and typographical mistakes, and refining the presentation

so that the instructions and examples were clearer and more appropriate for first-grade students. The pedagogical expert similarly recommended revising several parts of the learning material to better reflect first-grade students' characteristics and adjusting several steps in the lesson plan (RPP) to ensure consistency between the instructional procedures and the developed media. These revisions strengthened the alignment among the learning content, student characteristics, SAS activities, and instructional procedures.

The language expert recommended that the product be further developed. This feedback was considered in conjunction with the other validation results during the refinement process. The language aspects of the product were therefore reviewed alongside the material and pedagogical revisions, particularly in relation to the accuracy, clarity, and appropriateness of Indonesian language use. The revision process was completed before the limited field implementation so that the product tested with the teacher and students represented the revised version.

QR codes generated using ME-QR were incorporated to facilitate access to selected supplementary digital resources through mobile devices. YouTube was used selectively to provide audiovisual material related to the learning content, particularly vocabulary concerning professions and the students' surrounding environment. The audio, Wordwall activities, QR codes, and YouTube resources were therefore positioned as supporting components within the instructional sequence. Their inclusion was based on specific learning functions: audio for pronunciation modeling, Wordwall for interactive practice and formative checking, QR codes for convenient access to supplementary resources, and YouTube for contextual audiovisual stimulation.

The final expert validation results showed that the media aspect obtained a score of 91.52%, the material aspect 90.00%, the language aspect 90.00%, and the pedagogical aspect 84.17%, with an overall feasibility score of 88.88%. These results indicated that the product met the established feasibility criteria. The validation findings were used not only to determine the feasibility category but also to guide formative improvements to the product before its limited field implementation.

Overall, the developed product can be characterized as a multimodal interactive e-book in which digital features were functionally connected to the SAS instructional sequence. The product combined contextual text and illustrations with pronunciation audio, interactive practice, and selected supplementary audiovisual resources. Consequently, its interactivity extended beyond the basic page-turning function of a digital flipbook because students were required to engage with instructional content and respond to learning activities at several points in the sequence. The development results demonstrate the feasibility and design characteristics of the product rather than its effectiveness in improving students' early reading skills



Figure 1. Characteristics of Multimodal Media Components Based on the SAS Method (A–F)

4. Implementation Stage

The implementation stage was conducted after the multimodal interactive e-book based on the SAS (Structural Analytic Synthetic) method had been assessed as theoretically feasible by the expert validators. The limited field trial was conducted through two classical classroom meetings in grade one at SDN Purwadadi 1, Subang Regency, West Java, Indonesia. The implementation involved 28 students and the first-grade classroom teacher, Mrs. Andi Amilinda, S.Pd. The media was used with the support of the school projector and loudspeakers. This stage aimed to examine the operational practicality of the media in an authentic classroom setting and to obtain information about students' and teachers' responses during its use. Practicality data were collected through teacher and student response questionnaires, while additional information regarding classroom use was obtained through teacher interviews and observations during the implementation.

During the two meetings, the teacher used the multimodal interactive e-book as part of the early reading learning activities. The learning activities followed the SAS sequence developed in the media. Students were first introduced to language units through contextual visual materials and audio pronunciation features. The audio buttons allowed students to listen to the pronunciation of letters and words presented in the e-book, while the illustrations provided visual support for connecting the language units with familiar objects and contexts. The teacher guided students in following the sequence of activities and provided additional assistance when necessary. The use of the projector and loudspeakers enabled the digital content, including visual, auditory, and interactive components, to be presented to the class simultaneously.

The SAS activities in Chapters 2 and 3 were implemented progressively. Students were guided from the recognition of meaningful language forms toward the identification of smaller units, including words, syllables, and letters, before recombining these units into

words and simple sentences. The teacher used the audio pronunciation features during these activities to provide auditory models and repeated practice. At the evaluation stage, students participated in the contextual reading activity and completed Wordwall-based interactive games, including word completion, crossword activities, and profession-picture matching. These activities provided opportunities for students to respond directly to the learning content and practice the language units introduced through the SAS sequence.

Classroom observations and teacher interviews provided additional information beyond the quantitative questionnaire results. The observations focused on how students participated in the learning activities, followed the media sequence, interacted with the audio and game features, and responded to teacher guidance. The teacher reported that the presentation of the SAS material was systematic and that the combination of audio pronunciation and Wordwall games supported students' independence during learning activities. At the same time, the teacher identified a classroom-management challenge: the students' high enthusiasm during the interactive activities sometimes made classroom management more challenging. This finding indicates that the interactive features encouraged active participation, while teacher guidance and classroom management remained necessary during their use.

The implementation also revealed several technical and visual considerations. The use of Heyzine and Wordwall required stable internet access, and the teacher reported that internet stability was one of the operational challenges during classroom use. This dependency is important because interruptions in connectivity may affect access to interactive components and external resources. From the students' responses, the media was considered helpful for supporting letter pronunciation. However, students also provided input to slightly increase the text size in several visual sections. This feedback was considered in the final refinement of the product, particularly to improve text readability for first-grade students. The practicality questionnaire results are presented in Table 3.

Table 3. Summary of User Practicality Responses

No.	Respondent Group	Actual / Maximum Score	Percentage	Category
1	First-Grade Teacher	94 / 100	95.00%	Very Practical
2	Grade One Students (28 students)	36 / 40 (Average)	90.00%	Very Practical
	Combined Average	–	92.50%	Very Practical

Table 3 shows that the combined practicality score was 92.50%, categorized as Very Practical according to the criteria applied in the study. The teacher response reached 95.00%, while the average student response reached 90.00%. These results indicate a very positive user perception of the practicality of the developed media. The questionnaire results were interpreted as evidence of user-perceived practicality and acceptability, rather than as evidence of improved reading achievement or motivation.

The qualitative findings from classroom observation and teacher interviews complemented the questionnaire results by showing how the media functioned during actual classroom use. The teacher's assessment of the systematic SAS presentation and the supporting role of audio and Wordwall provided evidence concerning instructional usability, while the reported internet instability and classroom-management challenge identified

practical limitations. The students' feedback concerning pronunciation support and text size provided additional information about accessibility and readability. These findings were used as part of the final quality-control process, particularly in considering improvements to text readability and the usability of the media.

Overall, the implementation demonstrated that the multimodal interactive e-book could be operated in a classical first-grade classroom using a projector and loudspeakers and received very practical responses from both the teacher and students. The findings also showed that the media supported students' interaction with audio, visual, SAS-based, and game-based activities. Nevertheless, the results should be interpreted within the scope of a limited implementation trial. The 92.50% score represents perceived practicality, while the observations and interviews provide descriptive evidence of classroom interaction and operational issues. These findings do not establish the effectiveness of the media in improving students' early reading skills or motivation.

5. Evaluation Stage

The evaluation phase represents the final stage of the ADDIE model and was conducted to assess the overall quality of the developed multimodal interactive e-book based on the SAS method. The evaluation focused on product feasibility, practicality, observed user engagement, technical usability, and potential for further development. Formative evaluation was conducted throughout the development process through expert assessment and user feedback, while the final evaluation considered the results obtained after the limited classroom trial. The evidence consisted of quantitative scores from expert validation and teacher and student response questionnaires, as well as qualitative information from expert suggestions, classroom observations, and teacher interviews. Since the study did not employ a pre-test–post-test design, a control group, or inferential statistical analysis, the evaluation did not establish the effectiveness of the media in improving students' early reading skills or motivation.

The feasibility evaluation was based on assessments from four experts covering media design, materials, language, and pedagogy. The media design aspect obtained 91.52%, materials 90.00%, language 90.00%, and pedagogy 84.17%, resulting in an overall feasibility score of 88.88%. These results met the established feasibility criteria. The qualitative feedback from the experts was also used as part of the quality-control process. The media expert recommended improvements to the UI/UX and the addition of features that would facilitate media operation. The material expert recommended adapting the content to the characteristics of first-grade students, improving the use of Indonesian, and reducing typographical errors. The language expert recommended further development of the language component, while the pedagogical expert recommended revising several materials to better suit first-grade characteristics and adjusting several steps in the lesson plan (RPP). These recommendations were incorporated into the product before the classroom trial.

Practicality was evaluated through teacher and student responses after the two-meeting limited field trial. The first-grade teacher gave a response score of 95.00%, while the average student response was 90.00%, resulting in a combined practicality score of 92.50%, categorized as Very Practical. The teacher reported that the presentation of the SAS material was systematic and that the combination of pronunciation audio and Wordwall activities supported students during the learning process. Students also reported that the media was helpful for practicing letter pronunciation. These findings provide evidence of positive user perceptions regarding the practicality and usability of the product. They should not, however,

be interpreted as evidence of improved learning outcomes or statistically significant changes in motivation.

The qualitative evaluation further identified several strengths and limitations during actual classroom use. The main strengths of the product were its systematic SAS-based material structure, visual presentation, and integration of multimodal components, particularly pronunciation audio and Wordwall activities. These strengths were supported by the expert feasibility score of 88.88%, the very practical combined user response of 92.50%, and the teacher's feedback regarding the systematic presentation of the SAS sequence. Classroom observations also indicated that students interacted with the audio and game-based components during learning activities. However, these observations represent engagement with the product and do not establish increased reading motivation.

Several weaknesses were also identified from the implementation and user feedback. The product depended on internet connectivity for access to Heyzine and Wordwall, making network stability an important technical consideration. Students also suggested that the font size in several visual sections be increased to improve readability for early-grade learners. In addition, the evaluation activities required further consideration so that their difficulty level could be better adapted to the diverse early reading abilities of first-grade students. These findings provided concrete evidence for further refinement of the product rather than being treated as general limitations.

The implementation also revealed challenges related to classroom use. The teacher reported that students' high enthusiasm during interactive activities sometimes made classroom management more challenging. This finding indicates that interactive digital features can encourage active participation but may also require appropriate teacher guidance and classroom management strategies. In addition, differences in school infrastructure, particularly internet stability and access to digital devices, may influence the consistency with which the product can be used. These factors were therefore considered as technical and contextual constraints rather than as weaknesses in the instructional concept itself.

The evaluation findings also identified opportunities for the continued development and broader application of the product. The SAS-based structure and multimodal format provide opportunities for adaptation to other early reading topics, themes, and grade levels. Future development may also include a printed user guide to assist teachers in operating and integrating the media into classroom instruction. In addition, the product could potentially be adapted for use with parental guidance in home learning contexts. The possibility of adapting the media for Madrasah Ibtidaiyah is also relevant to the broader context of basic Islamic education; however, such adaptation and its outcomes were not empirically examined in the present study.

Based on these findings, the SWOT analysis was used as a complementary framework to synthesize the results of the evaluation rather than as an independent measure of product quality. The strengths were linked to the systematic SAS structure, multimodal integration, and positive expert and user responses. The weaknesses were linked to font-size readability, the need to adapt evaluation difficulty to students' diverse abilities, and dependence on internet connectivity. The opportunities were derived from the potential to develop the media for other topics and grade levels, provide a printed user guide, and explore teacher- or parent-guided use beyond the classroom. The threats were associated with technical infrastructure limitations, particularly unstable internet access, and the need for teachers to manage highly interactive classroom activities.

Overall, the evaluation process provided evidence that the developed multimodal interactive e-book met the established feasibility criteria and was perceived as very practical by its intended users. The combination of expert validation, user responses, classroom observations, and teacher feedback enabled the researchers to identify both the strengths and limitations of the product and to determine areas for further refinement. The findings support conclusions regarding feasibility, practicality, and observed engagement with the media, but they do not demonstrate its effectiveness in improving early reading skills or motivation. Further research using an effectiveness-oriented research design is needed to examine learning outcomes and changes in reading motivation.

3.2 Discussion

1. Digital Learning Media Planning Based on the SAS Method

The planning of the developed digital learning media was guided by the need to translate the Structural Analytic Synthetic (SAS) method into a multimodal digital learning environment for grade one early reading. Rather than treating digital technology as a replacement for conventional materials, the design positioned technology as a means of representing and practicing the instructional sequence of SAS. This distinction is important because previous research has shown that technology-delivered literacy instruction can support elementary students' literacy outcomes, but the effects vary across instructional approaches and conditions. A recent meta-analysis of 53 experimental and quasi-experimental studies reported a small positive overall effect of technology-delivered literacy instruction for elementary students, while emphasizing that further research is needed to determine which approaches work for particular learners and under which conditions (Dahl-Leonard et al., 2024).

The pedagogical rationale for the present design therefore lies in the alignment between the SAS sequence and the developmental demands of early reading. SAS begins with meaningful language units, proceeds to their analysis into smaller units, and then reconstructs those units into meaningful forms. In the developed media, visual representations were used to establish concrete meaning, pronunciation audio provided an auditory model, and digital activities provided opportunities to practice the transformation of language units. The sequence was consequently intended to provide multiple representations while maintaining a consistent instructional structure. This is particularly relevant for early-grade learners because early reading involves coordination between visual recognition of written symbols, spoken language, and meaningful language units.

The integration of multimodal features also needs to be understood critically. Previous research on children's interactive reading applications indicates that multimedia features such as illustrations and audio can support emergent literacy, but interactive functions can also become distracting when they are not closely connected to the reading content. The review by Chuang and Jamiat (2023), based on 50 studies, specifically emphasizes that the pedagogical value of interactive reading applications depends on how multimedia and interactive features are combined and related to the content. The present design responds to this consideration by assigning different functions to the digital components: visual elements support representation and recognition, audio supports pronunciation modeling, the SAS sequence structures the learning progression, and Wordwall provides practice after students have interacted with the target language material.

Accordingly, the contribution of the planning stage is not simply the use of several digital applications. The contribution is the attempt to organize those applications within an established early reading method. This distinguishes the present design from a digital book

that primarily reproduces printed pages in electronic form. The design provides a pedagogical structure for the use of digital affordances while retaining the instructional logic of SAS.

2. Characteristics of the SAS-Based Multimodal Interactive E-Book

The developed product demonstrates that an SAS-based early reading sequence can be translated into a multimodal interactive e-book. Its characteristics are reflected in the relationship among the instructional content, visual representation, audio pronunciation, digital navigation, and interactive practice. Rather than interpreting these characteristics as independent features, their significance lies in how they support different stages of the learning sequence.

The visual and auditory components are particularly relevant to the early reading context. Visual representations can provide concrete referents for vocabulary and letters, while pronunciation audio allows learners to hear a model while attending to written forms. This combination is consistent with research showing that multimedia features can contribute to children's emergent literacy when they are meaningfully integrated into reading activities. Chuang and Jamiat (2023) found that multimedia features in interactive reading applications were associated with positive emergent literacy outcomes, while also cautioning that excessive or poorly integrated interactivity can create attentional demands for young learners.

The role of Wordwall should similarly be interpreted as an opportunity for guided practice rather than as evidence of improved motivation or achievement. In the present product, the interactive activities were positioned after the presentation and analysis of the reading material. This placement gives the game-based component an instructional function: students respond to vocabulary and language units that have already been introduced through the SAS sequence. Such positioning is important because the literature suggests that games and interactive functions are more pedagogically defensible when they are connected to the content being learned rather than functioning solely as entertainment.

The findings therefore suggest that the product's distinctive characteristic is the functional integration of its components. Heyzine serves as the digital delivery environment, audio provides pronunciation support, visual elements provide contextual representation, and Wordwall provides interactive practice. The platforms themselves should not be interpreted as the source of learning gains. Instead, their contribution depends on how they are incorporated into the instructional design. This interpretation is consistent with broader evidence that technology-based literacy instruction can support elementary literacy but that its effects depend on instructional characteristics and implementation conditions (Dahl-Leonard et al., 2024).

3. Feasibility of the SAS-Based Digital Learning Media

The expert validation results provide evidence concerning the feasibility of the product rather than its effectiveness. The overall score of 88.88% indicates that the product met the established feasibility criteria across media, material, language, and pedagogical aspects. The increase in the media expert score from 65.91% to 91.52% and the material expert score from 76.25% to 90.00% is particularly informative because it demonstrates the role of formative expert feedback in improving the product before implementation.

The changes between validation stages indicate that feasibility was not treated as a single numerical judgment. Instead, the validation process functioned as quality control. Revisions to navigation, audio quality, accessibility guidance, sentence complexity, text readability, and the selection of familiar professions demonstrate that technical and instructional considerations were addressed simultaneously. The pedagogical validation

score of 84.17% further indicates that alignment between the media, learning activities, and lesson plan required attention. Thus, the final score should be interpreted together with the qualitative revisions rather than as evidence that the product was intrinsically superior to other media.

This interpretation is consistent with recent evidence on technology-based literacy instruction. Dahl-Leonard et al. (2024) found a small positive overall effect of technology-delivered literacy instruction across 53 studies but did not identify a single set of characteristics that could explain which technology-based approaches were most effective under all conditions. Therefore, the present validation findings are more appropriately understood as evidence that the particular product design satisfied the study's feasibility criteria, while its instructional effectiveness requires separate empirical testing.

4. User Response and Classroom Use

The teacher and student responses provide evidence primarily concerning practicality and user perception. The combined response of 92.50%, consisting of a 95.00% teacher response and a 90.00% average student response, indicates that the product was perceived as practical during the limited classroom implementation. The teacher's observation that the SAS material was presented systematically and that audio and Wordwall supported classroom activities further illustrates how the product functioned in actual use.

The classroom observations also showed that students interacted with the multimodal components, including pronunciation audio and interactive activities. These observations can be interpreted as evidence of engagement with the media, but they should not be equated with increased motivation. Engagement refers here to observable participation and interaction with the learning activities, whereas motivation is a psychological construct that requires specific measurement. Similarly, practicality indicates that users perceived the product as usable under the conditions of the trial; it does not establish that the product improved early reading outcomes.

This distinction is important when the findings are compared with previous research. The systematic review by Chuang and Jamiat (2023) found that interactive reading applications can support emergent literacy, but it also highlighted the possibility that interactive functions may distract young learners when they are poorly integrated. The high practicality response in the present study therefore provides evidence that the particular combination of features was acceptable to the users in the study context, while the limited implementation does not establish whether the same design would produce comparable outcomes across different schools or learner populations.

The teacher's report concerning classroom management also provides an important qualification. Students' enthusiasm during interactive activities required additional teacher guidance, indicating that interactivity may increase the need for classroom facilitation. Likewise, dependence on internet connectivity represents an implementation condition that may affect the consistency of access to Heyzine and Wordwall. These findings reinforce the view that the value of educational technology is shaped not only by the digital features themselves but also by classroom conditions and teacher facilitation.

5. Contribution of the Present Study Compared with Previous Research

The present study contributes to the existing literature in a more specific way than simply demonstrating that digital media can be used for early reading. Previous research has examined technology-delivered literacy instruction across a broad range of literacy skills and technological formats. The meta-analysis by Dahl-Leonard et al. (2024), for example, included 53 studies addressing literacy domains such as phonological awareness, phonics, word reading, fluency, vocabulary, comprehension, and writing. Research on interactive

reading applications has likewise examined a range of multimedia and interactive functions for emergent literacy.

In contrast, the present product was designed around a specific instructional method, namely SAS, and targeted grade one early reading. Its contribution therefore lies in demonstrating a design pathway for connecting the stages of SAS with multimodal digital affordances. The visual, auditory, and interactive components were not treated as separate innovations; they were organized around a pedagogical sequence that moves learners from meaningful language units to their constituent elements and back to meaningful forms.

This distinction also defines the scope of the study's contribution. The findings do not demonstrate that the product is more effective than printed textbooks, other interactive e-books, or other digital reading applications. Nor do they establish that the product significantly increases motivation or early reading achievement. Rather, the study provides evidence that the developed design was considered feasible by experts and practical by its intended users, while classroom observations indicated interaction with its multimodal components. These findings provide a basis for subsequent effectiveness research.

6. Implications and Limitations

The findings have several implications for the development of digital media for early reading. First, the instructional method should remain the organizing principle when digital features are selected. Second, multimodal elements should be assigned specific instructional functions rather than being included solely to increase visual or interactive appeal. Third, interactive activities should remain closely connected to the language material and should be accompanied by teacher guidance, particularly in early-grade classrooms. These implications are consistent with the systematic review evidence that the pedagogical value of children's interactive reading applications depends on the integration of multimedia and interactive functions with reading content.

The study also has several limitations that should guide interpretation. The implementation involved a limited number of students in a single school and did not employ a comparison group or pre-test–post-test measurement. Consequently, the study cannot determine whether the media improved students' early reading skills, increased reading motivation, or produced effects greater than those of other instructional media. The findings concerning feasibility, practicality, and observed engagement should therefore be distinguished from evidence of effectiveness.

Future research can extend this work by examining the product with larger and more diverse samples and by using an effectiveness-oriented design. Measures of specific early reading outcomes, such as letter–sound knowledge, syllable decoding, word reading, or reading fluency, could be combined with validated measures of motivation or engagement. Such research would allow the contribution of the SAS-based multimodal design to be examined beyond feasibility and practicality and would provide stronger evidence regarding its effects on early reading development.

Overall, the present study contributes a feasible and practical design for integrating the SAS method into a multimodal interactive e-book for grade one early reading. Its principal contribution is therefore pedagogical and design-oriented: it demonstrates how an established early reading sequence can be structured within a digital environment while maintaining distinct functions for visual, auditory, and interactive components. The findings provide a foundation for further effectiveness research rather than evidence of causal improvement in early reading skills or motivation.

4. Conclusions

This research developed a multimodal interactive e-book, "Learning to Read with Fun: SAS Method for Grade One Students," using the ADDIE model to support early reading instruction for grade one students. The findings indicate that the developed media achieved a feasibility score of 88.88% based on validation by media, material, language, and pedagogical experts, indicating that the product was very feasible for instructional use. Field implementation with grade one students at SDN Purwadadi 1, Subang Regency, also showed a very practical user response, with a combined teacher and student score of 92.50%. These findings suggest that the media provides a practical resource for organizing early reading activities through the structured SAS approach and multimodal learning experiences. Its contribution lies in integrating the SAS instructional sequence with interactive digital learning features in a single resource for grade one early reading instruction. However, the trial involved one teacher and 28 students in a single school and did not measure changes in reading ability, motivation, or instructional effectiveness. Therefore, further research with larger and more diverse samples and outcome-based measures is needed to examine its effectiveness and broader applicability.

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