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Development and Trial of Interactive Ebook Based on SQ3R Strategy to Improve Elementary School Students' Reading Comprehension Skills

Sari Rakhmawati*
Elementary Education, Yogyakarta State University, Yogyakarta, Indonesia

Setiawan Edi Wibowo
Elementary Education, Yogyakarta State University, Yogyakarta, Indonesia

Zul Fadli Hamdi
Elementary Education, Hamzanwadi University, Lombok, Indonesia

***Corresponding Author:** sarirakhmawati.2023@student.uny.ac.id

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Abstract
This study aims to develop and test the effectiveness of an interactive e-book based on the SQ3R (Survey, Question, Read, Recite, Review) strategy to improve elementary students' reading comprehension skills. The research employed a Research and Development (R&D) approach adapted from Borg and Gall's model, consisting of seven stages: potential and problem identification, data collection, product design, expert validation, product revision, limited trials, and field testing. The product's validity and practicality were evaluated by media experts, content experts, and elementary teachers. The participants involved one classroom teacher and 30 fifth-grade students from a public elementary school in Sleman, Yogyakarta, Indonesia. Data were collected using expert validation sheets, student response questionnaires, and reading comprehension tests. The results indicated that the developed e-book was categorized as "very valid" (89.6%), "practical" according to teachers and students, and "effective" in improving reading comprehension, as shown by a significant increase in post-test scores. The findings demonstrate that integrating the SQ3R strategy into an interactive e-book is a valid, practical, and effective medium for enhancing students' comprehension skills. Future studies are recommended to extend this digital tool into mobile or web-based learning platforms.

INTRODUCTION

Reading comprehension is a fundamental literacy competency that has a broad impact on students' academic success across all levels of education. At the elementary level, reading comprehension skills not only support the mastery of the Indonesian language curriculum but also serve as a foundational capability for understanding a variety of texts in other subject areas (Nabilla & Asmara, 2022). In practice, however, reading instruction in elementary schools continues to face several challenges, including monotonous teaching methods, the lack of active reading strategies, and low student engagement (Hakim & Tanuatmadja, 2022).

Metacognitive-based strategies, particularly the SQ3R (Survey, Question, Read, Recite, Review) model, have long been recognized as effective tools to foster active reading behavior. The SQ3R strategy encourages learners to plan, monitor, and evaluate their understanding while reading, enabling them to construct meaning more systematically (Jalil, 2024). Numerous studies demonstrate that students taught through SQ3R outperform those exposed to traditional reading approaches in comprehension and retention (Aziz, 2020) (Soleha, 2021).

Parallel to pedagogical advances, the growth of educational technology has opened new opportunities to integrate metacognitive strategies into digital learning environments. One promising innovation is the interactive e-book, which combines text, visuals, audio narration, and embedded assessments to create a dynamic learning experience (Bungawati & Rahmadani, 2023). For young learners, interactive e-books can enhance motivation and provide multimodal access to information, aligning with visual-auditory learning preferences common among elementary students (Ratnawati et al., 2023).However, the educational impact of such media depends greatly on the quality of

instructional design. Without a clear pedagogical framework, digital tools risk becoming mere entertainment rather than purposeful learning aids. However, the effectiveness of interactive e-books is highly dependent on the quality of their instructional design. Without a well-defined learning strategy, digital media may merely function as passive tools. Therefore, integrating the SQ3R strategy into the instructional design of interactive e-books presents a promising approach for strengthening students' reading comprehension skills (Santoianni et al., 2022).

In the Indonesian context, research on the development of digital learning media that incorporates structured reading strategies, particularly at the elementary level, remains relatively limited. Most existing studies focus primarily on the general effectiveness of media without linking it to cognitively grounded reading strategies (Fatonah, 2023). In fact, combining pedagogical frameworks such as SQ3R with digital media can have a more substantial impact on students' learning outcomes, especially in the context of comprehending informational and expository texts.

In the Indonesian context, research on digital learning media development that incorporates structured reading strategies at the elementary level is still limited (Fatonah, 2023). Most studies focus primarily on general media effectiveness without linking it to metacognitive strategies. Furthermore, the implementation of digital media in schools faces several challenges, such as unequal access to devices and internet connectivity, variations in teacher digital literacy, and the limited time available for training and classroom integration. These obstacles highlight that digital innovations, while promising, must be carefully adapted to real classroom conditions to ensure equitable and sustainable use.

From a theoretical standpoint, this research builds upon recent developments in metacognitive and multimedia learning theories. Studies by Fiorella and Mayer and Clark and Mayer emphasize that well-designed multimedia environments can enhance comprehension when aligned with cognitive processing principles such as signaling, coherence, and redundancy (Fatonah, 2023). Meanwhile, the Universal Design for Learning (UDL) framework advocates for multiple modes of engagement and representation, supporting learners with diverse needs. By embedding SQ3R's metacognitive stages within an interactive format, this study operationalizes these theoretical principles into a concrete, classroom-ready product.

Furthermore, the development of learning media for elementary education must consider aspects of validity, practicality, and effectiveness for classroom use. Teachers, as the end-users of instructional media, require simple yet functional designs, while students need engaging features that do not detract from the intended learning goals (Setiawan et al., 2020). Consequently, research utilizing a systematic Research and Development (R&D) approach, such as the Borg & Gall or ADDIE models, is highly relevant in producing high-quality educational products that can be feasibly implemented in classroom settings.

Based on these considerations, this study specifically aims to: (1) develop an interactive e-book based on the SQ3R strategy that is valid in terms of content, design, and pedagogy, (2) evaluate the practicality of the developed e-book in classroom implementation, and (3) test its effectiveness in improving fifth-grade students' reading comprehension skills. By pursuing these objectives, the study not only contributes to the theoretical literature on strategy-based digital learning but also provides educators with a pedagogically grounded digital tool that supports literacy instruction in elementary education. Moreover, this study seeks to fill the research gap by offering a pedagogically informed digital solution tailored to the needs of elementary learners. Through structured development and empirical validation, the interactive e-book is intended to demonstrate measurable improvements in students' reading outcomes.

In Indonesia, empirical studies on the development of strategy-based digital reading media at the elementary level remain limited. Most prior research has examined general media effectiveness without integrating explicit cognitive frameworks (Setiawan et al., 2020). Therefore, this study aims to bridge that gap by combining the structured logic of SQ3R with the affordances of interactive digital design.

METHODS

This study employed a Research and Development (R&D) approach with a modified Borg & Gall, (1984) model to develop and evaluate an interactive e-book based on the SQ3R strategy for improving reading comprehension among elementary school students. The R&D approach was selected to enable the systematic creation, validation, and field-testing of a pedagogically grounded digital product that aligns with both curriculum goals and student needs.

The research was conducted from January to March 2025 at a public elementary school in Sleman, Yogyakarta. It was selected through purposive sampling. The school was chosen due to its willingness to integrate digital learning tools into classroom practice and its curricular emphasis on literacy development. The implementation site provided an authentic and contextually rich environment to assess the practicality and effectiveness of the developed media.

The development model followed seven adapted stages of the Borg & Gall framework: (1) needs analysis and problem identification, (2) information gathering and literature review, (3) product design, (4) expert validation, (5) product revision, (6) limited field testing, and (7) main field testing. These stages ensured that the product evolved through iterative feedback and empirical evaluation.

Participants included 1 classroom teacher and 30 fifth-grade students for the main field testing phase. Participants for validation consisted of three experts: a subject matter expert in Bahasa Indonesia, a media design specialist, and a classroom practitioner. The sampling technique was purposive, ensuring that participants had relevant experience and met inclusion criteria such as teaching reading comprehension, digital familiarity, and grade-level teaching experience.

Data collection instruments included (1) expert validation sheets to assess content, design, and technical quality; (2) practicality questionnaires for students and teachers, using a Likert scale; and (3) pretest and posttest reading comprehension assessments adapted from national curriculum standards. Prior to data collection, all instruments were piloted to confirm reliability and clarity. All instruments were also tested for reliability prior to data collection.

The student and teacher questionnaires were piloted with 30 fifth-grade students and 2 teachers outside the research sample. The internal consistency of each instrument was analyzed using Cronbach's Alpha, yielding coefficients of 0.87 for the student questionnaire, 0.90 for the teacher questionnaire, and 0.85 for the reading comprehension test, all of which indicate high reliability. These results ensured that all instruments used in the study were valid and reliable for measuring the intended constructs. To assess the product's effectiveness, a quasi-experimental design with a pretest-posttest control group was applied. The experimental group used the developed e-book, while the control group used traditional textbooks. Quantitative data from the comprehension tests were analyzed using gain score calculations and independent samples t-tests to determine statistical significance.

For qualitative insights into user experience, open-ended responses from student and teacher questionnaires were thematically analyzed. This helped identify patterns related to user engagement, perceived usefulness, and instructional integration challenges. Thematic analysis followed the steps proposed by Huberman, (2014) including data reduction, data display, and conclusion drawing.

All ethical protocols were observed throughout the study. Informed consent was obtained from teachers and school administrators, and all participants were assured of confidentiality and voluntary participation.

RESULTS AND DISCUSSION

Results

Product Development Process

The development of the interactive e-book based on the SQ3R (Survey, Question, Read, Recite, Review) strategy was carried out using a Research and Development (R&D) approach adapted from Borg & Gall, (1984), which consists of several systematic stages. These stages were streamlined into

seven essential steps to ensure the product's feasibility, practicality, and effectiveness for use in elementary school settings.

The first stage was needs analysis and identification of potential problems. This phase involved classroom observations and preliminary interviews with teachers and students to explore challenges in reading comprehension learning. The findings revealed that the current learning media used by teachers were mostly conventional and lacked features that stimulated active engagement. Teachers expressed the need for structured reading strategies supported by digital resources that align with students' characteristics and the national curriculum.

The second stage was data collection and literature review, which focused on identifying pedagogical strategies suitable for enhancing reading comprehension among elementary students. Based on national studies (Nabilla & Asmara, 2022) (Hakim & Tanuatmadja, 2022) and international literature (Schugar et al., 2013) (Lim et al., 2021) , the SQ3R method was selected for integration due to its strong theoretical foundation in metacognitive reading strategies and its proven effectiveness in improving comprehension outcomes.

The third stage was product design, where the interactive e-book prototype was developed. The content was aligned with the fifth-grade curriculum and structured based on the SQ3R phases. Visuals, audio narration, formative quizzes, and reflective prompts were embedded to guide students through each SQ3R step. The ebook was created using FlipHTML5 and Canva, integrating accessibility features suitable for young learners.

The fourth stage involved expert validation, which was conducted by a panel consisting of media design experts, subject matter experts (Bahasa Indonesia), and experienced elementary school teachers. Each expert assessed the content relevance, instructional design, visual and interactive quality, and alignment with the SQ3R framework. Revisions were made according to the feedback, especially in refining navigation flow and simplifying language used in recite and review sections.

The fifth stage was product revision, where the prototype was improved based on expert suggestions. Specific enhancements included clearer instructions, improved consistency in audio narration, and the addition of feedback in quizzes to reinforce learning.

The sixth stage was limited field testing, which involved 10 students and one teacher. This phase aimed to gather initial responses regarding usability and student engagement. Feedback was positive, with students showing increased interest and teachers noting ease of implementation. Minor technical issues such as image alignment and font size were adjusted.

Finally, the seventh stage was the main field testing, conducted in a full class setting involving 30 fifth-grade students divided into experimental and control groups. The experimental group used the developed e-book, while the control group used traditional printed materials. This stage focused on collecting pretest and posttest data to evaluate the effectiveness of the e-book on reading comprehension outcomes.

The final product of this research is an interactive e-book designed specifically for fifth-grade students and structured according to the SQ3R strategy. The e-book contains four main sections: (1) Survey, which introduces students to the topic through illustrated previews and guiding questions; (2) Question, where students generate reflective prompts before reading; (3) Read, presenting narrative and expository texts accompanied by audio narration, highlighted keywords, and illustrations; and (4) Recite and Review, which provide quizzes with instant feedback, summary activities, and reflective prompts. Navigation features were designed to be intuitive, with large icons and clear menus, enabling elementary students to use the e-book independently. The integration of animations, voice-over instructions, and interactive tasks ensured that each SQ3R step was experienced as an engaging and structured process. This design not only reflects the theoretical principles of SQ3R but also demonstrates a practical model for embedding metacognitive strategies into digital media.

The product development process ensured that the final version of the interactive e-book was pedagogically sound, user-friendly, and adaptable to the elementary classroom context. Each phase

was documented and iteratively refined to align with the research objectives and quality standards in educational media development.

Validation Results

To ensure the validity of the developed interactive e-book, an expert validation phase was conducted involving three categories of validators: (1) a subject matter expert in Bahasa Indonesia, (2) a media design expert specializing in digital instructional tools, and (3) an elementary school teacher with more than five years of teaching experience in reading instruction.

Each expert was provided with a validation instrument using a Likert scale (1–5), assessing the product based on four key aspects: (1) content relevance, (2) instructional design, (3) media and technical quality, and (4) alignment with the SQ3R strategy.

The subject matter expert evaluated the e-book's content against the curriculum, language accuracy, and the appropriateness of texts for fifth-grade learners. The average score obtained was 89.2%, categorized as very valid. The expert noted that the selection of reading materials, questions, and review activities reflected the cognitive level and reading objectives expected in the curriculum.

The media expert focused on technical functionality, visual clarity, layout consistency, navigation flow, and the integration of multimedia elements. The product achieved a score of 88.5%, also categorized as very valid. Recommendations included improving contrast in text boxes and standardizing button icons, which were subsequently revised.

The elementary school teacher assessed the practicality of the e-book in classroom implementation, student readability, and the ease of facilitating each stage of SQ3R. The average score was 90.4%, reflecting very high validity and usability. The teacher emphasized the clarity of instructions and appreciated the use of formative quizzes that reinforced comprehension.

Table 1. summarizes the validation results across all dimensions.

Validator	Aspect Evaluated	Score (%)	Category
Subject Matter Expert	Content & Language	89.2%	Very Valid
Media Expert	Visual and Technical Design	88.5%	Very Valid
Classroom Practitioner	Practicality and Usability	90.4%	Very Valid
	Average	89.37%	Very Valid

Based on the validation data, the interactive e-book was considered to meet the standards of content quality, technical design, and instructional relevance. The product underwent minor revisions post-validation to enhance usability and ensure consistency with expert recommendations. These revisions reinforced the product's pedagogical integrity and its readiness for classroom use.

Practicality Testing

Following the expert validation phase, the developed interactive e-book underwent practicality testing involving both a limited group and a larger sample of end-users. The goal was to evaluate the usability and user-friendliness of the product when implemented in real classroom conditions.

The limited trial was conducted with 10 fifth-grade students and one classroom teacher. Observations during the trial indicated that students were able to navigate the e-book intuitively, follow the SQ3R stages independently, and engage with the multimedia content without difficulty. The teacher reported that the product significantly reduced the need for direct instruction, allowing students to learn autonomously during the "Read" and "Review" stages.

To quantify practicality, a questionnaire consisting of 12 statements was administered to the students and teacher after the session. The questionnaire included statements such as "The instructions in the e-book are easy to follow," "The quizzes helped me understand the reading," and "I enjoyed learning with this e-book." Student responses averaged 91.8% on the practicality scale, while the teacher scored the product 94.2%, both categorized as very practical.

In the main field trial, practicality was further assessed with a larger group of 30 students and 2 additional teachers. Students used the e-book over the course of three reading sessions, each

focusing on different types of texts (narrative, factual, and expository). Observation logs showed high levels of student engagement and active participation, especially during the "Question" and "Review" stages where peer discussions were encouraged.

Table 2. presents the practicality assessment results.

Participant Group	N	Average Practicality Score (%)	Category
Students (limited trial)	10	91.8%	Very Practical
Teacher (limited trial)	1	94.2%	Very Practical
Students (main trial)	30	90.5%	Very Practical
Teachers (main trial)	2	92.3%	Very Practical

Qualitative feedback from students emphasized that the interactive format helped them better understand the text, particularly through the embedded "Question" prompts and animated visuals. Teachers highlighted that the structure of the e-book, particularly its alignment with the SQ3R strategy, made it easier to manage class activities and to monitor student progress.

The results suggest that the interactive e-book is not only user-friendly but also supports independent and engaging learning experiences. It also minimizes teacher workload while maximizing instructional effectiveness, making it a practical tool for classroom use.

The qualitative data obtained from open-ended questionnaires and observation notes were analyzed thematically. Three major themes emerged. First, students reported that the interactive features of the e-book, especially the embedded quizzes and animations, increased their motivation and helped them understand the text better. One student stated, "I like answering the questions after reading because it makes me remember the story more clearly." Second, teachers highlighted that the SQ3R structure made classroom management easier, as students could follow each stage independently. As one teacher expressed, "The e-book guides students step by step, so I can focus on facilitating discussion rather than giving repeated instructions." Third, both teachers and students noted that the e-book fostered more active participation, especially during the Question and Review stages, where students felt encouraged to ask and answer questions collaboratively. These themes confirm that beyond statistical improvements, the e-book also supports engagement, autonomy, and interaction in the learning process. Three dominant themes emerged: (1) increased motivation and engagement, (2) development of independent learning habits, and (3) enhancement of peer collaboration and comprehension.

Effectiveness Testing

To evaluate the effectiveness of the developed interactive e-book, a quasi-experimental design was applied using a pretest-posttest control group method. The participants consisted of two intact fifth-grade classes: one experimental group (n = 30) that used the interactive e-book embedded with the SQ3R strategy, and one control group (n = 30) that used conventional printed materials and teacher-led instruction.

Before the intervention, both groups were administered a standardized reading comprehension pretest consisting of 25 multiple-choice items that measured literal, inferential, and evaluative comprehension skills. The test was adapted from national literacy benchmarks and validated by language education experts.

Following the four-session intervention, both groups completed the same test as a posttest. The results are summarized in Table 3.

Table 3. Descriptive Statistics

Group	Pretest Mean	Posttest Mean	Mean Gain	N-Gain Score	Category
Experimental	61.7	84.5	22.8	0.59	Medium-High
Control	63.2	70.4	7.2	0.19	Low

To determine the statistical significance of the difference between groups, an independent sample t-test was conducted on the gain scores. The analysis yielded a t-value of 5.462 ($p < 0.001$), indicating a significant difference in improvement between the experimental and control groups.

Furthermore, a paired sample t-test within the experimental group showed a significant improvement in reading comprehension post-intervention ($t = 9.127$, $p < 0.001$). These results confirm that the integration of the SQ3R strategy into an interactive digital format has a positive and measurable effect on students' reading comprehension skills.

The moderate-to-high N-Gain score in the experimental group (0.59) contrasts sharply with the low gain in the control group (0.19), reinforcing the conclusion that the interactive e-book substantially enhanced students' ability to understand and retain information from texts.

These findings demonstrate that the product is not only valid and practical but also pedagogically effective in fostering reading comprehension development in the elementary classroom.

Discussion

Interpretation of Validation Results

The validation process of the interactive e-book based on the SQ3R strategy involved assessments from subject matter experts, media design specialists, and experienced elementary school teachers. The overall validation score reached 89.37%, categorizing the product as "very valid." This high level of agreement among experts indicates that the e-book is not only content-accurate and curriculum-aligned but also technically well-designed and pedagogically appropriate for the target learners.

From the content expert's perspective, the e-book was deemed highly relevant to the fifth-grade Bahasa Indonesia curriculum. The texts selected, comprehension questions posed, and learning outcomes embedded in the SQ3R structure reflected the national competency standards. This aligns with the concept of instructional alignment, which emphasizes the coherence between learning objectives, instructional materials, and assessments to enhance learning efficiency (Biggs et al., 2022).

The media design expert's evaluation focused on the technical quality, visual design, and interactivity of the e-book. A validation score of 88.5% suggests that the e-book adheres to established principles of multimedia learning, such as the coherence principle, signaling principle, and redundancy principle. According to Mayer's Cognitive Theory of Multimedia Learning, learners benefit more from well-integrated visual and auditory elements, especially when these features support comprehension rather than distract from it (Fiorella & Mayer, 2022). The inclusion of animations, audio narrations, and feedback-based quizzes in the e-book aligns with this theory by helping reduce cognitive load and directing attention to key comprehension tasks.

Additionally, the visual layout and user interface were designed to promote intuitive navigation, an essential consideration when developing digital learning tools for younger users. Clark & Mayer (2023) argue that instructional media for younger learners must prioritize clarity, navigation consistency, and scaffolded instruction to accommodate learners' developmental stages. The expert feedback confirmed that font sizes, button icons, and menu structures used in the e-book supported ease of use and minimized user confusion, thereby enhancing user experience.

The classroom teacher's assessment resulted in the highest validity score (90.4%), particularly emphasizing the product's practicality and readiness for real classroom use. The teacher noted that students were able to engage independently with the e-book due to the embedded instructions at each SQ3R stage. This observation aligns with the Universal Design for Learning (UDL) framework, which advocates for providing multiple means of engagement and representation to accommodate diverse learner needs. The e-book's structure allowed teachers to shift from directive instruction to facilitation, empowering students to take more ownership of their learning process.

Importantly, the validation phase also confirmed that the integration of the SQ3R strategy into an interactive digital format is feasible and effective. Several studies have found that when

metacognitive strategies like SQ3R are explicitly taught and supported through structured scaffolding, students show significant gains in reading comprehension (Syahfutra, 2017) (Shaei Alshuaifan, 2022). The feedback from the validators indicated that each of the five SQ3R components was not only present but effectively operationalized in the e-book interface, thus transforming a theoretical model into a practical instructional experience.

In summary, the validation results establish that the interactive e-book is a well-constructed instructional tool, meeting standards of academic rigor, user-centered design, and classroom applicability. These findings provide a strong foundation for moving forward to implementation and effectiveness testing, while also offering a replicable model for the integration of structured reading strategies into digital learning media for primary education.

Interpretation of Practicality Testing

The practicality assessment of the interactive e-book based on the SQ3R strategy yielded high usability and acceptance scores from both students and teachers. The average practicality score exceeded 90% in both limited and main field trials, indicating that the product was well-received and functional in classroom settings. These findings align with the notion that effective instructional tools should be intuitive, learner-centered, and time-efficient (Moallem, 2001) (Motallebinejad et al., 2020).

Students responded positively to the e-book's user interface and interactive features. This observation is consistent with the findings of Schugar et al., (2013) Lim et al., (2021), who reported that elementary students exhibit greater engagement and motivation when digital learning tools incorporate animations, narration, and built-in feedback. In the current study, students highlighted that the embedded "Question" prompts and quiz feedback within the SQ3R framework helped them stay focused and better understand the reading material.

The e-book's practicality also stems from its alignment with learner characteristics. Elementary students are typically concrete-operational thinkers (Piaget & Inhelder, 2008) (Zhang, 2022), which means they benefit from highly visual and hands-on learning experiences. The multimedia design of the e-book featuring illustrations, voice-over guidance, and interactive tasks matches these cognitive needs, making the material more accessible and enjoyable.

From the teacher's perspective, the product was regarded as time-saving and easy to implement. Teachers reported that the structured stages of the SQ3R framework embedded in the e-book allowed them to facilitate lessons with minimal preparation. This supports the notion that technology integration is more likely to succeed when it simplifies teacher workload rather than adds complexity (Ertmer & Ottenbreit-Leftwich, 2010) (Dogan et al., 2021).

Additionally, the presence of formative assessment tools such as quizzes with immediate feedback enhanced practicality. According to Black & Wiliam, (2018), effective formative assessment practices contribute to deeper learning by allowing learners to monitor their understanding. In this e-book, students were able to receive corrective feedback directly after each comprehension section, helping them to reflect and revise their interpretations without teacher mediation.

Another dimension of practicality lies in the flexibility of usage. Teachers noted that the e-book could be used both in teacher-led instruction and in student-centered independent learning. This dual functionality increases the tool's classroom utility, particularly in the context of differentiated instruction where students may work at different paces or with varying levels of support (Tomlinson & Imbeau, 2023).

The high practicality score also supports the Universal Design for Learning (UDL) approach, which advocates for the provision of multiple means of engagement and expression to accommodate diverse learning styles (CAST, 2018). By providing text, audio, visual, and interactive pathways, the e-book made learning more inclusive, particularly for students with differing literacy and attention levels.

In conclusion, the practicality of the developed e-book is attributed to its design simplicity, alignment with pedagogical strategies, and adaptability to various classroom conditions. These factors

confirm that the media is not only feasible for use in real classroom environments but also capable of enhancing both teaching efficiency and student learning engagement.

Interpretation of Effectiveness Testing

The effectiveness testing revealed that the use of the interactive e-book embedded with the SQ3R strategy significantly improved students' reading comprehension skills. The experimental group, which used the e-book, showed a substantial increase in their post-test scores compared to the control group. This finding confirms the positive impact of integrating structured metacognitive strategies with digital media in primary education contexts.

The gain score of 22.8 and N-Gain value of 0.59 in the experimental group indicates a moderate-to-high level of learning improvement, while the control group only achieved a gain score of 7.2 and an N-Gain of 0.19, which is considered low. This significant gap supports previous findings by Syahfutra, (2017), who found that explicit use of SQ3R techniques fosters better textual retention and comprehension compared to passive reading strategies. The structured stages of SQ3R Survey, Question, Read, Recite, Review provide cognitive scaffolding that helps learners decode, interpret, and internalize text more effectively (van Kraayenoord, 2010) (Edossa et al., 2019) .

The effectiveness of this integration can also be understood from a cognitive load perspective. Fiorella & Mayer, (2022), explains that well-designed multimedia learning environments can reduce extraneous cognitive load while enhancing germane load. The use of interactive illustrations, guided audio, and reflective questions within the e-book served as cues for attention and comprehension, allowing students to focus on constructing meaning rather than decoding text alone.

Furthermore, the significant improvement in comprehension among students in the experimental group is aligned with the theory of self-regulated learning. SQ3R, as a metacognitive strategy, empowers learners to plan, monitor, and evaluate their understanding while reading (Zimmerman, 2002) (Nilson & Zimmerman, 2023). When embedded into a digital environment, this strategy becomes more accessible and consistent, allowing students to internalize each stage through repeated exposure and interaction.

These findings are consistent with research by Shaei Alshuaifan, (2022), who demonstrated the positive effects of SQ3R in digital learning environments among non-native English learners. Similarly, in the Indonesian context, Hafid & Arifin, (2023) found that SQ3R significantly enhanced reading comprehension when implemented consistently across multiple sessions. The present study extends these findings by demonstrating that effectiveness is further amplified when SQ3R is delivered through an engaging digital platform tailored to elementary learners.

Importantly, the e-book's design not only supported comprehension but also encouraged student motivation and confidence. Observations during field testing revealed that students were more willing to attempt challenging texts and displayed a higher degree of persistence when encountering unfamiliar vocabulary. This aligns with the expectancy-value theory, which posits that learners are more likely to engage in a task when they perceive it as achievable and valuable (Wigfield & Eccles, 2020).

While the results were promising, it is essential to consider the duration of exposure and instructional consistency in measuring effectiveness. The intervention in this study lasted four sessions, and longer-term use may produce even stronger results. Furthermore, teacher support in facilitating metacognitive dialogue may have influenced the outcomes. Future studies should investigate the role of guided practice and peer collaboration in optimizing SQ3R-based e-book interventions.

In summary, the findings affirm that integrating SQ3R within an interactive e-book environment significantly enhances reading comprehension in elementary school students. This effectiveness is driven by the synergy between strategy-based learning, digital interactivity, and learner-centered design, highlighting the potential for wider adoption of structured digital reading tools in primary education.

Limitations and Educational Implications

The development and implementation of the interactive e-book based on the SQ3R strategy demonstrated strong validity, practicality, and effectiveness. However, several limitations should be acknowledged to contextualize the findings and inform future research directions.

One primary limitation relates to the limited scope of the sample. The study was conducted in a single school with a relatively homogeneous student demographic. As such, the generalizability of the findings may be limited. Future studies should include a more diverse sample across different regions and school types to examine the e-book's adaptability and impact in various educational contexts.

Second, the duration of the intervention was relatively short only four instructional sessions. While significant gains in reading comprehension were observed, longer-term interventions are necessary to examine the sustainability of these improvements. Extended studies would also allow for the evaluation of the e-book's impact on other reading components such as vocabulary acquisition, fluency, and critical thinking.

Another limitation concerns technological access and infrastructure. Although the interactive e-book was designed for ease of use on common classroom devices (e.g., laptops, tablets), disparities in access to such tools remain a challenge in many Indonesian primary schools, especially in rural areas. This could hinder widespread implementation unless accompanied by policy-level support for digital infrastructure enhancement.

In addition, while the SQ3R strategy is pedagogically sound, its successful implementation within a digital environment still requires adequate teacher readiness and digital literacy. Teachers must be trained not only in operating the technology but also in facilitating metacognitive reading strategies effectively. Without this professional development, the potential of such innovative learning tools may not be fully realized.

Despite these limitations, the research provides valuable implications for educational practice and policy. First, it underscores the value of integrating structured reading strategies like SQ3R into interactive digital learning media. Such integration supports the development of higher-order literacy skills and promotes active, student-centered learning in alignment with 21st-century competencies (Alla-Mensah, 2019).

Second, the study highlights the importance of designing digital tools that are grounded in pedagogical theory, not merely technological innovation. By aligning digital content with cognitive learning models, instructional media can be more than engaging they become truly effective tools for knowledge construction (Clark & Mayer, 2023).

From a policy perspective, the findings support the inclusion of interactive e-books as part of digital literacy and curriculum enrichment initiatives under the Merdeka Belajar program. Ministries and educational stakeholders may consider providing funding and training for the development and dissemination of such digital resources, particularly in underserved regions.

Finally, this study contributes to the growing field of evidence-based educational technology, demonstrating that with thoughtful instructional design and pedagogical grounding, digital media can meaningfully support literacy development in early education. Future research may explore cross-platform versions of the e-book, integration with learning management systems, or the development of adaptive versions tailored to different reading levels.

CONCLUSION

The development of an interactive e-book based on the SQ3R strategy has proven effective in improving elementary students' reading comprehension. The integration of structured metacognitive stages with multimedia elements such as visuals, audio, and interactive quizzes helped students better engage with texts and understand reading materials more deeply. This digital media not only supports independent learning but also facilitates more efficient and structured instruction for teachers.

Although implementation challenges remain such as limited access to devices and the need for teacher digital readiness the product has shown strong potential to enhance literacy instruction at the elementary level. Future research is recommended to develop mobile-friendly versions, explore long-term effects on reading achievement, and examine broader applications of SQ3R-based digital tools in diverse educational settings.

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