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The Development of Readlab Interactive Application Using Scratch Programming to Enhance Reading Skill for Seventh Grade Students

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Abstract

Reading is an essential skill in English learning; however, students' reading achievement in Indonesia remains relatively low, and classroom instruction still relies largely on conventional methods which often reduce students' engagement. This study aims to examine the development process of the ReadLab interactive application, evaluate its feasibility as a learning medium, and identify the obstacles encountered during its development. This study employed a Research and Development (R&D) model adapted from the Borg and Gall model, consisting of eight stages: research and information collecting, planning, developing the initial product, preliminary field testing, main product revision, main field testing, operational product revision, and operational field testing. Data were collected through questionnaires, observation sheets, and documentation. Expert validation indicated that ReadLab was feasible for use without revision. The three field tests showed positive responses, ranging from 80%–100% in the preliminary field testing, 85%–100% in the main field testing, and 90%–100% in the operational field testing. These findings indicate that ReadLab is a feasible interactive learning medium for teaching reading skills. The challenges encountered during the development process were successfully resolved through revisions after each testing stage, ensuring that ReadLab operated effectively and was proven feasible for classroom use.

Keywords: Interactive; ReadLab; Reading Skills; Research and Development; Scratch

INTRODUCTION

Reading is one of the most important skills in English language learning because it enables students to construct meaning from written texts and acquire knowledge effectively. Grabe (2009) states that reading is a complex cognitive process that involves a combination of linguistic information, background knowledge, and strategies for reading. Strong reading skills support students' academic achievement and help them access information across different subjects. Students are required to critically evaluate and process information from a variety of sources. However, reading skills remains a challenge in many educational contexts, including Indonesia. Several studies have shown that students' reading ability in Indonesia is still relatively low. Agnia (2024) found that the results of PIRLS, IEA, and PISA indicate a worrying state of reading literacy in Indonesia. These findings are supported by Aprian et al. (2025) and Septiani & Helsa (2025) who stated that students' reading comprehension skills are still low at various levels of education. Reading difficulties may have a negative effect on students' engagement in class activities, academic achievement, and overall learning outcomes. Therefore, supporting students' reading skills has become an important goal in English language education.

The development of interactive learning media should be based on established learning theories to ensure that the media effectively supports students' learning processes. According to Mayer

(2020), students learn more effectively when information is presented through both verbal and visual representations. This study refers to Mayer's Cognitive Theory of Multimedia Learning (CTML), which states that humans learn through two channels: the verbal channel, consisting of written or spoken words, and the visual channel, consisting of images and animations. Learning becomes more effective when these two channels are used in a complementary manner. This theory serves as the grand theory underlying the development of ReadLab, as the application integrates textual reading materials with visual and interactive elements to optimize students' cognitive processing during reading instruction. In addition, the interactivity principle Betrancourt (2005) suggests that allowing learners to interact with content, for example through quizzes and feedback, helps increase engagement and supports deeper learning. Students' engagement, immediate feedback, and meaningful learning experiences can all be facilitated by interactive digital media. Therefore, technology-based learning tools have considerable potential to support reading skills development and increase students' motivation to learn. Despite these potential benefits, reading instruction in many classrooms continues to rely on conventional learning resources and teacher-centered approaches. Such practices may limit student interaction and reduce learning engagement

Several studies have shown how interactive learning tools can enhance student learning experiences, a finding consistent with the principles of CTML. Nadirah et al. (2020) found that multimedia-based instruction positively influenced students' reading comprehension and learning interest. In addition, digital learning applications have been shown to enhance students' engagement and academic achievement through interactive learning activities. Scratch, a visual programming platform that makes it possible to integrate text, images, audio, animations, and interactive features into educational applications, received a lot of interest among other educational technologies. Furthermore, Rosydiana et al. (2023) found that Scratch-based learning media enhanced students' problem-solving skills, while Irawan et al. (2023) reported that Scratch effectively supported the development of interactive learning media. These findings suggest that Scratch possesses considerable potential for educational applications.

However, most previous studies have focused on the effectiveness of Scratch in teaching programming, computer skills, motivation, or general learning outcomes. Lubis et al. (2023) focused on the effectiveness of Scratch Coding Activities (SCAs) in English language learning found that students' language fluency and reading comprehension improved. Using the PMRI approach, Gusman et al. (2023) investigated how well Scratch learning materials improved students' learning results. Additionally, Handayani et al. (2023) developed a Problem-Based Learning (PBL) e-module using Scratch apps to enhance students' computational thinking skills. In the same way, Asmara et al. (2024) investigated how to enhance students' involvement and problem-solving abilities through the use of online project-based Scratch programming.
There is still limited research on the creation of Scratch-based programs designed especially for junior high school student reading teaching. Furthermore, the development process, feasibility, and obstacles that were faced when creating Scratch-based reading applications have rarely been studied in the past.

Consequently, there is still a need for research to develop and evaluate Scratch-based applications tailored to the teaching of reading skills, whilst also investigating the challenges encountered during their development and implementation. To address this gap, this study developed ReadLab (Reading Laboratory), an interactive Scratch-based application designed

to support reading instruction for seventh grade students. This application integrates reading materials, examples and interactive quizzes within a multimedia learning environment. This study aims to investigate the development process of ReadLab, evaluate its feasibility as a learning resource, and identify the obstacles encountered during its development. It is expected that these findings will contribute to the growth of research on technology-supported language learning and provide practical guidance for teachers who wish to integrate interactive digital resources into their teaching of reading skills.

METHOD

To achieve the research objectives, an appropriate research design was required to guide the systematic development and evaluation of the learning media. This study employed a Research and Development (R&D) model, it is adapted from the Borg and Gall model (Gall et al., 2007). This model was chosen as it provides a systematic method for developing and evaluating educational products. Similar to previous research that modified Borg and Gall's original procedures to suit the research needs (Yuliani & Banjarnahor, 2021). This study implemented only eight stages: research and information collecting, planning, developing the preliminary product, preliminary field testing, product revision, main field testing, operational product revision, and operational field testing. Therefore, the study was limited to the operational field testing stage without conducting final product revision and dissemination because its objective was limited to developing the product, evaluating its feasibility, and identifying obstacles. Furthermore, the development and field testing were confined to one text genre, whereas ReadLab is designed to accommodate a wider range of text genres. Therefore, the current version of ReadLab cannot yet be regarded as a complete and finalized learning application. Accordingly, the final product revision and dissemination stages were beyond the scope of this study, as these stages are intended for products that have reached a final level of development and are ready for broader implementation.

The study was conducted at SMPN 3 Cimahi and involved one English teacher and seventh-grade students. The field-testing stages consisted of 10 students in the preliminary field testing (Class VII-B), 20 students in the main field testing (Class VII-F), and 30 students in the operational field testing (Class VII-E). Documentation, questionnaires, and observation sheets were used to gather data. Documentation was used to record the development process of ReadLab. Questionnaires were administered to the teacher and students to evaluate the feasibility of the application in terms of usability, design, engagement, and learning support. Observation sheets in the form of field notes were used to identify obstacles and technical issues encountered during development and implementation. Data were analyzed using descriptive qualitative analysis. Documentation data were used to describe the development process, questionnaire responses were calculated using frequencies and percentages to determine feasibility, and observation data were analyzed descriptively to identify obstacles encountered during the development and implementation stages. The findings from these instruments were then interpreted to answer the research questions.

RESULTS AND DISCUSSION

Results

1. The Process of Developing Media

The development process began with identifying students' needs, followed by designing and developing the initial version of ReadLab using Scratch programming. The product was then

evaluated through preliminary, main, and operational field testing, with revisions conducted after each testing stage to improve the application before further implementation.

The first stage involved collecting information related to the development of ReadLab. Data were gathered through a needs analysis questionnaire administered to seventh-grade students of SMPN 3 Cimahi. The questionnaire was distributed randomly and anonymously to 10 seventh-grade students from several classes to determine students' needs, preferences, and experiences regarding digital learning media. The results of the needs analysis served as the basis for developing the ReadLab application. The needs study examined four areas, such as technology use, learning media needs, reading challenges, and learning media use. The results showed that just 10% of the students had used educational applications, and only 20% of the students reported using digital media in reading lessons. However, 90% of students need learning resources to understand descriptive texts and were interested in learning through interactive application, and 80% of students preferred learning materials with pictures and animations. These findings highlight the need to develop ReadLab, an interactive Scratch-based learning tool that will assist students in strengthening their reading skills.

The planning stage was carried out to identify the goals, characteristics, and content of the application based on the findings of the needs analysis. At this stage, the researcher designed ReadLab as an interactive learning application focusing on descriptive text materials for seventh-grade students. The curriculum requirements and the needs of the students were taken into consideration when designing the application structure, learning activities, visual components, and evaluation aspects. At develop preliminary form of product stage, the initial version of ReadLab was developed using Scratch programming.

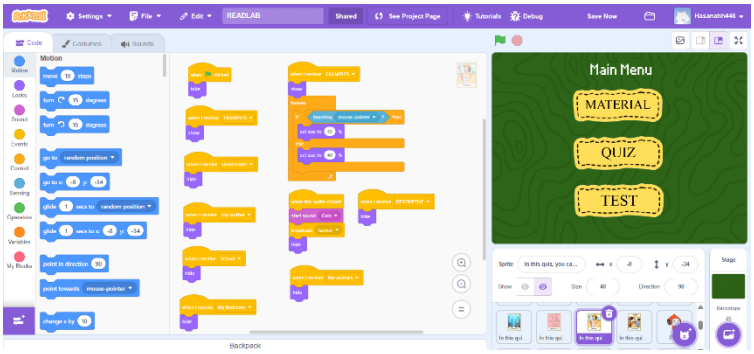

Figure 1. Process of developing ReadLab using Scratch

The development of ReadLab began with designing the application's visual interface and instructional content. The researcher independently designed the application's backgrounds, navigation buttons, animated elements, sound effects, and all textual content, including learning materials, examples, instructions, quizzes, and tests based on the seventh-grade curriculum. After completing the design stage, all visual, audio, and instructional components were integrated into Scratch. Block-based programming was then developed to control the application's navigation, animations, sound effects, quizzes, tests, scoring system, and user interactions. The programming process involved arranging, testing, and refining the coding blocks to ensure that every feature functioned properly and interacted as intended. The integration of these multimedia components and programming blocks resulted in the initial version of the ReadLab interactive application, which was designed to provide an engaging and

interactive reading learning experience. The application's interface and features are described as follows.

ReadLab's initial interface starts with a splash screen that shows the application's title and logo. When users run the application, this screen shows as the first page. The next interface presents a language selection page, where users can choose either English or Indonesian before proceeding. The selected language is then applied to the application interface and navigation. After selecting a language, users are directed to the main menu. This page provides access to the application's primary features, including Material, Quiz, and Test, through the available menu buttons displayed on the screen.

After accessing the main menu, users can select one of the available text types displayed in the application. The text selection page presents several text categories that can be accessed through the provided menu buttons. Once a text type is selected, the application directs users to the corresponding material page, which contains the definition, purpose, generic structure, and an example text related to the selected category. The definition section presents a description of the selected text type, while the social purpose section displays information regarding the purpose of the text. The generic structure section outlines the organizational elements of the text, and the example section provides a sample text corresponding to the selected category.

Students are given a series of multiple-choice questions regarding the text they have studied after gaining access to the quiz menu. This section's immediate feedback when students choose an answer option is one of its distinctive features. The application immediately shows a confirmation message stating that the response is correct when the right answer is selected. On the other hand, the program immediately notifies the learner that the response is incorrect if the wrong option is chosen. On the Test feature students are required to enter their names, which are used to identify individual test results. Unlike the Quiz feature, which uses multiple-choice questions and provides immediate feedback, the Test feature consists of short-answer questions that require students to type their responses in the designated answer fields. Upon completion of all questions, the application automatically calculates and displays the student's cumulative score along with their name.

After the product was developed, it was evaluated by expert validators consisting of a material expert and a media expert. The validation process aimed to assess the feasibility of the application and identify aspects requiring improvement.The validation results from both the media expert and the material expert indicated that the product was categorized as highly feasible and could be used without revision.

2. Feasibility of Media

Based on experts validation, the product was subsequently implemented in the preliminary field testing stage, which involved a small group of students to obtain initial data regarding the practicality of the media and users' responses to the developed product. Following expert validation, Product testing was conducted three times, covering aspects such as the use of learning materials, the learning experience, the fulfilment of user needs, and the use of technology, each of which had five statements on the questionnaire.

Preliminary field testing was conducted to obtain initial feedback from students regarding the feasibility of ReadLab. This stage involved 10 seventh-grade students of SMPN 3 Cimahi. After using the application, students completed a response questionnaire consisting of 20 items.The results showed that most questionnaire items received positive responses ranging from 80% to

100% in almost every aspect. The item related to students' familiarity with educational applications obtained the lowest positive response rate, at 50%. Based on the findings obtained during the preliminary field testing stage, several revisions were made to improve the quality of ReadLab. The revisions stage focused on revising the content clarity.

The updated version of ReadLab was implemented in the main field testing stage. This stage involved 20 seventh-grade students of SMPN 3 Cimahi. Students used the application and subsequently completed the same response questionnaire. The results showed that most questionnaire items received positive responses ranging from 85% to 100% in almost every aspect. The item concerning students' familiarity with educational applications obtained a positive response rate of 70%. However, during field testing, several technical issues were identified that required the researcher to revise the coding.

Following the operational product revision phase, the revised version of ReadLab was implemented during the operational field testing phase. The revisions involved the addition of coding blocks. Operational field testing stage involved 30 seventh-grade students of SMPN 3 Cimahi. Students were asked to use the application during the learning process and then complete a 20 item response questionnaire. The result showed that most questionnaire items received highly positive responses ranging from 90% to 100%. Several items obtained a perfect positive response rate of 100%, while the lowest positive response rate was found in the item related to students' familiarity with educational applications, which obtained 73%.

3. Obstacles of Media

During the development process, several technical challenges were encountered while developing ReadLab in Scratch. One of the major difficulties was synchronizing the block-based programming across different application features. When the programming blocks were not properly synchronized, the application interface became disorganized, and several sprites, navigation buttons, and interactive features did not function as intended. Resolving these issues required considerable time because even a minor error in a single programming block could affect the overall functionality of the application. Consequently, repeated debugging, code refinement, and functional testing were necessary to identify and correct the errors.

Another obstacle involved the limitations of Scratch in managing the application's visual content. Although the application backgrounds were initially designed with embedded instructional text, the imported text appeared unclear and difficult to read due to Scratch's rendering limitations. Therefore, all instructional text had to be retyped manually using Scratch's built-in text feature, which offers only limited font options. Furthermore, once the text had been placed on a background, it could not be edited directly. If any typographical or formatting error was identified, the background had to be replaced with the original version without text, and the entire process of inserting the text, repositioning the layout, and reconnecting the associated programming blocks had to be repeated. This significantly increased the development time and required careful attention to maintain the consistency and functionality of the application.

During the testing stages of ReadLab, several obstacles experienced by students while using the application. During the preliminary field testing, some students experienced difficulties in navigating the application because they were unfamiliar with educational applications. Several

students required initial guidance to access materials, operate navigation buttons, and complete learning activities. Observations also indicated that some students lost focus during certain learning activities. During the main field testing, some students encountered minor difficulties in understanding the learning materials and completing quiz activities. Additionally, observations showed that in order to encourage student enthusiasm and engagement, enhancements were required for the visual presentation, animation elements, and general user experience. Technical issues were also identified during the implementation process. On several digital devices, the application did not always run optimally, which occasionally affected students' learning experience. These obstacles were documented and used as the basis for product revisions throughout the development process.

Discussion

The findings indicate that ReadLab was successfully developed through a systematic R&D process involving preliminary, main, and operational field testing. Revisions were conducted after each stage based on expert validation, students' responses, and implementation observations. This iterative process is consistent with Fadhli et al. (2023),who emphasized that educational product development requires continuous evaluation and improvement. Similarly, Saepul (2024) highlighted the importance of revision based on expert feedback to enhance product quality, while Yousef & Ayyoub (2024) stated that systematic validation is essential to ensure the effectiveness of educational products before implementation. The systematic R&D process ensured that ReadLab was developed into a feasible learning application that met students' needs and supported reading instruction effectively.

During the development process, several obstacles were encountered. Technical issues in Scratch programming caused some features to malfunction and required the researcher to reconstruct parts of the application. Ma'rifah et al. (2024) explained that Scratch-based media development requires extensive testing and debugging to ensure functionality. In addition, observation results revealed difficulties related to navigation and instructions during the preliminary testing stage. This finding supports Nurani & Suyanta (2024), who argued that digital learning materials should be continuously revised to improve usability and practicality. These challenges became valuable feedback for improving ReadLab throughout the development stages.

The feasibility results demonstrate that ReadLab met the criteria of a suitable digital learning medium. High validation scores show that the application met requirements for functionality, presentation, and content. This finding is supported by Pastuti & Iskandar (2023), who emphasized the importance of expert validation in ensuring media quality. Likewise, Tan et al. (2024) explained that validation procedures help determine whether digital learning products meet pedagogical and user requirements. The positive feasibility results suggest that the revision process successfully improved the quality of the application.

The use of Scratch programming also contributed to the feasibility of ReadLab. Scratch made it possible to combine text, graphics, animations, navigation, and tests into a single learning environment. Previous studies have shown that Scratch can be used to develop valid and practical learning media (Yulianto & Subali 2024; Indahwati et al. 2024) . This finding is consistent with Grabe (2009) view of reading as a cognitive process, as ReadLab's integration of textual materials, visual support, and interactive quizzes reflects an effort to actively engage students' linguistic knowledge and reading strategies, rather than presenting text passively. Furthermore, interactive features play an important role in promoting active learning (Sari et

al., 2024) which aligns with the interactivity principle proposed by Betrancourt (2005), suggesting that allowing learners to control and respond to instructional content, such as through ReadLab's interactive quizzes, enhances engagement and supports deeper learning. The multimedia design of ReadLab is also supported by the Cognitive Theory of Multimedia Learning, which states that meaningful learning occurs when students process verbal and visual information simultaneously (Mayer, 2020). Similar findings by Setiani et al. (2024) showed that multimedia learning media can enhance students' learning experiences through multiple forms of representation. Therefore, the integration of Scratch programming, interactive features, and multimedia elements contributed to the development of a feasible learning application that effectively supported students' reading engagement and learning experiences.

Students' positive responses further indicate that ReadLab was feasible and acceptable for classroom use. Although some students reported that they were not familiar with educational applications such as ReadLab, the high positive responses indicate that they were able to use the application well and responded positively to its implementation. This suggests that prior experience with similar applications was not a major factor influencing students' acceptance of ReadLab. Aldresti et al. (2023) identified students' responses as important indicators of digital media acceptance. This finding aligns with Asmara & Ma (2024),who found that Scratch-based learning environments can enhance student engagement, and with Sipahutar et al. (2024) who reported increased learning interest through Scratch-based media. In addition, Komala et al. (2024) demonstrated the potential of Scratch-based digital media to support reading-related learning activities through interactive literacy environments. These findings suggest that positive student responses reflect the feasibility and acceptability of ReadLab as an interactive learning application that can support students' engagement and reading learning experiences in the classroom.

Finally, the growth of technological integration in education is shown in the development of ReadLab. Al-khresheh & Alkursheh (2024) argued that technology integration promotes more flexible and interactive learning experiences, while Sa'idah & Saefudin (2024) highlighted its role in improving accessibility and flexibility. Moreover, Hakim & Kasiyun (2024) and Fathurrahman et al. (2024) emphasized that interactive media developed through programming platforms can support innovative and meaningful learning. Therefore, the systematic development process, successful resolution of obstacles, and positive feasibility results indicate that ReadLab is a practical and feasible digital learning medium for teaching reading skills to seventh-grade students.

CONCLUSION

Based on the results and discussion, it can be concluded that this study successfully developed ReadLab (Reading Laboratory), a Scratch-based interactive learning application designed to support reading instruction for seventh-grade students. The conclusions of this study are presented as follows.The development process of ReadLab was conducted using the Research and Development (R&D) approach by adapting the Borg and Gall model into eight stages: research and information collecting, planning, developing preliminary product, preliminary field testing, product revision, main field testing, operational product revision, and operational field testing. The development process began with identifying students' needs and reading-learning challenges, followed by designing and developing the application using Scratch programming. The product was then validated, implemented through three field-testing stages,

and continuously revised based on expert feedback, students' responses, and observation results. The final product was an interactive multimedia environment that included reading materials, examples, tests, and quizzes.

The feasibility of ReadLab as a learning medium was determined based on expert validation and students' responses during the field-testing stages. The validation results from the media expert and material expert showed that ReadLab was categorized as feasible and could be used without revision. Furthermore, the students' response questionnaires indicated positive evaluations, with the preliminary field testing obtaining 80–100% positive responses, the main field testing obtaining 85–100% positive responses, and the operational field testing obtaining 90–100% positive responses. These results confirm that ReadLab fulfilled the feasibility criteria in terms of material presentation, visual design, usability, and its support for reading activities.

The obstacles encountered during the development and implementation of ReadLab included students' limited familiarity with digital learning applications, initial difficulties in understanding application navigation, and technical issues during Scratch development. The researcher also experienced programming problems, such as coding errors that caused several features to malfunction and required reconstruction. Additionally, for some devices, improvements were required for instructions, graphic components, and program performance. These obstacles were addressed through continuous revisions conducted throughout the development stages to improve the quality of ReadLab. Based on these findings, ReadLab can be considered a feasible Scratch-based interactive learning medium that has undergone a systematic development process, feasibility evaluation, and improvement based on several challenges encountered during development process. The developed application provides an alternative digital medium to support reading instruction for seventh-grade students.

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