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Effectiveness of Interactive E-Book Teaching Materials Development to Improve Students' Reading Comprehension Skills

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ABSTRACT

The low reading ability of students caused by the lack of interest in reading shows that reading learning in schools has not been running optimally, so students have difficulty in understanding reading. Theoretical development using the Thiagarajan model is carried out through four systematic stages, namely define, design, develop, and disseminate to produce effective and tested learning tools. The research instrument used is a questionnaire to assess the validity of the teaching materials and measure students' interest or attitude towards reading, while the test is used to measure the level of students' reading ability. The results showed that the development of teaching materials gets valid results from media, material, and media experts, and the use of interactive E-Books had a positive impact on student comprehension, as evidenced by the increase in pretest scores of 28 (fair category) to 57 (good category) on the posttest, with an N-Gain value of 0.4 (40%) which is included in the medium improvement category, so that interactive E-Books are declared effective even though they still require further development for more optimal results.

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1. INTRODUCTION

Reading comprehension skills are basic skills for further academic learning success (Sarlina & Nurbianta, 2018). Reading comprehension is a process in which a person simultaneously retrieves and constructs meaning from text through interaction and engagement with the language written in Snow (Butterfuss et al., 2020). Reading skills are an activity that everyone must have, especially for elementary school students (Alvioni et al., 2019). Reading comprehension in students can obtain various information actively receptively, meaning that by having high reading comprehension skills, students can obtain various information in a relatively short time (Sari et al., 2021). This shows that reading comprehension skills are important to master at the elementary school student level in order to understand various information effectively.

Analyzing the reading comprehension skills of fourth grade students in an elementary school found that students' reading comprehension test results were in the low category (Alpian & Yatri, 2022). Contributing factors included lack of motivation, lack of reading resources, and limited learning facilities that support reading comprehension. Research by Yanti et al. (2022) also corroborates previous findings where a study in Karawang found that fourth grade elementary school students have difficulty in understanding reading, mainly due to internal factors such as low interest in reading and lack of motivation.

Muliawanti et al. (2022) shows that reading comprehension problems have emerged early on, as seen from the difficulties faced by third grade elementary school students in understanding reading, especially in terms of inference and conclusion drawing. This suggests that reading comprehension learning interventions need to be carried out from the early stages of primary education. Overall, these studies show that the literacy problem in Indonesia is a complex challenge, involving various internal factors such as students' interest and motivation, as well as external factors such as the environment and access to reading materials. In addition, monotonous learning methods are an obstacle. This comprehensive improvements in educational strategies are needed to improve literacy skills of primary school students in Indonesia.

Of course, every problem that arises above must be found a solution so that the problem is resolved as expected. Likewise, with the problem of low reading comprehension skills in elementary school students, as much as possible it is necessary to find and implement appropriate steps in solving student problems in improving students' reading comprehension skills. In this case, all parties related to students have a role in accordance with their capacity in solving the problem of slow literacy development in students (Kharizmi, 2019). One of the efforts in improving children's literacy is by making teaching materials. With the availability of teaching materials, it is hoped that students can increase their interest in reading.

Teaching materials are a set of learning tools or tools that contain learning materials, methods, boundaries, and ways of evaluating which are systematically designed and attractive in order to achieve the expected goals, namely achieving competencies and sub-competencies with all their complexity (Magdalena et al., 2020). Teaching materials have an important role in learning (Rukiyah et al., 2022). Learning materials can act as learning materials that can be used independently anytime and anywhere according to the interests and learning styles of students (Jazuli et al., 2018). This teaching material is equipped with learning objectives or competencies to be achieved, learning materials described in learning activities, media illustrations, learning procedures, exercises to be done with answer signs, formative tests equipped with answer keys, feedback, and a bibliography (Hernawan et al., 2008).

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Currently, teaching materials used in schools are very minimal, usually only relying on printed books and LKS sold by publishers, so teaching materials that are specific to learning one material need to be developed (Andira et al., 2022). Technological developments can increase renewal by developing creativity in the field of education, especially teaching materials. By paying attention to the use of teaching materials, it can be done with technological developments by making learning resources, namely teaching materials in digital form (Utami & Lena, 2022).

E-books are interactive digital books, because they can integrate images, sounds, movie animations, and interactive evaluation questions, so that there is direct interaction between students and learning resources (Nur'aini et al., 2015). Technology in learning serves to make it easier for students to understand and explore learning concepts and can increase the enthusiasm for learning, because the material presented attracts students' attention (Anggraeny et al., 2020). Currently, printed books have been replaced by electronic books that are more interactive and varied. This makes learning activities more enjoyable with a variety of learning strategies that are relevant to the teaching topic and student characteristics (Novita, 2023). E-books can be used by students as an independent learning resource at home. The use of e-books is expected to help students visualize the content of the lesson (Ndoa & Jumadi, 2022).

The use of interactive e-books in learning reading comprehension in elementary schools has shown positive results in various studies. Nugroho (2022) stated that the application of the EMRED strategy through e-books can improve the reading comprehension skills of fourth grade students of SD Negeri Sindangmandi. This study showed that the average student score increased significantly after using interactive e-books.

Developed a digital book for nonfiction text learning in grade IV (Rahmawati et al., 2023). The results of this study show that students have improved their ability to understand nonfiction reading after using the digital book. Prasetya (2016) also examined the use of mobile-based digital books that revealed similar results, namely an increase in the ability to understand children's stories presented in e-book format.

Previous research has shown that interactive e-books have a positive impact on education, especially at the primary school level. The utilization of this media has proven to be effective in attracting students' interest during teaching and learning activities. In addition to being engaging, interactive e-books also assist teachers in delivering material in a visual and interactive way, making it easier for students to understand. As a result, students become more encouraged to read and participate in learning with enthusiasm. Therefore, interactive e-books not only make the learning process more interesting, but also significantly improve students' reading comprehension ability.

Research conducted by Pertiwi et al. (2024) reported that the use of e-books is very influential on learning activities so that it can improve reading comprehension skills in elementary schools. Restiani et al. (2022) is included in the category of very feasible and good for practicing reading skills in the learning process. The study of the two previous studies was carried out so that an analysis of the space for further development was obtained. The results of the analysis show that the electronic book developed has not yet contained the subject matter related to barter material in the Indonesian language subject of the independent curriculum, and the packaging of reading material is still a textbook narrative that is not packaged on a fairy tale basis. Therefore, the results of the analysis will be used as the focus of novelty in the development of teaching materials in this study students in elementary school.

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2. METHODS

The Research and Development research method is a research method used to test the effectiveness of the usefulness of a product. The research orientation is at the stage of product development and validation in the field of education (Hanafi, 2017). The resulting product development is in the form of teaching materials, one of which is an interactive e-book that can be used as information media and help educators in teaching their students. The development model that is the basis for this research is the 4D development model (four-D model) introduced by Thiagarajan (1976). The 4D development model stands for 4 (four) stages of the development process, namely Define (defining), Design (planning), Develop (development) and Dissemination (dissemination) (Handayani et al., 2023).The research design used in this research is the 4D model. Is one of the systematic learning design models, chosen based on the consideration that this model is developed systematically and rests on the theoretical basis of learning design. This model is structured programmed with a series of systematic activities in an effort to solve learning problems related to learning resources that are in accordance with the needs and characteristics of students (Widyastuti & Susiana, 2019). Here is **Figure 1** the framework of the development model by Thiagarajan (1976).

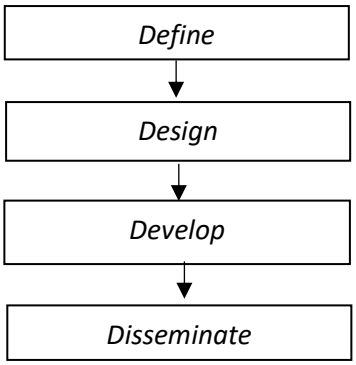

Figure 1. 4D Model Framework

3. RESULTS AND DISCUSSION

3.1 Define

In the determination or understanding phase is the phase of analyzing and identifying problems that are carried out to obtain various data related to the product to be developed. At the define stage, it was found that the reading comprehension skills of grade IV students were still lacking. These results were obtained from an initial test that had been carried out by testing five indicators of reading comprehension. The percentage value of the initial test of each reading comprehension indicator includes. literal comprehension 14%, reorganization 0%, inferential 18.7%, evaluation 6.7%, and appreciation 6.5%, so it can be concluded that the reading comprehension skills of elementary school students are still very low.

The analysis of the needs of students and teachers for the development of teaching materials was obtained from distributing questionnaires. The questionnaire analysis shows that teachers and students support the use of interactive web-based teaching materials as a way to improve reading comprehension skills. Students want materials that are short, bright, interesting, and accompanied by quizzes, games, and practice questions. Color visuals, animation, and sound effects are also considered significant, while teachers want teaching materials that are easy to use and support independent learning.

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The questionnaire results show that students still have difficulties in understanding reading, especially in finding the main idea, understanding the meaning, and summarizing the content of the text. Although books as teaching materials are very supportive, students responded positively to the idea of developing website-based interactive teaching materials with attractive designs, bright colors, animations, sound effects, as well as concise, clear material, and equipped with games and practice questions. Students also like Times New Roman font and want teaching materials to be presented in an interesting way so that learning becomes more fun and effective.

3.2 Design

The design stage includes activities to design a concept map as shown in **Figure 2**. This concept map aims to provide a visualization of the development of teaching materials. In addition, this stage is carried out the preparation of format selection such as font type, color display, music background, button sound effect, and image or animation. As for the design stage, this is done with the help of Canva, YouTube, and Heyzine.

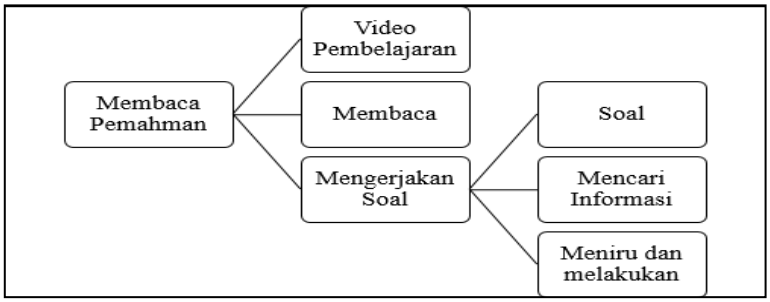

Figure 2. Concept Map

The **Figure 2** shows a competency map of teaching materials organized by initial ability, with the main emphasis on reading comprehension. This competency is divided into three sub-competencies included making learning videos, reading activities, and problem solving. The sub-competency in solving problems consists of three components, namely the problem itself, finding information, and imitating and doing, all of which support overall reading comprehension.

3.3 Develop

The third stage is the development stage consisting of the development of interactive e-book teaching materials in accordance with the planning that has been done in the design stage. In general, the appearance of interactive e-book teaching materials is adjusted to the results of respondents who have been carried out. The development of interactive e-book teaching materials is carried out using the Heyzine website. The following is a description of the content of the results of the development of interactive e-book teaching materials.

Figure 3. Cover

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Figure 3 shows the cover design of the teaching materials designed to be attractive for grade IV students. The title is made using large letters so that it is easy to read and striking. Animated illustrations are adapted to the content of the story to provide a relevant initial picture. Bright colors were chosen based on the results of a survey of student characteristics. The author's name is placed in the lower right corner proportionally so that it remains visible but does not interfere with the main display.

Figure 4. Instructions for Use

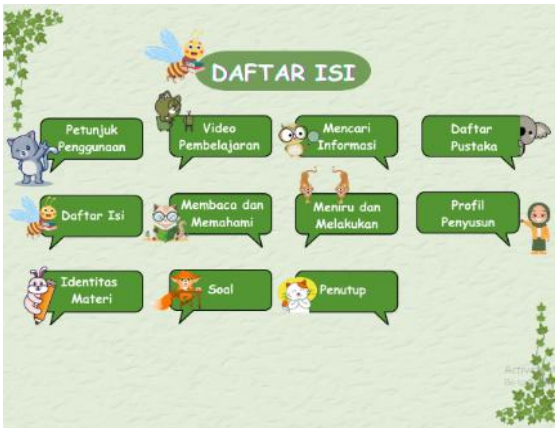

Figure 5. Table of Contents

Figure 4 In the teaching materials created, instructions for use have been included that explain the method of opening pages like a physical book, as well as interactive features such as navigation buttons and filling in questions, thus helping students to use the E-Book effectively. **Figure 5** In the teaching materials created, the table of contents is designed to be more comprehensive and clearer, including menus such as usage guides, material identities, learning videos, questions, to the list of compilers, and is equipped with attractive animations that are suitable for each menu.

Figure 6. Material Identity

Figure 7. Learning Outcomes

Figure 6 and **Figure 7** show the material identity section of the designed teaching materials. The identity of this material is compiled completely and systematically, including the initial competencies that students must have, the learning objectives to be achieved, and the expected learning outcomes. The preparation of this detailed material identity aims to provide clear direction for both teachers and students in carrying out the learning process. Initial competencies are presented so that the teacher can determine the readiness of students before entering the core material, while learning objectives are formulated as a guide in delivering the material in a directed and focused manner. Learning outcomes are

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explained explicitly to describe the expected outcomes after the learning activities are completed. With this complete material identity, teachers have a clear reference in developing learning strategies, while students can better understand the targets that must be achieved, so that learning becomes more structured, effective and meaningful.

Figure 8. Learning Video

Figure. 9 Reading and Understanding

Figure 8 In the teaching materials created, an animated video about the history of the evolution of money is added to stimulate students before reading the text, so that students' understanding of the lesson can increase. **Figure 9** In the developed learning materials, the reading text is displayed with animations that match the content of the story, such as animal characters and forest backgrounds, to make it easier and more enjoyable for students to imagine and understand the reading.

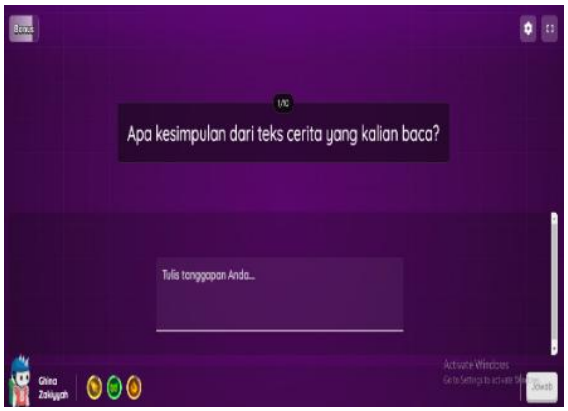

Figure 10. Practice Questions

Figure 10 displays part of the designed teaching materials, where the questions are presented interactively through the Quizizz application. In this view, students can access the quiz easily by simply clicking the “Start” button, which will then direct them to a collection of questions tailored to the reading text that has been studied. The presentation of questions in this interactive digital form aims to increase student involvement in the learning process. With an interesting and game-based format, students are not only tested for understanding, but also motivated to learn with more enthusiasm. The use of Quizizz also allows teachers to monitor student results and progress in real-time, so that learning becomes more fun, efficient, and technology-based that is relevant to the needs of the times. In this Quizizz, there are three types of exercises including essay questions, finding information, and imitating or doing with the aim of testing the extent of student understanding.

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Figure 11. Closing

Figure 12. Bibliography

Figure 11 while in the new teaching materials, the acknowledgments are placed on the final page as a form of appreciation to students for their dedication and efforts after completing all the learning materials. **Figure 12** In the learning materials created, the bibliography includes the sources used, such as textbooks for students and teachers as well as learning videos from YouTube, so that students can access references more easily and in-depth.

After completing the development, an assessment is carried out by experts both from the scope of media, material, and language. So that valid teaching materials are obtained and suitable for testing. Media validation was assessed by two expert validators. The data obtained from media validation consists of aspects of teaching material display, teaching material content, background display, and presentation. The following recapitulation results of media expert validation are presented in **Table 1**.

Table 1. Media Expert Validation Results

No.	Assessment Aspect	Number of Items	Score		Score Max	Percentage
			Before	After		
1.	Teaching Material Display	8	12	16	32	86%
2.	Teaching Material Content	4	8	8	16	100%
3.	Background display	6	11	12	24	96%
4.	Presentation	4	8	8	16	100%
Total Score				83		
Percentage				94%		
Category				Very Valid		

Based on **Table 1**, the media expert's evaluation of the interactive E-Book involves four aspects. The display aspect scored 16 out of 32 (86%), content 8 out of 8 (100%), background 12 out of 24 (96%), and presentation 8 out of 8 (100%). The total score achieved was 83 out of a maximum of 88 with a percentage of 94%, so it was declared “Very Valid” by the media expert.

The media expert validators provided input and revisions on several aspects of the teaching material developed. One of the main focuses of the revision is on the color display which is considered less attractive and less harmonious, so it is recommended to use a more contrasting and harmonious color combination so that the media display is more attractive to students and not boring. In addition, the validator also highlighted the limited or less than optimal use of animation. Therefore, it is recommended to add relevant and interactive animations to increase visual appeal and help clarify the delivery of material. This revision

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aims to make the teaching material developed more effective, interesting, and in accordance with the characteristics and needs of elementary school students.

Material validation was assessed by two expert validators. The purpose of material validation is to get input from experts for improvement before testing. The data obtained from material validation consists of aspects of materials, presentation, supporting learning materials presented in **Table 2**.

Table 2. Material Expert Validation Results

No.	Assessment Aspect	Number of Items	Validator I	Validator II	Score Max	Percentage
1.	Materials	8	15	15	32	94
2.	Presentation	6	10	11	24	88
3.	Supporting Learning Materials	8	13	15	32	86
Total Score				79		
Percentage				90%		
Category				Very Valid		

From the **Table 2**, the material expert validation of the interactive E-Book includes three aspects which are the material gets a percentage of 94%, the presentation is 88%, and the learning material support is 86%. The final score obtained is 79 with a percentage of 90%, so it is classified in the "Very Valid" category.

The material experts provided input and revisions related to several writing errors or typos found in the content of the material. These errors include incorrect word writing, spelling that is not in accordance with Indonesian language rules, and inconsistent use of punctuation. This is considered important to fix because it can affect students' understanding of the content of the material presented. In addition, language accuracy is also one of the indicators of the feasibility of learning materials, especially for elementary school levels which are in the early stages of forming literacy skills.

Language validation was assessed by one expert validator. The purpose of language validation is to get input from experts for improvement before testing. The data obtained from the material validation consists of aspects of Straightforward, Communicative, Appropriateness to the level of learner development, Appropriateness to language rules, Use of icons or symbols, Dialogical and interactive presented in **Table 3**.

Table 3. Linguist Validation Results

No	Assessment Aspect	Number of Items	Score	Score Max	Percentage
1.	Straightforward	2	6	8	75%
2.	Communicative	2	6	8	75%
3.	Appropriateness to the level of learner development	2	6	8	75%
4.	Appropriateness to language rules	2	5	8	63%
5.	Use of icons or symbols	1	3	4	75%
6.	Dialogical and interactive	1	3	4	75%
	Total Score		29		
	Percentage		73%		
	Category		Valid		

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Referring to the **Table 3**, language validation shows a percentage of 75% for the aspects of straightforwardness, communicativeness, suitability to the level of students, and icons/symbols respectively, while for the aspect of language rules it reaches 63%, and the dialogical and interactive aspects are also 75%. The total score is 29 out of a maximum of 40 with a percentage of 73%, so it is included in the "Valid" category.

The linguists provided input and revisions related to the use of grammar in the developed teaching materials. Some sentences are considered less effective, less precise in structure, or not in accordance with correct language rules. This is important to note, because the use of good and correct grammar greatly affects the clarity of information conveyed to students. Linguists suggested that the sentences used should be made simpler, more straightforward, and in accordance with the level of language development of elementary school students. In addition, improvements were made so that the use of words, phrases, and sentence structures did not cause double meanings and were able to strengthen students' understanding of the content of the material. Thus, the revision of grammar aims to improve the quality of language in the media to make it more communicative, educative, and in accordance with applicable language standards.

3.4 Disseminate

Teaching materials that have gone through several stages of development and are declared ready to be used as teaching materials, then distributed on a limited basis at SDN Bonang I. The main target users of this teaching material are 24 students of SDN Bonang I. This learning material will be distributed through the Heyzine website which can be accessed by students using links and barcodes. Interactive E-Book teaching materials are designed with an attractive and interactive display, accompanied by a story rich in animation. This interactive E-Book teaching material can be accessed easily through various devices. This interactive E-Book is only provided for students of SDN Bonang I who can access it via mobile phones.

3.5 Effectiveness of Teaching Materials

The effectiveness of this teaching material will be measured using pretests and posttests to determine the increase in student understanding before and after learning. The pretest is conducted before the delivery of the material to measure students' initial knowledge, while the posttest is conducted after the treatment to evaluate the improvement of students' understanding. The results of these two tests will be analyzed using the N-Gain value, which calculates the relative improvement of the pretest and posttest results. The N-Gain value provides a clearer picture of how much improvement has occurred and how effective interactive e-book teaching materials are in improving students' reading comprehension skills. In conducting the pretests and posttests, 24 students will participate in measuring students' changes in reading comprehension. The results of the pretest and posttest are as follows.

Table 4. Pretest and Posttest Results

Pretest		Posttest	
Score	**Category**	**Score**	**Category**
28	Fair	57	Good

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From the pretest and posttest data contained in **Table 4**, it can be seen that there is a significant improvement in students' reading ability after the application of interactive e-books. The pretest score reached 28 (medium category) indicating that students' initial comprehension was still weak, while the posttest score increased to 57 (good category), reflecting a significant improvement in comprehension. This shows that the interactive e-book successfully improved students' reading skills. The assessment of reading ability was carried out in three stages, namely pre-reading, reading, and post-reading, in order to observe the development of comprehension based on more detailed indicators. In the pre-reading phase, the pretest and posttest used similar questions, but the context of students' comprehension was different. In the pretest, students made conjectures about the content of the text based on their existing knowledge, while in the posttest, after the learning process, students were able to predict the content of the text more accurately by connecting the concepts they had learned. The results of the pre-reading assessment covering literal, reorganization, and inferential indicators are presented in **Figure 13**.

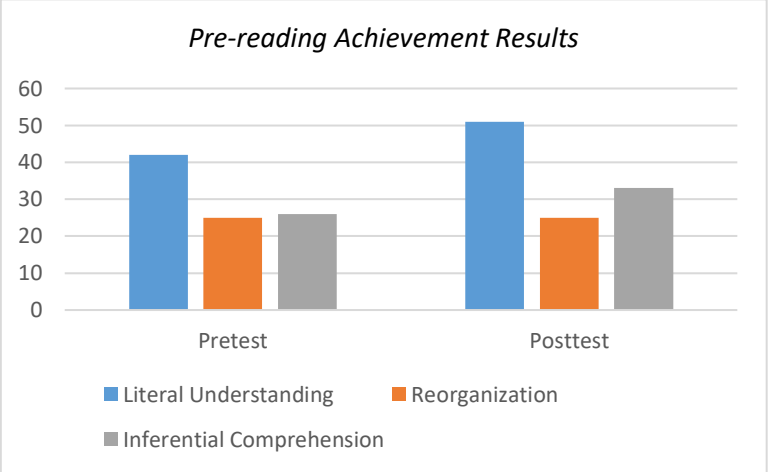

Figure 13. Pre-reading Achievement Results

Figure 13 shows the pre-reading achievement results based on three main indicators which are included literal comprehension, reorganization, and inferential comprehension. in the literal comprehension indicator, there was an increase in scores from 42 (fair category) to 51 (good category) after learning by using the interactive E-Book. This indicates that there is progress in students' ability to capture explicit information from reading. In contrast, for the Reorganization indicator, the pretest and posttest scores remained consistent at 25, which remains in the fair category. This indicates that students still have not made progress in the skill of reorganizing information from the text, possibly due to the unfocus of learning on this aspect. On the Inferential Comprehension indicator, the score increased from 26 to 33, although both remained in the fair category. This increase reflects a slight progress in students' ability to draw inferences from implied information, but still needs to be improved. In general, the use of interactive E-Books is effective in improving literal comprehension, but has less effect on reorganization and inferential skills. The assessment at the reading stage covered all four indicators, and the overall results are shown in the **Figure 14** below.

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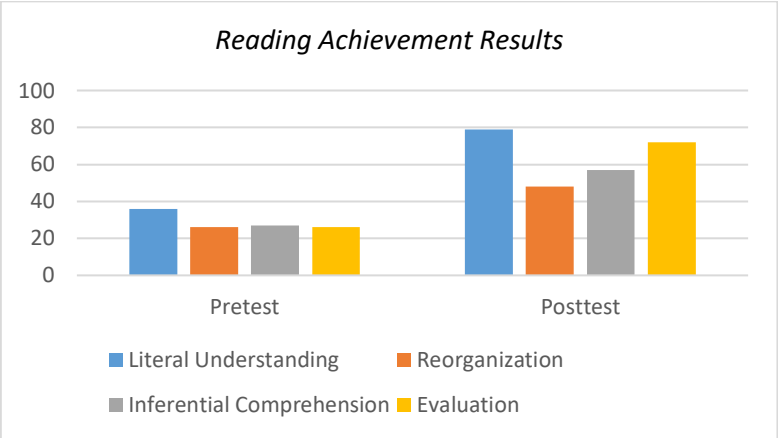

Figure 14. Reading Achievement Results

Figure 14 shows the results of reading achievement based on four indicators Literal Comprehension, Rearrangement, Inferential Comprehension, and Evaluation. In Literal Comprehension, scores jumped sharply from 36 (fair) to 79 (excellent), reflecting great progress in comprehension of clear information. Reorganization improved from 26 to 48, but is still in the fair category, indicating that the ability to reorder information still needs improvement. Inferential comprehension increased from 27 (fair) to 57 (good), showing progress in capturing implied meanings. Evaluation showed an increase from 26 to 72 (good), signalling progress in critically assessing text content. In general, all indicators showed improvement, with the most significant progress in Literal Comprehension. However, the Reorganization element still requires additional attention. This finding serves as a foundation for developing more efficient learning strategies. The post-reading stage evaluation included five indicators, and the results are summarized in **Figure 15.**

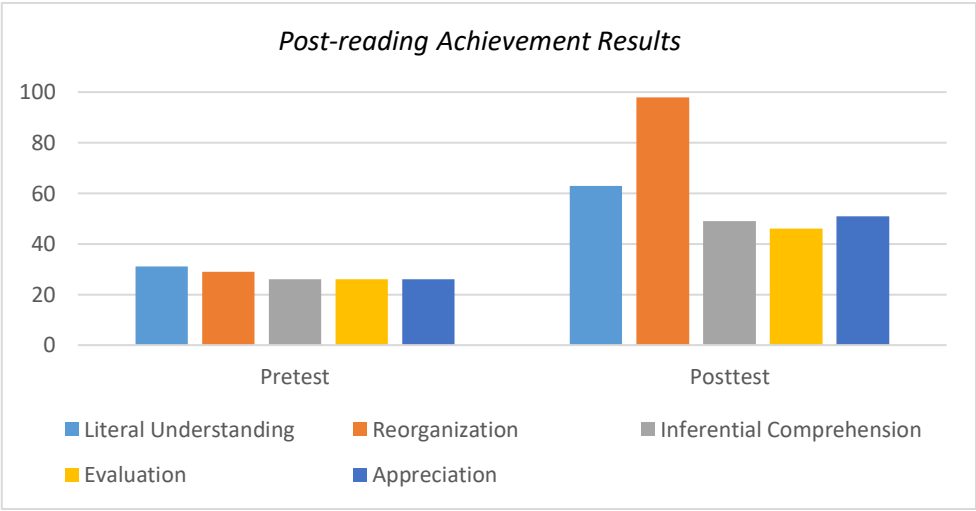

Figure 15. Post-reading Achievement Results

Figure 15 shows the results of the post-reading stage evaluation based on five indicators which are Literal Comprehension, Reorganization, Inferential Comprehension, Evaluation, and Appreciation. In Literal Comprehension, the score rose from 31 (fair) to 63 (good), indicating an improved ability to understand clear information. Reorganization achieved a large increase from 29 (fair) to 98 (excellent), showing rapid progress in reorganizing information. Inferential Comprehension increased from 26 to 49, but was still in the fair category, indicating a not fully optimal improvement in drawing conclusions from the text.

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Evaluation also rose from 26 to 46, but remained in the fair category, indicating that the ability to assess the content of the text was still not optimal. Meanwhile, Appreciation rose from 26 (fair) to 51 (good), reflecting improvement in appreciating the aesthetic value of the text. Overall, learning after reading has a positive effect, especially on the aspects of literal comprehension and rearrangement. However, skills in inference and evaluation still need to be improved. To find out the extent of students' comprehension improvement, an N-Gain test was conducted, the results of which are presented in the next **Table 5**.

Table 5. N-Gain Results

Data	Pretest	Posttest
Average	28	57
N-Gain	0,4	
Category	Medium	

Based on the data in the **Table 5**, the N-gain calculation results produced a value of 0.4 (40%) which is in the medium category. This N-gain value indicates that the use of interactive e-book teaching materials is quite effective in improving students' reading comprehension skills even though it is in the medium category. This means that learning using interactive e-books has a positive impact, but there is still room for further improvement in development so that the results can be more optimal. Overall, this N-gain analysis shows that there is an increase in student understanding, and the teaching materials used are quite successful in achieving learning objectives.

Effective interactive e-book teaching materials In line with this, Mayer (2009) Multimedia Learning Theory states that effective learning occurs when educational materials combine text, images, animation, and audio, following principles such as spatial contiguity, temporal contiguity, and modality. Spatial contiguity emphasizes placing related text and images in close proximity, while temporal contiguity advocates simultaneous presentation of audio and visuals to enhance comprehension (Chiu & Churchill, 2016; Husna et al., 2023). The modality principle suggests that using both visual and auditory channels can facilitate better information processing, thus enriching the learning experience (Suarsana et al., 2021). This theoretical framework is particularly relevant for designing interactive E-Books, as it provides guidance for optimizing multimedia elements, ensuring they support rather than overwhelm learners (Cavanagh & Kiersch, 2023; Ge & Lai, 2021). By applying these principles, E-Books can effectively engage students and improve students' understanding of complex concepts (Kanellopoulou et al., 2019).

4. CONCLUSION

The use of E-Books in education has many advantages, such as attractive displays, interactive, flexible, and environmentally friendly. However, there are still barriers such as limited tools, network access, and teachers' technological capabilities. Nonetheless, E-Books have the potential to support the digitization of education and flexible learning. Risks such as unequal access and misuse of content should be watched out for. For future development, it is recommended to include elements of educational games to make the learning process more interesting and meaningful for students. The development process follows the 4D model which are Define (determining needs), Design (designing the product), Develop (producing and improving the product), and Disseminate (circulating the product). This model guarantees quality and effective learning products. The results of the pretest and posttest

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analysis showed a significant increase in student understanding after using the interactive e-book, from 28 (fair category) to 57 (good category). The N-Gain of 0.4 (40%) indicates a medium category improvement. The interactive e-book proved effective in improving student comprehension, although there is still room for improvement.

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