

Digital Teaching Materials to Improve Students' Reading Skills Based on Ruddell Taxonomy in Senior High School

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Abstract: Digital teaching materials are essential in language learning, helping students understand reading. Reading comprehension can be obtained through the process of reading comprehension. Ruddell's taxonomy classifies reading comprehension levels into three groups, namely factual, interpretative, and applicative comprehension. This study uses Ruddell's taxonomy to determine the improvement of each reading comprehension level of public high school students in Bandung City after being treated using digital modules. This research used a quantitative method with a pre-experimental one-group pretest-posttest design. The subjects in this study were 10th-grade students in three public high schools in Bandung City, namely SMAN 1 Bandung, SMAN 19 Bandung, and SMAN 20 and non-test. Data analysis techniques in this study used quantitative analysis, which consisted of descriptive statistical analysis and inferential analysis. The data were tested for normality prerequisites, then continued with the nonparametric technique of the Wilcoxon test using the SPSS 24 application. The improvement of students' reading ability was known through the Normalized Gain test. The results showed a high-category increase in interpretative comprehension, a medium-category increase in applicative comprehension, and a low-category increase in factual comprehension. The treatment, with the help of digital teaching materials, caused a rise in students' reading skills.

Keywords: Digital; Reading skill; Ruddell taxonomy

Introduction

Digital teaching materials are critical supporting elements in learning. Teaching materials can also intersect with technology as a tool for teachers to deliver material to students, increasing and influencing motivation and improving learning conditions (Munawar et al., 2020). In language learning, digital teaching materials are essential to provide varied sources and reading materials to increase students' interest in reading.

Reading is one of the four language skills that students must master. Reading is not only the symbolization of letters and alphabets; more broadly, it can provide information for readers. Reading can also

be referred to as the process of obtaining messages to be conveyed by the author through written symbols (Tarigan, 2008).

One of the main actors in reading is the text, which functions as a medium to convey ideas, information, and meaning from the author to the reader. The hope is that the reader can understand the meaning or information in the reading. There are various types of reading, and the reading level can be divided into two parts: beginning reading and advanced reading. Beginning reading is usually done by elementary school children, while advanced reading requires more complex understanding and application (Rikmasari & Lestari, 2018). One type of advanced reading is reading comprehension.

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Reading comprehension can be central to all subjects as it underpins learning activities. The definition of reading comprehension is when the reader connects the information obtained from the text with the knowledge he already has to build a representation of the text. Another definition of reading comprehension is a simultaneous process that involves decoding words, understanding sentences, connecting ideas and text, and evaluating and criticizing information in the text.

The primary purpose of reading is the ability to comprehend reading (Duke & Cartwright, 2021; Magdalena et al., 2021; Snowling et al., 2022). Reading comprehension can be the core of all subjects because it underlies learning activities. The definition of reading comprehension explained by Kintsch (1998) is the process by which the reader connects the information obtained from the text with the knowledge he already has to build a representation of the text. Another definition explained by Snow (2002) about reading comprehension is a simultaneous process that involves decoding words, understanding sentences, connecting ideas and text, and evaluating and criticizing information in the text.

Tabel 1. Rudell's Reading Taxonomy

Competence	Level of Understanding		
	Factual	Interpretative	Applicative
Explanatory ideas	√	√	√
a. Identifying	√	√	√
b. Comparing		√	√
c. Classifying	√	√	√
Sequence	√	√	√
Cause and Effect	√	√	√
Main Idea		√	√
Predict		√	√
Assessing	√	√	√
a. Personal	√	√	√
Assessment			
b. Characterization		√	√
Identification			
c. Identify Author's Motif			
Problem Solving			√

Nurbaya et al. (2018) divides comprehension into three aspects of comprehension levels namely: the factual level of comprehension related to understanding the explicit information contained in the reading; the second level of comprehension, namely interpretative comprehension related to the reader's ability to understand implied information in reading; and the third level of comprehension, namely the applicative level related to the application of reading content to find information intended by the author. Ruddell suggests the importance of reading comprehension skills at each level so that readers can thoroughly understand the text.

Ruddell's reading taxonomy can be used to help educators and learners understand the various aspects and objectives of the reading process so that appropriate strategies can be determined in learning to improve students' reading comprehension (Nurbaya et al., 2020; Ruddell, 2005). The Ruddell reading taxonomy can be seen in the Table 1.

Ruddell's taxonomy is a framework used to understand the levels of reading and reading comprehension skills. There are three different levels: the factual comprehension level, which provides basic information about facts presented explicitly in the text. The interpretive comprehension level is the next level of comprehension in Ruddell's reading taxonomy, which involves interpreting implied information in the text. The third level is the applicative comprehension level, which involves applying information gained from the text to solve a problem (Ruddell & Ruddell, 2005).

This study was conducted in three public senior high schools (SMA) in Bandung City. During the initial interview, teachers from all schools mentioned that students were less interested in reading activities. Teachers explained that students often complained about the large number of texts in reading activities in Indonesian language learning. Teachers also face difficulties fostering students' interest in reading and finding texts appropriate for their developmental level.

The younger generation's reading process is more concerned and focused on information retrieval rather than reading as a complex experience (Kim, Burkhauser, et al., 2021; Kim, Relyea, et al., 2021). As a result, the reading process becomes more fragmented and ignores the structure and sequence of the content because it only focuses on the information to be obtained. Therefore, young readers are likelier to be bored, overworked, and impatient during reading (Kuhn, 2019).

OCED (Organization for Economic Co-operation and Development) explains the importance of reading literacy in reflecting on potential and developing knowledge to participate in society by understanding and using written text. The urgency of reading is not in line with the level of interest in reading among students in Indonesia. Santoso (2022) mentioned that after carrying out the Minimum Competency Assessment (AKM), the results showed that students' abilities still need special intervention. For example, if students are faced with reading material that has many pages, students will complain. This is in accordance with the statement from the teacher during the initial research study, which states that students often feel bored if the text presented is too long.

Based on the problems described by the teacher, appropriate teaching materials are needed to increase students' interest and reading ability. Along with the times, reading activities are paper-based and can be

carried out digitally. Sezgin (2022) mentioned that digital readers have an advantage over paper-based readers in that digital readers can have more complex interactions than print readers. For example, digital readers can more quickly access information with the availability of various media components such as audio, visual, and video.

The development of digital teaching materials has also Multifah et al. (2023) been carried out by the title "Development of Multiliteracy-Based Digital Teaching Materials to Train Reading Comprehension Skills in Elementary School". The study developed digital teaching materials that are innovative and exciting so that they can produce teaching materials that are feasible and can be used to train students' reading comprehension skills.

Other research on reading skills has shown that the comprehension of seventh-grade students at SMP Negeri Rejang Lebong still needs to improve (Sari et al., 2020). The research was collected using tests, observations, interviews, and documentation. Data analysis was also carried out qualitatively and quantitatively, showing that students still needed help explaining the text content they read. Based on the study results, the lack of interest in reading is due to the lack of reading hobbies, and students are more interested in social media than reading activities.

Another study conducted by Maulidia et al. (2018) entitled "Reading Comprehension Ability of Class VII Students of State Junior High School in North Pontianak District" obtained the results of the average score at each level (factual, interpretative, and applicative) as a whole can be concluded that the ability of students is in the medium category. The background of the study is the unknown reading comprehension ability of public junior high school students in North Pontianak. The researcher in the study gave advice on how to improve and develop students' reading skills because it will affect the improvement of their learning achievement.

Based on some of the research above, it is necessary to conduct further research on the reading comprehension of high school students. This research shows the importance of using digital teaching materials to improve student's reading comprehension skills based on the three levels of Ruddell's taxonomy reading categories.

Method

The method used in this research is a quantitative method with the type of pre-experimental research design one-group pretest-posttest. Experimental research methods are used to determine the effects of certain treatments whose data are analyzed statistically

(Creswell & Creswell, 2018). The one-group pretest-posttest design was used because the subjects in the study were limited, so the control class and experimental class could not possibly be formed by the researchers. The purpose of this study was to determine the improvement of the reading ability of grade X in Bandung City before and after the treatment was given based on Ruddell's Taxonomy. This study used instruments with test and non-test techniques. The test technique used instruments in the form of reading questions related to reading comprehension according to the three levels of Ruddell's reading taxonomy. The three levels in Ruddell's taxonomy include factual comprehension, interpretative comprehension, and applicative comprehension. The tests used in this study used pretest (initial test) and posttest (final test). The step is given in the form of treatment (X) between the pretest (O1) and posttest (O2).

Table 2. One-group Pretest-Posttest Method Design

O1	X	O2
Pretest (before treatment)	treatment	Posttest (after treatment)

The non-test techniques used in this study were interviews and documentation. Data were collected from reading skill tests as primary data. The reading skill test questions totaled 11 questions with details of 9 objective test questions and two subjective test questions that had been adjusted to the level of Ruddell's reading taxonomy. Furthermore, the instrument was validated by experts using content validation techniques as a data collection tool. The data analysis technique in this research uses quantitative analysis, which consists of descriptive statistical analysis and inferential analysis. The data were tested for normality prerequisites, then continued with the Wilcoxon test nonparametric technique using the SPSS 24 application. The sampling technique was simple random sampling with a population of class X students from public high schools in Bandung. Then, three public schools in Bandung City were taken, namely SMAN 1, SMAN 19, and SMAN 20 Bandung City, each class.

Result and Discussion

The data from the research on the reading ability of grade X students of public senior high schools in Bandung City are described as follows. The researcher used Ruddell's three levels of reading comprehension taxonomy to identify the reading comprehension level of students in three public senior high schools (SMAN) in Bandung City. According to Ruddell's taxonomy, the three reading comprehension levels are factual, interpretive, and applicative (Zuchdi, 2008) (Zuchdi,

2008, hlm. 100). The four reading comprehension levels are divided into 11 test questions, which can be seen in Table 3.

Table 3. Rubric for Student Reading Test Questions Based on Ruddell's Taxonomy

Comprehension Level	Question Number
Factual	1, 2, 7
Interpretative	3, 4, 6, 8
Applicative	5, 9, 10 description no 1

The students' reading ability test was based on the rubric and divided into nine multiple-choice objective test questions and two subjective test questions (descriptions). The questions were given to students for the pretest and posttest to obtain the following recapitulated results from three public high schools in Bandung City.

Table 4. Descriptive Statistics of Pretest and Posttest of Students' Reading Ability from the Three Schools

	N	Min	Max	Mean	Std. Deviation
Pretest	79	32	92	74.37	12.694
Posttest	79	65	99	87.14	7.825
Valid N (listwise)	79				

Based on the Table 4, 79 students from the three schools were used as research samples. The minimum score obtained was 32 during the initial test (pretest) and 65 during the final test (posttest). The average of students' reading skills between the pretest and posttest also increased from 74.37 to 87.14.

Before analyzing the improvement, the pretest and posttest data from the three schools were tested for normality as a prerequisite test. The normality test was conducted using SPSS 24 for Windows. The tests conducted were Kolmogorov-Smirnov and Shapiro-Wilk, which are described in the statistical Table 5.

Table 5. School-wide Normality Test

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	0.186	79	0.000	0.879	79	0.000
Posttest	0.124	79	0.004	0.926	79	0.000

a. Lilliefors Significance Correction

The table above shows that the sample used is 79, which is symbolized by df, so it uses the Shapiro-Wilk test because the Kolmogorov-Smirnov test is used if the data ≥ 100 . The sig value obtained from the Shapiro-Wilk test based on the table is 0.000, so the normality test shows that the pretest and posttest data have a significance value ≤ 0.05 . The conclusion that can be drawn from the normality test above is that the data is not normally distributed, so further testing uses

nonparametric techniques with the Wilcoxon test, which can be seen in the Table 6.

Table 6. Wilcoxon Test of Students' Initial and Final Test Data

Parameters	Pretest - Posttest
Z	-7.004 ^b
Asymp. Sig. (2-tailed)	0.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Table 6 shows the difference in pretest and posttest scores tested using the Wilcoxon test. The significance value obtained based on the Wilcoxon test displayed in Table 6 is 0.000. The significance value obtained is $0.000 \leq 0.05$, so the hypothesis used is H0 rejected and H1 accepted. There is a significant difference between the initial test and the final test if the sig value is ≤ 0.05 , while if the sig value is ≥ 0.05 , then there is no significant difference after treatment. Based on the Wilcoxon test conducted on the pretest and post-test scores of reading skills after the treatment, there is a significant difference between the initial test and the final test of students' reading skills. The improvement of reading skills can be determined by the Normalized Gain test, which is calculated using the formula developed by Hake (1998), with categorization that can be seen in Table 7.

Table 7. Categorization of N-Gain Values

N-Gain Value	Category
$N - \text{Gain} \geq 0.7$	High
$0.3 \leq N - \text{Gain} < 0.7$	Medium
$N - \text{Gain} < 0.3$	Low

Hake (1998) categorizes the normalized gain value into three categories: high, medium, and low. The following figure shows the overall pretest and posttest data from the three schools categorized based on the normalized gain test.

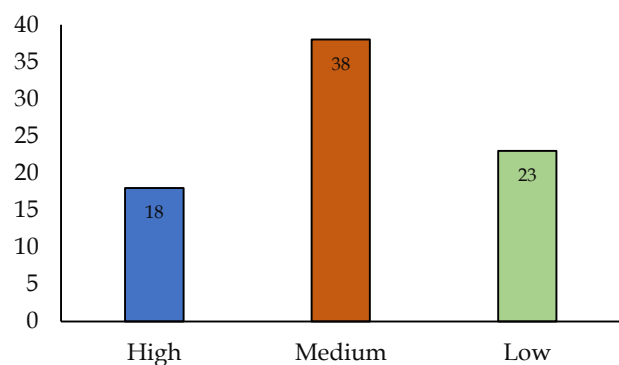


Figure 1. N-gain categorization of preliminary and final tests

Bar chart 1 above shows the increase in pretest and posttest scores from the three schools tested. There were

18 samples in the high improvement category, 38 in the medium improvement category, and 23 in the low improvement category. Based on the normalized Gain test, the overall pretest and posttest scores of the three schools were mostly in the medium category. The following table shows the improvement of students' pretest and posttest scores according to Ruddell's taxonomy from each school.

Table 8. Improvement in Pretest and Posttest Scores Based on the Normalized Gain Test

Ruddell taxonomy categories	SMAN 1 Bandung	SMAN 19 Bandung	SMAN 20 Bandung
Factual	0.0	0.2	0.0
Interpretive	0.7	0.6	0.3
Applicative	0.5	0.5	0.5

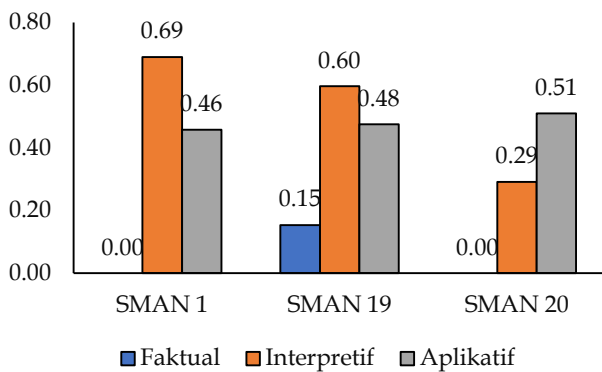


Figure 2. Improvement of students' reading ability based on ruddell taxonomy

Based on the Table 8, the increase in pretest and posttest scores in the high category is only found in the interpretive level with a value of 0.7 at SMAN 1 Bandung. The increase in pretest and posttest interpretive levels in SMAN 19 Bandung and SMAN 20 Bandung is still in the moderate category. The Applicative level in all three schools was still in the medium improvement category. The Factual level was in the low improvement category in all three schools.

Figure 2 shows that the interpretive level at SMAN 1 Bandung has the highest improvement in terms of normalized Gain value. The factual comprehension level is the only category with low improvement. Moderate improvement is found in the applicative comprehension level, which has almost the same improvement in all three schools. Overall, the treatment using digital reading materials increased the initial and final test scores.

The Wilcoxon nonparametric statistical test also showed a significant difference between the initial and final tests of students' reading comprehension. The difference is an increase in value after being treated with digital teaching materials. Digital devices developed

into teaching materials can help with classroom learning activities, making it easier for students to be comfortable learning even at home. Digital teaching materials that can be accessed through smartphones, laptops, and tablets attract students' attention more than traditional methods (Seethal & Menaka, 2019). Another advantage of digital reading activities is the variety of information combined through platforms that can flexibly contain a variety of text, audio, and visuals with the help of hyperlinks, helping students obtain additional information.

The existence of student freedom in acquiring knowledge with the help of digital teaching materials is expected as an application of the principle of learning integration so as to realize a holistic and contextual student learning experience. Holistic experience can be achieved if the teacher can provide a comprehensive understanding of the material studied so that students can apply it in their daily lives. Contextual experience can also be obtained by students if the material can be related to real-life experiences by students (Rahmadila et al., 2024).

Digital teaching materials as a learning resource can help realize a holistic and contextual student learning experience because they can provide information in an interesting and interactive way. Unfortunately, students' reading competence has not obtained maximum results, as evidenced by the initial test before using digital teaching materials; the minimum score obtained by students was only 32 out of a maximum score of 100 (see Table 3). Not maximizing students' scores in the reading test can be interpreted as the initial ability of students before the use of digital teaching materials is still low. Pratama (2022) explained that the low reading ability of students is characterized by the lack of students understanding of the reading.

Students' initial ability in reading, which is still low, is also influenced by external factors, namely environmental factors (Fortus & Touitou, 2021; Nurwidodo et al., 2020; Pitoyo, 2020). Lamb et al. (1975) said that the reader's environmental factors can affect the reading comprehension process. The environmental factors in question are the places around the reader. If the context is in classroom learning activities, then what is included is the condition of the class, the atmosphere, and the facilities used by students in the reading process. These facilities also include teaching materials used during the reading-learning process.

The importance of using digital teaching materials can also be seen in the improvement on the reading comprehension level based on Ruddel's taxonomy. There are three categories, namely factual, interpretive, and applicative. The factual level relates to the reader's ability to understand explicit information in reading. Based on Table 8, the increase in pretest and posttest

scores from the Normalized Gain test can be seen as the factual level having the lowest increase compared to the other two reading comprehension levels. This is influenced by the results of reading comprehension of students to find explicit information, which is good, so the digital teaching materials provided have a less significant effect on their improvement. This shows that digital teaching materials can less improve factual understanding if students already have a strong foundation in finding explicit information in reading. When students focus on explicit information, the ongoing cognitive process is recognizing or recalling factual details, main thoughts, a sequence, comparisons, cause-and-effect relationships, and character traits (Heilman et al., 1981).

Based on Table 8, another level of understanding, interpretive, is highly improved at SMAN 1 Bandung according to Hake (1998) categorization. Overall, in the three schools, the interpretive level has significantly improved. The interpretive level is related to the reader's ability to understand the implied information in the reading. The level of understanding, the reader must try to find information the author does not directly mention (Alexander, 1988). In this stage, students, as readers, have the potential to make mistakes when summarizing the reading. After being given the treatment, students minimize the potential for errors in reading conclusions, as evidenced by the increase in post-test scores in the high category.

The third level that has increased based on the normalized Gain test is the level of applicative reading comprehension. This level relates to the ability of readers who can apply ideas or information conveyed by the author. Students, as readers, will try to find what the author means and then think about how to use that knowledge. The three schools in grade 10 tested for reading comprehension ability showed significant improvement results, although the increase is still in the medium category after being tested for normalized Gain at the level of applicative comprehension.

Conclusion

Digital teaching materials, as one of the learning resources, can help realize a holistic and contextual student learning experience because they can provide information that is exciting and interactive. Competencies that digital teaching materials can support are reading comprehension competencies that are included in advanced reading. Reading comprehension is done to connect previously owned information with the representation of information that has just been obtained in reading. Ruddell categorizes reading into three comprehension levels: factual,

interpretative, and applicative. Factual comprehension is related to the explicit information in the reading. Research on students' reading skills in Bandung City shows that students' factual understanding of reading is good, so they experience a minimal increase before and after being treated with digital teaching materials. The second level is interpretative comprehension, which relates to the implied information in the reading so that students can find the conclusion intended by the author. After being given treatment using digital teaching materials, there was an increase with a high category in students' factual reading comprehension. The third level of understanding is the applicative level, which relates to applying the information obtained from reading. The increase obtained by students in applicative comprehension is included in the medium category increase between before and after treatment. Using digital teaching materials improves three reading comprehensions based on Ruddell's taxonomy despite the different improvement categories.

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Conflicts of Interest

The authors declare no conflict of interest.

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