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The Effectiveness of Multimedia Learning in Enhancing Reading Comprehension Among Indigenous Pupils

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Abstract
The development of education is growing, and the technology-infused lesson is a powerful tool to attract pupils' attention, especially in reading. This approach can be seen as an adaptive movement to equip the learning process and the fourth industrial revolution. Nowadays, the demand of the technology-infused lesson is increasing as it is proven to help pupils learn the language better. Hence, this study explores multimedia learning as an approach to teaching reading comprehension. Besides, this study aims to answer two questions, which are the effectiveness of multimedia learning in helping indigenous pupils learn comprehension and which elements of media are effective in enhancing reading comprehension among indigenous pupils in Malaysia. Two instruments used to collect the data from 20 indigenous pupils in one primary school located in Kluang, Malaysia, and an action research design was used to achieve the purpose. The respondents were chosen through the judgment sampling technique. SPSS was used to analyse the data collected from the test, and thematic analysis was employed to analyse the semi-structured interview. The result shows that the implementation of multimedia learning in teaching reading comprehension is useful as the combination of multiple elements of media scaffolded the process of understanding. On the other hand, audio is the least effective in helping pupils comprehend the information.
Keywords: Esl learner, indigenous pupils, multimedia learning, reading comprehension, technology-infused lesson

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Introduction

Malaysian education has shown tremendous progress from year to year, especially in terms of language skills. Despite the progress, indigenous pupils did not share the same glory as others. As reported by Renganathan (2016), the current education syllabus for indigenous pupils is not suitable for them, and we are imposing our education system on them. Hence, a new teaching approach is needed to compensate for the loophole.

Reading comprehension learning is a never-ending issue for the indigenous pupils as they were having a problem in conceptualising the information taught in class. Most of them were living in a rural area and not exposed to the outside world, which leads to poor language proficiency. According to Wahab, Jaafar, Mustapha, Kamis, and Affandi (2017), the factors influencing the problems were their parents' educational background, low confidence level, and limited general knowledge. Thus, visual stimulation is perceived as a plausible way to help the children comprehend the information in the reading comprehension lesson. Malaysia has started to implement technology-infused lessons in its education system to help the pupils familiar with recent trends of global education, as stated in the research by Karthigesu and Mohamad, 2020; Rafiq and Hashim, 2018; Yunus, Yaacob, and Suliman, 2020. In their research, the teachers and policymakers are aware of the importance of technology in assisting the learning process, especially for low proficiency pupils.

Besides that, the use of technology in teaching language has become a new trend among educational practitioners. This trend can be seen among the new generation as most of them rely on technology-based devices, software, and social media (Ahmad & Yamat, 2020; Yunus, Yen, Khair, Yusof, & others, 2020). Much research on the use of technology in learning language has proven the positive effect that is deemed useful for the learner (Bani-Hamad & Abdullah, 2019; Parvin, Omar, Osman, & Tamam, 2019). Besides, exciting features offered by technology-infused lessons helped guide the pupils to visualize the information through visualisation and boosting their confidence level in learning (Dedo & Hashim, 2019).

Despite the emergence of technology in the Malaysian education system, the research or study of the technology-infused lesson to indigenous pupils was rarely seen. It happened due to a lack of exposure to the teacher, inadequate resources, and the school's location, as reported in the research by Fazil, Ehsan, & Said, 2020. Most of the pupils live in rural areas and have no internet connection, which resulted in a lack of technology-infused lessons by the teacher. This problem has arisen the need to study the effect of multimedia learning on indigenous students as its findings will contribute to policy marker in planning the education development for them.

Therefore, the problem with reading comprehension and the lack of use of technology in lessons among indigenous pupils ignited the idea of combining both things into one. The idea led to the cognitive theory of multimedia learning, which suggested that the use of technology in learning can increase pupils' comprehension skills in understanding and visualizing the lesson. The cognitive theory of learning, which focuses on multimedia learning, has been popularised by Richard E. Mayer. It explained the process of comprehension in the human brain that occurred when people build mental representations from words and pictures (Mayer, 1997). Generally, the theory addresses how the teacher may structure their multimedia instructional practices and utilise

more effective cognitive strategies to help pupils process the information efficiently. Therefore, the purpose of this study is to investigate the effect of multimedia learning in teaching reading comprehension among indigenous pupils. It also explores the elements that influence multimedia effectiveness in enhancing reading comprehension among indigenous pupils.

Literature Review

Reading Comprehension

Children's willingness to read or comprehend the text is commonly believed to be based on the content and the excitement factor of the materials. The materials should be able to raise children's curiosity to help them read independently. Besides that, the content of the materials also has an impact on the children's reading performance and attitude (Asher, 2017). Therefore, researchers have built various theories and models to explain the process in order to understand comprehension and the processes involved. Some of the theories and models of the cognitive process have been discussed in the study by the researcher to examine the cognitive process, and the process is defining the meaning of comprehension. Comprehension is a cognitive process that the reader executes in decoding the information using bottom-up, top-down, or interactive model (Birch, 2007; Cohen & Upton, 2006; Gough, 1972; Gough & Cosky, 1977; LaBerge & Samuels, 1974). Besides that, comprehension also might be related to memorisation of the reader. The study by Carroll (1971) listed several techniques or methods to understand the comprehension process, and one of them is the reproduction of the information in other forms. The better memorization skills they have, the higher the chances for the pupils to reproduce the information in other forms. Memorisation of the information can be assisted through suitable verbal and image stimuli.

Multimedia Learning Approach in Education

The approach of multimedia learning is where the learners are going to be exposed to the utilisation of audio, pictures such as animation, video, and technology throughout reading comprehension lessons (Mayer & Moreno, 2002). Two components compose the process of reading comprehension, which are vocabulary knowledge and text comprehension. Besides that, multimedia learning can be used to support the children using their prior knowledge and new vocabulary to comprehend the text. Furthermore, the multiple components in multimedia learning can assist the learning process and boost their motivation to learn. Utilizing technology within the classroom is usually closely connected with the term multimedia learning, and the advancement of technology has to make the incorporation of multimedia easier and more complete. In general, the term "multimedia" is employed to indicate any sort of activity or application that used multiple types of media to present information or idea such as video, animation, and many more (Berk, 2009). The implementation of multimedia in text comprehension also able to improve memory retention, learning satisfaction, and learning achievement on the information presented using multimedia learning (Chiou, Tien, & Lee, 2015).

Principle Design of Multimedia

Mayer built an instructional model on how multimedia learning will help learners understand a scientific explanation by listing five principles of multimedia design (Mayer, 1997). The first principle, modality, explained the advantages of presenting information using two modes of presentation rather than one mode, such as the combination of words and picture or animation and audio narration. The modality principle can also help pupils to learn complex materials and

perform higher-order thinking skills (Fiorella, Vogel-Walcutt, & Schatz, 2012). The next principle is the contiguity principle, where the mode of presentation should be kept closed to make it related to each other rather than presented it separately (Fletcher & Tobias, 2005; Mayer & Moreno, 1998a). As an example, the explanation of cloud formation using picture and audio is better presented at the same time to ensure pupils can relate to both modes of presentation. The third principle, which is the split-attention principle, suggests words are better presented in auditory form rather than in text form in animation or video (Liu, Lin, Tsai, & Paas, 2012). The fourth principle is that individual differences and the effects of contiguity and split-attention differ with individuals. According to the CTML, pupils who have high-level prior knowledge will be able to create their mental image, and contiguity is not suggested for them.

On the other hand, pupils with a low level of prior knowledge might benefit from contiguity and split-attention. The last principle of multimedia learning, the coherence principle addresses the disadvantages of superfluous information in learning. According to Mayer, Heiser, and Lonn (2001), the materials presented in multimedia learning should avoid using too many words and pictures. Instead, use reasonable and essential words and pictures to foster pupils' understanding.

The Fusion of Multimedia Learning Theory and Dual Coding Theory in Reading Comprehension

The cognitive theory of multimedia learning discussed the process of comprehension with the aid of multiple media. The psychological feature of the cognitive theory of multimedia learning (CTML) targeted on the thought that learners decide to build meaningful connections between words and photos which they have learned a lot more deeply than the use of words or photos solely in the reading text (Kirschner, Park, Malone, & Jarodzka, 2017). In step with CTML, one of the principal aims of multimedia instruction is to support the learner to create a logical and reasonable mental representation from the information. The learner's job is to construct new information as an active participant ultimately. The learners can visualise and build mental images based on learning and be able to comprehend the text better using multimedia learning.

Meanwhile, the dual coding theory (DCT) by Allan Paivio attempts to prove the importance of two mental processing, which are verbal and non-verbal processing (Clark & Paivio, 1991). The theory explains how human brain processing information through the combination of verbal and nonverbal representations such as image and speech (Paivio 1986). Learning and cognitive processing are the two-issues investigated by the researcher to maximize the potential of successful learning and improving our brain ability in processing information. The dual coding theory emphasized the importance of visual cues in the learning as humans can decode the information they received effectively by linking the verbal and visual cues(Paivio, 1990; Sadoski & Paivio, 2013).

A concept of multimedia learning is closely related to the dual coding theory, as both theories accentuate the benefit of the human brain's duality function as an aid to the cognitive process in reading comprehension. Many researchers show a promising finding in their study when incorporating dual coding theory in reading comprehension, as stated in the study by Wang, & Li (2019), where students with imagery deficit able to recall and remember the words or information better with the help from innovative multimedia application. In their study, they found that

imagery-deficit students were having problems reading comprehension because of their slow and dull imagination and led to the failure to create a mental image. The failure to link the text and image resulted in the students' behavior as they could not understand and remember the information. Then, the researcher introduced a multimedia application that helps the students relate the words and pictures and the students' performance in reading comprehension. The relationship between multimedia and dual coding theory is proven through this research by Richard E Mayer, & Moreno (1998) when they discovered a split- attention in multimedia correlate with the theory of dual-coding theory and a group of students which received treatment with two stimulus shows better performance that other group which receives only one stimulus. In a nutshell, the combination of words and image catalyzed to boost readers understanding by ensuring the reader can create a mental image and link it to the text especially for the children who have

Methodology

Research Design and Research Questions

The idea of Action research, as described by Altrichter, Kemmis, McTaggart, and Zuber-Skerritt (2002), was used to conduct this study. The study employed five cycles of research by implementing different elements of multimedia to find out the effectiveness of each element in multimedia learning. The study aimed to answer two research questions, which are "how effective is multimedia learning in enhancing reading comprehension among indigenous people?" and "which elements of multimedia is effective in helping comprehension process among pupils?"

Participants and instruments

Based on this study, action research conducted in an indigenous primary school in Johor, Malaysia. Twenty pupils were selected based on their level of proficiency and reading fluency ability. Purposive sampling was used in this research, and all the participants have a low level of proficiency but mediocre in reading fluency.

The study employed two instruments in conducting the research, which involves a semi-structured interview and test. The test given to pupils was in the form of a worksheet and consisted of eight questions testing their comprehension skills. Meanwhile, a semi-structured interview is used to explore the pupil's opinion on multimedia learning in enhancing reading comprehension skills.

Procedures

A pre-test was given to the pupils before implementing the intervention to evaluate their reading comprehension skills. After that, every week, the pupils were taught using three elements of multimedia: audio, picture, and audio, to test each element's effect on pupils' comprehension skills. Lastly, the pupils were taught using a combination of all three media, as depicted in multimedia learning earlier. Then, the post-test was given to evaluate multimedia learning's effectiveness in enhancing reading comprehension skills. Finally, the interviews were conducted among the pupils to find out their opinion on the infusion of multimedia learning in reading comprehension lessons.

Data Analysis

Quantitative and qualitative data analyses were used in analyzing data collected from the instruments. Data collected from pre-test, post-test, and test were analyzed using SPSS software

to compare the findings. A semi-structured interview was analyzed using thematic review. The data from pre-test, post-test, and interview were used and compared to answer both research questions.

Findings and Discussions

First Research Question

Table 1. *Pre-test and post-test score*

PARTICIPANTS	PRE-TEST	POST-TEST	MARGIN OF DIFFERENCE
1	2	8	6
2	3	8	5
3	3	7	4
4	3	8	5
5	3	8	5
6	3	8	5
7	3	8	5
8	2	8	6
9	2	8	6
10	3	8	5
11	2	8	6
12	4	8	4
13	4	7	3
14	3	7	4
15	4	8	4
16	3	7	4
17	3	8	5
18	3	7	4
19	2	7	5
20	3	7	4
OVERALL MEAN SCORE	2.90	7.65	4.75

From table one, it can be seen the increasing mean from pre-test (2.90) to post-test (7.65). It showed the results of pupils' comprehension skills in answering the comprehension text before using multimedia in the pre-test and after using multimedia in using the post-test. The mean difference (4.750) showed a considerable increase in the score test after the intervention implemented on teaching reading comprehension.

Table 2. *Paired sample test analysis on the implementation of multimedia learning in teaching reading comprehension*

	Mean	Std. Deviation	Std. Error Mean	T	df	Sig. (2-tailed)

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Pair 1 score on test before intervention - score on test after intervention	-4.750	.851	.190	-24.971	19	.000

According to the paired samples test in table two, the P-value is below 0.5; thus, it is statistically significant, and the null hypothesis is rejected, which could be concluded that a significant difference does exist in this study. Furthermore, the association between the dependent variable and the independent variable is statistically significant. Thus, it has proven the assumption that the use of multimedia in teaching reading comprehension among indigenous pupils does enhance the pupils' comprehension ability. After the post-test, the interview was conducted to explore the pupils' opinions on multimedia learning.

Table 3. *Analysis of semi-structured interview*

Emerging Theme	Frequency	Percentage (%)
Developing comprehension skills	15	39.47
Vocabulary retention	6	15.78
Mental image creation	10	26.32
Learning satisfaction and motivation	7	18.43
Total	38	100

Based on the findings in table 3, 39.47%, or with a frequency of 15 responses, the pupils had mentioned they felt more comfortable in using multimedia learning to optimize their text comprehension. The pupils effectively used the elements available in multimedia in associating information taught with their existing knowledge. This finding is reflected in the response provided by the pupils when they agreed that multimedia learning facilitates the process of understanding text through multimedia. The findings showed that the pupils were able to recall the memory of the words during the test. Hence, it has proven that the proper stimulus used in multimedia learning can help the pupils to recall the vocabulary knowledge through memorization with an agreement of 15.78% or with a frequency of 6 responses, as depicted in table 4.3. In another response from an interview, a pupil recalled his vocabulary knowledge while interviewed. It showed the pupil was able to memorize and store the information in short- and long-term memory and recalled them if needed to comprehend it.

Besides that, the ability to create mental images based on the information learned is also one of the effects associated with multimedia learning, as illustrated in table 3, as 26.32% or with a frequency of 10 responses agreed. The pupils declared they were able to understand the information on comprehension text by creating a mental image. This finding is supported by a response from an interview as pupils agreed the use of textbooks hindered the process of comprehension and creating mental images. However, the implementation of multimedia learning while learning reading comprehension is assisting them in imagining and building meaningful visualization of the text discussed in class. Furthermore, the pupils agreed that creating mental images was possible due to multimedia learning, and it has proven its effectiveness in assisting pupils to comprehend. This finding comes as no surprise as it illustrates how the human mind

works according to dual coding theory, as found in the study by Clark and Paivio (1991); Paivio (1986); Paivio (1990); Sadoski and Paivio (2013).

The education field nowadays demands fun and interactive lesson in the classroom to attract pupils' attention. Without a doubt, multimedia learning has its share in ensuring the pupil's learning satisfaction and motivation are not being neglected. In order to process information, a conducive environment is needed to enhance pupils' reading comprehension, which is expertly handled by multimedia learning. In this study, the pupils revealed that they enjoyed and felt motivated to learn reading comprehension with multimedia as it offers a fun, exciting, and interactive learning experience. Given these points, it can be said that multimedia learning is effective in enhancing pupils' reading comprehension. It lessens the classroom anxiety, which conforms with Krashen (1983) and Krashen and Terrell (1983) studies on the theory of second language acquisition, which focuses on the affective filter hypothesis. The hypothesis explained the need for pupils to feel positive to acquire the second language and negative emotions such as embarrassment and fear of the unknown could hinder the acquisition (Du, 2009; Huang, 2012).

Second Research Question

Multimedia learning holds multiple elements of media, and a test was needed to evaluate the most effective elements in enhancing reading comprehension among indigenous pupils. The statistical test was chosen to analyse the data collected from the pupils. One-way ANOVA seems like the best option to reveal the finding which started with the null and alternate hypothesis, as stated below:

i. Null Hypothesis: There are no significant differences in the effectiveness of the three media elements in pupils' reading comprehension skills
ii. Alternate hypothesis: There are significant differences in the effectiveness of the three media elements in pupils' reading comprehension skills

Table 4. *Descriptive analysis elements of multimedia*

	N	Mean	Std. Deviation	Minimum	Maximum
Audio	20	3.40	1.095	1	5
Picture	20	5.05	.887	4	7
Video	20	6.45	.605	5	7
Total	60	4.97	1.529	1	7

Based on table four for the sample of this study (n = 20), the mean score of multimedia element effectiveness for video scored higher (m = 6.45, SD = 0.605, n = 20) compared to audio (m=3.40, SD=1.095, n=20) and picture (m=5.05, SD=0.887, n=20)

Table 5. *Result of differences between elements of multimedia using ANOVA*

	Sum of squares	Df	Mean square	F	Sig.
Between groups	93.233	2	46.617	59.444	.000
Within groups	44.700	57	.784		
total	137.933	59			

Meanwhile, based on table five, the findings revealed the *p*-value is < .00001; thus, the result is significant at $p < .05$ and indicated that the null hypothesis rejected. It can be concluded that there is enough evidence-based on 95% confidence interval to announce there are significant differences in the effectiveness of the multimedia elements in the reading comprehension skills of the pupils with F(2,57) =. 3.15; p< 0.05. Henceforth, the need for post hoc analysis is needed to identify and distinguish between the three elements.

Table 6. *The Tukey Post Hoc Test analysis on elements of multimedia in multimedia learning*

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.
AUDIO	PICTURE	-1.650*	.280	.000
	VIDEO	-3.050*	.280	.000
PICTURE	AUDIO	1.650*	.280	.000
	VIDEO	-1.400*	.280	.000
VIDEO	AUDIO	3.050*	.280	.000
	PICTURE	1.400*	.280	.000

Based on the result discussed so far, the findings indicated that there are statistically significant differences between the element as a whole in Table 5 but not as an individual. Thus, the result from The Tukey Post Hoc test in table six shows differences between the group. The table reveals there is a statistical difference in multimedia elements in enhancing reading comprehension between the picture and video. However, there were no differences between audio and video, as well as audio and picture.

Post hoc difference test results showed significant differences between audio group's mean scores and picture and video group means' scores. A negative sign of the mean difference indicates that the mean score of the audio group is smaller than the mean score of the other groups.

Table 7. The homogenous subset for elements of multimedia in multimedia learning

GROUP	N	Subset for alpha = 0.05		
		1	2	3
AUDIO	20	3.40		
PICTURE	20		5.05	
VIDEO	20			6.45
Sig.		1.000	1.000	1.000
Means for groups in homogeneous subsets are displayed.				
a. Uses Harmonic Mean Sample Size = 20.000.				

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Table seven on homogenous subset clearly showed that the mean score for the audio group (3.40) is significantly smaller than the mean of the image group (5.05) and the video group's mean score (6.45). The ANOVA test result and post hoc difference test showed that the audio element in multimedia was seen as less effective than other elements in enhancing reading comprehension skills among indigenous pupils. As discussed in the theory of multimedia learning by Kirschner et al., (2017) the human brain does not decipher the information from multiple media in multimedia learning such as words, images, video, and audio simultaneously but rather the elements of multimedia were selected purposely and organized to form a logical train of thought. This statement explains the reason most of the pupils disapproved of the use of audio in multimedia learning because the improper use of audio and execution has led to a mismatch between the information and the stimulus, as depicted in the finding.

Implication

The research indicates the positive effect of multimedia learning in reading comprehension lessons among indigenous people. For this reason, one of the implications of this study to the teachers and school is to plan a multimedia infused lesson with a proper guideline. Besides that, the school community should incorporate multimedia in their lesson as it will let them visualize difficult abstract information easily. This recommendation is in line with Mayer and Moreno (1998). Some of the guidelines that can be taken from this study are preparing the materials suited to the learner's cognitive level and meeting the pupils' needs, especially for indigenous and lower primary pupils, which are easily attracted by an interactive and bold multimedia presentation. Besides, teachers also should be aware of their pupils' interest before choosing the materials for multimedia presentation to avoid the failure of creating mental images in understanding the materials.

Conclusion

In conclusion, multimedia learning plays a vital role in scaffolding the indigenous pupils learning of reading comprehension. Most of the reading comprehension lie problems lie in deciphering unfamiliar words, understanding abstract ideas, and manipulating information acquired to answer comprehension questions. All these problems can be solved with multimedia learning as it lets the pupils visualise the information presented in the text, which is useful for the indigenous pupils. Besides that, this study enlightens the other researcher, such as teachers, to plan multimedia learning for indigenous students. Furthermore, from this study, it is well aware that the visualization process in multimedia learning, assisting indigenous pupils in understanding comprehension text, and the proper combination of multimedia is essential while planning the lesson. Hence explain that multimedia learning was effective in enhancing indigenous pupil's comprehension skills as it helps them visualize the information quickly without relying much on their existing knowledge. Some recommendations for further study would include enlarging the scope of the study to more than reading comprehension. Among the studies that may be conducted based on this study is to examine in more depth the use of audio in assisting the process of reading. The use of audiobooks is widespread and well-known, but according to the study's findings, it has been shown that students are less fond of audio as a teaching aid during the reading class. Therefore, studies on the use of audio, audio setting, and the appropriate types of audio when teaching reading should be conducted to assist teachers in the country.

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