Application of Mobile Augmented Visual Reality (MAVR) for Vocabulary Learning in the ESL Classroom

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https://doi.org/10.24191/ajue.v17i3.14507

Received: 15 June 2021
Accepted: 20 July 2021
Date Published Online: 31 July 2021
Published: 31 July 2021

Abstract: This repeated measure experiment study aimed to explore LINUS students or Low Achiever (LA) students' improvement in learning English language vocabularies using Mobile Augmented Visual Reality (MAVR). It specifically tried to analyse the effect of MAVR on the English vocabulary development of 45 primary school students from the LINUS programme in Selangor. In this study, they were provided access to an AVR-game based apps in learning English vocabularies with mobile computing devices. Vocabulary size was later measured using the British Picture Vocabulary Scale II and analysed with repeated measures ANOVA. Analysis showed that there was an increase in the scores and the differences between the levels of the within-subjects factor was significant. This implies that Mobile Augmented Visual Reality (MAVR) materials can be used as an interactive tool for LA learners in learning a language. Findings highlight the role of teachers in the implementation process and point out possible directions for more effective application of MAVR in this field.

Keywords: Augmented Reality (AR), LINUS students, Mobile Augmented Reality (MAVR), Visual Reality (VR), Vocabulary.

1. Introduction

In Malaysia, English language continues to be taught as one of the compulsory subjects for both primary and secondary school learners. Given the importance, English language has thus become the second language learnt after Bahasa Malaysia (BM). The Ministry of Education Malaysia (MOE) has also consistently improved and upgraded the learning and teaching approaches of English language to meet the demand of higher quality of language skills. More emphasis has been given on the root level that is primary education in mastering three basic skills namely reading, writing and arithmetic or what is recognised as 3M (Ministry of Education, 2012; Zinitulniza, 2011 as cited in Sani & Idris, 2013). One of the MOE efforts in improving English language learning in primary level is the introduction of LINUS (Literacy and Numeracy Screening) which is a remedial programme in 2012.

LINUS programme, which emphasises on vocabulary learning, aims to help weak students in English to build up their English language proficiency (Ministry of Education, 2012). Later in 2016, a new curriculum and format for primary school level national examination that is UPSR was introduced. UPSR or Ujian Penilaian Sekolah Rendah (Primary School Achievement Test) was a national examination taken by all students in Malaysia at the end of their sixth year in primary school and before they leave for secondary school. However, the new changes in 2016 gave more emphasis on HOTS (Higher Order Thinking Skills) questions and English subject later is divided into two papers namely Comprehension and Writing. This is to ensure that Malaysian learners are able to achieve higher levels of mastery and achievement in language skills as emphasized by Sulaiman, et al. (2017) that HOTS elements are important to encourage deeper thinking activities among learners.

Despite the new curriculum that has been introduced by MOE, the number of candidates with below minimum competency continues to rise and the former Education Minister Datuk Seri Mahadzir Khalid emphasized that there are some areas, especially in English, Science and Mathematics subjects, that need to be improved (Nasa, 2016). The UPSR Grade A would be categorised as ‘excellent’, grade B (good), grade C (satisfactory), grade D (achieved minimum level) and grade E (has not achieved minimum level). In 2016, out of 337, 633 candidates, 17.4% achieved below minimum competency level for English language test paper (comprehension) and 35.8% achieved below competency level for English language test paper (writing). Recently, the National Union of Teaching Profession (NUTP) has called on the Education Ministry to conduct a comprehensive study into the decline in English proficiency among learners (Mohammed Radhi, 2019). Azman (2016) argued that even though English is being taught to the learners from the age of six or at early English education in Malaysia, this does not guarantee proficient usage of English language among students. NUTP pointed out that it is perhaps due to a few factors such as learning environment, teaching approaches, and motivation among learners. Thus, this needs immediate action from MOE to find the ‘right medicine’ (Mohammed Radhi, 2019).

Of all the different factors, Alqahtani (2015) pointed out that vocabulary knowledge is a critical tool for second language learners because a limited vocabulary in a second language impedes successful learning. It is well established in previous studies that many young learners or children faced problems in learning the English language due to limited vocabulary. Limited vocabulary however causes an even bigger challenge to learn English language for some children who are categorised as slow learners. Malik (2009) defines slow learners as children with low cognitive abilities and are usually struggling to keep up with the teaching and learning process. As a result, their limitation has given a great impact in dealing with complex problems and learning. This has led slow learners to the situation of backward performance in school as they have very limited cognitive ability (Hassan & Murni Mahmud, 2018). Adams (2018) adds that “vocabulary deficiency” will hold back these group of learners not just in English but also across a range of subjects including History and Geography. Thus, greater involvements by teachers and parents were seen as the key to helping children improve their vocabulary (Adams, 2018).

Nation, I.S.P. (2001) suggested that gaining vocabulary knowledge involves knowing form, meaning and use. In other words, for a young learner to learn a word he or she must recognise the spelling of the word, be able to pronounce it, know its meaning and know how to apply it. This is indeed very challenging for young slow learners as their cognitive abilities are not fully developed. Furthermore, there are many abstract concepts within the English language which cannot be directly perceived by the young learners (Nation, I.S.P., 2001). While explaining the meaning of a word such as ‘time’, printed text with picture used in traditional instructional are not very useful. This is supported by Adam and Tatnall (2010) and, Ahmad and Abdul Mutalib (2015) who emphasise that learning assistance is important to provide the Low Achiever (LA) students with an attractive and attentive learning environment as it can affect the learning interest or motivation of learners. Motivation is the key to language learning, especially learning a second language. If teachers could not deliver a lesson using creative approaches, it will be hard to motivate and attract students’ interest to learn. Oberfeld & Franke (2013) have identified a few causes of lack of motivation among students. A few causes that are worth mentioning are syllabus density, shortage of materials, boring and colourless lessons, and traditional teaching methods like expository teaching. Therefore, to build up motivation among students, teachers will need to enrich the learning materials and adopt more colourful lessons. Hassan and Murni Mahmud (2018) suggested to give exposure and experience of the new technology use to assist their learning as the involvement of the technology has given impact on the development of application for users with learning disabilities. The only challenge is to identify and determine technology and applications that can assist and enhance learning and motivation of the slow learners (Hassan & Murni Mahmud, 2018). The next section will discuss further on the use of technology in learning and the challenges faced by the LINUS students who are categorised as slow learners in learning.

2. Statement of Problem

Poor learning ability has negative implications in the process of knowledge discovery among slow learners. In Malaysia, students with learning difficulties or literacy problems are put under a remedial program known as LINUS. These LINUS students are categorized as slow learners and also regarded as Low Achiever (LA) learners regardless of their education level. Even though the ministry has implemented the LINUS 2.0, its operation has encountered some problems thus far (Azman, 2016). Previous researchers (Ahmad & Abdul Mutalib, 2015) indicate that most of the teachers agreed that they are provided only with a LINUS workbook by the MOE. Instead of using the workbook, some teachers have to take their own initiative to enrich the learning materials based on their creativity such as by creating flash cards, presentation slides, and extra exercises to help the learners grasp the meaning of words first before being able to use them (Bokhari, Md Rashid, & Heng, 2015). According to the teachers, the scenario however becomes worse as these LINUS students often lose focus and are easily distracted during the learning process when the teacher uses common learning tools such as books, exercise sheets, flash cards and whiteboard (Sani & Idris, 2013). Therefore, based on the previous studies, the teachers highlighted that they require teaching and learning materials specifically designed and created for LINUS students and they pointed out that learning concepts in the form of computer based learning is important to promote a fun learning experience (Bokhari, Md Rashid & Heng, 2015; Ahmad & Abdul Mutalib, 2015). Augmented and Visual reality (AVR) technologies seem to be the key to alleviate all the issues in vocabulary learning among young learners.

In simple terms, augmented and visual reality is a technology that allows the real world that one experience augment with a layer of digital data or information. Previous researches have suggested that implementation of AR technologies in education provides various benefits such as improving learning motivation, enhancing creativity (Wei et al., 2015); having a positive effect on learning attitude (Jerry & Aaron, 2010); giving a sense of authenticity (Rosenbaum, Klopfer, & Perry, 2007); and improving students' engagement (Santana, Juarez & Magana, 2013). Annie et al. (2013) asserted that the AR learning tool could help children to better understand abstract concepts. Presently, combination of AR and VR are still far from being the mainstream technology in education (Cubillo et al., 2014). Siti Maftuhah Damio and Qistina Ibrahim (2019) also further added the use of AR and VR especially in language learning and teaching is still new and the literature is limited. Thus, more studies are needed to uncover the potential of MAVR in education. This study therefore is designed to investigate the effectiveness of Mobile Augmented Visual Reality (MAVR) as a learning tool particularly in the area of language development. Specifically, this study aims to investigate the effectiveness of mobile MAVR as a learning tool in developing the vocabulary learning among ESL learners. For the purpose of this study, MAVR materials were developed using a software called Unity. In Malaysia, implementation of MAVR in education is at its infancy stages. This study hopes to build a framework for further research into the application of MAVR in English learning in the educational field.

3. Theoretical Framework

This study was guided by the principles of cognitive theory of multimedia learning (CTML) by Mayer (2005). This theory basically provides guidelines that assist in the design and presentation of information by taking the human cognitive structure into consideration. CTML is particularly relevant to computer-based and online learning environments where auditory and numerous forms of visual stimuli (e.g. text, diagram, photo) are easily used and integrated into a curriculum. According to Mayer (2005), CTML posits that in order for learning to occur, humans must select relevant words from text or narration, select relevant images, organize both the words and images into coherent verbal and pictorial representations, and integrate the representations with new knowledge. This can be in the form of multimedia instructional message such as words and pictures which can be delivered using book-based-communication (i.e. printed words and static graphics) and the computer-based communication enhanced through animation or video clips for textbook chapters (Mayer, 2005). This form of multimedia instructional message are particularly viable means for engaging learners' visual and auditory channels especially in this online environment as it can "mediate between the sources of cognitive load and the elements of working memory" in ways that help learning. This is because multimedia instruction "can reduce the extraneous cognitive load placed on working memory during knowledge construction and thus can benefit the learning process" (Greer, 2013, p.46). The principles "apply to any format of multimedia instruction, but are especially important in the context of computer-based and online learning because in order to construct knowledge and develop understanding, learners need to be exposed to material in verbal (such as on-screen text or narration) as well as pictorial form (including static materials such as photos or illustrastions, and dynamic materials such as video or animation)" (Mayer & Moreno, 2002, p.188).

Clearly, the concept of this CTML framework take into consideration the cognitive load in relation to a learner's working memory limitations. This can benefit most of students with learning difficulty (LD) like LINUS students. Previous studies indicated that LINUS students are categorised as learners with learning difficulty and they seem to have a limited recall capacity when compared to same age peers. Goodglass and Kaplan (1993) added that students with LD also may demonstrate difficulties in the phonological loop processor. Deficits in this subsystem relate to the retrieval of verbal information. Some individiuals with LD have demonstrated an inability to accurately retrieve language-based information (e.g. Goodglass & Kaplan, 1993). Given this deficit, LINUS may gain advantage when multimedia interactive materials are provided rather than static materials. It will enhance their working memory by assisting their cognitive ability through visual or animation. This is parallel to the mainframe of this study where textbook (prepared by Ministry of Education) are enhanced by developing MAVR modules or learning materials to foster a more interactive learning and eventually promote understanding among LINUS learners. This theoretical framework (CTML) basically underlies the concept of how LINUS students can process a limited amount of information through the integration of Mobile Augmented Visual Reality (MAVR) in learning and teaching materials.

4. Method

4.4.1 Research Design

This study aimed to investigate the effect of a 6-month *Mobile Augmented Visual Reality (MAVR)* programme in learning vocabulary. It measured changes in the vocabulary size at 3 separate time points namely pre-, midway and post-exercise intervention. The same subjects were involved and measured more than once on the same dependent variable which was the vocabulary score. As this study involves multiple measures of the same variable taken on the same subjects under different condition, thus Repeated Measures experimental design was implemented. This design was preferred due to the fact that participant variables (i.e. individual differences) are reduced. This is especially important when comparison and study of changes between time (conditions) are studied (McLeod, 2017). Specifically, this study sought to answer the following question;

Is there a significant difference in vocabulary scores amongst LINUS students after six months of learning using Mobile Augmented Visual Reality (MAVR) materials?

In this study, the following hypothesis were posed;

Null Hypothesis-+*

H_0: population means at the different time points are equal (i.e., $\mu_{pre} = \mu_{mid} = \mu_{post}$) which means vocabulary scores are the same at all time points (pre=, 3 months and 6 months).

Alternative Hypothesis

H_A: at least one population mean is different (i.e., they are not all equal) which means vocabulary scores are significantly different at one or more time points.

4.4.2 Data Analysis

This repeated measure experimental study used a repeated measures ANOVA to understand whether there was a difference in vocabulary sizes amongst the LINUS learners after an MAVR programme was implemented (with three time points: pre-, 3 months and 6 months after the implementation of the Augmented Reality programme. In this study, 'vocabulary sizes' is the dependent variable whilst the within-subjects factor is 'time' (i.e. with three levels, where each of the three time points is considered a level). However, before a repeated measure ANOVA was done, two assumptions were run first to see whether the data fits the model. These assumptions were outliers and the normality tests.

4.4.3 Sampling

Purposive sampling was used in selecting samples for this study due to the nature of the samples of this research. This research only involved a small number of students namely 45 students from different geographical areas to represent the population. Thus, according to Heckathorn (1997) as cited in Lavrakas (2019) "purposive sampling may fit more when the purposes of the experimental research is on a small intersectional identity groups and it trade off the design-based representativeness against obtaining a sample size sufficiently large to powerfully estimate an experimental effect size" (p.422).

There were two factors that determined the number of participants in this study. Oberfeld and Franke (2013) listed three commons characteristics when choosing samples for repeated measures analyses of variance. The three characteristics are (a) small or very small sample sizes (typically, $N = 3$ to 30), (b) nonnormally distributed dependent measures, and (c) the use of a completely within-subjects design (i.e., there are no between-subjects factors).

In this study, the experimentation time required for each student is very important to study the changes and the researchers were interested in the best possible performance that subjects can attain, in order to explore the effect of the MAVR programme. Therefore, to keep experimentation time at a manageable level, small numbers of subjects were tested (N=45; e.g. Duncan & Humphreys, 1989; Eriksen & Eriksen, 1974; Ernst & Banks, 2002). Other factors imposing limitations on the sample are limited access to rare populations. In this case, persons with special needs in learning or learning difficulties were always kept at 20-25 students per class. In other words, there were very small numbers of students per class in the LINUS programme.

With the above reasons, only 45 students from LINUS programme in Year 2 were involved in this study. These students were from two different schools in Selangor rural areas. The areas were selected due to the availability and the highest number of LINUS students per class (roughly 20-25 per class). The classes were however selected by the headmaster after the researcher applied for permission to conduct the study at the schools.

4.4.4 Instrument

i) British Picture Vocabulary Scale III (BPVS III)

BPVS II is a one-to-one vocabulary test produced by GL Education Group UK that assesses a child's receptive vocabulary level. According to GL Education Group (GLE Education Group Website, 2018), for this test, no reading is required and thus, BPVS3 can be used to evaluate language development in non-readers and especially pupils with expressive language impairments. The assessment can be carried out for students with mild autism, other communication difficulties and English as an Additional Language (EAL) students because no spoken response is required.

In this test, the researchers uttered a word for each question, and the students responded by selecting a picture from four options that best illustrates the word's meaning. There are 12 levels in the test and the words represent a range of content areas such as actions, animals, toys and emotions and parts of speech such as nouns, verbs or attributes, across all levels of difficulty. The test would give a standard score, percentile rank and age equivalent for the child's level of receptive vocabulary. This means that the child's score can be compared with children of the same age and the score would indicate the age level of achievement (age 3 to 16 years old). For each student, the basal and ceiling sets were determined; these were the lowest set with 0 or 1 errors and the highest set with 8 or more errors, respectively.

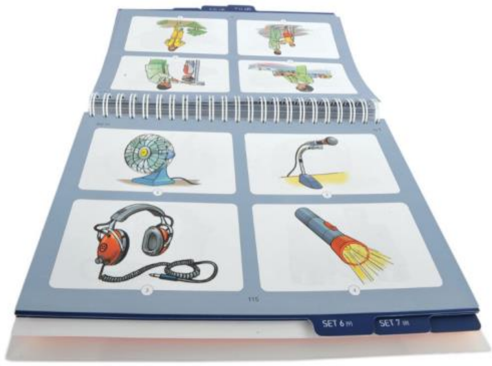

Fig. 1 British Picture Vocabulary Scale book

ii) Mobile Augmented Visual Reality (MAVR) programme

MAVR programme is a set of English language enrichment e-games using apps called *Hunting with e-language* that was created by the researcher using Unity software to assist primary school students in year 1 to 3 (7 to 9 years old) with special needs and learning difficulty to learn the English language by utilising the Augmented Reality (AR) and Visual Reality (VR) technology as part of their learning process. With the combination of AR and VR, this programme is an explore-based scavenger hunt which focuses on the vocabularies that the students have learnt in the syllabus.

In this study, the researcher taught the LINUS students using this MAVR programme for 6 months. There were two apps created under the MAVR Programme for the purposes of the study namely guessing the suitable vocabularies that represented the objects (Picture 3) and the next one was exploring two rooms which were filled with the objects that they had learnt as shown in Picture 2 below;

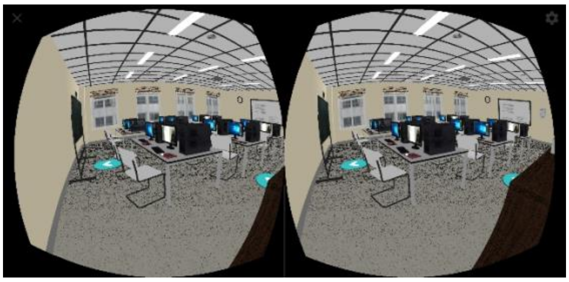

Fig. 2 Example of screenshot of Visual Reality

Fig. 3 Example of Augmented Reality material

4.4.5 Data Procedure

Assumption Test

In this study, a single group of 45 LINUS learners had all undergone a Mobile Augmented Visual Reality (MAVR) programme where they had their vocabulary scores (the dependent variable) measured at three time points: pre-invention, midway through the intervention and post-intervention. These three time points were the three levels of the within-subjects factor. To investigate differences between the means of these levels, pairwise comparisons using the Bonferroni post hoc test was run. In order to determine the magnitude of the differences, an effect size was calculated as well.

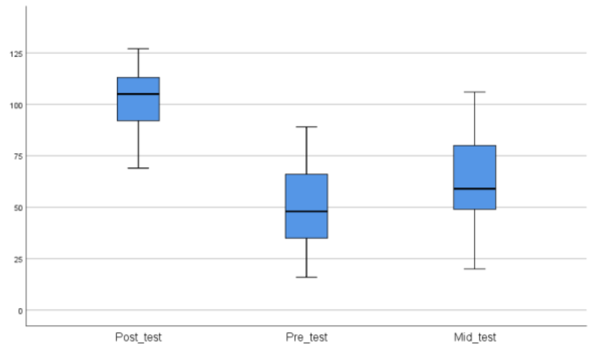

Fig. 4 Boxplot

Boxplot as shown above was used in this study to detect any outliers in the analysis. Any data points that are more than 1.5 box-lengths from the edge of their box are classified as outliers and are illustrated as circular dots. Any data points that are more than 3 box-lengths away from the edge of their box are classified as extreme points and are illustrated with an asterisk (*). Based on the boxplot above, there were no outliers in the data, as assessed by inspection of a boxplot for values greater than 1.5 box-lengths from the edge of the box.

The second assumption to be met was the normality of the data that was whether it was normally distributed using the Shapiro-Wilk test of normality and Normal Q-Q Plots. The Shapiro-Wilk test was used due to the small sample size (< 50 participants). The results of the Shapiro-Wilk test are presented in the Tests of Normality table, as shown below;

Table 1. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Post_test	.16	45	.006	.93	45	.17
Pre_test	.14	45	.031	.95	45	.16
Mid_test	.11	45	.200*	.97	45	.24

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

The table above shows that the significance level was more than .05 (they are .17, .16 and .24) which indicated that the dependent variable that was vocabulary size was normally distributed for each level of the within-subjects factor. This indicated that the assumption of normality was not violated. Thus, it can be concluded that the difference scores for the pre-test vocabulary size, mid and post-test vocabulary size were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$).

As the assumption of outlier and normality are met in this study, a one-way repeated measures ANOVA thus can be run to determine the mean difference between the levels of within-subjects factor. Since this study is interested in investigating all possible pairwise comparisons, a one-way repeated measures ANOVA with a post hoc test was run with a Bonferroni adjustment for multiple comparisons.

5. Findings

In this study, there were three levels (i.e. time points) of the within subject factors: Pre, Mid and Post. These have been given the labels 1, 2 and 3 respectively.

Table 2. Within-Subjects Factors

Measure: Test	
Time	Dependent Variable
1	Pre_test
2	Mid_test
3	Post_test

These labels would be used to represent the data analysis in the Descriptive statistics and Estimates table as shown below. These descriptive statistics will be discussed first to get the overall impression;

Table 3. Descriptive Statistics

	Mean	Std. Deviation	N
Pre_test	50.84	20.91	45
Mid_test	64.36	22.91	45
Post_test	102.13	14.05	45

In the table above, it can be seen that the size of each level of the within-subject factor was equal (n=10) and there was a trend of increasing vocabulary sizes at each successive time point (i.e. vocabulary sizes increased over the course of the augmented reality learning programme). Vocabulary sizes was 50.84 ± 20.91 pre-intervention, increasing to 64.36 ± 22.92 after 3 months of the intervention, and finally increasing to 102.13 ± 14.05 after 6 months of the intervention. This mean of each level of the within-subjects factor can be seen via the Estimates table as highlighted below;

Table 4. Estimates

			95% Confidence Interval	
Time	Mean	Std. Error	Lower Bound	Upper Bound
1	50.84	3.12	44.56	57.13
2	64.36	3.42	57.47	71.24
3	102.13	2.09	97.91	106.35

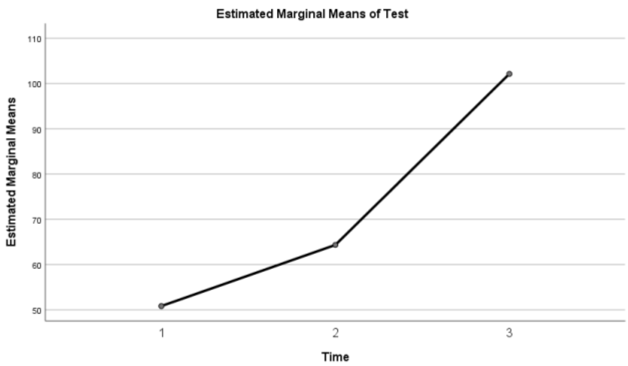

Fig. 5 Profile Plot

The profile plot above clearly shows that vocabulary sizes increased at each successive time point, with the increase from time 2 to 3 seemingly greater than that from time point 1 to 2. In order to see the differences between the levels of the within-subjects factor have equal variances, the assumption of sphericity is then run. To test this assumption, Mauchly's test of sphericity will be used.

Table 5. Mauchly's Test of Sphericity[a]

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.16	78.53	2	.000	.54	.55	.50

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.
a. Design: Intercept
Within Subjects Design: Time
b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

It can be seen that the significance level is .000 (i.e. p=.000), which means that sphericity has been violated because it is less than .05 (i.e. p<.05). All in all, Mauchly's test of sphericity indicated that the assumption of sphericity had been violated, $\chi^2(2) = 78.53$, $p = .000$. Since the assumption of Mauchly's test of sphericity had been violated, Greenhouse-Geisser correction is thus applied. The exercise intervention elicited statistically significant changes in vocabulary sizes over time as indicated below;

Table 6. Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	63603.91	2	31801.96	174.59	.000	.79
	Greenhouse-Geisser	63603.91	1.08	58483.58	174.59	.000	.79
	Huynh-Feldt	63603.91	1.09	58146.79	174.59	.000	.79
	Lower-bound	63603.91	1.00	63603.91	174.59	.000	.79
Error (Time)	Sphericity Assumed	16029.42	88	182.15			
	Greenhouse-Geisser	16029.42	47.85	334.98			
	Huynh-Feldt	16029.42	48.13	333.05			
	Lower-bound	16029.42	44.00	364.31			

Epsilon (ε) was 0.648, as calculated according to Greenhouse and Geisser (1959), and was used to correct the one-way repeated measures ANOVA. Vocabulary scores were statistically significantly different at the different time points during the exercise intervention, $F(1.088, 47.852) = 174.59$, $p < .0005$, partial $\eta^2 = .75$. To determine where the differences between the levels of the within-subjects factor lie, post hoc tests was then used.

Table 7. Pairwise Comparisons

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	-13.51*	.87	.000	-15.68	-11.35
	3	-51.29*	3.29	.000	-59.49	-43.09
2	1	13.51*	.87	.000	11.35	15.68
	3	-37.78*	3.56	.000	-46.64	-28.91
3	1	51.29*	3.29	.000	43.09	59.49
	2	37.78*	3.56	.000	28.91	46.64

Based on estimated marginal means
*. The mean difference is significant at the .05 level.
b. Adjustment for multiple comparisons: Bonferroni.

Post hoc analysis with a Bonferroni adjustment revealed that vocabulary sizes were statistically significantly increased from pre-intervention to three months (0.13 (95% CI, 15.7 to 11.35) words, $p < .0005$), and from pre-intervention to post-intervention (51.29 (95% CI, 43.1 to 59.5) words, $p < .0005$), and finally from three months to post-intervention (37.78 (95% CI, 28.9 to 46.6) words, $p < .0005$). Overall, there was a statistically significant difference between means. Therefore, null hypothesis can be rejected, and the alternative hypothesis can be accepted.

6. Discussion

Findings from this study indicates that Augmented and Visual Reality (AVR) can be used as interactive learning tools which are able to leverage on slow learners' attention to participate actively in the learning process. In the way, this shows that the features on the apps are able to ease their learning experience and motivate the slow learners to focus on the lesson learnt. Hassan and Murni Mahmud (2018) pointed out that the intuitive touch screen interface of the tablet with the apps actually allowed for a seamless experience for the slow learners to perform their tasks. The findings are aligned with the findings by Nur Idawati Md Enzai et. al. (2021) which verify that the AR interfaces help to increase the learning motivation of students in terms of attention, satisfaction and confidence.

In this study, technology has been implemented using augmented reality and visual reality as a tool to help learners understand the topic better. Findings show an increment in vocabulary size throughout the 6 months and there are significant differences in terms of the scores throughout the three phases. This is consistent with Surendheran et. al. (2021) study which found that there are improvement in terms of the mean scores obtained before and after the AR demonstration. Verbal feedback from their study also indicated the AR materials does excite the students to learn and thus increase their involvement with the content. This is also depicted in this study where the learners' vocabulary level not just increase after 6 months of implementation, but it also boosts the learners' involvement which can be seen from their responses during activities. This is consistent with the principle of CTML in which knowledge construction can be improved when the cognitive load is assisted with interactive multimedia.

7. Conclusion

Overall, this study found that students' vocabulary level manage to be improved and this study believes that the AVR materials help to build involvement and motivation among students which finally leads to a better score performance. This gives the impression that technology can assist learners with special needs, but a more thorough research needs to be conducted such as the teacher and learners' readiness and willingness to use AVR in learning.This study still lacks the efficacy aspects of using Augmented Reality (AR) and Visual reality (VR) in language learning. As Mohamed Jamrus and Razali

(2019) pointed out, the technology of Augmented Reality is still relatively new and not a lot of research have been done on its impact on language learning. Thus, it is imperative to consider other factors such as efficacy and self-regulation when analysing the impact of technology on learning. Furthermore, although this study was not intended to assess the reliability of BPVS in measuring vocabulary of special need students in Malaysia, findings do suggest that some BPVS could be appropriate for this population. BPVS was found to be child-friendly and teacher-friendly tools that can generate information on vocabulary effectively. It however, could potentially be adapted with minor alterations of certain test items that may suit Asian context.

8. Acknowledgements

The authors would like to acknowledge the financial and technical support of Universiti Putra Malaysia in the production of this work. Our recognition for Ministry of Education Malaysia and Secondary Schools in Selangor, a key factor for the project realization.

9. References

Adam, T. & Tatnall, A. (2010). Use of ICT to assist students with learning difficulties an Actor-Network analysis. In N. Reynolds and M. Turcsanyi-Szabo (Eds.), *IFIP advances in information and communication technology* (pp.1-11). New York: Springer Verlag.

Adams, R. (2018). *Teachers in UK report growing 'vocabulary deficiency'*. https://www.theguardian.com/education/2018/apr/19/teachers-in-uk-report-growing-vocabulary-deficiency. Accessed 20 December 2020.

Ahmad, S.Z. & Abdul Mutalib, A. (2015). Preliminary Study: An Investigation on Learning Assistance Requirement among Low Achievers in Primary Schools. *International Journal of Computer Application*, *114*(2), 48-54.

Alqahtani, M. (2015). The Importance of Vocabulary in Language Learning and How to be taught. *International Journal of Teaching and Education*, *3*(3), 21-34.

Azman, H. (2016). Implementation and Challenges of English Language Education Reform in Malaysian Primary Schools. *The Southeast Asian Journal of English Language Studies*, *22*(3), 65 – 78.

Bokhari, R., Md Rashid & Heng, C.S. (2015). Teachers' Perception on the Implementation of the Literacy, Numeracy and Screening (LINUS LBI 2.0) Programme among Lower Primary ESL Pupils. *Malaysian Journal of ELT Research*, *11*(1), 108-121.

Duncan, J., & Humphreys, G. W. (1989). Visual search and stimulus similarity. *Psychological Review, 96,* 433–458. doi:10.1037/0033-295X.96.3.433.

Eriksen, B. A., & Eriksen, C. W. (1974). Effects of noise letters upon the identification of a target letter in a nonsearch task. *Perception & Psychophysics, 16,* 143–149. doi:10.3758/BF03203267.

Ernst, M. O., & Banks, M. S. (2002). Humans integrate visual and haptic information in a statistically optimal fashion. *Nature, 415,* 429–433. doi:10.1038/415429a

Greer, D., Ingram, P. & Mayer, R. (2013). *Cognitive load and multi-media learning: Testing effective multi-media information conveyance in early adolescene with learning disabilities*. (Unpublished manuscript) Center on Online Learning with Disabilities, University of Kansas, Lawrence, KS.

Goodglass, H. & Kaplan, E. (1993). *The assessment of aphasia and related disorder* (2nd ed.). Philadelphia: Lea & Febiger.

Hassan, A. & Murni Mahmud, M. (2018). Learning Motivation for Slow Learners with Tablet Technology. *International Journal for Studies on Children, Women, Elderly and Disabled, 5*(10), 201-210.

Lavrakas, P.J., Traugott, M.W., Kennedy, C., Holbrook, A.L. Leeuw, E.D. & West, B.T. (2019). *Experimental Methods in Survey Research: Techniques that Combine Random Sampling with Random Assignment*. US: John Wiley & Sons, Inc.

Malik, S. (2009). Effect of Intervention Training on Mental Abilities of Slow Learners. *International Journal Educational Sciences, 1*(1), 61-64.

Mayer, R. (2005). Cognitive Theory of Multimedia Learning. In R. Mayer (Ed.), *The Cambridge Handbook of Multimedia Learning: Cambridge Handbooks in Psychology* (pp. 31-48). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511816819.004.

Mayer, R. & Moreno, R. (2002). Animation as an aid to multimedia learning. *Educational Psychology Review, 14*(1), 87-99.

Ministry of Education Malaysia (MoE). (2012). *National Education Policy (3rd Edition).* Kuala Lumpur: MoE.

Mohamed Jamrus, M.H. & Razali, A.B. (2019). Augmented Reality in Teaching and Learning English Reading: Realities, Possibilities, and Limitations. *International Journal of Academic Research in Progressive Education and Development*, *8*(4), 724-737.

Mohamed Radhi, N. A. (2019, May 19). Call for Comprehensive study into decline in English Proficiency among students. *New Straits Times,* https://www.nst.com.my/news/nation/2019/05/489779/call-comprehensive-study-decline-english-proficiency-among-students-nsttv. Accessed December 20, 2020.

Nasa, A. (2016, November 17). Education Ministry on UPSR result: "Students' achievements at level we can be proud of". *New Straits Times. https://www.nst.com.my/news/2016/11/189351/education-ministry-upsr-results-* . Accessed January 12, 2021.

Nation, I.S.P. (2001). *Learning Vocabulary in Another Language*. Cambridge: Cambridge University Press.

Nur Idawati, M.E., Norhayati, A., Mohd Amir Hamzah, A.G., Siti Sara,R., & Syazilawati, M. (2021). Development of Augmented Reality (AR) for Innovatice Teaching and Learning in Engineering Education. *Asian Journal of University Education (AJUE)*, *16*(4), 99-108.

Oberfeld, D. & Franke, T. (2013). Evaluating the robustness of repeated measures analyses: The case of small sample sizes and nonnormal data. *Behavior Research Methods, 45*, 792-812.

Sani, N. & Idris, A.R. (2013). Implementation of Linus Programme based on the Model of Van Meter and Van Horn. *The Malaysian Online Journal of Educational Science*, *1*(2), 25–36.

Siti Maftuhah, D. & Qistina, I. (2019). Virtual Reality Speaking Application Utilisation in Combatting Presentation Apprehension. *Asian Journal of University Education (AJUE), 15*(3), 235-244.

Sulaiman, T., Muniyan, V., Madhvan, D., Hasan, R. & Abdul Rahum, S. S. (2017). Implementation of Higher Order Thinking Skills in Teaching of Sciences: A Case Study in Malaysia. *International Research Journal of Education and Sciences*, *1*(1), 1-3.

Surendheran,K., Mohd Helmy, A.W., Sagayam,K.M., Radzi, A., & Hazwaj, M.P. (2021). Impact of pairing an augmented reality demonstration with online video lectures… Does it improve students'performance? *Asian Journal of University Education (AJUE)*, *16*(4), 92-98.