

The Effects of iPad Device on Students' Mathematics Achievement and Attitudes

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Abstract: Digital technology in education is proven to provide positive effects on student development. iPads is an easy-to-use wireless digital tool that helps students to access unlimited learning materials and it is getting attention to be introduced in teaching and learning session. The aim of this study is to investigate the comparison of students' achievement between students learning with iPADS and with conventional method within the same mathematics topics. This study was conducted on 38 of form 4 students at MRSM Pengkalan Hulu, Perak which were evenly divided into two groups including Group A, students who were learning using iPADS and Group B, students who were learning using conventional method. This study was included the quasi-experimental quantitative and qualitative data in order to investigate the effects of iPADS as an individual learning tools on students' achievement and attitudes towards mathematics. The data of students' achievement was collected through pre and post-tests, while students' attitudes were measured based on an Attitudes Towards Mathematics Inventory (ATMI). Interview was conducted with the participating teacher to provide more inclusive and holistic results. In addition, the teacher's lesson plans on how to use iPADS in learning activities were analyzed. ANCOVA test was used to determine weather the group of students with iPADS has gained higher achievement compared to group of students without iPADS. Meanwhile, t-test was applied to investigate the mean difference of both groups statistically on attitudes through ATMI. Based on the results, there is inconsistency between quantitative and qualitative data. Post-test and ATMI results show that there is no statistically significant difference, while interview results show that there is significant improvement on students' involvement, attitudes and productivity among students who used iPADS in learning activitied compared to students who learned without iPADS.

Keywords: iPADS; mathematics achievement; attitudes towards mathematics.

1. INTRODUCTION

A rapid technology development produced a disruptive era which has led to widely significant changes that can change the way of human interaction in variety of fields including education sector. Therefore, education sector should be given appropriate attention in order to improve the teaching and learning system by following innovation patterns so that the learning quality can be improvised. Incorporating digital tools in class is an essential necessity to preserve the relevancy of educational institutions (Dal Pai & Borba, 2012). There are a lot of previous research works studied about the use of digital technology in teaching and learning system (Joubert, 2013). Digital technology in teaching and learning system that implements iPADS in classrooms is getting attention as this tool is known as a user-friendly, lightweight and wireless medium (Zakrzewski, 2016). iPADS also can motivate and engage students as iPADS help students in learning, increasing student creativity, independence and productivity (Ingram et al, 2016). Although iPADS may be considered as expensive, however iPADS can provide access to online textbooks that can be updated annually, thereby reducing costs (Zakrzewski, 2016).

The use of iPADS in learning is a digital learning medium based on incorporated tablet with the learning system in both primary and secondary schools. Learning with iPADS can promote students to gain a better understanding. The use of digital technology in classrooms overall can help students to improve the students' achievement especially in

mathematics. The previous study confirmed that the use of iPads can provide a positive influence on students' engagement and attitudes towards mathematics (Hilton, 2018). Although it is proven that this digital technology has potential in contributing to teaching and learning system in mathematics, however the application of this kind of technology still not well implemented (Joubert, 2013). Therefore, the aim of this study is to investigate the comparison of students' achievement between students learning with iPads and students learning with conventional method (without iPads) within the same mathematics topics.

2. METHODOLOGY

This study is to investigate the effects of iPads usage on students' achievement and attitudes towards mathematics. The quasi-experimental quantitative and qualitative data was used to design the research questions. This approach is widely used in education studies as it provided a better understanding towards research problems as well as qualitative components help to verify quantitative data (Singer, 2015). The purpose of this research design is to determine the relation of variables statistically and to gain experiences by using qualitative approach. The research design combined the quasi-experimental quantitative and qualitative data to compare the students learning with iPads and students learning without iPads based on students' achievement and attitudes towards mathematics.

This study was conducted on two groups of Form 4 students at MRSM Pengkalan Hulu, Perak that consisted of 19 students for each group. These two group were divided into Group A and Group B. Group A was known for the students who used iPads in learning activities, while Group B was for students who used conventional method. Basically, both groups were given written test with the same topics. The results for both groups were analyzed to compare their performance. Besides, Group A and Group B also were given questionnaire about The Attitudes Towards Mathematics in order to analyze students' attitudes towards mathematics. At the end of quantitative data collection, the mathematics teacher was interviewed to determine how iPads digital tool can influence the learning and attitudes of the students. The teacher was asked how iPads been used in class as well as her teaching plannings were reviewed.

The students in Group A gained fast responses from iPads and are able to design their own knowledge. The students in Group B were learning with different way whereby the teacher was the main individual during teaching session in classroom. Therefore, the obtained data from both groups which were taught by the same teacher with different ways of teaching was analyzed to determine the relation between the two different methods.

2.1 Research Questions

The aim of this study is to investigate the influence of iPads on students' achievement and attitudes towards mathematics. Based on the research questions that combined quasi-experimental quantitative and qualitative data, the data is obtained to provide the understanding on the iPads implementation because it is related to students' learning and attitudes towards mathematics. The emphasized questions in this study as per stated:

Question 1: How does the students' achievement differ when using iPads compared to conventional method?

This question was analyzed by evaluating the achievement of students learning mathematics with iPads compared to students learning with conventional method. Learning with conventional method means the teaching session is conducted by the teacher by referring textbooks and worksheets.

Question 2: How do the students' attitudes towards mathematics differ when using iPads compared to students learning with conventional method?

This question is to determine the effects of iPads on the students' attitudes towards mathematics. The question was discovered by managing attitude inventories to both of Group A and Group B. Data regarding students' attitudes was collected through an inventory that illustrated the various ways on how the students felt about mathematics and their own feeling concerning the subject. Through the research questions, data revealed how students' attitudes are impacted by the use of iPads in class.

2.2 Measurement of Academic Achievement

The learning achievements for both groups were measured through written test. The selected topics were learnt since second semester for 2019. The students in Group A learnt the selected topics from second semester by using iPads, while the students from Group B learnt the same topics by conventional method.

2.3 Measurement of Students' Attitudes Towards Mathematics

All the students from both groups had completed Attitudes Towards Mathematics Inventory (ATMI) to determine the effects of iPads on students' attitudes towards mathematics. ATMI is designed by Tapia & Marsh (2004) to address several areas related to mathematics attitudes including self-confidence, value, enjoyment and motivation (Tapia & Marsh, 2004). ATMI is a survey consisting of 40 questions using a five-point Likert-type scale. The students were required to response the questions on a scale with the following values: strongly agree, agree, neutral, disagree and strongly disagree. The ATMI has been proven to be a reliable instrument for measuring students' attitudes towards mathematics (Tapia & Marsh, 2004).

3. FINDINGS

All the data were collected and analyzed after completing the post-test and attitude survey by the selected groups of students. Histograms provided a graphical representation of the data compared to a normal distribution so that the collected data can be compared to a normal curve. The results of the histograms show a fairly normal distribution. Since the data are normally distributed, measures of central tendency are used to check how representative of the final sample compared to the population. Besides, as the data checked out to be normal, the mean is used as a measure of the central tendency, and parametric testing like ANCOVA and t-test are used to test the hypotheses.

Normality is tested by examining the descriptive statistics. The values of Skewness dan Kurtosis are used to ensure the data meet the normality assumption. After completing the normalization and running several hypotheses tests for all the quantitative data, the actual learning outcomes are measured. ANCOVA tests are useful to determine whether group of students learning using iPads could obtain higher academic achievement compared to group of students learning without iPads. Based on the ANCOVA outcomes, students learning using iPads do not obtain a significant achievement compared to students learning without iPads. Beside that, based on this analysis, there is no significant difference between both groups whereby the students learning using iPads are at standard $\alpha=.05$, $F(1,35) = 3.779$, $p = .060$, $\eta^2 = .097$.

A t-test is employed to examine whether the means of both groups on the ATMI are statistically different from each other. The mean outcomes on ATMI for both groups show that the mean difference is small. The commonly recognized benchmark of statistical significance is $p \leq .05$. The benchmark p-value indicates that the smaller the significance level, the less likely there would be a difference in the sample if there is no difference in the population (Muijs, 2011). In this case, since the p-value is .954, it shows that there is no a statistical difference in the ATMI scores between the control group and experimental group. It means that there is a 95 % chance of the difference has been found in the sample may be based on the chance and not based on actual representation of the population ($t = .058$, $df = 36$, $p = .955$).

4. DISCUSSION

This study shows that the use of iPads could increase the productivity in class eventhough the instrument does not support the outcomes as the teacher reinforced the positive impacts of iPads in class. The study outcomes illustrate a better educational practice and should be taken into consideration. Although there is no statistical outcome, however qualitative data shows that there are positive changes in attitude, involvement and productivity of students in class.

The previous studies in literature stated that there are several advantages in integrating technology into educational system. The integration of iPads in secondary school showed that there is higher level of active engagement when students learning using iPads compared to students learning without iPads (Haydon, et al, 2012). In another study, Lage et al. (2000) stated that the students in public universities prefer to use tablet devices as a way to listen the lectures outside of classroom. The use of technology increased the students' attitudes and engagement throughout the course because of the technology. There are many studies that reported increment in students' attitudes, engagement and motivation when utilizing the technology as a learning tool.

Same result is found in this study where the teacher affirmed that the experiences for the students that used iPads in learning increased the attitudes, engagement and motivation. Li & Pow (2011) quantified that this user-friendly device facilitated the environment to encourage students to succeed. Conn (2012) believed that technology as a learning tool can help students to do more tasks, and even for those who are usually hard made them to play their own roles. This study

revealed that iPads can motivate students to respond and maintain their focus. The applications that the students used to learn are interactive and stimulate individuals to interact with their own personal hands-on learning tool that the iPads provided.

In order to comprehend the improvement of attitudes, engagement and productivity, many studies support the fact that how technology helps teachers to improve teaching in class. The study done by Amin (2010) claimed that iPads allow the learning session to run smoothly throughout the session. Besides that, the use of technology as a teaching tool can promote students to create new knowledge rather than memorizing the learnt knowledge (Amin, 2010). In another study done by Enriquez (2010), tablet devices were used in a higher education level to study the impact on student performance and perception of their own learning experience. This study emphasized that technology provides students with a more interactive and collaborative learning experience. In the same way, the teacher in this study expressed that iPads help her to convey the information and instruction better as well as iPads provide all of the information needed by the students for their learning at their fingertips. Same goes to ideas of Takahashi (2011), the students were able to receive personalized instruction based on their own learning requirements. For example, the students that needed to practice and memorize their multiplication facts were using the applications focused on that specific skill. On the other hand, students that had previously mastered their facts were able to challenge themselves with the other topics that were specific to their learning requirements.

The students in this study can easily access the internet to find the answers for all the questions during learning session. In order to integrate iPads effectively in class, the teacher needs to learn and know how to operate the device properly. The outcomes of this study are well agreed with the previous study that the implementation of iPads in class requires a lot of faculty training and development (Kiger et al., 2012). To successfully implement iPads in school, the teachers are necessary to be carefully trained by providing adequate professional development. As stated before by Holcomb (2009), the teachers need time and training for a program to be successful and effective when implementing technology in class.

It should not be assumed that the teachers are expert in using iPads in learning activities. A study conducted by Drijvers and Weigand (2010) stated that lack of teachers' knowledge and preparation can interrupt the students' achievement. Prior to the previous study done by Ifenthaler & Schweinbenz (2013), it is proved that the teachers may be hesitated to implement the technology in the classrooms as they are unclear on how mobile technology can actually aid learning and teaching. Not only the teachers need to get professional development on how iPads can be integrated in class, but also the teachers need to be educated on the positive results and impacts such devices have made. Based on the previous literature, the interviews in that study showed that the hands-on training in the classrooms would be the most appropriate preparation for a smooth implementation. This is well agreed with the study done by Murray & Olcese (2011) whereby the models of teaching with technology need to be taught in addition to just funding and supplying the devices. Murray & Olcese (2011) also emphasized that it is necessary to provide examples how to use iPads in classrooms to help in producing a high student achievement and essential teacher preparation.

In this study, the data shows that the classroom management of the devices is a remarkably important when implementing iPads technology in class. While studies emphasized on the actual implementation of technology, the previous literature did not highlight on the management of the devices. Specific techniques are required to ensure the students carry the given tasks and use the applications that are supportive for students learning.

In order to meet the goal of this study in investigating the academic achievement and students' attitudes in mathematics class of form 4 at MRSM Pengkalan Hulu, this study depended on the Constructivist Learning Theory and the Technological Pedagogical Content Knowledge (TPACK) theory. This theory is about the direction for the research and provided the findings regarding how iPads can successfully be integrated into the classrooms. An element that can be described by the constructivist learning theory includes the belief that the learners can create new knowledge for themselves through experiences (Liu & Chen, 2010). The students learning in this study involved interaction, collaboration and real world situation as part of their learning process (Zhang & Kou, 2012). Students interact with each other by using iPads to learn a new content. The findings in this study indicated that the instructor believed that the students can create their own knowledge when using iPads as a tool of learning. In clarifying the learning within the

classroom, the findings also revealed that the iPADS helped to create student centered environment. The teacher understood that iPADS helped students to lead their own education. The constructivist principles designed by the belief that the students are succeed when they participate on an active role in their learning in order to create their own knowledge (Liu & Chen, 2010). Moreover, when the teacher participates in the role of a facilitator who provides information and organizes activities for learners is also another element of constructivist principles (Liu & Chen, 2010). Based on comments gained from the interviews, the instructor found that the constructivist philosophy is closely aligned with the instructional approach when iPADS are used in the classroom. iPADS no longer require the teacher to be standing in front of the class to deliver the teaching material and telling them what to do. The students can discover and create their own understandings.

Besides that, a constructivist learning environment is established by integrating the iPADS in classroom. Students and teacher built new understandings regarding the previous knowledge, created new learning experiences and cooperated with each other to form a learner-centered classroom (Kopelman & De Ville, 2001). This relates how Liu & Chen (2010) viewed on constructivism whereby students are the most successful when they participate actively in their formation of knowledge. Not only that, these findings well agreed with Barone dan Wright (2009) whereby iPADS improved the communication between the teachers to students and students to students because of the convenience and easy way to share and transfer the information.

The impact of technology specifically iPADS on the teacher's instruction was designed using Mishra & Koehler's (2006) concept of Technological Pedagogical Content Knowledge (TPACK). A teacher demonstrated the TPACK in teaching students which focused on the content, pedagogi and technology as well as the correlation between them (Mishra & Koehler, 2009). Both of teacher and students became more familiar with the programs and applications that are used daily. These findings related to how Jang (2010) found that the teacher should have the ability to implement technological strategies to encourage students' learning.

Another component of this study that is based on this theory is the impact of teaching with iPADS on the students' attitudes and motivation towards mathematics. Even though there is no statistical significance found using the Attitudes Towards Mathematics Inventory, the interview done by the participated teacher stated that iPADS influenced on the students' attitudes and motivation. This study complemented that iPADS enhanced the learning for unmotivated students or for those who are not fully put sufficient effort. More specifically, this technology provided a different way to learn. iPADS also can give motivation and self-stimulation for students to keep practicing skills as well as maintain students' focus and attention while learning.

In answering the research questions to understand the process and impact of use of iPADS as a teaching tool had on the mathematics student achievements and attitudes in classroom, comparison groups are established and pretests, post-tests and attitude inventories are evaluated using measures of central tendency, ANCOVA test and t-test. The reason of determining these statistics are to provide a more solid data to support the findings. The comparison of the academic achievements for both groups found that the students thought by the integration of iPAD devices overall is similar to those learnt by conventional method. The students' performance on the post-test is supported by the theoretical framework that acted as a basis for this study. The constructivist framework stated that there is a connection between the environments whereby humans are in the process of psychology (Liu & Chen, 2004). Besides that, the TPACK framework claimed that the the success of the technology integration depended on the interactions between teacher and students as well as how it can be applied in the classroom.

Next, the impacts towards students' attitudes are constant either when they using iPADS or when receiving conventional instructions. As stated earlier, the quantitative data revealed that the students learning with iPADS do not have different attitudes compared to the students learning without iPADS. However, the teacher does not agree with these findings. The interview outcomes show that the impacts are more positive towards mathematics learning when using iPADS. Even though the findings of using iPADS are not sufficient to significantly influence the students' achievement and attitudes, but the interview outcomes represented positive impacts in attitudes, engagement and productivity. These findings can be an outcome of certain limitations that may have existed in this study.

5. CONCLUSION

This study shows that the use of iPADs in teaching and learning system does not give significant difference statistically through post-tests and ATMI compared to conventional method. However, iPADs give positive impacts on qualitative components.

5.1 Limitations

This study was limited only among Form 4 from MRSM Pengkalan Hulu, Perak. Therefore, the findings cannot be generalized to all instructors in other district and other MRSM. The larger the sample, the more solid the findings of the sample may represent the population. A larger sample size can help to gain a better research finding and limit the influence of outliers in the data. Further larger studies may be beneficial to validate these findings. The teacher in this study is an experienced teacher. Her ability to integrate the new methodologies and adapt the new components into her teaching style may be more capable than could be anticipated from a more beginner teacher in a similar situation. Furthermore, her skill level may allow her to more effectively integrate the iPADs into the classroom to generate an environment whereby students can be developed with the technology.

5.2 Implications

Practice: The overall results gave insights into the area that can be used to support the success of integrating iPADs into classrooms. Based on the quantitative data, interviews and teacher lesson planings, students' data and teacher via their individual experiences showed that the implementation of iPADs should be expanded to many other schools.

Professional Development: In order to integrate iPADs in teaching, the fundamental considerations including professional development and support for teachers and students need to be taken into account. The teachers need to spend sufficient time to become familiar with the technology and plan properly to ensure a successful program. The workshop and training materials for teachers must be effective. The trainings that can help teachers to successfully integrate iPADs in classroom need to be designed well and appropriately. This kind of training would be able to show the teachers how to intergrate the devices into their classrooms and teaching. Besides that, adequate allocated time is recommended for the teachers to learn and practice incorporating technology into their classrooms.

Student Development: There is a lot of students have iPADs for their personal use outside the classrooms, but need to educate them on how to utilize the devices for learning purpose. The students should understand the ethics of using iPADs and know to differentiate between the main and side stuffs related to iPADs usage. The students should focus on the device management procedures as well as care and user agreement information. The students will benefit when iPADs are used properly in terms of educational propuses.

5.3 Further Research Recommendations

The findings from this study are relevant to the current learning style. As the society is moving aligned with rich technology culture, methodologies in classrooms need to be shifted to meet the students' requirements. In order to further investigate the study on how students' achievement and attitudes are affected by the integration of iPADs, there are variety of aspects that can be further investigated and analyzed. As this study only focused on one teacher from one chosen school, it is recommended to conduct the study on the use of iPADs in other schools. The future study should be conducted at different age of students to determine how iPADs can change the educational experiences. The study should apply the qualitative and quantitative data to ensure that the findings will be well agreed to each other. This study was solely focused on mathematics. The further studies can be included the other subjects such as science, languages and so on. Another recommendation for future studies is to focus on teaching methods that utilizing iPADs. Since the devices are still new for students in teaching and learning in this school, therefore there are only a few programs involved in the teacher's instructions. It is also recommended that the future studies to explore the other effective methods, programs and applications for students learning with iPADs.

In conclusion, the analysis of the findings data shows that it is not found that iPADs statistically made a difference in students' achievement and attitudes, however the qualitative component does show positive changes. Generally, the findings illustrated that the use of iPADs in mathematics class for form 4 at MRSM Pengkalan hulu promoted student motivation, engagement and attitudes towards the subject. The findings data led to recommendations on how to integrate iPADs into classrooms along with the suggestions for further studies.

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