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THE FLIPPED CLASSROOM STRATEGY: THE EFFECTS OF IMPLEMENTATION AT THE ELEMENTARY SCHOOL LEVEL MATHEMATICS LESSONS

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Abstract: Students have been applied great pressure from global expectations and challenges of the 21st century. Brunei Darussalam, with its new education system (SPN21) aims to prepare the students in facing the challenges and globalized world. This study investigated the effects of flipped classroom on students' academic performance. At the same time, this study helps to provide the students to improve on their 21st century skills, provide a student-centered learning environment and allow students to be responsible in their own learning. This study, involving 16 Year 7 participants from an all-girls high school in Brunei, was an action research study and uses quantitative methods for data collection. Pre-test, post-test and delayed post-test were given to the students to measure their learning of mathematics in three teaching cycles involving the topics *Whole Number and Operations, Integers, and Fractions and Decimals.* Analysis of the results from the pre-test, post-test and delayed post-test indicated an improvement in the overall students' performance.

Keywords: Flipped Classroom, Mathematics Lessons, Academic Performance

Introduction

There are many variations in which researchers defines 'flipped' but the main idea is just the shift in which students attain the content knowledge outside of the class or before class in any form of medium or media, then, the in-class time is spend to apply the content through problem solving, deeper coverage and interaction with peers. Hanover Research (n.d) noted that the term 'flipped classroom' can be used in many blended instructional methodologies in which students can access the pre-prepared materials and then engage structured in-class activities. Moreover, in that research stated that there is no singular model for a flipped classroom, but the underlying concept is to reverse or invert the traditional approach of teaching and learning, where lecture materials which can be viewed at home in advance before a class and in-class time can be used to work through problems, advance conceptual knowledge and engage in peer-centred learning activities. Furthermore, Braseby (n.d) stated that knowledge can be acquired through many different media including TED talks, YouTube videos, journals, newspaper, textbooks, or any combination of these other than recorded online lectures.

Bergmann *et al.* (2011) summarised what is a flipped classroom and what is not. According to them, flipped classroom is when the teacher is not the 'sage on the stage', but will be guiding on the side of the students and the students take their own responsibility for their own learning. Moreover, they stated that flipped classroom increases the interactions through engagement in students' learning, personalised education and contact time between students and teachers. Additionally, Bergmann *et al.* (2011) also stated that a flipped classroom is not a synonym of online videos because most people hear about flipped classroom will think about the videos. In addition, they further stated that a flipped class is not an online course, or students working unstructured, or

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students spending whole lesson in front of computer, and most importantly teachers are not replaced in a classroom setting with videos.

McKnight *et al.* (2013) explained that flipped classroom is an alternative way, in which content of the lessons will be delivered outside of the classroom and students will be engaged with activities such as hands-on activities that will require collaborative works with peers and teacher will be having more time in one-on-one. Moreover, some essential skills which have been identified as the 21st century skills by P21 are such as: communication skills; numeracy skills; ICT skills; thinking and problem-solving skills; study and work skills which will be polished up by the students in the flipped classroom.

Review of Literature

Flip Classroom and Flipped Learning

Flip Classroom and Flipped Learning are two different terms that were distinguished by the Flipped Learning Leaders (Flipped Learning Network, 2014). A cadre of experienced educators from the Flipped Learning network identified four pillars of F-L-I-P in flipped learning, an acronym of Flexible environment, Learning culture, Intentional content and Professional educator.Accordingly, flipping a class can, but does not necessarily lead to Flipped Learning. Flipped classroom is just having the students read the text, watch video or solve additional problems outside of a classroom.Flipped Learning Network (2014) stated that"flipped learning is a pedagogical approach in which direct instructions moves from group learning space to the individual learning space, and the resulting group space is transformed into dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter" (p. 1). Hence, Flipped Learning Network (2014) clarified that in order to engage in flipped learning, teachers must incorporate the key features of flipped learning into their practices.

Bergmann and Sams (2012) stated that there is a high tolerance for change in flipped classroom and there is no specific methodology to replicate, no checklist to follow and no single way in flipping your classroom. Flipping is more about the mind-set of putting attention on students' learning and redirecting away from the teacher. The theoretical framework in Figure 1 by Strayer (2007) shows that flipped classroom provides opportunity for learning through activities and uses educational technology which can influence the learning environment.

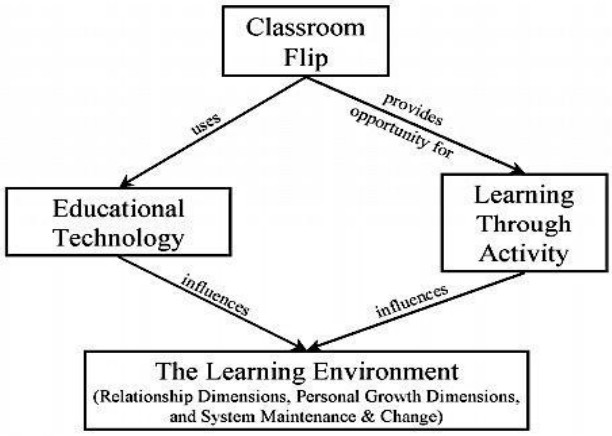

Figure 1Theoretical framework of flipped classroom (taken from Strayer, 2007, p. 16).

Referring to Figure 1, a flipped classroom will require students to view lecture material using the educational technology before they arrive into the classroom. This uses multiple technologies for instruction, which includes

lecture capture online podcasts, tutoring, social networking and recorded lectures (Brame, n.d.). The use of video or any other pre-recorded media gives student the opportunity to self-control their learning either by re-watch, rewind, fast-forward if needed or pause, and hence, more human or face-to-face contact with each student during in-class time (Nawi*et al.*, 2015; Manjanai and Shahrill, 2016). Bruff (2012) pointed out that flipping a classroom does not necessarily require the use of video. According to him, textbook is also an educational technology where teachers should embraced to the extent as they could (Best Practices for the Flipped Classroom, 2013).On the other hand, there are greater time for learning activity where the activity can be student-led and communication among students can be the dynamic learning through hands-on activity (Educause, 2012).

Benefits of Flipping a Classroom

According to Bergmann and Sams (2012), they had pointed out some reasons for flipping a classroom such as: Flipping helps busy students cause flipped classroom create a flexible environment for the learning of the student; Flipping helps struggling students as educators spend most of the time walking and communicating to help students who struggle most, compared to the traditional role of teaching where educators spend most of the time delivering content and student listen passively; Flipping helps students of all abilities to excel because students do not need to take-notes while hoping they can understand them later. Instead, students can just pause or rewind the video when necessary so that they actually learn the important concepts, if they are watching vides.

In addition, Bergmann and Sams (2012) added that Flipping increases interactions either between students to teacher or students to students, where there are more face-to-face or in-class time. Students have more opportunity to talk with others, especially during collaborative group activity; Flipping allows for real differentiation for students with different ability ranges from those who excel, to the average student, to student who struggle, to students who cannot read. Hence, personalised learning can be modified according to their ability and Flipping changes classroom management where in traditional teaching approach, students did not pay attention, often distracted and negatively affected by others while in flipped classroom, students either do hands-on activity or works in small groups where students' distraction or student getting bored is not an issue.

Methodology

The aim of this study was to investigate the effects of flipped classroom on Brunei Secondary Mathematics in students' performance. This study will also be guided by the following research question guided this study: How does flipped classroom affect the students' performances?

Sample and Setting

The sample size was 16 students with average learning ability. The contact hours between students and teacher were seven periods in a week, which was approximately 25 minutes per period.This study was conducted in an all-girls high school, situated in the Brunei-Muara district. The school is a mixed ability school, and most of the students in this school are within this catchment area. This study was conducted to the Year 7 students with an age range from 11 to 12 years old.

Procedure

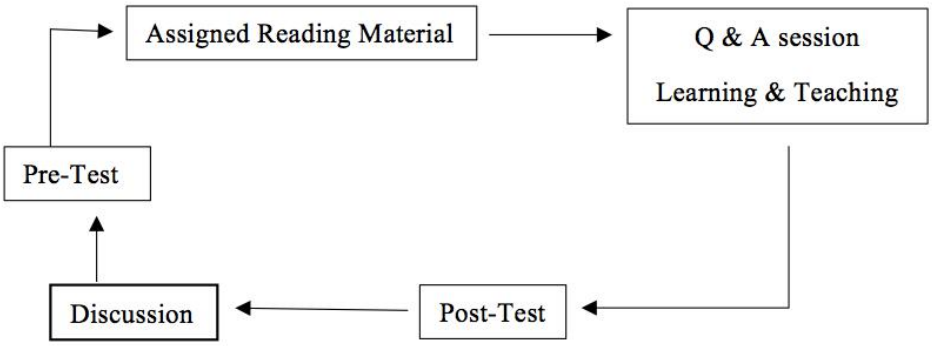

Figure 2Flowchart of teaching and learning in a flipped classroom

This study involved a three cycle action research. The process of flipped classroom for this study in each cycle can besummarised by Figure 2 above. In the first cycle, during the introduction lesson, a pre-test was conducted to test students' prior knowledge on the topic 'Whole Number and Operations'. After the pre-test 1, students were given assigned reading materials in the form of textbooks and videos as homework so that they can watch the videos or do their reading outside of the classroom on their own pace. At the same time, the learning objectives that they should have achieved at the end of the topic was explained to them.

When they returned for the next lesson in the flipped classroom, a question and answer session took place to help those students who found difficulties in their assigned 'homework. The lesson continued with some hands-on activity or problem-solving activity to enhance students' learning. A post-test was given at the end of the topic which was approximately two weeks after pre-test 1 and that will be labelled as post-test 1. In the next lesson, a discussion session took place after the post-test1 was marked. The discussion session was conducted one-on-one to those students who performed quite weak in their post-test1. This discussion session was aimed to help those students who faced difficulty in answering the questions from the post-test 1 to perform better. In addition, a delayed post-test 1 was given after 1 or 2 weeks gap from post-test 1.

Students worked in a small groups (around 4 to 5 students each) for any in-class activities. They were grouped randomly by the teacher during the introductory lesson and they will be working in the same group throughout the study. This study repeated for another two cycles, hence covering another two topics which follows the scheme of work of the Year 7 Secondary Mathematics in Brunei Darussalam. The other two topics covered in this study were 'Integers' as well as 'Fractions and Decimals'. All questions in pre-test, post-test and delayed post-test are set to be in the same questions but the arrangement of the questions are in different sequences.

The process of the second cycle was similar to Cycle 1 (refer to Figure 2). And the test instruments were labelled as pre-test 2, post-test 2 and delayed post-test 2. In this cycle, the students were assigned to read from their textbooks only and no videos were used. Whereas in the third cycle, the same process took placed as shown in Figure 2. The test taken by the students were labelled as pre-test 3 and post-test 3. There was no delayed post-test 3 in this cycle due to time constrained. In cycle 3, textbook was assigned as reading materials but students have to answer some 'Test Yourself' questions after they had done their reading outside of the classroom and no video was used. The aim of the 'Test Yourself' questions was to assess students' understanding on the content they had read. The questions are available at the end of each section of the assigned readings in their textbooks, and there are usually three to four questions for them to answer. Students then discuss the questions in their respective groups in the next flipped classroom lesson followed by in-class activities to enhance their learning on the mathematics content.

Data Collection

Mixed method of quantitative and qualitative method will be carried out to collect data in this study. The pre-test was conducted firstly before a chapter start which test the students' prior knowledge on the topic and at the same time, it will be used as a benchmark to be compared with their post-test and delayed post-test mark. The post-test will be conducted at the end of the chapter. The aim of the post-test is to measure the learning during the class, at the same time, it helps in recognising students who need additional helps in the topic. A delayed post-test was carried out one or two weeks after the post-test. This is to measure the application and the impact of the learning but not measure the students' ability to retain the knowledge (pre- and post-testing). All the pre-test, post-test and delayed post-test marks were converted to percentages so that the marks can be analysed easily. The maximum possible marks score for pre-test, post-test and delayed post-test was 100 and the minimum possible marks score was zero.

Data Analysis

Data were collected by using pre-test, post-test and delayed post-test. Statistical data such as mean and standard deviation will be calculated to compare the results between the tests in the three cycles. A paired sample t-test was used to compare the mean difference of pre-test, post-test and delayed post-test in determining whether there is any significant difference between each other under normal distribution. The use of pairwise t-test was to compare the pre-test, post-test and delayed post-test of the same students in this study. All the data were entered and analysed using the SPSS software.

Scope and Limitations

The sample size of the study was 16 students. Due to the small sample size collected in this study, the data collected may not be used to generalise with the population of Brunei but the data will only be used to investigate the effects of flipped classroom in this study. In addition, the data may be used as a benchmark or reference for other researchers especially in Brunei who may be interested to do further investigation on the study area.

Furthermore, time is also another limiting factor, where this study will only be carried out in a limited time frame (2 months). Since this study is an action research that involves intact classroom where there are interactions between teacher and students in a natural classroom setting, so the data collected in that time frame is just a snapshot of flipped classroom during that time.

In addition, students' proficiency in English language may vary. Since this study will be conducted in English medium only, so some students might find some difficulty in expressing their ideas and may often create misunderstood which might also affects the peers in evaluating them in regard to the students' engagement during in-class activity. Moreover, it may also influenced the students' achievements indirectly.

Furthermore, it may be difficult for some students to access to the computer due to the inadequate or limited number of computers provided in the school computer lab, time constraint in using a computer in the library (usually 30 minutes) or cannot afford for the technology which lead to student failing in doing the assigned 'homework' in flipped classroom.

Results and Discussions

According to Pallant (2005), there are some general assumption that apply to the use of parametric statistics test such as the measure of dependent variable is measured using a continuous scale rather than categorical, random sampling, independence observations, homogeneity of variance and normal distribution of sample.

The dependent variables for this study is the students' marks for pre-test, post-test and delayed post-test from the three cycles. Hence, the marks is a measure of continuous scale. The sample used in this study is a purposive sampling and not a random sampling. As Pallant (2005) agreed that it is not often the case (i.e. random sampling) in a real-life research. The observations made from my data is independent, even though Gravetter and Wallnau (2004) argued that studying the performances of students working in small groups might influences all the other group members and thereby violating the assumptions of independence. According to Stevens (1996), it is very serious if this assumption is violated, but he recommended a more rigid alpha value, for example $p<.01$, for any suspicion in violating the assumptions.

A normality test can be assessed to ensure that the data were normally distributed. The normality test consisted of the Kolmogorov-Smirnov test or Shapiro-Wilk's test, skewness values, kurtosis values and visual representation ofhistogram and normal Q-Q plot (Pallant, 2005). Shapiro-Wilk's test is being explored to examine the normality of the variable as the test was originally restricted for sample size less than 50 (Shapiro and Wilk, 1965). In Shapiro-Wilk's test, the hypotheses are Null hypothesis: The data are normally distributed; and Alternate hypothesis: The data are not normally distributed. Hence if the p-value is above .05 then the null hypothesis is accepted while if the p-value is below .05 then the null hypothesis is rejected (Rose *et al.*, 2014). According to Rose *et al.* (2014), the skewness and kurtosis Z-score for a normal distribution should be in between -1.96 to +1.96, and the Z-score can be obtained by dividing the statistics skewness or kurtosis value with their respective standard error.

The entries in Table 2 below shows the Shapiro-Wilk's test results. The results from the table shows that all the p-values for pre-test and post-test for the three cycles is above .05. Since $p>.05$, then the null hypothesis is accepted (i.e. the data are normally distributed). The entries in Table 3 below shows the skewness and kurtosis statistics.

Table 1 Results from Shapiro-Wilk's test

	Shapiro-Wilk's Test
Pre-test 1	.934*
Post-test 1	.161*
Delayed post-test 1	.351*
Pre-test 2	.325*
Post-test 2	.113*
Delayed post-test 2	.171*
Pre-test 3	.132*
Post-test 3	.397*

N=16, *p >.05

Table 2 Descriptive statistics on skewness and kurtosis

	Skewness Statistics	Kurtosis Statistics
Pre-Test 1	.048	-.058
Post-test 1	.082	-1.153
Delayed post-test 1	-.473	-.647
Pre-test 2	-.353	-1.001
Post-test 2	.175	-1.320
Delayed post-test 2	-.268	-.692
Pre-test 3	.439	-1.145

Post-test 3	-.625	.664

N=16, Standard Error Skewness = .564, Standard Error Kurtosis = 1.091

From Table 3 above, the Z-score for skewness and kurtosis can be calculated and is shown in Table 4 below. It can be noted that the Z-score for all pre-test, post-test and delayed post-test in all the three cycles are in the range of -1.96 to +1.96.

Table 3 Z-score for skewness and kurtosis

	Skewness Z-score	Kurtosis Z-score
Pre-Test 1	0.085	-0.053
Post-test 1	0.145	-1.057
Delayed post-test 1	-0.839	-0.593
Pre-test 2	-0.626	-0.918
Post-test 2	0.310	-1.210
Delayed post-test 2	0.475	-0.634
Pre-test 3	0.778	-1.049
Post-test 3	-1.108	0.609

N=16

In addition, the results from the pre-test, post-test and delayed post-test for the three cycles are approximately normally distributed and all the normal Q-Q plot are plotted in its best fit straight line. Hence, it can be concluded that all the pre-test, post-test and delayed post-test from all the three cycles are approximately normally distributed. Furthermore, homogeneity of variance makes the assumptions that the samples are obtained from population of equal variances and the scores in between the groups is similar (Pallant, 2005). A Levene's test for homogeneity of variance has been conducted since the data are approximately normally distributed. The hypotheses for Levene's test are Null Hypothesis: There is an equality of variances; and Alternate Hypothesis: There is an inequality of variances.

The entries in Table 5 below shows the results from Levene's test on pre-test 1, post-test 1 and delayed post-test 1 for Cycle 1. The results indicated that only the pair between post-test 1 with delayed post-test 1 has a p-value of .940 which is greater than .05 while the other two pair results, pre-test 1 with post-test 1 and pre-test 1 with delayed post-test 1 have p-value of .029 and .33 respectively, which are less than .05.

Table 5 Results from Levene's test for Cycle 1

	Levene Statistics	Sig.
Pre-test 1 & Post-test 1	5.250	.029
Post-test 1 & Delayed 1	.006	.940*
Pre-test 1 & Delayed 1	4.969	.033

*p>.05

Table 6 below shows the results from Levene's test on pre-test 2, post-test 2 and delayed post-test 2 for Cycle 2. The p-value for the pair between pre-test2 with delayed post-test2 is .037 which is smaller than .05 while p-value for the pair between pre-test 2 with post-test 2 is .158 while post-test 2 with delayed post-test 2 is .349, which are greater than .05.

Table 6 Results from Levene's test for Cycle 2

	Levene Statistics	Sig.
Pre-test 2 & Post-test 2	2.095	.158*
Post-test 2 & Delayed 2	.904	.349*
Pre-test 2 & Delayed 2	4.782	.037

*p>.05

Table 7 below shows the results of Levene's test for pre-test 3 and post-test 3 in Cycle 3. The p-value between pre-test 3 with post-test 3 is .055, which is greater than .05. The Levene's test verified that if the p-value is above .05, the alternate hypothesis is rejected and it shows there is an equality of variance (Martin and Bridgmon, 2012).

Table 7 Results from Levene's test for Cycle 3

	Levene Statistics	Sig.
Pre-test 3 & Post-test 3	3.975	.055*

*p>.05

As referred to Table 5, Table 6 and Table 7 above, it shows that there are some results that shows equality in variances and some do not. Pallant (2005) recommended to stringent the significant level (p<.01) if inequality of variance was suspicion when evaluating the results.

Validity and Reliability of Instruments

All the pre- and post-tests were validated by the researchers to ensure that the tests were suitable to assess the students' knowledge on the mathematics content. SPSS software was used, where split-half test was conducted to check the reliability of the test. The reliability test was performed to all the three pre-tests (pre-tests 1, 2 and 3). Only the pre-tests were used in the reliability test as the questions for the pre- and post-test are the same. There are 25 questions in total from all the three pre-tests, and by using the split-half method, the Spearman-Brown coefficient showed 0.705 which is relatively reliable, with a correlations between forms of 0.545.

Analyses result of Pre-test and Post-test

By using SPSS, a paired sample t-test was conducted between the pre-test, post-test and delayed post-test, in order to find out the effect of flipped classroom on students' performance in Year 7 secondary mathematics. The hypotheses areNull hypothesis: There is no significant difference between the means of the pre-test and post-test; and Alternate hypothesis: There is a significant difference in between the means of the pre-test and post-test.

The entries in Table 8 below summarized the mean and standard deviation of students' marks for Cycle 1. It can be noted that the mean marks for post-test 1 (M=79.81, SD=9.874) is higher than the pre-test 1 mean marks (M=54.13, SD=21.159), while the delayed post-test 1 has a higher mean marks (M=81.63, SD=10.210) compared to its pre-test and post-test marks.

Table 8 Descriptive statistics of students' marks in Cycle 1

	M	N	SD	Standard Error Mean
Pre-test 1	54.13	16	21.159	5.290
Post-test 1	79.81	16	9.894	2.474
Delayed post 1	81.63	16	10.210	2.553

M = Mean, SD = Standard Deviation

The entries in Table 9 indicated that the mean marks for post-test 2 (M=65.31, SD=10.910) is higher than the pre-test 2 mean marks (M=45.69, SD=14.916), while the delayed post-test 2 has a higher mean marks (M=75.00, SD=9.571) compared to its pre-test and post-test marks.

Table 9 Descriptive statistics of students' marks in Cycle 2

	M	N	SD	Standard Error Mean
Pre-test 2	45.69	16	14.916	3.729
Post-test 2	65.31	16	10.910	2.728
Delayed post 2	75.00	16	9.571	2.393

M = Mean, SD = Standard Deviation

The entries in Table 10 below summarized the mean and standard deviation of students' marks for Cycle 3. From Table 10 above, it shows that the mean marks for post-test 3 (M=55.00, SD=9,980) is higher than pre-test 3 mean marks (M=43.56, SD=13.692). Hence, this shows that there is an improvement in the average marks between pre-test, post-test and delayed post-test for all the three cycles and the average mean marks for all tests in all the three cycles was summarized in Figure 3 below.

Table 10 Descriptive statistics of students' marks in Cycle 3

	M	N	SD	Standard Error Mean
Pre-test 3	43.56	16	13.692	3.423
Post-test 3	55.00	16	9.980	2.495

M = Mean, SD = Standard Deviation

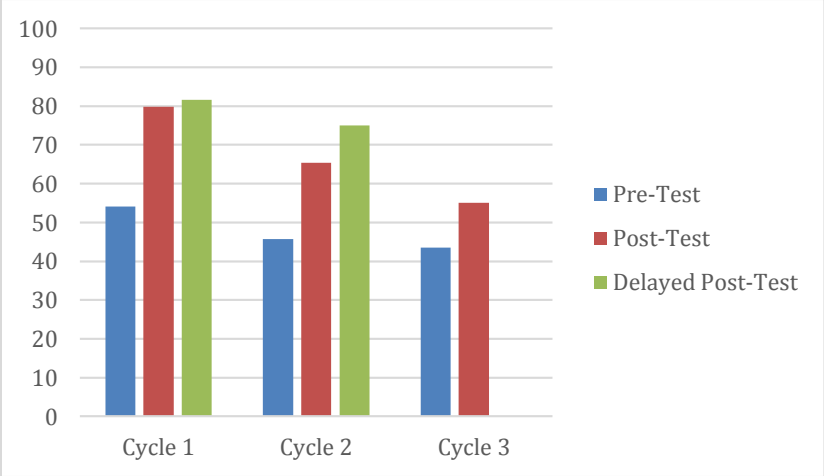

Figure 3. Summary of mean marks for all the three cycles

Next, the paired sample t-test differences were generated. The entries in Table 11 shows the results of paired sample t-test in Cycle 1, and it shows that the mean marks for the first pair between post-test 1 and pre-test 1 is

25.688 with standard deviation of 6.039, while the second pair between delayed post-test 1 and pre-test 1 mean is 27.5 with standard deviation 19.796. This shows that the mean between the two pairs (post-test 1 and pre-test 1 with delayed post-test 1 and pre-test 1) increased by approximately 32%. Moreover, the paired sample t-test shows both pairs, between post-test 1 with pre-test 1 and between delayed post-test 1 with pre-test 1 are statistically significant at p<.01, which means that the students' performed significantly better in their post-test 1 and delayed post-test 1 compared to their pre-test 1.

Table 11 Paired sample t-test results for Cycle 1

	M	SD	Std. Error Mean	t	df	Sig(2-tailed)
Post 1 – Pre 1	25.688	24.157	6.039	4.253**	15	.001
D 1 – Pre 1	27.5	19.796	4.949	5.557**	15	.000

**p<.01, D= Delayed Post-Test, Std. Error Mean= Standard Error Mean, M = Mean, SD = Standar Deviation

Entries in Table 12 shows the results of paired sample t-test in Cycle 2, and the mean for the first pair between post-test 2 and pre-test 2 is 19.625 with standard deviation 15.874, while the second pair between delayed post-test 2 and pre-test 2 mean is 29.313 with standard deviation 12.794. This shows that the mean marks between these two pair (post-test 2 and pre-test 2 with delayed post-test 2 and pre-test2) have an increase of approximately 49%. For the third pair in between post-test 3 and pre-test 3, the mean is 11.438 with standard deviation of 9.906. Furthermore, paired sample t-test shows that the three pairs in Table 12 above have a statistically significant increase at p<.01, which means students' performance in their post-test and delayed post-test are better than their pre-test.

Table 12 Results from paired sample t-test in Cycle 2 and Cycle 3.

	M	SD	Std. Error Mean	t	df	Sig(2-tailed)
Post 2– Pre 2	19.625	15.874	3.968	4.945**	15	.000
D 2 – Pre 2	29.313	12.794	3.199	9.164**	15	.000
Post 3– Pre 3	11.438	9.906	2.477	4.618**	15	.000

N=16, **p<.01, D= Delayed Post-Test, Std. Error Mean= Standard Error Mean, M = Mean, SD = Standard Deviation

Although the results from the pre-test, post-test and delayed post-test for all the three cycles shows that there is a significant increase in the marks, but it does not tell us the magnitude of the intervention's effect. Hence, one way to find it out is by calculating the effect size statistic. One of the most common used effect size statistics is eta squared and can be calculated using the formula:

$$Eta\ squared = \frac{t^2}{t^2 + N - 1}$$

Where t is the t-value from paired sample t-test and N is the number of sample. Eta squared ranges from the value 0 to 1 (Pallant, 2005). Guidelines are being used to interpret the eta squared values, where .01 means small effect; .06 means moderate effect; and .14 means large effect (Cohen, 1988). From Table 13, the eta squared statistics are shown for all the pre-test, post-test and delayed post-test in the three cycles. All the eta squared statistics are larger than .14, hence indicates a large effect size.

Table 13 Effect size statistics for Cycles 1, 2 and 3.

	t	Eta squared statistics
Post 1 – Pre 1	4.253	.55
Delayed 1 – Pre 1	5.557	.67
Post 2 – Pre 2	4.945	.62
Delayed 2 – Pre 2	9.164	.85
Post 3 – Pre 3	4.618	.74

N=16

Conclusions

This study was conducted in an all-girl high school in Brunei Darussalam which aim to investigate the effect of flipped classroom. Due to the small sample size, the finding from this study should be viewed as tentative and suggestive rather than conclusive. Moreover, the conclusion drawn for this study are restricted to the particular sample, topic covered and the test used.

By using Paired sample t-test, it can be concluded that there seemed to be a statistically significant improvement in Year 7 Secondary Mathematics after the flipped classroom throughout the three cycles giving us evidence that flipped classroom approach does have a positive impact in the performance of the students.

Flipped classroom can be considered as one of the effective teaching and learning strategies to be applied in a mathematics classroom. In addition, flipped classroom promotes student-centered learning. In a flipped classroom, teachers are no longer acting as the only person who deliver information and students are the one copying down notes. The role of the teacher in a flipped classroom is to facilitate students. Moreover, in a flipped classroom, students are no longer sitting in rows and columns, but they are sitting in groups. By sitting in groups, it can encourage students to discuss and participate in the process of their learning. As they get involved in the process of learning, knowledge is constructed which tends to make things easy and better for them to understand.Furthermore, students are working in groups which helps in polishing up one of the 21st Century Skills: Teamwork. At the beginning when students first entered secondary school, they may not be familiar with the new environment especially the new learning environment. Hence, students working together in groups helps to provide the students with the sense of belonging. At the same time, when they share knowledge or ideas with their friends, they create a common understandings which helps to improve their learning in mathematics. More 21st Century skills are being integrated in the flipped classroom, such as communication skills in which students might be shy at first when they entered a new environment, but after some times working in groups, they tend to slowly open up and starts to communicate with each other's. In addition, numeracy skills was also being polished in which students doing operations mentally without the use of electronic calculator.

Flipped classroom encourage students to be responsible in their own learning as students in a flipped classroom will acquire knowledge outside of the classroom and practice the knowledge learned in-class. In this sense, students will have more time interact with the teachers and teachers have more time to help those students who are struggling in learning mathematics.

The present study is concerned with Year 7 students that was taught in an all-girls high school. It could be more interesting to check whether a co-ed school will give the same findings. In other words, investigating the genderaffectsof flipped classroom. For the population of students in this research, future studies may consider to expand the number of sample by involving more groups of students from different abilities or even more school of the same ability participating in the research.Last but not least, this research study hopes to contribute either

directly or indirectly to the educational research for flipped classroom in mathematics especially in secondary mathematics in Brunei Darussalam.

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