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STATISTICAL ANALYSIS ON THE EFFECTIVENESS OF SHORT-TERM PROGRAMS DURING COVID-19 PANDEMIC: IN THE CASE OF PROGRAM BIJAK SIFIR 2020

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At the start of 2020, the whole world faced the Covid-19 pandemic spreading across countries, including Malaysia. The pandemic caused the Malaysian government to take immediate action to declare a Movement Control order (MCO). This MCO has a severe impact on almost all sectors of Malaysia, including the economic, social, and education sectors. For primary school students to strengthen their mathematics skills, we believed that short programs significantly affect their performance during MCO implementation. This study was conducted to measure the primary school students' performance during MCO for the short-term Mathematics program by applying the Naimo method in improving students' understanding of the basics of multiplication. There were two sets of mathematics score data before and after the program considered in this study. The Mann-Whitney test was conducted to test whether there is any significant difference in performance between genders for both data sets. Meanwhile, the Wilcoxon Signed Rank test was conducted to evaluate student performance's significant difference before and after the program. It was found that there was a significant difference in students' performance before and after the program, increasing the performance after the program. Although this program is conducted for a short time, this face-to-face learning program is one factor that significantly impacts student performance. As we believed, face-to-face teaching and learning activities are still necessary for all education levels, especially at the primary level, even if it only involves a short period. Nonetheless, the hybrid platform of teaching and learning must be prepared due to the pandemic era's uncertainty.

***Keywords*:** Covid-19 pandemic, short-term programs, performance

1. Introduction

The Covid-19 pandemic, which began in 2020, shook the world. In March 2020, the number of Covid-19 positive cases in Malaysia skyrocketed, prompting the government to issue a Movement Control Order (MCO) beginning March 18th. Schools, colleges, universities, and other Malaysian sectors were closed during the MCO. Teaching and learning (T&L) programs for a total of 2,741,837 primary school students were halted. Many parties were concerned that MCO would result in a drop in academic performance during the school closure. As a result, the Malaysian government changed how teaching and learning activities are delivered online (MOE Malaysia, 2020).

However, there are some challenges that teachers and students must overcome to engage in this online learning. To begin with, we cannot presume that all teachers and students have access to laptops, desktop computers, or smartphones. Second, internet coverage and speed differ according to budget and location. Third, we assume that this would result in a decrease in the standard of primary education.

In Malaysia, school closures for nearly four months may affect the T&L activities where all T&L activities have been planned by all parties such as teachers, administrative staff, principals, and ministries from the beginning of the year 2020. As a result, public examinations had to be cancelled, such as Form Three Assessment (PT3) and Primary School Achievement Test (UPSR). Some were even postponed, such as the Malaysia Education Certificate (SPM) and Malaysian Higher School

Certificate (STPM). Students also faced the challenges of coping with online T&L, especially for the B40 groups who do not have internet access, no computer, or smartphone that live in rural areas. Based on this situation, we believed that the performance of the students would be affected.

It is believed that T&L for mathematics subjects is more effective through a face-to-face approach. Learning mathematics subject needs to be the focus and understand from the core of the subject. It can be done effectively by face-to-face classes with direct communication between teachers and students. It is believed that there was a significant difference in performance when using different T&L approaches (face-to-face versus online). The objective of this study was to determine the primary school performance in mathematics subjects by applying the Naimo method in improving students' understanding of the basics of multiplication by comparing mathematics test scores before and after attending a short-term program during MCO using statistical analysis.

2. Literature Review

The average impacts on academic outcomes during the Covid-19 are mostly negative (Aucejo et al., 2020).The average subjective treatment impact is 0.17 points on semester-level GPA. More than half of the students in the sample expect their GPA to drop as a result of the procedure, and only 7 percent expect an increase in their GPA. However, because of their prior experience with online instruction, 4 percent of the study's sample would prefer online instruction if given a choice between online and in-person instruction. In comparison, 47 percent of the study's sample would prefer in-person instruction. It shows that most students are more interested in following the face-to-face T&L process when compared to online learning.

In addition, the T&L processes during the Covid-19 pandemic in the context of physics courses at the university level also had a negative impact. Students who have studied physics for six years or more rate the efficacy of the recitations higher than younger students who were exposed to the Covid-19 pandemic. Moreover, first-year students have the lowest perceived acquisition of experimental skills (Klein et al., 2020). They argue that direct learning and reconstructions of problem solutions are important to increase their understanding of something being learned compared to the distribution of solutions. Face-to-face recitations are incomplete without group conversations, corporate problem-solving events, and active exchange, which cannot be substituted by handing out ideas that enable participants to retrace the solution independently.

Moreover, online learning shows a significant difference compared to traditional learning (Adnan & Anwar, 2020). 78.6 percent of the students agreed that the face-to-face learning method with the teacher is essential as it helps in increasing the motivation of the students to follow theT&L process. Nevertheless, only 10.3 percent of students felt that online learning increased their motivation to learn compared to traditional learning. Furthermore, group assignments become more complicated to perform if this online learning is continued. This is because students find it challenging to discuss and share ideas when compared to face-to-face learning. Therefore, this online learning causes communication between students to fade.

Furthermore, online learning also influences academic achievement. For example, teacher strikes in Canada reported that school closures of ten days statistically and significantly impacted student achievement, with the most significant effects in Mathematics (Baker, 2013). Standardizing his findings for the impact of a four-week (20-day) closure, we would expect students to lose half a standard deviation in their achievement distribution. Writing about strikes and labor conflicts in Canada tells a similar story, emphasizing the impact on children whose parents are less educated (Johnson, 2011).

In Malaysia, students show a positive reaction to the short-term program conducted, which can strengthen students' mastery of the size of the Arabic vocabulary and then practice it in daily lives using the correct usage context (Ramli et al., 2019). Moreover, the academic programs held can be an injector of enthusiasm and motivation for students to improve their academic achievement and subsequently remain excellent in their studies (Aziz et al., 2006). Sixty percent of the Master's Degree students from the Faculty of Computer Science and Mathematics (FSKM) UiTM Perlis have shown significant changes in their academic results before and after the program (Abd Halim et al., 2015).

Therefore, based on the study conducted, a short-term program conducted face-to-face has proven to be effective in helping students improve their academic performance.

As Choong (2020) reported, pandemic Covid-19 had a deep impact on the tertiary education sector in Malaysia in terms of financial challenges in online T&L, administrative challenges that directly impact the students' and employees' performance. T&L activities move to online approaches that cause challenges for teachers and students. Allam et al. (2020) reported that MCO had effects on online teaching for Communication and Media Studies undergraduate students. They found that interactive learning should be carried out to improve student performance, especially in the communication and media studies program. But the nature of each subject in tertiary, secondary, and primary education is different and needs different approaches of T&L. For example, the mathematics subject is one of the critical subjects in school or university where it needs other methods.

3. Data and Methods

This study is a quantitative study to measure the primary school students' performance during MCO for the short-term Mathematics program. It applies the Naimo method to improve students' understanding of the basics of multiplication, which has some interesting features compared to traditional methods that involve memorization. This Naimo method means that students use their limbs, i.e., fingers, in solving a given multiplication question (sifir). Students use this method to master in sifir two until sifir 10. The program was held for three days.

The sample of the study consisted of 38 students involving 19 females and 19 males. The sample of this study was randomly selected involving primary school students in Kuala Nerus, Terengganu, aged between 8 to 12 years. The instruments used in this study were a set of pre-test and post-test questions. The test consists of 30 objective questions. The time allowed for students to answer the pre-test and post-test questions is one hour. Pre-tests are given to students before the program begins to identify level of knowledge in the basics of multiplication. Then, post-tests are given to students to see the effectiveness of short-term programs conducted by applying the Naimo method in improving students' understanding of the basics of multiplication.

On the first day, students are taught to master the sifir two until sifir five through the Naimo method using fingers. The following are the steps for sifir two until sifir five.

1. Our fingers have 10. Each finger represents a group.
2. Sifir 2:-
    - One finger@group represents two segments.
    - 5 x 2. So there are five groups@5 of fingers.
    - Each finger counts two segments, and then the result will be the answer 5 x 2 = 10.
3. Sifir 3:-
    - One finger@group represents three segments.
    - 6 x 3. So there are six groups@6 of fingers.
    - Each finger counts three segments, and then the result will be the answer 6 x 3 = 18.
4. Sifir 4:-
    - One finger@group represents four segments.
    - 8 x 4. So there are eight groups@8 of fingers.
    - Each finger counts four segments, and then the result will be the answer 8 x 4 = 32.
5. Sifir 5:-
    - One finger@group represents three segments.
    - 8 x 3. So there are eight groups@8 of fingers.
    - Each finger counts three segments, and then the result will be the answer 8 x 3 = 24.

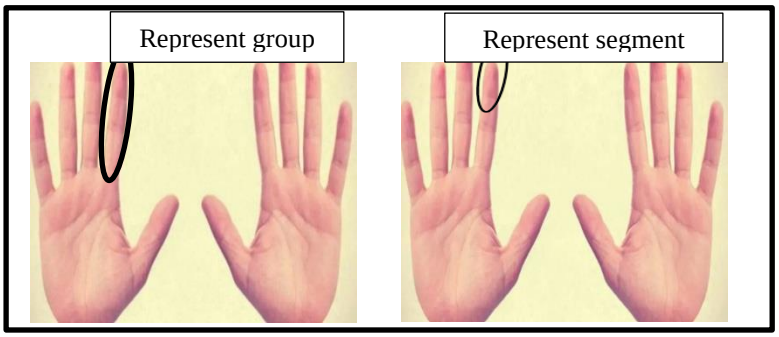

Figure 1: Sifir two until Sifir five

Next, the focus is given to the students to master the sifir six until sifir ten on the second day. The steps in the Naimo method used are as follows.

1. For example, sifir 6:-
   - 8 x 6. So close the thumb of the right hand, which represents the number 6, and close the three fingers of the left hand, which represents the numbers 6, 7, and 8.
   - Thus, the closed finger is as many as four fingers representing the number in front.
   - And the open finger@stay needs to be multiplied, 2 x 4 = 8
   - Then the result will be the answer 8 x 6 = 48.

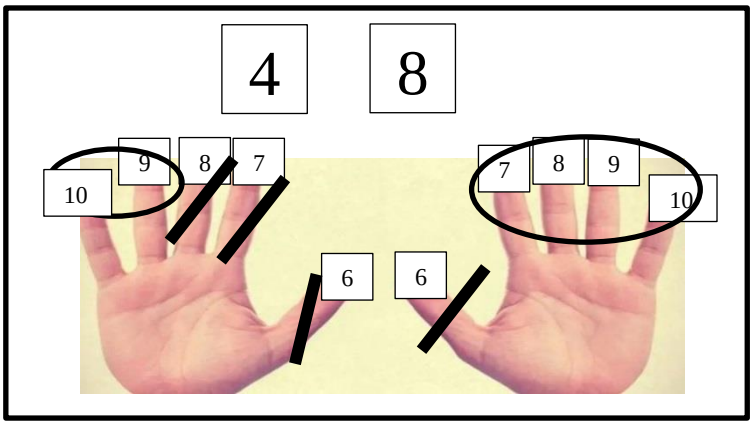

Figure 2: Sifir six until sifir ten

On the third day of the program, students are given a post-test to see the effectiveness of the Naimo technique taught to students in solving multiplication questions (sifir). Data were analyzed using Statistical Package for Social Science (SPSS) software. The data consisted of mathematics test scores before the program (pre-test), after the program (post-test), and the gender of students.

Many of the statistical analysis methods, known as parametric methods, can be conducted based on the assumption that the data are normally distributed (Ghasemi & Zahediasl, 2012). Thus, this study started with the refinement of the normality test using the Shapiro-Wilk method (S-W). The hypothesis statements for this test are:

H0: The data are normally distributed
H1: The data are not normally distributed

It was found that the data were not normally distributed, so the non-parametric tests were chosen for further analysis. First, the Mann–Whitney test was used to determine whether there is a statistically significant difference in scores between genders (independent group).

The hypothesis statements of the Mann-Whitney test are as follows:

H0: There is no significant difference in median scores between genders
H1: There is a significant difference in median scores between genders

Test statistics for Mann-Whitney Test can be written as follows:

$$U_1 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$$

$$U_2 = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2$$

$$U = \min(U_1, U_2)$$

where
n_1: sample size of 1st sample
n_2: sample size of 2nd sample
R_1: adjusted rank-sum of 1st sample
R_2: adjusted rank-sum of 2nd sample

Meanwhile, the Wilcoxon Signed Rank test was conducted to investigate any difference in median scores of pre-test and post-test for all students (Bluman, 2015).

The hypothesis statements of the Wilcoxon Signed-Rank test can be written as:

H0: There is no significant difference in median scores for pre and post-test
H1: There is a significant difference in median scores for pre and post-test

The Wilcoxon Signed-Rank test statistics are computed using the following steps:

1. Subtract the hypothesized mean,μ_0 from each data value. Rank the values according to their absolute values.
2. Compute the sum of the positive ranks *Sp* and the sum of the negative ranks *Sn*. The test statistic, W_R is the minimum of *Sp* and *Sn*.
3. Compute the mean and standard deviation of W_R using the formulas below

$$\mu_{W_R} = \frac{n(n+1)}{4}$$

$$\sigma_{W_R} = \sqrt{\frac{n(n+1)(2n+1)}{24} - \frac{\sum t^3 - \sum t}{48}}$$

where *t* represents the number of times the i^{th} value occurs.

4. Compute the z-value using

$$z_W = \frac{W_R - \mu_{W_R}}{\sigma_{W_R}}$$

The significance of the test statistic is determined by computing the p-value using the standard normal distribution. If this p-value is less than a specified level (usually 0.05), the null hypothesis is rejected in favor of the alternative hypothesis. Otherwise, no conclusion can be reached.

4. Result and Discussion

Table 1 shows the descriptive statistics of Mathematics scores for both tests based on gender. The total score for this test is 30 marks. Thus, the male students' score mean is greater than the female students in both tests along the median value. However, is there any significant difference in the score between genders? This can be found by conducting the Mann-Whitney test.

Table 1: Descriptive statistics 1

Test	Gender	n	Mean	Median	Std. Deviation
PRE	F	19	23.1053	27	8.4189
	M	19	26.2105	29	4.4294
POST	F	19	28.2105	29	2.8400
	M	19	28.5263	30	3.6873

Table 2 shows that test 1 (Pre) mean scores are less than test 2 (post), with 24.6579 before the program and 28.3684 after the program. The mean score of pre-test for male students is higher at 26.2105 compared to the mean score of female students which is 23.1053. Meanwhile, for the post-test mean score, male students also showed a higher mean score of 28.5263 compared to female students 28.2105. However, there is only a slight difference in the mean score of the post-test between male and female students which is 0.3158 compared to the difference in the mean score during the pre-test which is 3.1052. The median score also showed an improvement where the median score of female students before the program which is 27, increased to a median score of 29. Furthermore, the median score of male students also increased from 29 (pre-test) to a median score of 30 (post-test). This result parallels our assumption that the performance of students had increased after attending the program. To check the significant difference, the Wilcoxon Signed Rank test was conducted.

Table 2: Descriptive statistics 2

Test		Mean	Median	N	Std. Deviation
Pair 1	Pre	24.6579	28	38	6.8192
	Post	28.3684	29	38	3.2501

The result of the S-W normality test shows that the mathematics score of sample data does not follow a normal distribution in which all categories of data have a p-value (sig.) less than 0.05, as shown in Table 3. Here, Pre stands for the mathematics pre-test, post stands for the mathematics post-test, M for male, and F for female.

Table 3: Normality test

Mathematic test	Gender	S-W statistic	Sig.
Pre	F	0.746	0.000
	M	0.819	0.002
Post	F	0.636	0.000
	M	0.440	0.000

Due to the data not complying with the normality assumption, further analysis was carried out using non-parametric methods. The result has shown no significant difference in median scores between male and female students for both mathematical scores. That means the performance of female and male students was not significantly different, with a p-value (sig.) greater than 0.05 for pre and post-tests.

Table 4: Mann-Whitney (independent samples) test

Test	W-value	Sig. (2-tailed)
Pre (F-M)	337.50	0.337
Post (F-M)	330.00	0.210

The Wilcoxon Signed-Rank test results showed a significant difference in scores in Mathematics before and after the program where the p-value (sig.) was less than 0.05 for both data sets with gender factor considered constant. In other words, it is implied that the program impacted the performance in Mathematic, where the performance increased after the program even if carried out in a short time.

Table 5: Wilcoxon signed-rank test

Test		W-value	Sig.
Pair	Pre-post	1167.0	0.002

5. Conclusion

As an initial assumption, we believed that performance would increase, although it is only for a short-term Mathematics program. As a result, it was found that the performance of females and males students is not significantly different for both tests. But there is a significant difference in mathematics tests scores before (pre) and after the program (post), where the score for post-test was greater than the pre-test. It means that their performance after attending this program increased. The usage of the face-to-face platform may become a factor. No system or software was prepared for this pandemic in assisting its effectiveness in the teaching and learning process.

As we believed, face-to-face teaching and learning activities are still necessary for all education levels, especially at the primary level, even if it only involves a short period. Nonetheless, the hybrid platform of teaching and learning must be prepared due to the pandemic era's uncertainty. So, this pandemic drove all parties to be better prepared for unexpected situations in the future. As the sample size is too small, a future study with a bigger sample size is needed to verify the effectiveness in the short term programs.

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