MENTOR-MENTEE PROGRAM FOR WEAK STUDENTS IN CALCULUS

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Abstract: *Mentor-Mentee Program is proposed in order to cater the weak students in Calculus at Universiti Teknologi PETRONAS (UTP). This program has been running on three consecutive semesters i.e. March 2016 (as control), July 2016, March 2017 and July 2017, respectively. To measure the effectiveness of the program, the coursework (CW) and Final Exam (FE) of all mentees are recorded and were analysts by applying one-way ANOVA test. The main outcome of the study indicates that the Mentor-Mentee Program has improved the performance of all mentees in the final exam.*

Keywords: *Mentoring; Performance; ANOVA*

1. Introduction

There are many ways that the teachers and lecturers can assist the weak students. For instance, give students with many exercises and homework. Usually this is lecturer centered. Apart of teaching innovation as well towards teaching 4.0 agenda, many active learning (AL) activities has been integrated and incorporated in teaching and learning (T&L) via cooperative learning (CL) as well as online T&L such as e-learning, ULearn, MOOCS and Open Distance Learning (ODL). Besides that, mentoring also can be used as one of teaching innovation in lectures or tutorial [1, 2, 3, 4].

To assist the weak students (Foundation Studies) in Calculus at UTP, we choose difference approach compared than the existing T&L methodology. We implement Mentor-Mentee Program (MMP) or peer mentoring by choosing mentees with their CW is less than 25 out of 50. Mentors are choosing from UTP undergraduates which have scored at least B+ in Calculus. All the mentees are needed to undergo minimum 12 hours mentoring activities per semester. Throughout the program, we implement many AL activities such as Brainstorming, Reflection, Think Pair Share (TPS), Pair Testing, Question and Answer Pairs and Closure Review Pairs (CRP). The results are collected and recorded for every semester. We compare their performance before the mentees join the MMP (March 2016 semester) and after they has successfully participating the event (July 2016, March 2017 and July 2017). One-way ANOVA is used to measure the effectiveness of the MMP at UTP. To our knowledge, this is the first study in improving students' in Calculus by using Mentor-Mentee Program.

2. Methodology

For every semester, we select 40 mentees and 20 mentors with three dedicated lecturers respectively. Due some unforeseen circumstances, usually the turn up for mentees are only around 17-30 meanwhile for mentors around 10-20, respectively. Table 1 summarizes the number of mentees and mentors for four semesters. In order to apply the ANOVA test, we choose March 2016 semester as control variable i.e. we calculate all descriptive statistics for all mentees without joining MMP.

The methodology framework is divided into the following four stages:

(1) Choosing mentee (CW less than 25 out of 50) and mentors (at least grade B+ in Calculus)
(2) Running MMP event on Week 12 or 13 with 12 hours intensive T&L with cooperative learning.
(3) Collect and record the data
(4) Analysis the data by using statistical techniques and finalize the outcome of the study

The details for stages 1 until 2 can be found in Karim and Azman [2]. We only emphasize on the data collection in Stage 3 and results analysis in Stage 4 for this study.

Data Collection

From Table 1, we collect the results for each mentee for each semester. We use simple descriptive statistics by calculating the mean, variance and to determine whether the data is follows normal distribution or not. If it's followed, then we can use one-way ANOVA tests (or any other parametric statistical tests). Figure 1 summarizes the obtained data for CW, FE and Total (CW+FE) for each mentee –for July 2016 semester. For complete data sets, the reader can refer to Azman and Karim [2].

Table 1 Mentor and Mentees.

Semester	Mentees	Mentor
March	30	15
July 2016	30	15
March 2017	21	15
July 2017	17	10

In the MMP, the lecturer will prepare set of exercises given in the form of Workbook to all mentees and mentors. The topics covered include Differentiation and Its Applications, Integration and Its Applications, Series and Solving System Linear of Equations. In total, they must complete 12 hours mentoring processes that involving many AL activities as well as peer teaching and learning. Furthermore, after each session, mentor will provide to the mentees instant feedback regarding on the discussed topics in each session such as where is the mistake and what need to be do, how to tackle those problems, how to get better understanding in difficult topics such as series and power series involving interval of convergence etc. This will ensure that, mentees will receive instant

feedback in order to improve their performance in the final exam. Indeed, mentees can contact their respective mentors via social media such as What Apps, Telegram etc.

(a)

(b)

Fig. 1: Some pictures on MMP event at UTP.

3. Results and Discussion

We calculate all description statistics for all four semesters. Table 2 summarize the value. From Table 2, the mean for July 2016 is higher than the means for March 2017 and July 2017. From Azman and Karim, it can be shown that the grades for all batches (July 2016, March 2017 and July 2017) can be considered as the normal distribution's i.e. ANOVA or any other parametric statistical tests can be used.

One-way ANOVA at 95% confidence interval (CI) is used in this study. We set the null hypothesis (H_0) and alternative hypothesis (H_0) as follows:

$$H_0: \mu = \mu_1 = \mu_2 = \mu_3$$

$$H_A: \mu \neq \mu_1 \neq \mu_2 \neq \mu_3$$

Where μ is a mean for March 2016 semester (without MMP). This is control variable in one-way ANOVA statistical test i.e. the results before the weak students (mentees) are undergone an intensive MMP under the mentoring and guiding by the dedicated mentor and lecturers. Meanwhile μ_1, μ_2, μ_3 are mean for July 2016, March 2017 and July 2017 semesters, respectively.

Null hypothesis indicates that there is no improvement in the performance of all mentees for each semester. To reject the null hypothesis, we use two statistical values i.e. p-value obtained from the ANOVA is less than critical level $\alpha=0.05$ and the $F_{statistic}$ is greater than $F_{critical}$ obtained from F-Table with degrees of freedom.

Table 2 Descriptive Statistics for ANOVA Test

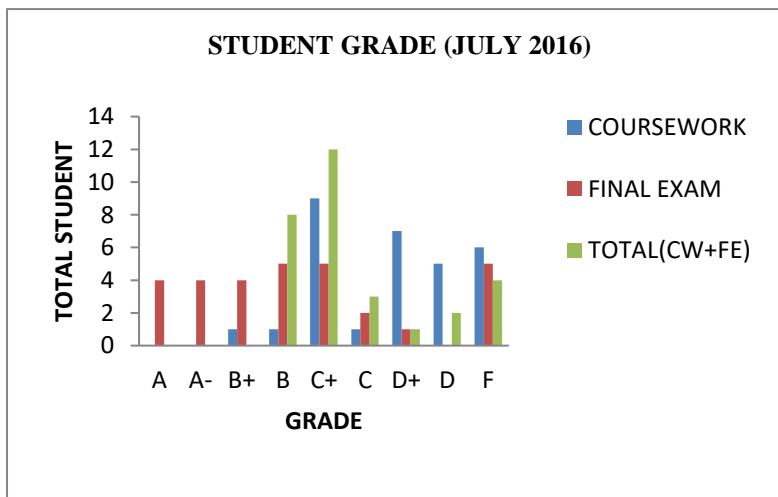| Groups	Mean	Variance	Standard Deviation
Mar-16	39.66	86.69	9.31
Jul-16	63.44	68.11	8.25
Mar-17	52.96	52.77	7.26
Jul-17	54.02	86.34	9.29

Fig. 2: Results for July 2016 Semester.

By using one-way ANOVA in Microsoft Excel, the following results are obtained:

$$F_{statistic} = 22.15$$

$$p - value = 0.000000000594$$

$$F_{critical} = 2.75$$

Since $F_{statistic} > F_{critical}$ at 95% CI as well as $p - value < 0.05$, then the null hypothesis can be rejected i.e. the mean for July 2016, March 2017 and July 2017 is difference than the mean for March 2016 (without MMP). This shows that, the MMP has improved the performance of the mentees. Evidently it can be seen from Table 2. Mean for March 2016 is less than 40%. Meanwhile, mean for July 2016 is the highest compared with March 2017 and July 2017. Overall the MMP event provide some meaningful activities to all students.

Thus from descriptive statistics and ANOVA results, we could say that the performance of all mentees has been improved significantly. For March 2018 semester, the MMP also has been implemented on 20-21 June 2018 at UTP. From the students' feedback, they all enjoy the MMP event and indeed it has improved them a lot. Furthermore, since the students just finished their final exam, thus there are no data that available for statistical analysis. For more details and complete data analysis on the MMP results, the interested readers can refer to Karim and Azman [2].

4. Acknowledgement

5. References

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