

FREE TUTORIAL PROGRAM AND ITS EFFECTS TO MATHEMATICS PERFORMANCE OF COLLEGE STUDENTS AT PAMPANGA STATE AGRICULTURAL UNIVERSITY

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ARTICLE INFO

Article History:

Received : 08-August-2022

Revised : 18-August-2022

Accepted : 21-August-2022

Keyword:

Free tutorial program;
Extension activity;
College students;
Test of difference;
Test of relationship

ABSTRACT

The study sought to describe the free tutorial program and its effect to mathematics performance of college students at Pampanga State Agricultural University. Cross sectional and descriptive-correlational research designs were used in this study and there were a total of 520 student participants that were selected using convenience sampling since the tutorial program is noncompulsory. The free tutorial program is a 5-year extension activity administered by the Mathematics Society (MathSoc) and the Department of Mathematics faculty members. It is implemented semesterly from August 2014 to March 2018 to prepare students for both midterms and final examinations on selected Mathematics subjects such as College Algebra, Plane Trigonometry and Calculus. A pre-test on the said math subjects was administered to students who voluntarily participated in the program before the tutorial. MathSoc officers were the tutors guided by the Mathematics faculty members. Subsequently, the same test was answered by the students as their post-test. Results showed that the pre-test performance of students is significantly different to the post-test across all the free tutorial programs conducted for each semester in five school years from 2014 to 2018. Moreover, the tutorial performance and the mathematics performance of students were significantly related. Thus, the free tutorial program is effective for students who participated in the program. The findings of the study suggest the continuation of the tutorial program with wider dissemination for the increase of participants.

How to Cite:

Calma, J. & Villavicencio, A. (2022). Free tutorial program and its effects to mathematics performance of college students. *Paedagogia: Jurnal Pendidikan*, 11(1), 1-13. <https://doi.org/10.24239/pdg.Vol11.Iss2.319>.



<https://doi.org/10.24239/pdg.Vol11.Iss2.319>



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INTRODUCTION

Mathematics is a powerful tool that has many applications. With a number of very useful benefits, it develops our reasoning and analytical thinking, quickens our mind, and generates practicality that is applicable to our day-to-day life. For some students, boredom in mathematics is negatively correlated with achievement in mathematics.¹ However, it is a subject that is part of the study of life which usually involves constant practice. Students have frightened away from mathematics and treated it as a lifeless subject. But through mathematics exposure, they will be able to learn mathematical concepts and could overcome mathematical anxiety.

Mathematics nowadays grows in a fast rate which is caused by technology and continuous research. Many researchers conducted studies that contribute to the development of mathematics. Magayon and Tan² stated that Differentiated Instruction (DI) has been found to be effective in catering the individuality of students. At the same time, DI helps students to have positive attitudes about school, increased engagement in learning, and improved achievement. They also added that DI motivates students' interest making mathematics easier, and challenges students to learn and do more. However, the study also argued that students have difficulties in learning and doing mathematical tasks.

In a study of Sangcap³, there were positive beliefs that Filipino students valued effort in increasing one's mathematical ability and considered mathematics as useful in their daily lives. On the contrary, Filipino students believed that all word problems can be solved by simple step by step procedure and are not important. Sangcap also stated that gender difference in positive beliefs that effort can increase mathematical ability and in the usefulness of mathematics is significant. This gender difference in the beliefs mentioned reflected also in all year levels and in various field of specializations.

¹ Sparfeldt, J.R., Buch, S., Schwarz, F., and Jachmann, J. (2009). "Math is boring" – Boredom in mathematics in elementary school children. *Psychologie in Erziehung und Unterricht*, 56(1). 16-26

² Magayon, V. C. and Emily B. Tan. (2016). Learning mathematics and differentiated instruction in the Philippines: A phenomenographical study on struggles and successes of grade 7 students. *International Journal of Educational Studies in Mathematics*, 3(3), 1–14

³ Sangcap, P. G. A. (2010). Mathematics-related beliefs of Filipino college students: Factors affecting mathematics and problem solving performance. *Procedia - Social and Behavioral Sciences*, 8, 465–475.

According to Silao⁴, the problem-solving skills and Filipino pupils' mastery of basic skills are related. He stated that attitude towards mathematics and parenting involvement are factors affecting the problem-solving skills of pupils. While according to Jaen and Baccay⁵, curiosity and motivation are related to the mathematics performance of students. But male and female students differed in their performance. The findings of Matsoso and Iwu⁶ indicated that lectures as well as tutorials are vital for student performance.

Sa'ad et al.⁷ concluded that some of the causes of poor mathematics performance were students' negative attitude toward mathematics, anxiety and fear of mathematics, insufficient qualified teachers, poor teaching methods, insufficient teaching materials, and overcrowded classes. According to van Veggel and Amory⁸, small group tutorials of mathematics are effective methods to enhance the confidence and performance of the students.

The participant ages, positions, tutee skills, length of sessions, and frequency were not significant moderators of academic progress. Meanwhile, educational stage, study design, program duration, tutor knowledge level, time of day, and sample size were found to be important factors in academic achievements, Alegre-Ansuategui, et al.⁹

Some who determined strategies and method on how to improve teaching mathematics are successful in this endeavor. Other stated the factors that affect the performance of students in this subject while developed and constructed some techniques for advance learning and further improvement. Until now, researchers still look for the best possible methods, strategies and techniques that will make learning in mathematics easier, more exciting, and more appealing to students.

⁴ Silao, I. (2018). Factors affecting the mathematics problem solving skills of Filipino pupils. *International Journal of Scientific and Research Publications*, 8(2).

⁵ Jaen, M. C. and Baccay, E. S. (2016). Curiosity, motivation, attitude, gender, and mathematics performance. *The Normal Lights*, 10(2). 89–103

⁶ Matsoso, M. L. & Iwu, C. G. (2017). Assessing student performance with the help of tutorials and lectures. *International Journal Education Economics and Development*, 8(1), 34-45.

⁷ Sa'ad, T. U., Adamu, A. & Sadiq, A. M. (2014). The causes of poor performance in mathematics among public senior secondary school students in Azare Metropolis of Bauchi State, Nigeria. *IOSR Journal of Research & Method in Education*, 4(6), 32-40

⁸ van Veggel, N., & Amory, J. (2014). The impact of maths support tutorials on mathematics confidence and academic performance in a cohort of HE Animal Science students. *PeerJ*, 2, e463

⁹ Alegre-Ansuategui, F. J., Moliner, L., Lorenzo, G. & Maroto, A. (2017). Peer tutoring and academic achievement in mathematics: a meta-analysis. *EURASIA Journal of Mathematics, Science and Technology Education*, 14(1), 337-354

Jameel and Ali¹⁰ indicated that teachers utilized learning methods that learners did not easily understand, they do not make mathematics teaching practical and entertaining, which leads to negative attitudes and, eventually, poor performance of students in mathematics. Majority of participants believed their teachers lacked the ability to teach mathematics.

In relation to this, the Department of Mathematics faculty members, in cooperation with the Mathematics Society, a minor organization governing all BS in Mathematics students, offered a free tutorial program on different Mathematics subject such as Algebra, Trigonometry and Calculus to students who find difficulties in the said math subjects. It aims to prepare college students in their midterm and final examinations every semester. The main purpose of this research is to seek out the effectiveness of the free tutorial program to the mathematics performance of college students.

The study aimed to discuss the mathematics performance of college students as affected by free math tutorial program. Specifically, it sought to answer the following: (1) How may the free mathematics tutorial program be described? (2) Is there a significant difference between the pre-test and post-test performance of students who participated the free tutorial program? and (3) Is there a significant relationship between the tutorial performance of students to their major exam performance?

Methods

Cross sectional and descriptive-correlational research designs were used in this study in determining the mathematics performance of college students who participated the free tutorial program. They were applied in the determination of the significant relationship and difference of the factors of the study.

This study used a test questionnaire for pre-test and post-test of students. For the examination on first semester, the test was on selected topics on College Algebra since the said subject was offered in the said semester. While for the examination on the second semester, the test was about Plane Trigonometry since the said subject was offered during the second semester. Calculus subject were also taught in the tutorial program, when it is needed by the participants.

¹⁰ Jameel, H. T. & Ali, H. H. (2016). Causes of poor performance in mathematics from teachers, parents and student's perspective. *American Scientific Research Journal for Engineering, Technology, and Sciences*, 15(1), 122-136

Convenience sampling was done in the conduct of the study since the free tutorial program is voluntary for students. Thus, the respondents of the study were students who participated voluntarily in the free tutorial program that spearheaded by the Mathematics Society during the school years 2014-2015, 2015-2016, 2016-2017, and 2017-2018 for both first and second semesters.

Wilcoxon Signed-Ranks test was used to determine the significant difference of pre-test and post-test performance of students who participated the free tutorial program and Spearman correlation was used to determine the relationship of the tutorial performance to the major exam performance of students.

RESULT AND DISCUSSION

Free Mathematics Tutorial Program

The Mathematics Society (MathSoc) is a student organization under the College of Arts and Sciences of Pampanga State Agricultural University that governs all the Bachelor of Science in Mathematics students. The society conducts different activities inside and outside of the university that adheres its principles to develop and promote enthusiasm in the field of Mathematics among the students at the university and the community and to stimulate greater participation of students in matters affecting their well-being. Hence, different student activities, such as the free mathematics tutorial, are conducted.

The free mathematics tutorial program is conducted four times in every school year (two for each semester). The purpose of the said program is to prepare and review students who find difficulties in their mathematics subject (College Algebra, Plane Trigonometry or Calculus).

Difference Between the Pre-Test and Post-Test Mathematics Performances of College Students

Table 1 shows the significant difference on the pre-test and post-test performance scores of students who participated in the free tutorial program before their midterm and final exam. It shows that in the school year 2014-2015 for both the first and second semesters, there is a high significant difference between the pre-test and post-test mathematics performance of college students using the Wilcoxon-Signed Rank test.

The results show that the pre-test and post-test performance of students were significantly different ($p < .05$) in the midterm of the first semester of the said school year. it implies that the free tutorial program is effective among the students since the mean of post-test is higher than the mean of pre-test performance of students. Moreover, Table 1 also shows that were thirty-two (32) students who participated in the tutorial program in the final term of the

first semester in the year 2014-2015. There is a high significant difference between the pre-test and post-test performance of students who participated in the tutorial program in the said term, $p < .05$. It means that the free tutorial program is effective since the mean score of students in the post-test is higher as compared to mean score in the pre-test.

In the midterm of the second semester of the said school year, there were thirty-four (34) students who participated in the free tutorial program. Since the p -value is less than .05 level of significance, thus, there is a high significant difference between the pre-test and post-test performance of students. It implies that the free tutorial is effective to the students. In addition, there were eleven (11) students who participated the tutorial program during the final term of the second semester of the school year 2014-2015. There is a significant difference between the pre-test and post-test scores of students, $p = 0.049$, this means that the tutorial program is effective to the students since there is an improvement on the performance (mean of post-test is higher than the mean of pre-test).

Table 1. Significant Difference between the Pre-test and Post-test Performance of College Students

School Year	Semester	Term	<i>n</i>	Pre-test Mean	Post-test Mean	<i>p</i>
2014-2015	1 st semester	Midterms	234	13.48	15.69	0.000*
		Finals	32	10.31	12.91	0.000*
	2 nd semester	Midterms	34	12.79	18.44	0.000*
		Finals	11	16.82	18.82	0.049*
2015-2016	1 st semester	Midterms	61	10.77	13.80	0.000*
		Finals	17	10.47	14.24	0.000*
	2 nd semester	Midterms	9	11.00	14.89	0.021*
		Finals	12	11.50	13.83	0.043*
2016-2017	1 st semester	Midterms	14	19.36	28.36	0.002*
		Finals	22	12.27	13.91	0.030*
	2 nd semester	Midterms	10	20.10	26.70	0.025*
		Finals	15	22.40	27.00	0.007*
2017-2018	1 st semester	Midterms	12	11.08	14.17	0.027*
		Finals	19	23.11	28.89	0.001*
	2 nd semester	Midterms	8	22.88	29.38	0.017*
		Finals	10	14.70	20.10	0.015*

* $p < .05$

The results of the school year 2014-2015 supported the claim of Alegre et al.¹¹ that Math peer tutoring has been shown to improve academic

¹¹ Alegre, F., Moliner, L., Maroto, A., & Lorenzo-Valentin, G. (2020). Academic achievement and peer tutoring in mathematics: A comparison between primary and secondary education. *SAGE Open*, 10(2)

performance at all academic levels, from preschool to higher education. Also, as claimed by van Veggel and Amory⁷, small group tutorials were an effective method of mathematics support to enhance student mathematics confidence, performance and ultimately employability.

Moreover, during the school year 2015-2016, the pre-test mathematics performance of college students is found to be significantly different with their post-test mathematics performance for the midterm and final terms of both first and second semester. There were sixty-one (61) students who participated in the free tutorial program in the midterms of first semester of the said year. Table 1 also shows that there is a high significant difference between the pre-test and post-test performances of students, $p < .05$. It implies that there is an improvement on the performance of students since the mean post-test score is higher than the mean pre-test score. Thus, the tutorial program is effective. Also, the pre-test performance is highly significant different with the post-test performance of students who participated in the said activity, ($p < .05$) in the final of term of the first semester of school year 2015-2016. Since the mean score on the post test is higher than the mean score on the pre-test. Thus, the tutorial program is effective to students.

Table 1 shows that there is a significant difference between the pre-test and post-test performance of students who participated in the tutorial program ($p = .021$) of the midterm of school year 2015-2016. It implies that the free math tutorial is effective among students. Moreover, the table shows that there were twelve (12) students who participated in the program in the final term of the said school year. The p -value of .043 suggests that the pre-test and post-test performances of students were significantly different. It means that the tutorial program of students is effective since the mean of post-test is higher than the mean of pre-test.^{7,10}

In the school year 2016-2017, there were a total of sixty-one (61) students who participated in the tutorial program of the Mathematics Society. During the midterm of the first semester of the said school year, there were fourteen (14) participants in the tutorial program. The p -value of .002 means that there is a significant difference between the pre-test and post-test performances of student who participated in the program. It implies that the tutorial program is effective among students. Table 1 also shows that there is a significant difference between the pre-test and post-test performance of students who participated in the free tutorial program ($p = .03$). There were twenty-two (22) students who availed the tutorial program during the first semester of the school year 2016-2017 in preparation for final exam. Based on the foregoing data, the tutorial program is effective to the students.

In addition, the pre-test performance is significantly different with post-test performance of ten (10) students who participated in the tutorial program ($p = 0.025$) in the midterm of second semester of the said school year. The tutorial program is effective, since the mean of post-test is higher than the mean of pre-

test. There were fifteen (15) students who availed the in the free tutorial program during the final term of the second semester of the school year 2016-2017 for final exam. The p -value of .007 suggests that there is a significant difference between the pre-test and post-test performance of students. It implies that the free tutorial is effective to student-participants since the mean of post-test is higher than the mean of pre-test of students.^{7,10}

Furthermore, during the school year of 2017-2018, the Wilcoxon-Signed Rank test found that there is a significant difference between the pre-test mathematics performance and post-test mathematics performance of college students. Table 1 shows that there were twelve (12) students who participated in the tutorial program in the midterm of the first semester of the said year. The pre-test performance and post-test performance of students were significantly different since the p -value is .027. Therefore, the free tutorial program is effective to students. Table 1 also shows that there were nineteen (19) students who participated in the tutorial program during the second semester of the school year 2017-2018 for final examination. The p -value of .001 suggests that the pre-test and post-test performances of students were significantly different. It implies that the free tutorial program is effective to students since the mean in post-test is higher than the mean in pre-test.

There is a significant difference between the pre-test and post-test performance of eight (8) students during the free tutorial of the second semester school year 2017-2018 in preparation for midterm exam ($p = .017$). It implies that the tutorial program is effective to students since the mean of post-test is higher than the mean of pre-test. Also, Since the p -value of .015 is less than the level of significance (5%), the pre-test performance of students is significantly related to their post-test performance in the final term of the second semester. It implies that the free tutorial program is effective to students since the mean of post-test is higher than the mean of pre-test.^{7,10}

Relationship Between the Performance of Students on the Tutorial Program to their Major Exam Performance

Table 2 shows the significant relationship between the performance of students on the tutorial program to their major exam performance in all semesters from 2014 to 2018. Using the Spearman correlation, the relationship between the tutorial performance and major exam of college students in the school year 2014-2015 is found to be significantly related, $p < 0.05$. Moreover, there is a low positive correlation to high positive correlation between the tutorial performance and major exam performance of students in the said school year, that is, student who obtained high performance on the tutorial performance scored high performance on their major examination.

Table 2. Significant Relationship between the Tutorial Performance and Major Exam (Midterms/Finals) Performance of College Students

School Year	Semester	Term	Coefficient	<i>p</i>	Verbal Interpretation
2014-2015	1 st semester	Midterms	0.258	0.000*	Low positive correlation
		Finals	0.503	0.003*	Moderate positive correlation
	2 nd semester	Midterms	0.757	0.000*	High positive correlation
		Finals	0.650	0.030*	High positive correlation
2015-2016	1 st semester	Midterms	0.301	0.019*	Low positive correlation
		Finals	0.668	0.049*	High positive correlation
	2 nd semester	Midterms	0.668	0.049*	High positive correlation
		Finals	0.611	0.035*	High positive correlation
2016-2017	1 st semester	Midterms	0.745	0.002*	High positive correlation
		Finals	0.431	0.045*	Moderate positive correlation
	2 nd semester	Midterms	0.710	0.021*	High positive correlation
		Finals	0.546	0.035*	Moderate positive correlation
2017-2018	1 st semester	Midterms	0.661	0.019*	High positive correlation
		Finals	0.532	0.019*	Moderate correlation
	2 nd semester	Midterms	0.899	0.002*	Very high positive correlation
		Finals	0.947	0.000*	Very high positive correlation

* $p < 0.05$

In the school year 2015-2016, the tests found that there is a significant relationship between the tutorial program performance and major exam performance of college students for both the first and second semesters, $p < 0.05$. Between low positive to high positive correlations, it implies that students who obtained high performance in the tutorial program scored high result on their midterm exam.

Furthermore, during the school year 2016-2017, the tutorial program performance of college students is found to be significantly related to their major exam performance for both the first and second semesters, $p < 0.05$. This means that students who participated in the tutorial program obtained a higher score in their major examination having a correlation of moderate to high positive in the said school year.

Lastly, in the school year 2017-2018, there were thirty-nine college students who participated in the tutorial program. The test results show that there is significant relationship between the tutorial program performance and major exam performance of college students, $p < 0.05$. That is, having a moderate positive to very high positive correlations, students who obtained high performance on the tutorial performance scored high performance on their major examination.

CONCLUSION

The free mathematics tutorial program is being conducted twice a semester (midterm and finals) every school year. The Mathematics Society officers have been disseminating the information about the tutorial program to students in supervision with Department of Mathematics faculty members.

Before the tutorial proper (intervention), the participants of the tutorial program answered a pre-test questionnaire on the subject they need (Algebra, Trigonometry or Calculus). After the administration of the tutorial, the same questions were answered by the participants (post-test). The tutorial performance was correlated to their major examinations.

During the first semester of the school year 2014-2015, the free math tutorial was found effective to students in preparation for both midterm and final examination. There was also a significant relationship between the tutorial performance and their major examinations. While in the second semester, the free tutorial program is effective to student in preparation for the two major exams. Their performances on their major exams were related to the tutorial performance of students during the second semester of the school 2014-2015.

The free tutorial program was also held in the school year 2015-2016 for both the semesters with two tutorial programs in each semester (for midterm and for finals). All free tutorial programs conducted in the school year were found effective to the participating students. They were also found to be significantly correlated to their respective examinations.

During the school year 2016-2017, the free tutorial program was conducted four times, in preparation for both midterm and final exam for the first semester and in preparation for midterm and final exam for the second semester. The study found that the all the tutorial programs concluded during the said school year were found effective to students. It was also found that the tutorial programs were significantly related to the major exams (midterm and final exam) of students.

The free math tutorial was also conducted four times in the school year 2017-2018. They were all found effective to the students and have a significant relationship to the major exams of students. In totality, all the free math tutorial programs that were held from 2014 to 2018 were found effective and have a significant relationship to the major exams (midterm and final exam). This result confirmed by Arco-Tirado et al.¹² where they claimed that peer-tutoring programs were effective and sustainable solution to higher education productivity problems, particularly those affecting freshmen students.

Based on the findings of the study, the following were recommended: (1) The Mathematics Society with Math faculty members should continue conduct the free tutorial program to students who encounter difficulties in

¹² Arco-Tirado, J. L., Fernández-Martín, F. D., & Hervás-Torres, M. (2020). Evidence-based peer-tutoring program to improve students' performance at the university. *Studies in Higher Education*, 45(11), 2190–2202

different Mathematics subjects; (2) Free tutorial program for the additional Mathematics subjects should be offered since there is a new curriculum for General Education courses; (3) Proper dissemination and announcement of the free tutorial program through social media and other forms should be executed so the number of participating students will also increase; and (4) Other student organizations may use this study as a basis for the conduct of their own tutorial program in different disciplines or subjects.

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