

Effectiveness of Back-to-Basic Mathematics on Physics Performance of the Students in Mindanao State University-Sulu in the Southern Philippines

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ABSTRACT— It is said that one major requirement for learning Physics is the mastery of Mathematics. Comprehensively, one cannot really learn Physics if he has no background of Mathematics. While the mastery of Mathematics is a far-fetched, learning some of its basic concepts is beyond someone's reached. The competence in basic Mathematics will drive someone to meaningful learning experiences in Physics. So the researcher suggests that one should consider learning basic Mathematics before he or she learns Physics. This study investigated the effectiveness of back-to-basic Mathematics on the Physics performance of Grade 12 students in Mindanao State University-Sulu in the Southern Philippines. Descriptive survey method was employed in this study. The data gathered through a survey questionnaire and from the teacher's class record were analyzed using arithmetic mean. The significant difference between the Physics performances of the students when they are classified in terms of gender was interpreted using t-test for independent samples. This study revealed that back-to-basic Mathematics is highly effective in improving the Physics performance of the students. With this, it is recommended that Physics teachers should consider starting their classes by recalling some concepts of basic Mathematics before they proceed to the discussion of Physics topics. The study concluded that back-to-basic Mathematics is effective in improving the Physics performance of the students.

Keywords— Physics performance, back-to-basic Mathematics, descriptive survey method, Mindanao State University-Sulu, Southern Philippines, Asia.

I. INTRODUCTION

The continuous downfall of students' academic performance in Science and Mathematics in the Philippine education system has been alarming. Result of national surveys indicates that most schools in the Philippines especially those that are in the remote region have a low performance rating in these subjects. The Philippine Information Agency cited in their website the result of 2018 Programme for International Student Assessment (PISA) which revealed that out of 79 countries surveyed, Philippines ranked second lowest in both mathematics and science. While the survey focused on elementary education, the same holds true in the secondary. In the context of senior high school in the Philippines, the issue of Physics performance rating is evident. Much research in recent years suggested that in order to improve the learning performance in Physics, basic Mathematics should be recalled to the students at the start of the classes. This was demonstrated by the results of the study of Izaak (2015) which revealed that there is a positive relation between

interest at Physics and knowledge of Mathematics basic concepts with students' ability to solve Physics problems. (Dehipawala, Shekoyan & Yao (2014) added that mastery in basic arithmetic, algebra, and trigonometry is necessary to perform well in physics courses. Unfortunately, there remains a doubt of its effectiveness in improving the Physics performance of the students in the Southern Philippines.

This study investigated the effectiveness of back-to-basic Mathematics on the Physics performance of the senior high school students in Mindanao State University-Sulu in the Southern Philippines. The difference between the Physics performances of the students was also determined in this study.

II. LITERATURE REVIEW

This study assumed that back-to-basic Mathematics is positively related to Physics performance of the students. It means students will excel better in Physics if they are competent in basic Mathematics. It is also assumed that the intervening variable which is gender can interfere with the level of performance of the students. In other words, the performance may change depending whether the student is male or female. The following related studies support this claim.

For a long time, Soviet students learned 'pure' mathematics in their mathematics classrooms, while applications of mathematics were introduced in their science (mainly physics) classrooms. This approach was a part of a uniform and rigid national curriculum. Even when in the 1990s the world was moving towards including applications in school mathematics, Russian students continued to engage in pure mathematics learning in their mathematics classrooms. It was physics teachers' responsibility to teach applications of mathematics; therefore, physics courses were highly mathematics-intensive, making extensive use of mathematics from algebra to calculus in the formulation of scientific laws and the investigation of their consequences. The collapse of the Soviet Union and some liberalization in educational policy led to changes in graduation requirements in mathematics and physics as well as diversity in mathematics and physics curricula in schools. Based on a review of textbooks, standards, curriculum documents, and other resources, in this paper we analyze changes that affected the teaching and learning of mathematics in physics classrooms in Russia from the Soviet period to the present (Lyublinskaya, I., & Petrova, E., 2021).

In order to learn Physics, students need basic knowledge of Mathematics. The dependence of Mathematics to understand Physics and interrelationship have been identified since secondary school level. This is so because mathematical concepts that students acquire can be applied in Physics such as functions, derivatives, equations and other aspects with similar concept (Rosdy M., Michael R., Janteng J., Andrew S.A., 2019).

Among others, the study revealed that; all mathematics skills (Computation skills, geometry skills, algebra skills, interpretation of graphs and table skills, measurement skills and Probability and statistics skills) has strong positive influence and strongly predictive value on physics students' performance in Senior Secondary Schools. Conclusion and recommendations were also made in this paper (Awodun, A., Omotade, O., & Adeniyi, O., 2013).

Mastery in basic arithmetic, algebra, and trigonometry is necessary to perform well in physics courses. According to the results of our study introduction of mathematics review at the beginning of the class can help students improve their problem solving skills in physics (Dehipawala, S., Shekoyan, V. & Yao, H., 2014).

The results of our study show that there is a positive relation between interest at Physics and knowledge of Mathematics basic concepts with students' ability to solve Physics problems (Izaak, H. W., 2015). Mathematics plays a crucial role in physics. This role is brought about predominantly through the building, employment, and assessment of mathematical models, and teachers and educators should capture this relationship in the classroom in an effort to improve students' achievement and attitude in both physics and mathematics (Michelsen, C., 2015).

II.A OBJECTIVES OF THE STUDY

This research study generally aimed at examining the effectiveness of back-to-basic Mathematics on Physics performance of Grade 12 students in MSU-Sulu. Specifically, the study sought to: 1) explain back-to-basic Mathematics; 2) identify the level of Physics performance of Grade 12 students in MSU-Sulu; 3) determine the level of effectiveness of back-to-basic Mathematics on Physics performance as perceived by these students; and 4) ascertain if there is a significant difference between the Physics performances of the students when they are classified in terms of gender.

III. METHODOLOGY

This section presents the research design, research site, participants, instrumentation, research ethics protocol, data collection and statistical technique used in the study.

IV. DATA ANALYSIS & RESULTS

A Research Design

This research study used descriptive survey method. Said method is considered apt because it enables the researcher to generate information from the respondents through research instruments based on well-defined concepts and related variables. According to Zurmuehlin (1981), a descriptive survey method attempts to establish the range and distribution of some social characteristics, such as education or training, occupation, and location, and to discover how these characteristics may be related to certain behavior patterns or attributes.

B Research Site

The study was conducted in Mindanao State University-Sulu Senior High School. The school is situated at Jolo, Sulu, Philippines.

C Participants

The participants for this study were the Grade 12 students of Mindanao State University-Sulu Senior High School who were officially enrolled in the school year 2019-2020. The participants comprised of a total sample size of 50 students which was randomly selected using simple random sampling.

D Instrumentation

A self-developed questionnaire titled “Effectiveness of Back-to-Basic Mathematics on Students’ Physics Performance” was used to get the desired information from the respondents. The questionnaire was divided into two parts. Part 1 was used for the collection of personal data of the respondents while Part 2 consisted of questions that elicited responses from the respondents with response choices: Highly Effective (HE), More Effective (ME), Probably Effective

(PE), Least Effective (LE) and Not Effective at all (NE). This questionnaire was validated by three experts in the field of research.

E Data Collection

After the validation of the questionnaire, the researcher sought permission from the director of the Senior High School to administer the survey questions. The researcher personally administered the questionnaire on February 14, 2020. The retrieval of the questionnaire occurred on the same date. The researcher also went personally to the Physics teacher of the students for the collection of grades needed for interpretation.

F Statistical Technique

Responses from the questionnaire and grades of the respondents were analyzed using the descriptive statistics of frequency counts and arithmetic mean, and inferential statistics of t-test for independent samples.

Frequency counts and arithmetic mean were used in analyzing demographic variables and research questions while the t-test for independent samples was used to test the stated hypothesis at 0.05 level of significance.

V. DISCUSSION AND RESULTS

This section presents the result of the study. Answers to the research questions through the gathered data are discussed here.

V.A What is back-to-basic Mathematics?

Back-to-basic Mathematics is a collection of some basic topics in Mathematics printed in a form of module. The module used is titled “Math Essentials” which was authored by one faculty member of Mindanao State University-Sulu Senior High School. It includes *simple arithmetic, fractions, least common multiple, greatest common factor, divisibility rules, signed numbers, rules of exponent and polynomials*. These basic topics are important for solving Physics problems. For examples, mastery of fractions is a pre-requisite for solving measurement problems particularly on conversion; rules of exponents are necessary for simplifying scientific

notations; know-how on polynomials is much needed in finding the unknown for the x- and y-intercepts of a graph; and knowledge on signed numbers can make the students easily solve equation. Contextually, these topics were reviewed to the students for duration of two consecutive weeks. Each topic was complemented with a written and oral evaluation.

V.A What is the level of Physics performance of Grade 12 students in MSU-Sulu?

Table V.A. Level of Physics performance of Grade 12 students in MSU-Sulu

Subject	Average Grade in Physics	Description
Physics	88.36%	Very Satisfactory

Legend: *Outstanding* = 90-100; *Very Satisfactory* = 85-89; *Satisfactory* = 80-84; *Fairly Satisfactory* = 75-79; and *Did not meet the expectation* = 74 and below.

Table V.A shows that the average grade of the respondents in Physics is 88.36% which corresponds to the description *very satisfactory*. This means that the level of Physics performance of Grade 12 students in MSU-Sulu is very satisfactory. This also implies that the respondents perform better in Physics because of back-to-basic Mathematics.

V.B What is the level of effectiveness of back-to-basic Mathematics on Physics performance as perceived by these students?

Table V.B. Effectiveness of back-to-basic Mathematics on Physics performance as perceived by students

Statement	Mean	Description
1. Recalling basic Mathematics concepts helped me in dealing Physics problems.	4.81	Highly Effective
2. Solving measurement problems became easy for me because of my knowledge on the four fundamental operations in Mathematics.	4.73	Highly Effective

4. GEMDAS rule (Grouping symbols, Exponent, Multiplication, Division, Addition, and Subtraction) or order of operations guided me in solving equation.	4.63	Highly Effective
5. My knowledge on the rules of exponents guided me in solving equation.	4.56	Highly Effective
6. My knowledge on the signed numbers guided me in solving equation.	4.53	Highly Effective
7. My learning on fractions helped me in dealing Physics problems.	4.40	More Effective
3. My learning on the greatest common factor and the least common denominator aided me in simplifying complex Physics problems.	4.42	More effective
8. I easily solved Physics problems because of my knowledge in basic Mathematics.	4.13	More Effective
Grand Mean	4.52	Highly Effective

Legend: *Highly Effective* = 4.50-5.00; *More effective* = 3.50-4.49; *Probably Effective* = 2.50-3.49; *Least Effective* = 1.50-2.49; and *Not Effective at All* = 1.00-1.49.

Table V.B shows that the level of effectiveness of back-to-basic Mathematics on Physics performance as perceived by the students is *highly effective*.

Is there a significant difference between Physics performances of these students when they are classified in terms of gender?

Table 5.C. Gender difference on students' Physics performance

Students' Gender	N	Average Grade	Description
Male	25	90.08%	Outstanding
Female	25	86.64%	Very Satisfactory

Legend: *Outstanding* = 90-100; *Very Satisfactory* = 85-89; *Satisfactory* = 80-84; *Fairly Satisfactory* = 75-79; and *Did not meet the expectation* = 74 and below.

Table V.C shows that the average grade of male respondents is 90.08%, while the average grade of female respondents is 86.64%. This implies that male students perform better in Physics than the female students.

V.D T-test on the Physics performances of the students according to gender

	N	Sig. (2-tailed)	Alpha Level	Degrees of Freedom	Decision Rule
Physics Performance	50	0.001	0.05	48	Reject H_0

Table V.D shows the t-test on the Physics performances of the students when they are classified according to gender. Since the sig. value of 0.001 is less than the alpha level of 0.05, the null hypothesis (H_0) is rejected. This means there is a significant difference between the Physics performances of the students when they are classified in terms of gender.

VI. CONCLUSION

Based on the findings of the study, it is evident that back-to-basic Mathematics is effective in improving the Physics performance of the students. This is reflected on the level of effectiveness of back-to-basic Mathematics as perceived by the students which is highly effective. This means the students believe they learn better in Physics if the basic Mathematics lessons will be reviewed to them. In addition, the study showed that the average grade of the

students in Physics which is very. Moreover, the study also revealed that male students perform better in Physics than female students. This study recommended that Physics teachers should consider starting their classes by recalling some concepts of basic Mathematics before they proceed to the discussion of Physics topics. They can begin by conducting pre-test and post-test every quarter in order to evaluate the performance of the students.

REFERENCES

- [1] Awodun, A., Omotade, O. & Adeniyi, O. (2013). Mathematics skills as predictors of physics students' performance in senior secondary schools. *International Journal of Science and Research* 2 (7), 391-394
- [2] Lyublinskaya, I., Petrova, E. (2021). Mathematics learning in physics classrooms of Russian schools: a changing landscape from the Soviet period to the present. *ZDM Mathematics Education*. <https://doi.org/10.1007/s11858-021-01248-z>.
- [3] Rossdy M., Michael R., Janteng J., Andrew S.A. (2019). The Role of Physics and Mathematics in Influencing Science Students' Performance. In: Mat Noor A., Mohd Zakuan Z., Muhamad Noor S. (eds) *Proceedings of the Second International Conference on the Future of ASEAN (ICoFA) 2017 - Volume 1*. Springer, Singapore. https://doi.org/10.1007/978-981-10-8730-1_40
- [4] Zurmuehlin, M. (1981) *Descriptive Survey*. Working Papers in Art Education IOWA Research Online.
- [5] Dehipawala, S., Shekoyan, V. & Yao, H. (2014). Using mathematics review to enhance problem solving skills in general physics classes. *Proceedings of the 2014 Zone 1 Conference of the American Society for Engineering Education*, 1-4.
- [6] Izaak, H. W. (2015). The correlation study of interest at physics and knowledge of mathematics basics concepts towards the ability to solve physics problems with 7th grade students at Junior High School in Ambon Maluku Province, Indonesia. *Education Research International*, 2015 (2015), 396750. Google Scholar.

[7] Michelsen, C. (2015). Mathematical modeling is also physics-interdisciplinary teaching between mathematics and physics in Danish upper secondary education (Vol. 50). Denmark: Physics Education Issue 4, article id. 489 (2015). Google Scholar.