

Finer In the Permutations and Combinations of Grade 10 Students

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Abstract — Amidst this time of pandemic, planning an effective instruction demands every educator today to embrace the challenge of teaching in a new normal way. One of the strategies that may contribute to the effectiveness of teaching and learning is the use of FINER, an innovative self-learning material, in teaching permutations and combinations. This action research was theorized to determine the effectiveness of FINER in the Permutations and Combinations as an intervention in enhancing the problem-solving skills of Grade 10 students of Itawes National High School, using the quasi-experimental design particularly One-Group Pretest Posttest Research design. The participants of the study were thirty (30) grade 10 students who were classified as struggling learners based on the diagnostic test result. Findings of this study revealed that there is an improvement in the performance of the learners as shown in the computed values of mean and standard deviation. Anent to this, there is a significant difference between the mean pretest and posttest scores of the participants. Moreover, results revealed that there is a very large effect size of the intervention in the performance of the respondents. Hence, it is then recommended that Mathematics teachers may utilize FINER in teaching Permutations and Combinations and that school administrators should support the teachers on the preparation of contextualized and localized instructional materials to improve or enhance the performance of the learners in Mathematics. Nonetheless, the conduct of similar study was as well recommended for the enhancement of FINER.

Keywords — *FINER, Competencies, Permutations and Combinations*

I. Introduction

Universally, mathematics played a vital role in the day-to-day lives of people from simple to complex activities and disciplines involving numerous mathematical concepts and principles. In fact, without the utilization of mathematical principles and applications, today's mathematical achievements would not be feasible. In the field of learning, mathematics dominated more in the arts, sciences, business, and entrepreneurship providing us with deep-rooted and lifelong benefits.

Despite its overt importance, many learners perceive mathematics as a difficult subject even to a point that they are expressing it verbally. This view about the subject resulted in an apparent lack of interest of learners towards it. Many students didn't put much effort in learning the subject, thus, they failed to possess the required knowledge and skills that they are expected to acquire. Accordingly, it could lead to unsatisfactory ratings in their examinations and evaluations, thereby affecting not just the performance of the school but also the country as whole.

In response thereto, the Department of Education, in collaboration with all teachers and stakeholders, continually innovate methods or systems that would be adopted to attain specific educational goals which could lead to the improvement of the country's overall academic standing. As such, the Department of Education implemented a mathematics curriculum which aimed to facilitate a more efficient and effective teaching and learning. This helped students to easily acquire the skills for them to achieve national and global competitiveness.

In addition, due to the present COVID-19 pandemic, the Department of Education adopted defined alternative learning delivery modalities parallel to the absence of face-to-face learning. The printed Self Learning Modules (SLMs), online learning and other available resources for teaching modalities were used to ensure continuous learning amid the present worldwide fight against such pandemic, (Department of Education, 2020). In some parts of the country, the SLMs/LAS were printed-out and delivered to the students for them to be studying and working on it at their respective homes. As the students acquired the needed competencies, scaffolding (Vygotsky, 1978) had been supervised by their parents and other people concerned, (Kurt, 2020). Therefore, despite this pandemic, the teaching and learning process would still be possible and effective in promoting basic education learning, (Department of Education, 2020).

The concepts in permutation and combination interfered with each other (Suriyanto, Subanji, Nusantara, & Candra, 2016) to the students' minds because as they examined the problem, they thought that permutation and combination were both applicable to answer the problem. Thereby, it had been observed that permutations and combinations topics were the least mastered skill of grade 10 students for this S.Y. 2020-2021 because their diagnostic test showed a Mean Percentage Score of 69 percent, which was far beyond the 75 percent passing mark.

In relation to those challenges, the researcher believed that teachers should produce and develop contextualized and localized teaching and learning materials in accordance with the national policies and standards, (Republic Act No. 10533). With that, the researcher's one mode of innovation centered on the use of FINER which provided the students an avenue to discover the topic more interestingly as well as to be exposed to engaging hands-on activities that solidifies learning. It allowed the students to think deeply, critically and logically by correlating important concepts, rules and applications in the study of math, particularly in learning about permutations and combinations.

With utmost eagerness to search for the best teaching supplement in order to create a motivation towards the subject, to improve academic outcomes and to contribute to quality learning, the proponent desired to introduce FINER in the Permutations and Combinations of Grade 10 Students.

Hence, this action research aimed to help Grade 10 students in improving and enhancing their skills in solving using the innovative self-learning material known as FINER.

This action research aimed to examine the effectiveness of FINER. It was discerned as contributory to quality learning and excellence. Mathematics focuses on structure, numbers, interrelations, combinations, generalizations and transformations which connotes a FINER way of understanding complex principles, concepts and ideas that are used in daily activities. This had been the reason for the researcher's goal of elevating the problem-solving skills of the students. Hence, this study was known as FINER, Fortifying Instructions in the New Normal through Enriched and Reinforced Sheets, a progressive strategy in teaching the Permutations and Combinations of Grade 10 students of Itawes National High School, Alabug, Tuao, Cagayan.

FINER was an individualized instruction which comprises well-developed activity sheets with pre-requisite skills shown progressively to attain the indicated essential competencies.

FINER applied the concept and principle of John Dewey's Learning by Doing in which learners can learn best through hands-on activities, (Williams, 2017; Pegg, 2020; Shawal, n.d.). It improved the student's way of learning by providing them a chance to encounter and undergo drills and activities in solving problems about permutations and combinations.

FINER linked the real-world problems of students to learning about certain learning material by applying critical thinking processes and problem-solving skills, (Andrew & Trueman, 2015) as cited by Suparman (2019).

Students were given problems aligned to the target' skills showing each step, along with hints and explanations of the solution of the problems. Students could work individually by following the steps. Reflective Notes were included in the student's FINER.

FINER provided puzzles and riddles in the activities to boost the interest of the students to solve problems.

FINER was a teacher-made teaching strategy divided into six parts: Focus, Initialize, Nurture, Enrich, Reinforce, and Show.

The first part was focus, which was the title of the material. It includes the specific subject matter covered. Those were the topics on permutations and combinations which were considered the focus' skills in Mathematics 10. In this part, the students identified the topic they would be learning.

The second part was initialize, which showed the preview of what the students would learn. It emphasized the students' essential target skills based on the indicated learning competencies being tested as expected from the students to demonstrate. In this part, students determine the skills they need to attain.

The third part was nurture, which was considered as the heart of the material. This part consisted of activities that fostered student's deeper understanding of knowledge and skills based on the objectives of the topic. It provided students' drills, exercises, and activities with clear

directions to build necessary knowledge, skills and values represented from real-life situations. This part nurtured students' systematic way of learning while discovering the process of answering the activities required to them. In this part, students were expected to learn and work on the activities for them to meet the competencies.

The fourth part was enrich, which was made up of drills, activities or tests aligned to the previous part to assess the students' learning. This part distinguished the impact of this material as a tool for the teaching-learning process. In this part, students had done another activity that tests their learning about the topic.

The fifth part was reinforce, which includes additional activities or drills that strengthened their knowledge about the topic. In this part, students answered additional activities that sharpened their minds.

After the students underwent FINER, they were to apply the knowledge and skills they acquired that leads to the last part which was show. This part includes concrete activities related to the topic. Hence, the students showed practical applications of the topic in their daily lives. Students built their critical thinking and creativity in applying the topic. Students as well shared their experiences through journal writing.

Objectives of the Study

This aims to evaluate the effectiveness of the FINER method in teaching permutations and combinations to Grade 10 students. Specifically, the study aims to determine the mean scores of the respondents before and after their exposure to FINER. It also seeks to identify whether there is a significant difference between the pretest and posttest scores of the respondents after being exposed to FINER. Additionally, the research will assess the effect size of using FINER on solving problems involving permutations and combinations. Finally, the study intends to develop an activity plan to sustain, improve, or further develop the intervention and its utilization. This research aims to provide insights into the impact of FINER on student performance and propose actionable strategies for its continued application in educational settings.

II. Methodology

The study made use of One Group, Pretest-Posttest Research design as it involves only one class of Grade 10 students who were only grouped according to residency but with different levels of academic performance.

Participants and/or other Sources of Data and Information

The study involved thirty (30) Grade 10 students of Itawes National High School who are enrolled and belong to one class and who were classified as the lowest 30 among the group of 44 students. In order to identify the respondents for remediation, the researcher made use of their

diagnostic test scores from the topic's permutations and combinations. The mechanics of the intervention, concerns and queries were discussed exclusively to the respondents via Group Chat. The respondents were asked to answer thirty (30) – item problem solving pretest and posttest based from different Mathematics books. The selection of questions was aligned to the competencies and the diagnostic test' result of Grade 10 students in Mathematics for the S.Y. 2020-2021. To ensure the validity and reliability of the scores, the cooperation and guidance of parents were needed in the administration of the test. The scores were recorded, tabulated and analyzed by the researcher as bases in answering the research questions.

Data Gathering Methods

The researcher prepared and administered a 30-item diagnostic test as a tool in assessing the learners' prior knowledge on the competencies and the scores were determined as the basis for the development of worksheets. The researcher prepared ahead of time the worksheets needed for the study.

In like manner, a 30-item problem solving pretest and posttest were constructed by the researcher which were quality assured using the test validation tool by the school and district Technical Working Group (TWG). The 30-item posttest was paralleled with the pretest based on the competencies to be tested. The pretest was administered to the respondents following the proper Inter-Agency Task Force protocols and certain precautions given by the DepEd Memorandum No. 43 s. 2020 also known as the Guidelines on the Alternative Work Arrangements in the Department of Education in Light of the Covid-19 Stringent Social Distancing Measure. After which, FINER in the Permutations and Combinations of Grade 10 Students was introduced to the respondents. After all the competencies were taken up, a 30-item posttest was administered to the respondents following the safety protocols. The same students were used for the said pretest, FINER and posttest.

Before the implementation of the research, the researcher informed the parents regarding their duties and responsibilities to their child as respondents. Likewise, the students were instructed about their roles in the said study.

The Pretest and Posttest scores of the respondents were treated statistically to determine the effectiveness of using FINER in improving and enhancing their skills in solving permutations and combinations.

Ethical Issues

Prior to the conduct of the study, the researcher sought the permission of the Principal, the Public-School District Supervisor and the Schools Division Superintendent, through channels.

Upon the approval of proper authorities, the parents of the respondents were given a letter of consent informing that their children were used as respondents of the study, strictly following

the guidelines issued by the IATF for safety measures of health issues and concerns. The proponent also informed the respondents that their scores and the result of the study were treated with utmost honesty, integrity and confidentiality.

Moreover, the proponent properly acknowledged and cited authors of different books, journals, publications and unpublished thesis and dissertations and other websites used as references in the conduct of the study.

III. Results and Discussion

Table 1. Mean Pretest and Posttest Scores of the Respondents

	Mean	Standard Deviation
Pretest	17.23	3.48
Posttest	23.00	2.65

The table shows that there is an increase in the posttest scores of the respondents and their scores are closer to one another, exemplifying their homogeneity. This implies that the use of intervention has greatly boosted the respondents' posttest scores when compared to their pretests' result. This further implies that their exposure to FINER has greatly helped in the improvement of their skills in solving permutations and combinations.

In the study of Vergara (2017), it was concluded that the learners' performances improved significantly after exposure to the developed module.

The result of the study of Prado, Tan, & Capuyan (2019) showed that the respondents had low performance in General Mathematics and High School Statistics before the conduct of the study. Moreover, it was found out that the learners' performance has a significant increase after the treatment period.

In the study of Kul, Celik, & Aksu (2018), the results of the meta-analysis revealed that the use of educational materials in mathematics has a positive and high influence on achievement.

Thus, the use of the developed instructional materials contributed to an increase in the learner's performance and achievement after being exposed to it.

Table 2: Test of Difference between the Pretest and Posttest of the Respondents

	Mean	SD	t-computed	Critical Value	Statistical Inference
Pretest	17.23	3.48	-18.20	2.045	Significant
Posttest	23.00	2.65			

It can be deduced from the table that there is a significant difference between the pretest and posttest scores of the respondents after their exposure to FINER at 0.05 level of significance indicated. The respondents got higher posttest scores which reveals their well-improved performance. This implies that the intervention used has contributed to the enhancement of the respondents' problem solving skills.

The reflective notes of the learners were recorded which attested their enjoyment in the learning activities. The puzzles motivated them more to answer the drills given to them. Hence, it had been an igniter to their desire in solving problems that resulted in an increase in their posttest scores.

This corroborates to the study of Cubillas (2020) which revealed that there is a significant difference between the pretest and posttest scores of Grade 7 students, and further concluded that CLM is effective in developing the conceptual understanding of the learners on the indicated competency.

It is also confirmed in the study of Adebule & Ayoola (2016) which showed that a significant difference exists between the performance of students taught with instructional materials and those who were taught without instructional materials.

Abubakar (2020) further reiterated that learners taught with instructional materials were found to be of improved performance compared to those taught without instructional materials.

Hence, the learners' posttest scores and performance had greatly improved after being taught with instructional materials because it had developed their conceptual understanding in the said competency.

Table 3: Test of Effect Size

	Mean	Effect size	Descriptive Rating
Pretest	17.23	1.86	Very large effect
Posttest	23.00		

Results in Cohen's D analysis shows that there is a very large effect of the FINER in improving the competencies of the students. This means that FINER is effective in improving the learner's problem solving skills in permutations and combinations due to its actual effect size of 1.86.

This is in consonance to the study conducted by Prado, Tan, & Capuyan (2019) that the utilization of instructional materials had shown potential effectiveness to enhance student's performance among the high school students.

It is also supported by the study of Dhana (2017) which revealed that the use of instructional materials has the greatest effect on achievement of the learners rather than without using instructional materials.

The study of Aguinaldo & Domingo (2019) found that the developed CLMS are valid and effective because it may not only be used as support to the increasing need for motivating learners but will also pave the way to a much higher level of achievement among the learners.

Indeed, the utilization of instructional materials is effective in motivating the learners to acquire the needed competencies; and has the greatest effect on their achievement and performance.

This study addresses the enhancement of the competencies in permutations and combinations through FINER. It also intends to contribute to better learning and progress in the performance of the learners.

The study's findings address the questions posed in the Statement of the Problem. The mean pretest score of the learners was 17.23, with a standard deviation of 3.48, while the posttest mean score increased to 23.00, with a standard deviation of 2.65. A significant difference between the pretest and posttest scores was revealed, with a computed t-value of -18.20, which exceeds the critical value of 2.045 at a 0.05 level of significance. Furthermore, the intervention's effect size, calculated using Cohen's D, was very large, with a value of 1.86. The sustainability plan to maximize the intervention's utilization benefited students by enhancing their competencies in permutations and combinations, and it fostered stronger partnerships among stakeholders.

IV. Conclusion

Based on the results and findings of the study, a substantial increase is manifested in the mean score of students in the posttest as compared to the pretest which implies that the learners performed better after the use of FINER. Also, a significant difference is shown in the computed t-value and probability value. In addition, there is a very large impact of the intervention to the performance of the students. This concludes that FINER is an effective strategy to improve the competencies on permutations and combinations of the Grade 10 students.

Moreover, students were able to improve their learning ability through the use of the intervention. They engaged and enjoyed learning which was validated by their responses on the survey conducted in the implementation of the intervention. Some of the learners' comments toward the intervention were the following: a) Learners build their knowledge beyond life scenario

while answering the FINER; b) Learners love the activities because it created them an avenue to discover and master specific solving skills; c) Learners appreciate the different levels of difficulty in the worksheets for it leads them apply their higher-order thinking skills and creativity in answering tough problems.

In relation to this, FINER indeed greatly affects the learning competencies of Grade 10 Students in solving problems involving permutations and combinations.

However, this study also has limitations as to its conduct. There were two learners whom I didn't meet face-to-face during their posttest due to their case of under home quarantine, but I was able to administer the test through an online platform. Besides, some students who are working find it difficult to cope up because their time is divided.

As a general conclusion, learners performed better after the use of FINER and the great increase of the posttest scores are credited to FINER. So, FINER is a very effective strategy in enhancing the academic performance of Grade 10 students in Mathematics. Hence, teachers may maximize the utilization of the said intervention.

V. Recommendations

In light of the previously presented and discussed findings and conclusions of this study, the following recommendations are hereby advanced: Learners may use FINER to improve their skills in solving problems involving permutations and combinations. To enhance mastery levels, learners should be exposed to FINER for longer periods. By utilizing FINER, learners can broaden their approaches and perspectives in addressing real-life problems. Additionally, engaging more with FINER can increase learners' ability to think and solve problems with speed and accuracy. Mathematics teachers are encouraged to create a FINER Game App, integrating technology into the intervention to foster a more engaging and interesting learning experience. Teacher-researchers across disciplines should contextualize and reproduce the use of FINER in teaching through similar studies to validate the results. Schools should strengthen the use of contextualized teaching-learning materials to support the country's goal of promoting quality learning and excellence, especially during the pandemic. Furthermore, school heads, district supervisors, and division education program supervisors should continuously conduct seminar-workshops and training sessions to guide and train all teachers in developing and producing instructional materials.

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