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Line by Line Hints vs. Repeated Parallel Questioning Feedbacks on Grade 7 Students' Mathematics Achievement

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Abstract This study examined the use of line-by-line hints and repeated parallel questions as feedback mechanisms to promote students' mathematics achievement. These methods were already proven effective when applied to modular distance learning, however, after a literature review, it was found that there has yet to be a study conducted where these methods were applied during face-to-face classes. The participants were the Grade 7 students of Misamis Oriental General Comprehensive High School (MOGCHS) during the school year 2022–2023. Two intact classes were randomly assigned as Experimental Group 1, which was exposed to line-by-line hint feedback, and Experimental Group 2, which was treated with the repeated parallel question method during the experiment. Using a pretest-posttest quasi-experimental research design, a 30-item researcher-made test in algebra focusing on rational numbers up to subsets of real numbers served as the main instrument of the study. The students' performance was measured using their achievement test scores. To determine the students' level of achievement, descriptive statistics (mean and standard deviation) were utilized, while a one-way analysis of covariance (ANCOVA) was used to determine if there was a significant difference between these two feedback methods on the students' mathematics achievement during face-to-face classes. The results of the analysis revealed that line-by-line hints were more successful in improving students' performance than the repeated parallel question method. It offers more support in correcting student misconceptions. Thus, the researchers recommend the use of this kind of feedback to mathematics teachers at all levels, for it is more effective in enhancing students' mathematics achievement and encourages students' active participation in the feedback process.

Keywords: *feedback, repeated parallel question, line-by-line hints, mathematics achievement*

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1. Introduction

Mathematics achievement is a vital component of academic success. Success in many professions depends on it. For instance, people who work with money, such as in stores, banks, and other businesses, require mathematics skills. Additionally, mathematics plays a crucial role in medicine as it provides the foundation for understanding medical concepts, treatments, and procedures. A strong understanding of mathematical principles is necessary for medical professionals to accurately interpret and analyze medical data, including lab results, imaging, and patient records. It is also used to develop and validate medical models, such as predicting the effectiveness of a treatment or identifying risk factors for a disease. Without a strong foundation in mathematics, medical professionals may struggle to make informed decisions about patient care, potentially putting patients' health and lives at risk [1].

In reality, mathematics is an essential skill for most occupations. But unfortunately, Filipino students' performance in mathematics was relatively low. The results of various national and international assessments, such as the National Achievement Test (NAT), the Program for International Student Assessment (PISA), and the Trends in International Mathematics and Science Study (TIMSS), have all shown this low performance over a long period of time [2]. This is alarming and requires significant action, especially for mathematics teachers.

Conceding to the above problem, the researchers believed that providing corrective feedback could be one way to address this concern. This kind of feedback gives the correct answer, reinforces skills, and reassesses student learning. It has been found to accelerate the rate and amount of learning and can be one of the most

effective instructional methods for improving student performance [3]. The learning process is greatly aided by corrective feedback, which gives students information beyond just whether their answers were correct [4].

However, in most cases, teachers devote less time to providing learners with corrective feedback [5]. As experienced by the researchers, most teachers check students' work very late or don't check at all, so students receive no feedback on their output. Students' papers are returned simply with tick marks for correct answers and an "X" mark for the incorrect ones and are not provided with corrective activities. Without the teacher's timely feedback, students' misconceptions will not be addressed immediately, and the use of the wrong processes will continue [6]. That is why feedback should be given as soon as possible to avoid a more serious problem where children may advance without understanding. According to [7], it is the teachers' effective use of feedback that sets the foundation for learner independence and creates a framework for high achievement, which means scaffolding improves learning. Indeed, teachers' feedback on students' work is significant.

Despite existing literature outlining the importance of high-quality and timely feedback, there is still limited study on it in the Philippine context. A particular study conducted in the country employed line-by-line hints and repeated parallel questions as feedbacking methods in mathematics. Line-by-line hints refer to written feedback with hints in each line of the solution where the error can be found. The students will use these hints to improve and revise their solutions. On the other hand, repeated parallel questions as a type of corrective feedback are done through examining a worked-out solution to the missed item and answering a parallel question [2]. These methods were proven effective in promoting students' mathematics achievement during the pandemic, where the modality of learning was modular distance learning. The authors recommended applying these feedbacking mechanisms to mathematics teachers at all levels to promote better understanding and encourage students' active participation in the feedback process. The general inspiration for this study came from here. The present study aims to further support the authors' assertion that feedbacking methods like line-by-line hints and repeated parallel questions provide positive results on students' achievement by conducting a similar study to see if the findings from the original study are closely related to the newly collected data in order to have generalizability of the results. Specifically, this study assessed if there is a significant difference between line-by-line hints and repeated parallel questions on Grade 7 students' mathematics achievement during face-to-face classes.

2. Methods

This study employed a pretest-posttest quasi-experimental research design. The pretest and posttest scores were used to examine the students' mathematics achievement in relation to how the two types of feedback mechanisms affected them. The pretest was administered prior to the use of the feedback method to gauge the students' prior knowledge. After the experimentation phase, the students took the posttest, which served as their final assessment. Moreover, the one-way analysis of covariance (ANCOVA) was used to determine the degree of the significant difference between the two feedbacking methods.

2.1. Research Setting

The study was conducted at Misamis Oriental General Comprehensive High School (MOGCHS), which is at Don Apolinar Velez Street, Cagayan de Oro City. The late Don Apolinar Velez Y. Ramos, the first elected governor of Misamis Province, took the initiative to create the Misamis Oriental High School, which is currently known as the Misamis Oriental General Comprehensive High School. It was formally inaugurated on December 15, 1909. On June 19, 1965, RA 4247, enacted by the Fifth Congress of the Republic of the Philippines, was approved, and Misamis Oriental General High School was converted into a national high school. MOGCHS is in the heart of the city of Cagayan de Oro, with a total area of 7.3629 hectares. The Misamis Oriental General Comprehensive High School is a public school that provides students with an education and the development of skills to prepare them for college and become better citizens of the country. It is a big school that has more or less 9,000 students (School and College Listings, n.d.).

2.2. Sampling Procedure

The grade 7 enrolment committee formed the two intact classes at the start of the academic year. Hence, the make-up of each entire class was not under the researchers' control. One intact class was exposed to line-by-line hint feedback. The remaining intact class was treated using repeated parallel question feedback. To guarantee correct use of the two feedback methods, these classes were handled by the same teacher. Thus, confounding factors that might have tainted the results were avoided.

2.3. Participants of the Study

The participants of the study were the seventy-four (74) grade 7 students from sections Quezon and Uldarico Akut of Misamis Oriental General Comprehensive High School during the second quarter of the school year 2022–2023. Grade 7 Quezon which was the experimental group 1 (line by line hints) was composed of 38 students meanwhile Grade 7 Uldarico Akut which was the experimental group 2 (repeated parallel question) was composed of 36 students.

2.4. Research Instruments

This study's main instrument was a 30-item researcher-made test. The test was prepared with a table of specifications (TOS) covering the topics of rational numbers up to subsets of real numbers. The instrument was validated by four experts (grade 7 mathematics teachers) using a checklist for making multiple-choice tests. Test items subject to rejection or revision were considered and was pilot tested in grade 8. The test was analyzed and it was found to be a good test with a reliability coefficient of 0.8062.

2.5. Data Gathering Procedure

Following the approval of the proposal, the researchers submitted a letter to the principal of Misamis Oriental General Comprehensive High School requesting permission to conduct the study, which was later signed. After that, the researchers began the experiment by administering the pretest to the two intact classes. The cooperating teacher does the conventional teaching and the giving of quizzes, and the researchers' task was the checking of papers and providing feedback. A total of four quizzes were successfully corrected and provided with feedback by the researchers during the nine-week duration of the study. The students in experimental group 1 (grade 7-Quezon) were provided with hints in each line of the solution where the error occurred. The students were asked to use the hints as a guide in revising their work. On the other hand, experimental group 2 (grade 7-Uldarico Akut) received worked-out solutions and parallel questions to the items the respondents' missed in the previous quiz to re-assess their skills. This modality was used throughout the nine-week duration of the study. The experimental period concluded with a posttest.

2.6. Data Analysis

To analyze the collected data, different statistical tools were employed. The mean and standard deviation were used to analyze and explain the students' performance on the pretest and posttest. The mean descriptive levels shown below were used to answer the first research question of this study, which was found in Chapter 1.

Mean Level	**Descriptive Level**
0.00–5.99	Beginning
6.00–11.99	Developing
12.00–17.99	Approaching Proficiency
18.00–23.99	Proficiency
24.00–30.00	Advanced

A one-way analysis of covariance (ANCOVA) was also used to assess and analyze variation as well as the significant effects of the different feedback mechanisms. To control the early variations in the study subjects' mathematics achievement, the pretest scores were employed as a baseline covariate. After the effects of the covariate are under control, the ANCOVA is used to determine the impact of the various feedback methods [2].

3. Results and Discussion

This chapter presents the results of the analysis of the data gathered, findings and interpretation. The presentations are arranged based on the order of the problems in Chapter 1. The explanation was aided by tables and statistical computations.

The mean and standard deviation of the students' achievement scores for the two experimental groups' pretest and posttest are shown in Table 1. The experimental groups 1 and 2 have mean pre-test scores of 9.56 and 9.29, respectively, for the entire pretest. The experimental group 1 outperformed the experimental group 2 by just a margin of 0.27. Moreover, both groups' standard deviation was almost the same, which means their scores are dispersed and are farther from the mean. All groups, however, were still at a developing level of proficiency. This further suggests that before the study was conducted, the mathematical proficiency levels of the students in the two groups were comparable and therefore relatively close. This could be attributed to the similarity of their prior learning experiences in mathematics through face-to-face instruction.

In the posttest, the students in experimental group 1 exceed those in experimental group 2 by a margin of 2.36, which is a noticeable difference between the mean scores of the two experimental groups. In terms of standard deviation, experimental group 1 was just 0.37 lower than that of experimental group 2, but both had wider dispersion compared to their respective pretest standard deviations. Moreover, the standard deviation of the posttest results for the two groups shows that they responded similarly. It is clear that both experimental groups 1 and 2 improved and attained a proficient and approaching level of proficiency, respectively. Experimental group 1 in which the type of feedback used was Line-by-line hints has a higher performance level compared to experimental group 2 in which the type of feedback used was repeated parallel question.

To verify whether the difference was significant, a one-way analysis of covariance (ANCOVA) was used. Prior to the analysis using one-way ANCOVA, the assumptions were checked, and the results showed that the assumptions were met.

Table 1. Mean and Standard Deviation of Students' Achievement Scores

		Pretest			**Posttest**		
Group	**N**	**Mean**	**Standard Deviation**	**Descriptive Level**	**Mean**	**Standard Deviation**	**Descriptive Level**
Line-by-line Hints	36	9.56	2.42	Developing	18.78	3.59	Proficient
Repeated Parallel Question	38	9.29	2.83	Developing	16.42	3.96	Approaching Proficiency

Legend: 0.00–5.99 = Beginning, 6.00–11.99 = Developing, 12.00–17 = Approaching Proficiency, 18.00–23.99 = Proficient and 24.00–30.00 = Advanced.

Table 2. One-way ANCOVA Summary of the Students' Achievement Scores

Source	**Df**	**Adj SS**	**Adj MS**	**F-value**	**P-value**	**Effect size**
Intervention	1	76.381	76.381	17.903	<0.001	.201
Error	71	302.918	4.266			
Total	74	23974.00				

*significant at p<0.05 alpha level.

Table 2 shows the summary of the one-way analysis of covariance. The table shows a probability value of <0.001*. This revealed that there is a significant difference between line-by-line hints and repeated parallel question feedback on the students' mathematics achievement during face-to-face classes, therefore, the null hypothesis was rejected. The results of this study support the findings of [8], who found that students were able to complete more mathematical tasks with the use of feedback methods and corrective actions.

Additionally, it was clear from the results that the line-by-line hint feedback had a more remarkable impact on the students' mathematics achievement during face-to-face classes, which differs from the findings of [2], who found the repeated parallel question feedback to be superior in modular instruction, which served as the general inspiration for the present study. The outcomes of this study were in line with those of [9], [8], and [10], demonstrating that providing students with clues at each step of the solution allowed them to complete more mathematical tasks. The current study also demonstrated that giving students feedback in the form of hints is a two-way, active process [2]. First, the teacher challenged the student to think about and understand the clues by presenting them in a logical order. Second, the student revised his solutions in response to the feedback and made use of the hints. The study by [11], which stated that the step-by-step hint is a reflection-in-action process in which new knowledge is attained through self-reflection, supports this idea. He added that the teacher's suggestions help students connect with feedback and consider how well they comprehend the problem and how to solve it. This approach gives students the chance to clarify their knowledge, conceptualize, and apply feedback to complete a mathematical task.

On the other hand, the same findings were found with those of [2] with the repeated parallel question method, where students just copied the feedback's idea (the worked-out solution) when completing a task of a similar nature. Although they actively developed the cognitive schema for the solution method for the parallel question, rather than the creation or generation of an alternate solution, it was built based on a worked-out solution. There may be a misconception among the students due to this imitation phenomenon that there is just one correct approach to presenting and completing the task. As a result, the teacher's input was regarded as critical. The National Council of Teachers of Mathematics backed up this assertion by emphasizing the use of feedback to validate performance expectations, assess students' understanding, and identify misconceptions (NCTM, 2000). Thus, this study further recommends that if students receive this kind of feedback, they should be encouraged to offer an alternative solution.

4. Conclusions and Recommendations

Based on the study's results, the researchers concluded that there is a significant difference between the two methods of assessment feedback used in this study in terms of improving students' mathematics achievement. Specifically, feedback using line-by-line hints was more effective than the repeated parallel question feedback during face-to-face classes. With this method, the student gets more help and a mechanism for fixing misconceptions. However, the drawbacks of each feedback method must be taken into consideration because they have an impact on students' participation in the feedback process and their performance. Students with limited prior knowledge struggle to understand and interact with the clues. On the other hand, students' performance may be affected since they just imitate the feedback (the worked-out solution) rather than coming up with an alternative solution.

Considering the findings of the study, the researchers recommend to mathematics teachers at all levels that they may use feedback with line-by-line hints to foster better understanding and encourage students' active participation in the feedback process. Future researchers may also explore the significant effects of the language used in providing line-by-line hint feedback in mathematics on the students' performance.

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