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IMPLEMENTATION OF BUTTERFLY METHOD TO STRUGGLING MATHEMATICS LEARNERS: AN EXPERIMENTAL STUDY

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ABSTRACT
This experimental study investigates the implementation of the Butterfly Method as a remedial strategy for struggling mathematics learners. The Butterfly Method, a visual and structured approach to teaching fraction operations, aims to simplify complex arithmetic processes, making them more accessible to students with difficulties in mathematics. The study involves grade 5 struggling learners in mathematics based on their performance in the standardized mathematics tests. Participants were the 43 grade 5 students of Magugpo Pilot Central Elementary School as the experimental group, identified under low level of proficiency in mathematics subject based on the grade of 79 and below in the First Quarter of the School Year 2023-2024. Over a 5-session intervention period, participants were assessed on their understanding and application of fraction operations through pre-tests and post-tests. Results indicate that the experimental group demonstrated significant improvement in their mathematical performance, suggesting the effectiveness of the Butterfly Method in enhancing the mathematical skills of struggling learners. The study concludes with recommendations for integrating the Butterfly Method into regular mathematics curricula and further research on its long-term impacts on learners' mathematical proficiency.

KEYWORDS: *teaching strategy, butterfly method, struggling mathematics learners, addition and subtraction of dissimilar fractions, academic performance, experimental research design*

INTRODUCTION

Butterfly Method, also known as the Cross Multiplication Method, is a mathematical technique used to streamline the addition and subtraction of dissimilar fractions by finding a common denominator without explicitly determining the least common multiple. This method, which derives its name from immediately multiplying across the numerators and denominators of the fractions in a diagonal pattern that resembles a butterfly's wings, makes fraction operations easier, especially when working with fractions of different denominators. The effectiveness of the Butterfly Method as an intervention for fifth-grade students who struggle in Mathematics may be determined by examining its potential to improve conceptual knowledge, procedural fluency, and overall mathematical proficiency in this group of students. This information could then be used for curriculum development strategies and instructional practices.

In Brunei, fraction is the most challenging topic for students to learn (Damit, 2002; Harun, 2003). This issue is not only prevalent in primary, but also in secondary level especially on the addition and subtraction of fractions (Suffolk & Clement, 2003). Yusof and Malone (2003) suggested that poor introduction of elementary fraction, weak basic knowledge, and mechanical skills in calculating operations of fractions, language barrier, and ineffective teachers' instructional activities could be the possible factors in such learning difficulty. Hence, teachers are encouraged to apply innovative pedagogies to enhance quality of mathematical education amongst students, as stated in SPN 21, specifically in fraction (Ministry of Education, 2013).

Moreover, in the Philippines, mathematics education faced challenges and ranked lowest in international assessments (San Juan, 2019). In the PISA 2018 International Report, Filipino students' average score in mathematical literacy was 353 points, significantly lower than the Organization for Economic Cooperation and Development (OECD) average of 489 points, indicating a below Level 1 proficiency (OECD, 2019). The Philippines also scored 297 in math in the 2019 Trends in International Mathematics and Science Study (TIMSS) by the International Association for the Evaluation of Educational Achievement (Mullis et al., 2019). It is necessary to deal with the problem of students' confidence in mathematics and develop effective strategies to enhance mathematics education in the Philippines.

In Tagum City, particularly, Magugpo Pilot Central Elementary School with a minimum enrollment of 4,000 students every year, the result from the consolidated least learned competency in the First Quarter for school year 2023-2024 shows that the learners are struggling in solving addition and subtraction of fractions. Academic teachers in Mathematics encounter a concerning trend among its students, a notable difficulty in problem solving skills. Such reasons prompted the researcher to conduct a study on the Implementation of Butterfly Method shortcut in adding dissimilar fractions to struggling Mathematics learners in

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Magugpo Pilot Central Elementary School, Mabini Street, Tagum City, Davao del Norte. For struggling learners who may find traditional methods complex or abstract, the visual nature of the Butterfly Method provides a concrete framework that enhances comprehension. The Butterfly Method lies in its potential to address the specific learning needs of struggling mathematics learners by providing a supportive and accessible tool for navigating fraction operations.

OBJECTIVES

The purpose of this study was to help students become proficient in using the butterfly method for adding and subtracting dissimilar fractions and to enhance critical thinking and problem-solving abilities through fraction addition and subtraction.

METHODS

This study was a quantitative study employing an experimental method or one-group pre-test and post-test design in gathering data for research of the implementation of butterfly method to struggling mathematics learners. This research study utilized experimentally as the research design.

Purposive sampling, a non-probability sampling method, was used to select participants for this study. The subjects of the study were the 43 Grade 5 students of Magugpo Pilot Central Elementary School as the experimental group, identified under low level of proficiency in Mathematics subject based on the grade of 79 and below in the First Quarter of the School Year 2023-2024.

The instrument used in gathering the data is the 20-item assessment test from the (SIM) Strategic Intervention Material for the pre-test and post-test. The researcher also developed a 5-session using butterfly method which serves as the intervention during noon break. The pre-test and post-test instruments were validated by experts, tried out through pilot testing before using it in the study.

A Table of Specifications (TOS) was also prepared so that the items of the test can be distributed to the different problem-solving skills. The questionnaire was a multiple-choice type of test and consisted of 20 items with 25% remembering or understanding questions, 25% applying or analyzing questions and 50% evaluating or creating questions. This test served as the pre-tests and post-tests of the research study.

With the approval of the Division of Tagum City, this research was conducted in Magugpo Pilot Central Elementary School, Mabini Street, Tagum City, Davao del Norte.

The researcher conducted the test questionnaires for post-test with forty-three (43) participants to determine their proficiency, critical thinking and problem-solving abilities in using butterfly method after the 5-day intervention program.

After the conduct of the test, the researcher proceeded to quantitative data analysis to evaluate the effectiveness of the Butterfly Method for struggling fifth-grade mathematics learners. The analysis involved several key steps to ensure a comprehensive understanding of the data. First, the researcher collected pre-test and post-test scores from the experimental group. Second, descriptive analysis was calculated including the mean, class proficiency and competency level of both pre-test and post-test. Lastly, the calculated result of the test difference between pre-test and post-test performances of grade 5 students.

RESULTS AND DISCUSSIONS

Table 1
Pre-test Performance of the Grade 5 Students

Skills	No. of Students	Mean	Class Proficiency	Competency Level
Addition and Subtraction of Dissimilar Fractions	43	6.83	34.15	No Mastery

Competence Level of the students' pre-test scores in addition and subtraction of dissimilar fractions

As shown in table 1, addition and subtraction of dissimilar fractions skills of the Grade 5 students in the pre-test has a mean of 6.83 which has a class proficiency of 34.15. Based on the DepEd Mastery Level Classification, the competency level of the students in pre-test is no mastery.

This implies an evident need for instructional intervention of Grade 5 students to help them understand the fundamental concepts in adding and subtracting dissimilar fractions. This might include re-teaching, employing different teaching methods for intervention, or offering additional practice opportunities.

Fractions knowledge proved to be the most prominently studied indicator of future mathematics proficiency. This is most likely since this content area has also been shown to be the single most effective indicator of future mathematics proficiency (Siegler et al., 2012).

Specifically, it may also improve eagerness of an individual to try to analyze mathematical problems and to improve their determination and self-concepts with respect to the abilities to solve problems; make the individual aware of the problem-solving strategies, value of approaching problems in an orderly manner and that many problems can be solved in more than one way and; improve individuals' abilities to select appropriate solution strategies, capacity to implement solution strategies accurately and abilities to get a correct answers to problems (Hoon, Kee, & Singh, 2013).

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However, Bailey et al. (2012) also argued that competence with fractions might not be the critical element to future mathematics achievement since finding that fractions measures solving skills would suggest that these measures improve their level of problem-solving ability. The research data overwhelmingly points to fractions, as the main and strongest predictor of future mathematics performance.

Table 2
Post-test Performance of the Grade 5 Students

Skills	No. of Students	Mean	Class Proficiency	Competency Level
Addition and Subtraction of Dissimilar Fractions	43	15.49	77.45	Mastery

Competence level of the students' post-test scores in addition and subtraction of dissimilar fractions

As shown in the table 2, addition and subtraction of dissimilar fractions skills of the Grade 5 students in the post-test has a mean of 15.49 which has a class proficiency of 77.45. Based on the DepEd Mastery Level Classification, the competency level of the students in post-test is mastery.

This implies that the Grade 5 students have effectively learned to add and subtract dissimilar fractions using butterfly method as intervention. They have a thorough understanding and can consistently apply the concepts and procedures accurately reflecting successful instruction and a solid foundation for future mathematical concept which highlights their academic progress and preparedness for continued learning.

The teaching-learning process of mathematics generates many difficulties in students, especially in higher education, of a different nature. Some of them have their origin in factors such as low academic performance, high absenteeism rates, etc. High dropout rates, mainly in higher education, have been identified as consequences of these difficulties encountered by students and have become concerns of governmental educational institutions, as well as teachers at all educational levels (Chong, 2017).

According to Duzenli-Gokalp and Sharma (2010), the use of visual images can help students to calculate the addition and subtraction of fractions with like and unlike denominators. The Butterfly Method will leave a mental picture of the algorithm that can be easily applied.

Miller and Obara (2017), the Butterfly Method, illustrated by drawing two loops across the numerators and denominator of the other fraction, followed by adding antenna and bottom of the butterfly body, provides struggling mathematics learners with a visual and procedural scaffold. The method commences with base multiplication, where both denominators are multiplied, resulting in the new common denominator. This step is crucial in simplifying fraction operations. Then, each loop (wing) is multiplied, and the products are written under the antenna.

Finally, learners add or subtract the numbers under the antenna, contingent upon the operation required by the question. By breaking down the fraction arithmetic process into manageable steps and offering a tangible representation of the mathematical operations involved, the Butterfly Method aids struggling learners in understanding and executing fraction addition and subtraction more confidently and effectively (Boaler, Chen, Williams, & Cordero, 2016).

Table 3
The Test of Difference of means in Pre-test and Post-test Performances of the Grade 5 Students

	Mean	p-value	t-value	Remarks
Pre-test	6.83	0.000	-26.1	Significant
Post-test	15.49			

Difference between the pre-test scores and post-test scores of the respondents

Table 3 Table 3 presents the test of difference of means in pre-test and post-test of the performances of the students under the Butterfly Method. Students' performance in the pre-test has a mean of 6.83 while they garnered 15.49 as a mean for the post-test. The results gave a p-value of 0.000 and t-value of - 26.1 which indicates that the null hypothesis was rejected and accept the alternate hypothesis that there is a significant difference between the pre-test scores and post-test scores of the respondents.

Butterfly Method is a visual and an alternative method for teaching the addition and subtraction of fractions where diagonal and horizontal multiplication of denominators and numerators are applied (Rosli, Han, Capraro, & Capraro, 2013). Effective practice leads to the ability to learn and apply solutions, impacting students' mathematics performance. Key factors include student-educator interactions, interventions, and educational environments, which influence high failure rates in mathematics. (Khan, Begum, & Imad, 2019).

Students will construct their understanding of adding and subtracting fractions by using the Butterfly Method. As far as is known, the study on the Butterfly Method algorithm on the addition and subtraction of fractions is very limited. Adopting the Butterfly Method concept as a reference for the new teaching strategy during the intervention perhaps may help to add further information to the existing literature on solving fractions. The conceptual knowledge of understanding the method expects to assist students in improving their procedural knowledge when applying the Butterfly Method

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(Cardone 2015).

CONCLUSION

The view of foregoing findings, the researcher concluded that in addition and subtraction of dissimilar fractions, the respondents have a mastery competency level. There is a significant difference in pre- test and post- test scores which means, the students have improved their addition and subtraction of dissimilar fraction skills.

The performance level of respondents in pre-test and post-test using the Butterfly Method improved the problem-solving skills of students at Magugpo Pilot Central Elementary School in terms of addition and subtraction of dissimilar fractions have a mastery competency level. The manifestation of the pre-test and post-test increase is a good sign of developing problem-solving skills. Through the strategies came from the improvised approach by other materials such as Strategic Intervention Material (SIM) about the Butterfly Method in Mathematics of Magugpo Pilot Central Elementary School. This implied that if there was an intervention to be employed there is always good response in their problem-solving skills.

RECOMMENDATIONS

The researcher believed that Butterfly Method and learning materials facilitated and encouraged the learners especially the Grade 5 students to learn. It was because there was something unique in it, and something that would tickle their minds at exploring things around them.

In view of the foregoing research, the following recommendations were formulated:

1. At least two types of evaluation tools should be used to get the authentic output of the intervention, like paper and pencil test, and problem-solving questions.
2. The use of Butterfly Method to other grade level, teachers can support students' mathematical development throughout their learning process by offering a consistent and visually appealing approach to teaching fractions.
3. Further exploration and experimentation on this line of research to cope up with the global standard

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