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Effects of Fraction Board on the Skill in Solving Fractions

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***Abstract*—** *The main thrust of this study was to determine the effect of Fraction Board as an enrichment technique on the skill in solving fundamental operations on fractions to the Grade 7 students of Sierra Bullones Technical Vocational High School for the Academic Year 2020 - 2021 residing at Barangay Canlangit, Sierra Bullones, Bohol. This study used quasi-experimental design, specifically the pretest-posttest design. The participants were divided into two groups, a control group and an experimental group. A pre-test and post-test were administered to collect the needed data. The data gathered were treated using the the t-test formula for dependent and independent samples. The result showed that there is no significant difference between the pretest performance of the control and experimental group. Also, there is no significant difference between the pre-test and post-test performance of the control group. On the other hand, there is a significant difference between the pre-test and post-test performance of the experimental group. Further, the difference between the post-test of both groups is significant. Hence, the study concluded that Fraction Board has a positive effect in enriching the skills of the students in solving fundamental operations on fractions. The procedures, content and design of the tool used in this study are subject for further enhancement to address the needs and interests of the learners.*

***Keywords*—** *Effects of Fraction Board on the Skill in Solving Fractions: Fraction Board : Modules: Skills on Solving Fundamental Operations on Fractions.*

I. INTRODUCTION

The Philippine mathematics curriculum aims to develop critical thinking and problem solving. These two goals are integrated into the curriculum, along with the skills, processes, values, and attitudes of Filipino students, which received much consideration in its creation. To teach Mathematics effectively, the curriculum encourages the use of technology aids as appropriate in the teaching mathematics. Hence, many teachers are now incorporating a broader range of strategies into their teaching.

One concept in Mathematics curriculum that students need extra support as observed by the researcher in her three years of teaching is fraction. Fraction is a numerical quantity that has a numerator and a denominator that can never be zero. It serves as a prerequisite for many advanced mathematical topics such as algebra. In the Philippines K-12 curriculum, the instructions about fractions extend across Grades II to VI, with operations being taught after students have firm understanding of where fractions lie on a number line under the common core state standards in Mathematics. However, despite this long exposure of students to the concepts and principles of fractions and their operations, many high school students experience difficulty in solving higher concepts that involve fractions.

Cantoria (2016) suggests that the hindrances preventing the students from developing functional knowledge of fractions are attributed to the structure of fractions themselves or to the methods of teaching that teachers employ. Hence, to overcome this challenge, mathematics educators have to employ strategies that enhance students' mathematical abilities. Some studies have shown that there are higher test scores with active learning techniques. Effective learning needs hands-on methods where student-friendly educational aids are used to foster their ability to think critically and attentively.

Moreover, during the ongoing period of lockdown and social distancing, many have observed a significant increase in the use of games at home to pass the time and to deal with stress. These are perceived as a relief for families, both for parents and children. A recent study of Bayeck (2020) strongly suggests that board games are spaces for mathematical learning that can enable the learning of various contents. In addition, Kriz (2020) emphasizes that there is an increase engagement of families in analog play such as table tennis and favorite board games.

One fun board game that learners are fond of is the game called Snakes and Ladders. Inspired by this board game, the researcher is motivated to introduce a board game, "Fraction Board", designed for students having difficulty in solving fundamental operations involving fractions. The focus of this game is not purely on transmitting explicit conceptual knowledge but also includes the embodied experience and related tacit knowledge of the participants.

In the light of the preceding discussions, this study aims at contributing to the body of information, helping to provide evidence on the tool's efficiency and effectivity and examining how well students are learning by determining the effect of Fraction Board as an enrichment technique on the skill in solving fractions to the Grade 7 students of Barangay Canlangit, Sierra Bullones, Bohol for the Academic Year 2020 - 2021.

II. LITERATURE REVIEW

This study is grounded in Dale's Cone of Experience, Bruner's Theory of Intellectual Development, and the Law of Exercise. Dale's theory was selected due to its emphasis on the crucial role that experiences play in information retention. The cone of experience suggests that the level of information retention depends on how people encounter the information, and specific experiences at the bottom of the cone involve more sensory involvement. The theory posits that learners remember more from active participation than from passive

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activities like hearing, reading, or observing. It highlights that hands-on, direct learning experiences result in the highest retention rates, up to 90% according to Dale (1969).

Bruner's Theory of Intellectual Development, as cited by Lucas and Corpuz (2011), outlines three modes of representational thought: enactive, iconic, and symbolic. Enactive learning involves direct, hands-on experiences and is characterized by its immediacy. Iconic learning uses visual mediums such as models and pictures, allowing learners to form mental images. Symbolic learning involves abstract thinking with symbols. Bruner emphasizes the importance of enactive learning as foundational before progressing to iconic and symbolic learning stages (Cope, 2015).

Both Dale's Cone of Experience and Bruner's Theory of Intellectual Development suggest that hands-on experiences enhance learning, especially in mathematics. Effective teaching methods in mathematics should include strategies that motivate students through engaging, hands-on activities like games, puzzles, and problem-solving exercises. Teachers are encouraged to create a dynamic learning environment where students actively participate in mathematical exercises, which aligns with the principle that learning is an individual process shaped by personal experiences and beliefs.

Additionally, the Law of Exercise supports the idea that frequent use strengthens the connection between stimulus and response, while disuse weakens it. This law implies that repeated practice, such as through games and drills, enhances students' computational fluency and retention. Incorporating games into the classroom can provide opportunities for students to practice and deepen their understanding of mathematical concepts, fostering a strong foundation in fractions and other essential skills. Games also facilitate a school-to-home connection, allowing parents to engage with their children's mathematical learning through interactive play.

III. Research Methodology

Design

The researcher used a quasi-experimental design, specifically a pretest – posttest design. This design has pretest which was administered to the participants to serve as basis for grouping. The participants were divided into two groups (control and experimental), then experimentation and post-test were administered. The control group was given an enrichment module about fractions while the experimental group was exposed to the use of Fraction Board, before both groups were given the post-test..

Respondents

The study involved Grade 7 students from Barangay Canlangit, Sierra Bullones, Bohol, during the 2020-2021 academic year. Out of the 323 Grade 7 students enrolled at Sierra Bullones Technical Vocational High School, 45 resided in Barangay Canlangit. The selection of Grade 7 for the study was based on the fact that basic lessons on fractions are introduced in Grades 2 to 6 and reinforced in Grade 7. The researcher informed the parents in Barangay Canlangit about the study and explained the voluntary nature of their children's participation, giving them a week to decide. Eventually, 30 out of the 45 students participated, as some parents declined to sign the consent form due to pandemic concerns. These 30 participants were then equally divided into control and experimental groups, matched based on their pretest scores to ensure fair distribution..

Environment

The study was carried out at Sierra Bullones Technical Vocational High School, a public secondary school located along the Central Nautical Highway in Salvador, Sierra Bullones, Bohol. This institution, one of four public secondary schools in the municipality, had a student population of 1,245 for the 2020-2021 school year. The research focused on the Grade 7 students, particularly the 45 students from Barangay Canlangit, which is home to 373 families and situated approximately 3 km from the town center. To facilitate easy contact tracing and adhere to health protocols, the researcher chose Barangay Canlangit as the study location and conducted the study in designated Purok Centers, scheduling participants in batches to comply with safety guidelines.

Instrument

A self-designed questionnaire, covering the four fundamental operations in solving fractions, was utilized for both pretests and posttests among Grade 7 students. Following a structured process for preparation and validation, including content validity and pilot testing with Grade 8 students, a final set of 30 questions was established. The study, conducted in Barangay Canlangit, involved thorough pre-experimental preparations, including securing necessary permissions and orienting parents. Students were divided into control and experimental groups based on pretest scores, with the experimental group engaging in a game using Fraction Board materials. Data collection involved multiple stages: preliminary planning, pilot testing, pretesting, topic discussion, intervention with modular learning or the Fraction Board game, and post-testing. Health protocols were strictly observed throughout the process, ensuring a controlled and safe environment for all participants.

IV. Results and Discussions

This presentation, analysis and interpretation of data collected from an assessment of 8th grade students exposed to modular learning and functional impairment.

TABLE 1. Research Participants per Station

Range	Description	Control Group		Experimental Group	
		Frequency (*f*)	Percentage (%)	Frequency (*f*)	Percentage (%)
26-30	Outstanding	1	7%	1	7%
23-25	Very Satisfactory	1	7%	1	7%
21-22	Satisfactory	-	-	-	-
18-20	Fairly Satisfactory	3	20%	2	12%
0-17	Did Not Meet Expectations	10	66%	11	74%
Average Score		12.6		12.0	
Description		Did Not Meet Expectations		Did Not Meet Expectations	

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Table 1 shows the pre-test results of the two groups. The scale was based on the transmuted grading scale prescribed by the Department of Education. The scores were categorized as "did not meet expectations" with a score interval of 0 – 17; "fairly satisfactory" with a range of 18 – 20; "satisfactory" with students who got scores of 21 – 22; "very satisfactory" for 23 – 25; and "outstanding" for those who got 26 – 30.

Table 1 reveals that the highest percentage of the control and experimental groups fall on the range 0 – 17, described as "did not meet expectations" performance. The average scores of both groups also fall under "did not meet expectations" category. Generally, both groups have relatively similar pretest performances.

Based on the results of the pre-test, the students' performance implies that these students have a poor foundation in solving fundamental operations on fractions. It could be that the students have poor retention on the said topic or have encountered problems in learning this topic. This is supported by the Law of Recency which states that learners tend to recall or remember more lessons that are taught recently and tend to forget the previous lessons.

Table 2 exhibits the post-test results of the students from both groups. It appears the highest percentage of the control group still falls on the range 0 – 17 described as "did not meet expectations" performance while the highest percentage of the experimental group falls both on the ranges 0 – 17 and 18 – 20 described as "did not meet expectations" and "fairly satisfactory" respectively. The average post-test scores of the control and experimental groups fall under "did not meet expectations" and "satisfactory" respectively.

Based on the results of the post-test, it can be observed that there were improvements in the scores obtained by the students from both the control group which was exposed to modular learning and experimental group which was exposed to Fraction Board. This implies that both means of enriching students' performance in solving fundamental operations on fractions are effective. However, it can be noticed that the experimental group performed better and showed a positive effect on the learning achievement of the students as compared to that of the control group.

Table 3 reveals the difference between the pre-test performance of the students in solving fundamental operations on fractions of the control and the experimental groups.

As shown, the mean scores in the control and experimental groups are 12.6 and 12 respectively. The standard deviation of the control group is 7.16 while the standard deviation of the experimental group is 7.08. This indicates that the mean scores of both the control and experimental groups are heterogeneous.

The table also revealed the insignificant difference between the pre-tests of the control and experimental groups. Since the p-value is greater than 0.05, this suggests that the pre-test scores of both groups are insignificantly different. Thus, the null hypothesis is accepted. This implies that the two groups have more or less the same level of entry knowledge on the topic prior to the given intervention. This could be because the participants in each group were determined by matching those students with nearly the same pre-test scores. The more similar the two groups are at the baseline, the more likely that the observed difference between the two groups after the intervention can be attributed to the intervention itself and not to the other pre-existing differences (either observable or unobservable) between the two groups.

TABLE 2. Post-test Performance of the Control and Experimental Groups

Range	Description	Control Group		Experimental Group	
		Frequency (*f*)	Percentage (%)	Frequency (*f*)	Percentage (%)
26-30	Outstanding	-	-	3	20%
23-25	Very Satisfactory	2	13%	3	20%
21-22	Satisfactory	-	-	1	7%
18-20	Fairly Satisfactory	2	13%	4	27%
0-17	Did Not Meet Expectations	11	74%	4	27%
Average Score		**15.0**		**20.53**	
Description		**Did Not Meet Expectations**		**Satisfactory**	

TABLE 3. Difference in the Pre-test of the Control and Experimental Groups

Groups	Mean	SD	Mean Difference	Computed Value at 0.05 level of significance	p - Value at 0.05 level of significance	Decision	Interpretation
Control	12.6	7.16	0.6	0.23076	0.81917	Accept the null hypothesis	Not significant
Experimental	12.0	7.08					

TABLE 4. Difference Between the Pre-test and Post-test Results of the Control Group

Groups	Mean	SD	Mean Difference	Computed Value at 0.05 level of significance	p- Value at 0.05 level of significance	Decision	Interpretation
Pre-test	12.6	7.16	2.4	-2.02287	0.06262	Accept the null hypothesis	Not significant
Post-test	15.0	5.33					

Table 4 shows the difference between the pre-test and post-test performance of the students in solving the basic operation with fractions of the control group.

The mean difference shown in the Table is 4, which means that the post-test result was a little higher than the pre-test result. The result reveals that there is no significant difference between the pre-test and post-test performance of the control group because the p-value is greater than 0.05. This prompted the researcher to accept the null hypothesis. This implies that after the intervention was given, the scores of the students

increased insignificantly. In this group, students are provided only with formulas and examples in the modules, thus only a few senses are being utilized. This is based on Edgar Dale's Cone of Experience, which states that more senses are needed in order to build up knowledge.

Table 5 exhibits the t-test results of the pre-test and post-test performance of the students in the experimental group who were exposed to the Fraction Board.

The experimental group had a mean difference of 8.53 after subtracting the results of the post-test scores with the pre-test scores. The result implies that the students performed much better in the post-test considering the mean score of the post-test which was 20.53 compared to that pre-test which was only 12.

The result also reveals that there is significant difference between the pre-test and post-test performance of the experimental group since the p-value is lower than 0.05. Hence, the null hypothesis is rejected. The result would also mean that Fraction Board was effective in enriching the skills of the students in solving fundamental operations on fractions based on the significant increase of the scores. It helps students manipulate concrete materials in learning the concept which leads to meaningful learning. Repetition or drills using the board also helps in the improvement of their performance. This is supported by the Law of Exercise which states that the S-R connection is strengthened by use and is weakened with disuse.

TABLE 5. Difference Between the Pre-test and Post-test Results of the Experimental Group

Groups	Mean	SD	Mean Difference	Computed Value at 0.05 level of significance	p- Value	Decision	Interpretation
Pre-test	12.0	7.08	8.53	-6.24788	0.00002	Reject the null hypothesis	Significant
Post-test	20.53	5.29					

TABLE 6. Difference in the Post-test of the Control and Experimental Groups

Groups	Mean	SD	Mean Difference	Computed Value at 0.05 level of significance	P- Value	Decision	Interpretation
Control	15.0	5.33	5.53	-2.85335	0.00804	Reject the null hypothesis	Significant
Experimental	20.53	5.29					

Table 6 presents the difference between the post-test performance of the students in solving fundamental operations on fractions of the control and the experimental groups.

As the data show, the control group had a mean score of 15 while the experimental group had a mean score of 20.53. The standard deviations of the scores are 5.23 and 5.29 for both the control group and experimental group respectively. This shows that the mean scores of both control and experimental groups are heterogeneous.

The result yields a p-value of 0.00804 which is lower than 0.05. Hence, the null hypothesis is rejected which means that there is a significant difference between the post-test results of the control group from that of the experimental group. Both groups improved their performance in the post-test after they were exposed to the two different interventions given. However, the students in the experimental group who were exposed to the Fraction Board had a better performance considering the mean score of 20.53 than that of the control group with a mean score of 15.

These results led the researcher to the implication that Fraction Board could be a good alternative technique in enriching the skills of the students in solving fundamental operations on fractions. Furthermore, the students in the experimental group are exposed to a more motivated and engaging learning environment. Russo (2021) pointed out that mathematical games were highly effective in engaging students. In addition, Ke and Grabowski (2007) emphasized that cooperative game playing was the most effective for promoting positive math's attitude regardless of students' individual differences. These statements are also supported by Dale's Cone of Experience and Bruner's Theory of Intellectual Development which states that learning should involve concrete experiences rather than just feeding them with information. Moreover, the results also show the positive effect of using game in the learning process.

V. Conclusion

As shown in the findings, the researcher concluded that Fraction Board has a positive effect in enriching the skills of the students in solving fundamental operations on fractions. The students in the experimental group who were exposed to Fraction Board performed and learned better as compared to the control group who were exposed to modular learning. Engaging students with active learning techniques show the significant impact towards the students as they become self-reliant, flexible, responsible and accountable of their own learning.

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