

# Effect of Function Damath on the Skill of Evaluating Functions

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**Abstract**— This study aimed to determine the effect of Function Damath on the skill of evaluating functions. This study used the quasi-experimental design specifically the matching-only design. The 30 grade 8 students of Mahayag National High School, San Miguel Bohol during S.Y 2020-2021 currently residing at barangay Mahayag were the respondents of the study. They were divided into two groups: control and experimental group. The study was conducted through purok stations of barangay Mahayag to observe proper health protocol implemented by the province due to the pandemic. This study also sought to determine the pre-test and post-test performances of the students exposed to Function Damath and modular learning and the differences of their performances. The data gathered were treated using the t-test formula for dependent and independent samples. The difference between the pre-test of both groups is insignificant. The difference between the pre-test and post-test result of the control group is insignificant while significant for the experimental group. The difference between the post-test of both groups is significant. Therefore, the researcher recommended that the Function Damath may be utilized as an enrichment tool in learning how to evaluate functions. The procedures, content, and design of the tool are subject for further enhancement to address the needs and interest of the learners. Future researchers who intended to conduct study having similar concerns may refer to this study for further development of the tool.

**Keywords**— Function Damath: Skills on Evaluating Functions: Modules

## I. INTRODUCTION

The basic activities of counting, measuring, and characterizing item shapes gave rise to mathematics, the science of structure, order, and relation. Its development has involved an increasing degree of idealization and abstraction to its subject matter. Mathematics has developed far beyond basic counting. The greatest growth has occurred in civilizations that are sophisticated enough to support these activities, offer time for reflection, and allow mathematicians to build on the work of their predecessors.

The study focuses on the challenges encountered by Grade 8 students in mastering the skill of evaluating functions in Mathematics, an essential component for more advanced mathematical operations. Recognizing the importance of addressing this issue, the Department of Education (DepEd) has encouraged teachers to undertake action research and implement continuous improvement plans. In response, the researcher, in collaboration with a student from Mahayag National High School, developed Function Damath, a modified version of the popular Damath board game. Function

Damath is designed to specifically target the enhancement of students' understanding and proficiency in evaluating functions. By incorporating the process of substituting values into functions, the game aims to make learning more engaging and enjoyable for students while reinforcing critical thinking skills. Moreover, given the current limitations on face-to-face interactions due to the pandemic, Function Damath serves as a valuable tool for promoting independent learning and skill development among students.

The adaptation of the Damath board game into Function Damath represents an innovative approach to address the pressing issue of low proficiency in evaluating functions among Grade 8 students. Through this modification, the researchers aim to provide students with a dynamic and interactive learning experience that fosters not only mathematical skills but also strategic thinking and problem-solving abilities. By engaging students in a competitive yet educational game environment, Function Damath encourages active participation and deeper comprehension of mathematical concepts. Additionally, the game's format enables students to practice evaluating functions in a fun and accessible manner, facilitating continuous learning and skill refinement outside of traditional classroom settings. The study seeks to evaluate the impact of Function Damath on students' performance in evaluating functions, with the hope of contributing valuable insights to the improvement of mathematics education in the Philippines.

## II. LITERATURE REVIEW

The study draws upon Edgar Dale's Cone of Experience and Jerome Bruner's Theory of Intellectual Development to inform the creation and implementation of Function Damath, an educational board game aimed at enhancing students' skills in evaluating functions. Dale's Cone of Experience emphasizes the importance of hands-on experiences and active engagement in learning, asserting that learners retain more information through doing rather than simply hearing or observing. This theory underscores the significance of providing concrete experiences, particularly in mathematics education, to build a strong foundation for understanding abstract concepts (Lee et al., 2018; Davis et al., 2015). Bruner's Theory of Intellectual Development complements Dale's model by proposing that any subject, including mathematics, can be effectively taught in a developmentally appropriate manner. Bruner's Modes of Representational Thought suggest that learning progresses from enactive

(concrete experiences) to iconic (visual representations) to symbolic (abstract concepts), highlighting the importance of concrete experiences as a precursor to understanding abstract mathematical concepts (Cope, 2015; Cherry, 2020).

The convergence of Dale and Bruner's theories emphasizes the necessity of providing hands-on, experiential learning opportunities for students in mathematics education. This aligns with the shift towards student-centered learning environments, where learners are actively engaged in their own learning process. Moreover, legal frameworks such as the Philippine Innovation Act and the Enhanced Basic Education Act of 2013 underscore the importance of integrating innovative strategies to meet the evolving needs of learners and foster holistic development (Republic Act No. 11293; Republic Act No. 10533). The Code of Ethics of Professional Teachers further emphasizes the responsibility of educators to ensure optimal conditions for learner development and to address learning difficulties effectively (Republic Act No. 10533).

Educational games, such as Function Damath, emerge as effective tools for promoting mathematical learning and engagement among students. Research indicates that mathematical games encourage exploration, deepen mathematical understanding, and foster rich mathematical discussions (Rutherford, 2015; Russo, 2021). Studies also demonstrate the effectiveness of board games in developing mathematical thinking skills, reasoning abilities, and intrinsic motivation among students (Smith & Golding, 2018; Cramer, 2019; McFeeteters & Palfy, 2018). Function Damath, a modification of the popular Damath board game, focuses on algebraic functions, providing players with opportunities to manipulate functions and practice evaluating them. By integrating Function Damath into algebra instruction, the researcher aims to assess its impact on students' proficiency in evaluating functions and contribute to the enhancement of mathematics education.

Incorporating Function Damath into teaching practices aligns with the principles of active learning, experiential learning, and student-centered instruction advocated by educational theorists and supported by legal mandates. By providing students with hands-on experiences and opportunities for exploration, Function Damath aims to make algebraic concepts more accessible and engaging, ultimately fostering deeper understanding and mastery of mathematical skills. Through rigorous evaluation and assessment, the researcher seeks to contribute to the body of knowledge on effective instructional strategies in mathematics education and support the ongoing efforts to improve learning outcomes for students.

### III. RESEARCH METHODOLOGY

#### *Design*

This study employed the quasi-experimental design to determine if there is a significant difference in students' skill on evaluating functions on the used function damath and modules. This design made use of matching the scores of the respondents to form two groups. The participants were given a pretest as the basis of groupings. The participants were grouped into two (control and experimental), the experimentation and the posttest were administered.

#### *Respondents*

The study focused on thirty Grade 8 students from Barangay Mahayag, San Miguel Bohol, for the Academic Year 2020-2021, chosen due to their struggles with evaluating functions, a topic in Grade 8 Mathematics. Among the school's five Grade 8 sections, one was selected as it exclusively housed students from Barangay Mahayag, in line with pandemic safety measures. The participants were selected from the researcher's own school, where Mathematics performance was a focus of the Action Research initiative for the academic year. With parental consent obtained through orientation sessions, the study ensured voluntary participation without affecting students' grades.

#### *Environment*

The study was conducted at Mahayag National High School in Bohol, focusing on Grade 8 students residing in Barangay Mahayag. With a total population of 1180 students for the academic year 2020-2021, the school consists of 843 junior and 337 senior high school students distributed across thirty sections. The researcher selected thirty Grade 8 students from Barangay Mahayag, out of a total of forty, with the consent of their parents. This selection aimed to facilitate contact tracing and ensure adherence to health protocols amidst the pandemic. To ensure safety, the study was conducted in designated purok stations within Barangay Mahayag, specifically Purok 4, Purok 5, Purok 6, and Purok 7, with respondents scheduled according to approved numbers and protocols throughout the study period.

#### *Instrument*

The preparation and validation of the questionnaire used in the study involved several key steps. Initially, a table of specifications was constructed to guide the creation of the questionnaire, ensuring alignment with the curriculum guide provided by the Department of Education. Content validity was ensured by basing test items on specific competencies related to evaluating algebraic functions. A trial run of the test was conducted with Grade 9 students to identify any necessary revisions, followed by item analysis to determine the acceptability of each item. The test demonstrated high reliability, as indicated by a Kuder-Richardson value of 0.97. Additionally, a semi-detailed lesson plan was developed in accordance with Department of Education guidelines and evaluated by the Mathematics Coordinator for consistency and reliability. The Function Damath board game, designed to enhance students' skills in evaluating functions, was prepared based on the format of the original game and utilized as a concrete learning tool. Modules provided by the Department of Education were also used with modifications to suit the study's objectives.

### IV. RESULTS AND DISCUSSIONS

This presentation, analysis, and interpretation of the gathered data on evaluating functions of the Grade 8 students exposed to modular learning and the use of function damath.

Table 1 shows the profile of the pretest results of Grade 8 students in evaluating functions. It reveals that the highest percentage of the control and experimental group fall on below 75, described as did not meet expectations. The average

scores of both groups are the same that fall under “Did No Meet Expectations” category. Generally, both groups have similar pre-test performance. The respondents in each group were formed by pairing those students with the same or nearly the same pre-test scores.

The result of the two groups implies their performance in the pre-test is very low indicating that most of the respondents were not equipped on how to evaluate functions. It can also be proved that the two groups which were made after the pretest have comparable foundation in evaluating functions due to the matching of scores of students having nearly or the same scores.

Table 2 reveals the profile of the post-tests results of the respondents in evaluating functions. It shows that the highest percentage score of the control and experimental group falls under below seventy-five (75) described as did not meet expectations. The average score of the control group falls

under did not meet expectations while the average score experimental group falls under satisfactory.

These implied that the students from the experimental group learned better from the session conducted. The increase of their average score from seventy (70) under did not meet expectations to eighty (80) under satisfactory shows that the respondents’ performance had improved. Meanwhile, for the control group, the average score slightly increases from seventy (70) to seventy-two (72) but falls with the same category under did not meet expectations. The results showed that educational game greatly influence the students learning. A previous study conducted by Bernard (2015) stated that if game process is replaced with the educational game and the students understand the mathematical concepts in the game, they may be able to master mathematics and are motivated to learn.

TABLE 1. Pre-test Performance of the Control and Experimental Groups

Range	Description	Control Group		Experimental Group	
		Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)
90-100	Outstanding	1	7%	-	-
85-89	Very Satisfactory	2	13%	3	20%
80-84	Satisfactory	1	7%	-	-
75-79	Fairly Satisfactory	-	-	-	-
Below 75	Did Not Meet Expectations	11	73%	12	80%
<b>Average Score</b>		70		70	
<b>Description</b>		Did Not Meet Expectations		Did Not meet Expectations	

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

Range	Description	Control Group		Experimental Group	
		Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)
90-100	Outstanding	1	7%	3	20%
85-89	Very Satisfactory	-	-	2	13%
80-84	Satisfactory	3	20%	1	7%
75-79	Fairly Satisfactory	1	7%	3	20%
Below 75	Did Not Meet Expectations	10	66%	6	40%
<b>Average Score</b>		72		80	
<b>Description</b>		Did Not Meet Expectations		Satisfactory	

TABLE 3. Difference Between the Pre-test Results of the two Groups

Groups	Mean	SD	Mean Difference	Computed Value	P-Value	Interpretation	Decision
				At 0.05 level of significance			
Control	12.8	7.34	0.27	0.10	0.918	Insignificant	Accept the null hypothesis
Experimental	12.53	6.70					

As shown in Table 3, the mean scores in the control and experimental group are 12.8 and 12.53, respectively. The standard deviation of the control group has a value of 7.34 and 6.70 for the experimental group which means that the data in the control group is more spread than the experimental group. Their mean difference is 0.27 indicating that both groups have nearly similar mean with each other. The result means that there is no significant difference between the pre-test results of both groups because the P-value of 0.918 is greater than 0.05 level of significance and a computed t-value of 0.10. Thus, the

null hypothesis is accepted. This shows that the control and experimental groups have comparable performance in the pre-test. This is due to the exact grouping of which respondents were determined by matching those students with the same or 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 4. Difference Between the Pre-test and Post-test Results of the Control Group

Test	Mean	SD	Mean Difference	Computed Value	P-Value	Interpretation	Decision
				At 0.05 level of significance			
Pre-test	12.8	7.34	2.67	-1.29	0.2193	Insignificant	Accept the null hypothesis
Post-test	15.47	6.50					

Shown in Table 4 is the difference between the pre-test and post-test results of the control group. Standard deviation of the pre-test and post-test of the control group are 7.34 and 6.50 respectively which means that the data of the pre-test are more spread than the post-test. Post-test scores are more clustered towards the mean compared to the pre-test scores. The mean difference shown in the table is 2.67 which manifest that the post-test result was higher compared to the pre-test result. As manifested in the table, the P-value is 0.2193 which is greater than 0.05 level of significance and the computed t-value of 1.29 thus, the null hypothesis is accepted.

The result means that there is no significant difference between the pre-test and post-test of the control group. This signifies that the students' performance did not significantly enrich their skills on evaluating functions using modules. As stated in Edgar Dale's Cone of Experience (1969), more sense is needed in order to build up knowledge. Students are provided only with formulas and examples in the modules thus

only few senses are being utilized. In the study of Russo (2021), being highly effective in engaging students promotes rich mathematical discussions. Students need to be highly engaged utilizing more senses to increase learning and mastery, and to be motivated during the learning process.

The difference between the pre-test and post-test results of the experimental group is presented in table 5. The P-value is 0 which is less than 0.05 level of significance and the computed t-value of 4.61. This means that there is a significant difference in the performance of the experimental group in pre-test and post-test. Thus, the null hypothesis is rejected. This implies that using function damath is effective in enriching the skills on evaluating functions. It helps students manipulate concrete materials in learning the concept leading to meaningful learning. Comparing the increase in the pre-test to post-test between the experimental and control groups, it is the experimental group that did better in the post-test.

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

Test	Mean	SD	Mean Difference	Computed Value	P-Value	Interpretation	Decision
				At 0.05 level of significance			
Pre-test	12.53	6.70	7.94	-4.61	0	Significant	Reject the null hypothesis
Post-test	20.47	6.75					

TABLE 6. Difference Between the Post-tests Results of the two Groups

Groups	Mean	SD	Mean Difference	Computed Value	P-Value	Interpretation	Decision
				At 0.05 level of significance			
Control	15.47	6.50	5	-2.07	0.0481	Significant	Reject the null hypothesis
Experimental	20.47	6.75					

The difference between the post-test results of the two groups is presented in table 6. The mean of the scores in the control group is 15.47 while that of the experimental group is 20.47. The standard deviation shows a value of 6.50 for the control group and 6.75 for the experimental group. It shows that there is a significant difference between the post-test result of both groups. The P-value 0.0481 is less than 0.05 level of significance and the computed t-value is 2.07. Thus, the null hypothesis is rejected. It can be deduced that there is a significant difference between the performance of those who were subjected to modular learning and those who were subjected to function damath. The mean difference between the post-test results of the two groups is 5. It proves that the experimental group performed better than the controlled group and the use of function damath is more effective than the use of modules as an enrichment tool.

The result implies that function damath could be a good alternative method in enhancing the skills on evaluating function. The positive effect of using the game was shown in the improvement of the performance of the learners on evaluating functions through the post-test. Function damath is proven effective in this study that it helped learners increase their skills on evaluating functions. As the students like game environment more than the typical class environment, they enjoy it more and consequently they have better learning and higher academic performance (Chizary et al., 2017). A study conducted by Bernard (2015) states that someone prefers to play until they understand and if the students understand the

mathematical concepts in the game, they are motivated and may develop mastery in any mathematical concepts. As a result, the creation of math-related instructional games might alter students' perceptions of mathematics as an enjoyable subject with principles that are clear, appealing, and inspiring to study.

Thus, students in the experimental group are more engaged and motivated than the students in the control group. It is supported by Dale's cone of experience and Bruner's Theory of Intellectual learning that emphasize the importance of learners' opportunities to work with concrete forms of concepts before they expect the learners to analyze the abstract forms of the concepts.

V. CONCLUSION

Function Damath is effective in enriching the skill on evaluating functions of the students. Students significantly perform better using function damath compared to the use of modules and the positive effects of function damath attributed to the fact that students understand concepts better if more senses are being utilized in the process and that they are motivated in game environment rather than typical class environment.

Suggestions

Based on the conclusions drawn from the study, the researchers formulated the following recommendations:

1. School administrators may encourage Math teachers in their respective school areas to use Function Damath in enriching the skills on evaluating functions of students.
2. Math supervisors may include in the seminars for Math teachers the topic on how to integrate function damath as an enrichment activity.
3. Math club advisers may use Function Damath in conducting remedial tutorial or review classes in enriching the skills on evaluating functions and recommend it to students who are having difficulty on this topic.
4. Other researchers may replicate this study sample conducting more exposure, using more items in tests to provide additional data with regards to the effect of Function Damath. The researcher also recommended other researchers to conduct the post-test with enough long-time intervals after the last experiment sessions to determine the effect of Function Damath as retention aid. And conduct enhancement of this tool and assess results.

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