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Research Article

Enhancement of the Performance of Junior High School Students using Numeracy Mobile Game on Operations of Integers

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ABSTRACT

This study aimed to evaluate and validate the developed numeracy mobile game to help improve the performance of junior high school students on the operations of integers in a public national high school in Antipolo City, the Philippines. The researcher used experimental and descriptive research designs in the study. The sources of data in this research were eighty (80) JHS students, twenty (20) from each grade level, from Old Boso-Boso National High School. Other respondents were the forty (40) teacher respondents consisting of twenty (20) experts and twenty (20) math teachers from Schools Division of Antipolo. The statistical tools used in this study were the frequency, percentage, weighted mean, independent-samples t-test, and paired t-test. It was revealed that there was no significant difference between the evaluations of the two groups of respondents on the developed numeracy mobile game in operations of integers in terms of game mechanics, visual aesthetic design, narrative design, incentive system, musical scores, and content and skills. It is recommended that the user interface of the game needs some enhancements like the controls for arrows up and down and improve the tutorial part before starting the real game or at the start of every level.

Keywords: *Academic performance, numeracy skills, mobile games*

Background

Education is continuously evolving as it also adapts to the changing world. Efforts are made to ensure the attainment of the goal of education. However, there are different challenges in delivering quality education. As a response, information and communication technologies (ICTs) are considered. It paves the way for the utilization of new tools and devices as a medium of instruction, both for learners and teachers. The mobile device is one example. The number of mobile phones surpassed the population of the planet in 2018. They have become our tools in social life, work, and leisure (Garcia et al., 2020). As the digital age arises, learners and educators are engaged

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with their mobile devices as their source not only of entertainment but for instructional purposes, too. As mobile devices become more affordable, sustainable, and accessible, they have become a personal environment for people in the 21st century. They provide excellent educational opportunities to students from all socioeconomic backgrounds (Jin & Sabio 2018). As cited by Jinot (2019), mobile learning is advanced as learning content is delivered through mobile devices, allowing for communication and collaboration among learners and between learners and teachers (Parajuli, 2016). Besides, with learner-generated content, including social media, mobile game-based learning (gamification), and augmented reality, learners may connect, communicate, collaborate, and create new enriching learning experiences through situational instruction.

Plass et al. (2015) proposed in their study, Foundation of Game-Based Learning, a simplified model of game-based learning and have emphasized that one of the unique characteristics of games is that game designers are solely concerned with the quality of the learning experience and that, in part because of this concern, digital games are able to engage learners on an affective, behavioral, cognitive, and sociocultural level in ways that few other learning environments can. The design elements used in games for learning were described to elicit this engagement. These include the game mechanics, visually aesthetic design, narrative design, incentive system, musical scores, and content and skills. Game-Based Learning Theory addresses game design aspects as ways to achieve learner engagement based on known cognitive, affective, motivational, and sociocultural underpinnings that might contribute to a more systematic approach to conceptualizing and building games.

As the challenges in education continue, particularly in different disciplines like mathematics, concerns should be addressed. Mathematics, the discipline of structure, order, and relationship, has evolved from the elemental practices of counting, measuring, and describing the shapes of objects. It deals with logical reasoning and numerical calculations, and its evolution has included a growing degree of idealization and conceptualization of its subject matter. (Berggren et al., 2019). Teaching and learning mathematics is a major concern in any educational system. Various researchers make large efforts to find out the causes of students' poor performance in the subject. Despite every one of these endeavors, the issues still endure. (Guinocor et al., 2020).

The Philippines entered the Programme for International Student Assessment (PISA) of the Organization for Economic Co-operation and Development (OECD) in 2018, as part of the Quality Basic Education reform project and a step toward globalizing the quality of Philippine basic education. The results revealed that the Philippines scored 353 in mathematics, significantly lower than the OECD average (489 points) and classified as below Level 1 proficiency. At Level 1, students can answer questions involving familiar contexts where all the relevant information is present. (PISA National Report of the Philippines, 2018).

In the researcher's school, Old Boso-Boso National High School, numeracy tests were conducted through DD cards involving integers. The result showed that students have difficulty with integers and are labeled non-numerates. In Grade 7, it's 22%, Grade 8 is 20%, Grade 9 is 17%, and Grade 10 has 16%. (School-Based Management Report Card, 2019).

One of the competencies that need attention in mathematics is the fundamentals, like operating on integers. Difficulties in solving basic operations involving directed numbers or integers have been widely documented worldwide, especially in addition and subtraction (Khalid & Embong, 2019).

It is revealed that learners' understanding of negative numbers and identifying difficulties and concepts related to them is part of identifying problems with negative numbers. Even though teachers had discussed the counting operation procedure of integers, there was concept confusion among students. (Fuadiah et al., 2016). In response to this issue, teachers should provide motivation, intervention, and enhancement to help the students cope with their difficulties operating integers.

As a teacher, the researcher comes upon developing a numeric mobile game for the operations of integers. This is anchored in TPACK. The technology integration framework identifies three types of knowledge instructors need to combine for successful educational technology integration—technological, pedagogical, and content knowledge (Rogers, 2019). Technological tools (hardware, software, applications, associated information literacy practices, etc.) are best used to teach and guide students toward a better, more vigorous understanding of the subject matter (Kurt, 2019).

It also upholds the K-12 curriculum features stated in DepEd Order No. 21, series of 2019, known as Policy Guidelines on K to 12 Basic Education Program. As one of the provisions, the K to 12 graduates must possess 21st-century skills, including information, media, and technology. It deals with different sub-skills such as visual and information literacy, media literacy, and basic, scientific, economic, and technological literacy. These skills allow learners to navigate the fluid and active knowledge creation and acquisition environment. These skills are rooted in subjects such as mathematics. The Math Curriculum Guide also cites in its conceptual framework that appropriate tools are necessary for teaching mathematics. These include manipulative objects, measuring devices, calculators, computers, smartphones and tablet PCs, and the Internet.

Thus, this study's objective is to develop a numeracy mobile game. It will help the learners and the teachers deal with the concepts of the operations of integers.

Statement of the Problem

This study aimed to evaluate and validate the developed numeracy mobile game for the enhancement of the performance of junior high school students on the operations of integers at Old Boso-Boso National High School during the school year 2021 – 2022.

Specifically, it sought answers to the following questions:

1. What was the evaluation of the Math experts and the Math teacher respondents on the developed numeracy mobile game on operations of integers in terms of the following criteria?
   a. Game Mechanics
   b. Visual Aesthetic Design
   c. Narrative Design
   d. Incentive System
   e. Musical Scores
   f. Content and Skills
2. Was there a significant difference between the evaluations of the two groups of respondents on the developed numeracy mobile game on operations of integers according to the given criteria?
3. What was the performance of the JHS students during the pretest and posttest on operations of integers?
4. Was there a significant difference between the pretest and posttest mean scores of the JHS students?
5. What were the feedbacks of the JHS student participants after playing of numeracy mobile game on operations of integers?
6. What were the comments and suggestions of the respondents to improve the numeracy mobile game on operations of integers?

Significance of the Study

This study seeks to develop educational material in the form of a Numeric Mobile Game in the operations of integers to enhance the performance of grade 7 to 10 students. This study is significant since it provides insight into the following:

Students. For they will benefit the most from the study's findings, which will aid in their knowledge of the operation of integers. As a result, it can help students understand the concepts more completely and apply them in their daily lives.

Teachers. This study may serve as their guide in the teaching operation of integers. The result of the study could certainly make their task easier in preparing enhancement materials for their students. They would realize that they can make materials that will help their students, especially those who have trouble with integers, understand their lessons better.

School Administration. The study's findings may help to improve administrative skills and make them more effective. It may guide others to increase their performance, especially those students with low performance in Mathematics, for the school and its stakeholders. It will serve as baseline data to improve programs for school advancement.

Future Researchers. The results of this study can be used as a basis for more research on how to teach and learn math and how well students do in math, especially with operations on integers.

Scope and Delimitations of the Study

This study focused on the evaluation and validation of the developed numeracy mobile game for the enhancement of the performance of junior high school students on operations of integers at Old Boso-Boso National High School during the school year 2021 – 2022.

The respondents of the study were the 20 Mathematics teachers and 20 mathematics experts from selected secondary schools in the Division of Antipolo with master teacher positions and department head/chair who are knowledgeable and experts in terms of instructional leadership.

Related Literature

In a published journal by the International Electronic Journal of Mathematics Education (2018), as per Etcuban (2013), teachers lead all educational institutions. They instruct and cultivate the brains of students. Gioia and Proserpio (2007) emphasized that teachers are accountable for recognizing the needs, interests, and talents of their pupils to prepare efficiently and intelligently for these demands.

As Dio explained as cited by Satiada (2020), seconded, an appropriate selection of instructional media with due consideration of students' schema could help facilitate effective teaching based on the learning objectives.

According to Adeoye and Arome (2020), the influence of digital technology in society has made it critical for all students in the 21st century to become literate using digital tools. The application of instructional technology will positively impact the given environment to satisfy the learners' needs.

Herold (2016) stated that technology is everywhere in education. But a significant body of research has also made clear that most teachers have been slow to transform their teaching methods, despite the influx of new technology into their classrooms. As teachers, it is a call to adjust to the new technology in the classrooms.

As posted in the Philippine Journal of Science (2018), de las Peñas et al. (2019) stated technology has turned out to be important – if not necessary – part of the mathematics classroom, not only because it improves learning but also because the ability to use technological tools is an essential skill in today's world. The Philippine K to 12 mathematics curriculum framework acknowledges that "appropriate tools are needed in teaching mathematics." These include manipulative objects, measuring devices, calculators, computers, smartphones and tablet PCs (personal computers), and the internet (DepEd 2012).

For Schwabe (2020), mobile technologies offer the opportunity to embed learning in a natural environment. Currently, there are increasing efforts to apply mobile technology to learning.

According to Rondina and Roble (2019), teaching mathematics is a practice where the teachers support the learner in developing thinking. Instructional games may assist in the process because they encourage discussion among the players. Also, each member can request the required mathematics concepts needed for the game. The students were motivated to join in the game and were able to apply the mathematics concepts required to play.

Khateeb (2019), averred that mobile gaming allows students to look at things in new ways. Games can accomplish this without relying on details or extensive explanations to get the learner's mental distribution started. Learning through mobile gaming is greater than learning from books. It is more effective in conveying the information because it fills the gap between the student and the academic subject. In addition, the learners' enthusiasm for playing games on their mobile phones is evident. They diligently utilize their available time playing and due to this fact, employing a pool of mobile games that include mathematical concepts may lead to providing these concepts to students. In addition, it is stated that it is essential to build a visually appealing and technologically advanced mobile method that encourages teaching mathematical concepts to students.

Related Studies.

A study was done by Cepe (2017) on the Development and Validation of Strategic Intervention Materials on Integers for Grade 7 Mathematics which focused on integers. This study utilized both experimental and descriptive methods of research. The result revealed that the student respondents' academic performances were improved, and the teacher respondents evaluated the developed SIM as very evident in terms of the indicators for guide card, activity card, assessment card, enrichment card and reference card.

The reviewed research is related to the present study because of the content about integers. Also, the current study is noteworthy because it utilized both experimental and descriptive methods. However, it differs from the previous research because it deals only with grade 7 students, while the latter deals with grade 7 to 10 students.

Tumaque (2018) conducted a study on "Utilization and Evaluation of Electronic Daily Drill Card for Non-Numerate Grade 8 Students". This study looked at whether the use of the electronic daily drill card by grade 8 students at San Jose National High School, who were non-numerates, helped them learn more about integers. The descriptive-evaluative method was utilized by the researcher in the evaluation of multimedia instructional materials. On the other hand, experimental method was used for pretest and posttest of controlled and experimental group. The controlled group used the traditional way of daily drill through pen and paper while the experimental group used the developed Electronic Daily Drill Card for Non-Numerate. The result revealed that there was a significant difference between the posttest of the controlled and experimental group. Thus, the developed Electronic Daily Drill Card for Non-Numerate is more effective in learning more about integers.

The study of Tumaque is somewhat similar in dealing with the non-numerates in terms of the operations on integers. Furthermore, both studies utilized the descriptive method of research. They differ, however, in the materials used. The reviewed study utilized the Electronic Daily Drill Card while the present study used the Numeracy Mobile Game. In addition, they also differ in the locale; one was in San Jose National High School, and the other was in Old Boso-Boso National High School.

The study of Bungay (2020) aimed to determine the effectiveness of ICT-based instructional materials for grade 10 at San Roque National High School. Mathematics teachers and experts evaluated the developed ICT-based instructional material according to the following criteria: content, organization and presentation, language and style, modifiability, and user-friendliness. The study used the experimental research method utilizing two-group pretest-posttest design to determine the effectiveness of the developed ICT-based Instructional Material in teaching Mathematics 10. The statistical tools used to treat the data were the weighted mean, independent t test and paired t test. The result presented that there was a significant difference in the pretest and posttest mean score of the participants from control and experimental group. It was concluded that the used of ICT-based instructional material improved the level of performance of Grade 10 learners in Mathematics.

Taroy's (2017) study attempted to determine the effectiveness of utilizing GeoGebra Graphing Calculator Mobile Application in selected topics of Grade 8 Mathematics as a teaching strategy. The bases of data of this study were 50 Grade 8 students handled by the researcher during second quarter of school year 2016 – 2017 at Mambugan National High School. It utilized the experimental method of research. The instruments used in this study were pretest, posttest, survey questionnaires and the GeoGebra Graphing Calculator Mobile Application for Activity-Based Learning Mathematics in teaching Mathematics 8. The following statistical treatments were utilized: Frequency, Ranking, Weighted Mean, Pearson Product-Moment Correlation Coefficient, Paired t Test and Independent t Test. The findings revealed that GeoGebra Graphing Calculator Mobile Application was effective as evidenced from the results of the posttest of the two groups and also from the results of the pretest and posttest of the experimental group. In addition, the perception of the respondents about GeoGebra Graphing Calculator Mobile

Application are functional, easy to use, available, accessible, and relevant for Activity-Based Learning Materials.

Conceptual Model of the Study

The researcher used the system approach, which consists of three elements: the input, the process, and the output.

Figure 1 shows the conceptual model for the validation of the developed Numeracy Mobile Game in the operation of integers.

The input frame includes the Foundations of Game-Based Learning, the TPACK Framework, the developed Numeracy Mobile Game, survey questionnaires for evaluation; math teachers and expert respondents for evaluation; Grade 7-10 students; and the pretest and posttest.

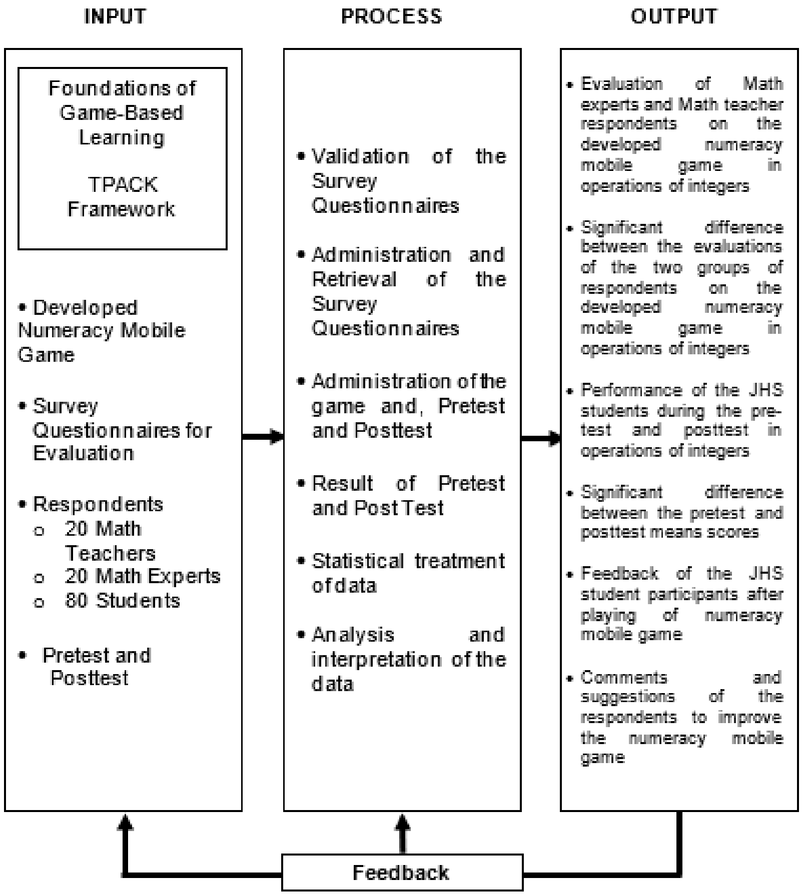

Figure 1. Conceptual Model for the Validation of the Developed Numeracy Mobile Game in Operations of Integers

The process includes content validation of the survey questionnaires, administration, and retrieval of the survey questionnaires, result of the pretest and posttest statistical treatment of the data analysis, and interpretation of the data.

The output shows the evaluation of math experts and math teacher respondents on the developed numeracy mobile game in operations of integers; a significant difference between the evaluations of the two groups of respondents on the developed numeracy mobile game in operations of integers; performance of the JHS students during the pretest and posttest in operations of integers; significant difference between the pretest and posttest mean scores; feedbacks of the JHS student participants after playing the numeracy mobile game; and comments and suggestions of the respondents to improve the numeracy mobile game.

Research Hypotheses

The hypotheses tested in this study were:

1. There is no significant difference between the evaluations of the two groups of respondents on the developed numeracy mobile game in operations of integers.
2. There is no significant difference between the pretest and posttest mean scores of the JHS students.

Research Design

Methods

This study utilized the descriptive method of research. In addition, the study also used the experimental method of research. Based on Bairagi et al. (2019), it is performing any type of experiment that tends to infer or come up with something innovative. One of the designs of the experimental method is the pretest and posttest only, without the control group, where the experimentation group is selected and was only taken for action. Then the outcome of the treatment is measured based on the difference on the performance before and after the action has been taken. This was used in this study to compare how well junior high school students did on a test before and after they learned how to work with integers.

Sources of Data

The research sources of the data were twenty (20) math experts and twenty (20) junior high school mathematics teachers. The respondents were selected based on purposive sampling. In a study conducted by Crossman (2020), a purposive sample was a non-probability sample that was chosen based on the characteristics of a population and the objective of the study. It was also known as judgmental, selective, or subjective sampling. Researchers use purposive sampling when they want to interview a particular subset of people, as all study participants are selected because they fit a specific profile (Foley, 2018). The respondents were mathematics experts, mathematics department heads and master teachers, math teachers who were knowledgeable in evaluating instructional materials and developing curriculum, and grammar experts.

Table 1. Presents the distribution of the teacher respondents in the study.

Respondents	Frequency	Percentage
Math Teachers	20	50%
Math Experts	20	50%
Total	40	100.00

Table 1 shows that there were twenty (20) Mathematics experts and twenty (20) Mathematics teachers from selected secondary schools in the Division of Antipolo City, with a total of forty (40) respondents to the study. They evaluated the developed Numeracy Mobile Game through a survey questionnaire.

There were 20 students selected in each grade level at Old Boso-Boso National High School based on their scores in the pretest given. Table 2 shows the distribution of student participants from Grade 7 to 10.

Table 2. Distribution of the student participants

Participants	Frequency	Percentage
Grade 7	20	25%
Grade 8	20	25%
Grade 9	20	25%
Grade 10	20	25%
Total	80	100%

Table 2 presents the distribution of the students' participants which composed of 25% or 20 students per grade level with a total of eighty (80) students.

Data Gathering Instruments

In this study, the main tools used to collect data were the pre-test, the posttest, survey questionnaire, and the developed Numeracy Mobile Game in the operation of integers. The questionnaire was for the evaluation of the developed Numeracy Mobile Game in the operation of integers as to the following criteria: game mechanics, visual aesthetic design, narrative design, incentive system, musical scores, content, and skills.

The instrument underwent validation among experts that included a Master Teacher, a research coordinator, a psychologist, and an Information Technology expert. After confirmation, the materials were presented to the researcher's adviser, master teachers, and mathematics teachers from other schools for recommendations and suggestions

Data Gathering Procedure

Permission to conduct the study was first secured by the researcher from the Schools Division Superintendent of Antipolo to allow her to administer the questionnaires to the teachers and experts.

Following the development of the Numeracy Mobile Game in the operation of integers, the evaluation by the two groups of respondents—experts and teachers was done. The questionnaires for the evaluation were filled out by the respondents and were retrieved by the researcher via Google Forms.

The researcher used pretest, posttest, and the developed numeracy mobile game. Students were given a 40-item test before and after playing the game. The posttest is the same as the given 40-item pretest.

The researcher administered the instrument via Google Forms to the respondents. Then, after taking the test, the results were automatically retrieved and tallied through Google Forms for statistical treatment of the gathered data.

Statistical Treatment of Data

The statistical tools that were used to treat the data in this study are as follows:

Weighted Mean. This was used to determine the respondents' evaluations of the developed numeracy mobile game in operations of integers in terms of game mechanics, visual aesthetic design, narrative design, incentive system, musical scores, and content and skills. Table 3 shows the descriptive value of a 4-point scale to interpret the weighted mean scores of the respondents.

Table 3. Scale, range and verbal interpretation

Scale	Range	Verbal interpretation
4	3.50-4.00	Strongly Agree (SA)
3	2.50-3.49	Agree (A)
2	1.50-2.49	Disagree (D)
1	1.00-1.49	Strongly Disagree (SD)

Frequency, Percentage and Mean. This was applied to get the level of students' performance in pretest and posttest.

Table 4 presents the score points and descriptors of the students' performances in pretest and posttest.

Table 4. Scope and descriptors for the performance of the student participants

Scores	Descriptors
36-40	Highly Proficient
30-35	Proficient
20-29	Nearly Proficient
10-19	Low Proficient
0-9	Not Proficient

Independent-Samples t Test. This was used to determine if there is a significant difference between the evaluations of the two groups of respondents on the developed numeracy mobile game in operations of integers.

Paired t test. This was used to examine if there is a significant difference between the mean scores of the pretest and the posttest of Junior High School Students in operations of integers.

Results and Discussion

Evaluation of Math Experts and Math Teacher Respondents on the Developed Numeracy Mobile Game in Operations of Integers

Tables 5 to 10 show the evaluation of the math teachers and expert teacher respondents on the developed numeracy mobile game in operations of integers as regards to game mechanics, visual aesthetic, narrative design, incentive system, musical scores, content, and skills.

Game Mechanics. Table 5 presents the two groups of respondents' evaluations of the developed Numeracy Mobile Game in Operations of Integers about game mechanics.

It can be observed in Table 5 that both the math teachers and expert respondents Strongly Agree (SA) on the game mechanics of the developed Numeracy Mobile Game in Operations of Integers, as shown by the overall weighted mean of both 3.82, and standard deviation of 0.24 and 0.33, respectively.

It means that the game mechanics of the Numeracy Mobile Game in Operations of Integers are clear and easy to understand, support the objective of the game, and provide significant learning. It also engages the players in the game and provides immediate feedback. It also gives the player the ability to collaborate and interact with other players.

Table 5. Respondents' Evaluations on the developed numeracy mobile game in operations of integers as regards game mechanics

No	Indicator	Respondents			
		Teachers		Experts	
		WM	VI	WM	VI
1	It is clear and easy to understand	3.75	SA	3.85	SA
2	It support the goal of the game	3.85	SA	3.85	SA
3	It gives significant learning in the game	3.90	SA	3.80	SA
4	It engages the players in the game	3.80	SA	3.90	SA
5	It provides immediate feedback to players	3.70	SA	3.80	SA
6	It give excitement to the game	3.80	SA	3.85	SA
7	It motivates the players to continue playing	3.80	SA	3.85	SA
8	Players are given opportunities to interact to others	3.95	SA	3.70	SA
9	It allow the player to collaborate with other players	3.80	SA	3.80	SA
	Overall Weighted Mean	3.82	SA	3.82	SA
	Standard Deviation	0.24		0.33	

Legend: WM-Weighted Mean VI-Verbal Interpretation SA-Strongly Agree

According to Plass et al. (2015), game mechanics define the basic game play. Because of this, game mechanics determine the overall direction of the game as well as the manner in which learning will happen.

Visual Aesthetic Design. Table 6 reveals the evaluation of math teachers and experts on the developed Numeracy Mobile Game in Operations of Integers regarding visual aesthetic design.

It can be seen in Table 6 that the math teachers and expert respondents **Strongly Agree (SA)** on the visual aesthetic design of the developed Numeracy Mobile Game, as indicated by the overall weighted mean ratings of 3.76 and 3.82, and standard deviation of 0.32 and 0.29, respectively.

Table 6. Respondents' Evaluations on the developed numeracy mobile game in operations of integers as regards visual aesthetic design

No	Indicator	Respondents			
		Teachers		Experts	
		WM	VI	WM	VI
1	The characters show the personalities needed in the game.	3.75	SA	3.80	SA
2	Images of the characters are well-designed.	3.75	SA	3.85	SA
3	Players can connect to the characters.	3.90	SA	3.85	SA
4	Characters are simple.	3.75	SA	3.75	SA
5	The setting of the game captivates the attention of the player.	3.75	SA	3.75	SA
6	The setting of each stage shows the difficulty of the level	3.65	SA	3.90	SA
7	Colors, props, and other tools included are appropriated in the game	3.70	SA	3.75	SA
8	The theme of the game gives the player an exciting ambiance	3.80	SA	3.85	SA
9	The theme of the game allows the players to be reminded of the different cultural backgrounds	3.75	SA	3.85	SA
	Overall Weighted Mean	3.76	SA	3.82	SA
	Standard Deviation	0.32		0.29	

It means that the visual aesthetic design of the Numeracy Mobile Game on Operations of Integers possesses the needed elements like the characters, images, settings, props, themes, and background. It helps the player to enhance their learning and playing experience.

It is supported by the study of Godfrey, et al. (2018) that visual aesthetic design can be used to stimulate the interest of students in learning numeracy skills.

Narrative Design. Table 7 displays the evaluation of math teachers and experts on the developed Numeracy Mobile Game in Operations of Integers as regards narrative design.

Table 7. Respondents' evaluations on the developed numeracy mobile game in operations of integers as regard narrative design

No	Indicator	Respondents			
		Teachers		Experts	
		WM	VI	WM	VI
1	The storyline is well presented.	3.80	SA	3.85	SA
2	Dialogues are constructed properly.	3.80	SA	3.85	SA
3	It connects other game elements to each other.	3.75	SA	3.90	SA
4	It provides a motivational function that makes the Player continue or return the game.	3.80	SA	3.85	SA
5	The story gives a historical vibe.	3.79	SA	3.95	SA
	Overall Weighted Mean	3.79	SA	3.88	SA
	Standard Deviation	0.37		0.23	

Table 7 reveals that both respondents Strongly Agree (SA) on the narrative design as shown in the overall weighted mean ratings of 3.79 and 3.88, and standard deviation of 0.37 and 0.23, respectively.

The findings above show that the Numeracy Mobile Game in Operations of Integers provides an acceptable narrative design that includes a well-presented storyline and dialogue, and how it connects and provides motivational function to the players.

Incentive System. Table 8 presents the evaluation of math teachers and experts on the developed Numeracy Mobile Game in Operations of Integers as regards incentive system.

It is shown in Table 8 that the math teachers and experts **Strongly Agree (SA)** on the incentive system of the developed Numeracy Mobile Game in Operations of Integers as shown in the overall weighted mean ratings of 3.80 and 3.79, and standard deviation of 0.33 and 0.32, respectively.

Table 8. Respondent' Evaluations on the developed numeracy Mobile game in operations of integers as regards incentive system

No	Indicator	Respondents			
		Teachers		Experts	
		WM	VI	WM	VI
1	Scores are presented properly.	3.75	SA	3.85	SA
2	Players are encouraged to continue.	3.80	SA	3.70	SA
3	Point system serves as feedback in attaining the goal	3.90	SA	3.85	SA
4	Reward and special abilities are present	3.75	SA	3.75	SA
	Overall Weighted Mean	3.80	SA	3.79	SA
	Standard Deviation	0.33		0.32	

This means that the incentive system of the developed Numeracy Mobile Game in Operations of Integers includes the scores and feedback, as well as the rewards and special abilities that are present in the game.

This was supported by Homer et al. (2015) as stated by Zittah et al. (2018), that the incentive system of a game seeks to promote players to continue their efforts and feedback to learn.

Musical Scores. Table 9 presents the evaluation of math teachers and experts on the developed Numeracy Mobile Game in Operations of Integers as regards Musical Scores.

Table 9. Respondent' Evaluations on the developed numeracy Mobile game in operations of integers as regards musical scores

No	Indicator	Respondents			
		Teachers		Experts	
		WM	VI	WM	VI
1	Background sounds are present	3.90	SA	3.90	SA
2	Music and sounds are appropriate to the events that are happening	3.80	SA	3.85	SA
3	It adds to the excitement to the game	3.85	SA	3.80	SA
4	It stirs up the emotions of the players	3.75	SA	3.75	SA
	Overall Weighted Mean	3.83	SA	3.83	SA
	Standard Deviation	0.34		0.33	

It is revealed in Table 9 that the math teachers and experts **Strongly Agree (SA)** on the musical scores of the developed Numeracy Mobile Game in Operations of Integers, as shown in the overall weighted mean rating of 3.83 and standard deviation of 0.34 and 0.33.

It can be inferred that on the musical score on the developed Numeracy Mobile Game offers the background sounds and music that aid in stirring the emotions and excitement of the players.

Content and Skills. Table 10 depicts the evaluation of math teachers and experts on the developed Numeracy Mobile Game in Operations of Integers as regards content and skills.

It can be observed in Table 10 that both the math teachers and experts responded **Strongly Agree (SA)** on the content and skills of the developed Numeracy Mobile Game in Operations of Integers as shown by the overall weighted mean of 3.87 and 3.78, and standard deviation of 0.29 and 0.33, respectively.

This means that the contents and skills in the Numeracy Mobile Game in Operations of Integers are given and included in the game. Contents and skills are aligned in the objectives, enhances the players performance in operations of integers and allows the players to think critically and collaborate to others.

Table 10. Respondent' Evaluations on the developed numeracy mobile game in operations of integers as regards content and skills

No	Indicator	Respondents			
		Teachers		Experts	
		WM	VI	WM	VI
1	The objective are suited to the content of the game	3.90	SA	3.90	SA
2	The game can enhance players' skills in performing operations on integers	3.90	SA	3.80	SA
3	The contents are well illustrated	3.85	SA	3.85	SA
4	The content used is challenging	3.85	SA	3.75	SA
5	The procedures aid in understanding the lesson	3.80	SA	3.75	SA
6	The game guides students to formulated the concept	3.95	SA	3.65	SA
7	The game guides students to think critically	3.90	SA	3.75	SA
8	The player's previous learning can be used in the game	3.90	SA	3.75	SA
9	Players can share their learnings	3.85	SA	3.70	SA
10	The content of the game gives opportunities to the players to collaborated with other players	3.85	SA	3.85	SA
11	The skills that the player learn can be used to latter learning activities	3.85	SA	3.80	SA
12	The content can cause the players to show emotions	3.80	SA	3.80	SA
	Overall Weighted Mean	3.87	SA	3.78	SA
	Standard Deviation	0.29		0.33	

This supports the study of Navalta (2020) that contents and skills must be comprehensible, topics should be aligned with the Department of Education standard, content must be presented logically and orderly sequence, content should motivate the students to synthesize the concepts, and exercises should be thought provoking leading to measure the mastery of students.

Summary. Table 11 presents the summary of the evaluation of the two groups of respondents on the developed Numeracy Mobile Game in Operations of Integers regarding its game mechanics, visual aesthetic design, narrative design, incentive system, musical scores, content, and skills.

Table 11. Summary of respondents' evaluations on the developed numeracy mobile game in operations of integers

	Criteria	Respondents			
		Teachers		Experts	
		OWM	VI	OWM	VI
a	Game mechanic	3.82	SA	3.82	SA
b	Visual aesthetic design	3.76	SA	3.82	SA
c	Narrative design	3.79	SA	3.88	SA
d	Incentive system	3.80	SA	3.79	SA
e	Musical scores	3.83	SA	3.83	SA
f	Content and skills	3.87	SA	3.78	SA
	Overall Weighted Mean	3.81	SA	3.82	SA

Note: OWM- Overall Weight Mean

As reflected in Table 11, the two groups of respondents had particularly similar evaluations of the developed Numeracy Mobile Game in Operations of Integers regarding its game mechanics, visual aesthetic design, narrative design, incentive system, musical scores, content, and skills, as revealed by the grand weighted mean ratings of 3.81 and 3.82, respectively. This shows that the respondents strongly agree with all its criteria and indicators.

Test of Significant Difference between the Evaluations of the Two Groups of Respondents on the Developed Numeracy Mobile Game in Operations of Integers

The statistical data results of the difference between the evaluations of the math experts and teacher respondents on the developed Numeracy Mobile Game in Operations of Integers are shown in Tables 12 to 17 and the summary in Table 18.

Table 12 reveals the test of significant difference in the evaluation of the two groups of respondents on the developed Numeracy Mobile Game in Operations of Integers as to game mechanics.

Table 12. Test of significant different in the evaluation of the two groups of respondents on the developed numeracy mobile game in operations of integers as to game mechanics

Respondents	n	OWM	s	Computed t value	Critical t value	Decision	Interpretation
Teachers	20	3.82	0.24	0.06	2.02	Fail to reject the H_0	Not significant
Experts	20	3.82	0.33				

Note: n - sample size Level of Significance, α=5% H_0-Null Hypothesis
s - standard deviation Degrees of freedom, df = 38

At the 5% significance level with 38 degrees of freedom, the critical t value is 2.02, and the computed t value is 0.06 as displayed in Table 12. As the computed t value is lower than the critical t value, the statistical decision is to fail to reject the null hypothesis. Hence, there is no significant difference between the evaluations of the two groups of respondents on the developed Numeracy Mobile Game in Operations of Integers in terms of game mechanics. It implies that they both strongly agreed that it has well-structured game mechanics.

Table 13 shows the test of significant difference in the evaluation of the two groups of respondents on the developed Numeracy Mobile Game in Operations of Integers as to visual aesthetic design.

Tabel 13. Test of significant different in the evaluation of the two groups of respondents on the developed numeracy mobile game in operations of integers as to visual aesthetic design

Respondents	n	OWM	s	Computed t value	Critical t value	Decision	Interpretation
Teachers	20	3.76	0.32	0.63	2.02	Fail to reject the H_0	Not significant
Experts	20	3.82	0.33				

Table 13 depicted that the computed t value of 0.63 is less than the critical t value of 2.02. At a 5% significance level, this means that the null hypothesis cannot be rejected. This indicates that there is no significant difference between the evaluations of the two groups of respondents on the developed Numeracy Mobile Game in Operations of Integers in terms of visual aesthetic design. It means that they both strongly agreed that the visual aesthetic design elements, such as characters, images, settings, props, themes, and backgrounds, are presented well.

Table 14 shows the test of significant difference in the evaluation of the two groups of respondents on the developed Numeracy Mobile Game in Operations of Integers as to narrative design.

Table 14. Test of significant different in the evaluation of the two groups of respondents on the developed numeracy mobile game in operations of integers as to narrative design

Respondents	n	OWM	s	Computed t value	Critical t value	Decision	Interpretation
Teachers	20	3.79	0.37	0.93	2.02	Fail to reject the H_0	Not significant
Experts	20	3.88	0.23				

As shown in Table 14, the computed t value of 0.93 is below the critical t value of 2.02. At 5% significance level, the statistical decision is to fail to reject the null hypothesis. As a result, there is no significant difference between the evaluations of the two groups of respondents on the developed Numeracy Mobile Game in Operations of Integers in terms of narrative design. It indicates that they both concur that the narrative design, which includes storyline and dialogue, is constructed properly.

Table 15 presents the test of significant difference in the evaluation of the two groups of respondents on the developed Numeracy Mobile Game in Operations of Integers as to incentive system.

Table 15. Test of significant different in the evaluation of the two groups of respondents on the developed numeracy mobile game in operations of integers as to incentive system

Respondents	n	OWM	s	Computed t value	Critical t value	Decision	Interpretation
Teachers	20	3.80	0.33	0.12	2.02	Fail to reject the H_0	Not significant
Experts	20	3.79	0.32				

It can be seen in Table 15 that the computed t value of 0.12 is smaller than the critical t value of 2.02. Therefore, the statistical decision is not to reject the null hypothesis at the 5% level of significance. This suggests that there is no significant difference between the evaluations of the two groups of respondents on the developed Numeracy Mobile Game in Operations of Integers in terms of incentive system. Hence, they both strongly agreed that the incentive system provides feedback and motivation to players.

Table 16 shows the test of significant difference in the evaluation of the two groups of respondents on the developed Numeracy Mobile Game in Operations of Integers as to musical scores.

Table 16. Test of significant different in the evaluation of the two groups of respondents on the developed numeracy mobile game in operations of integers as to musical scores

Respondents	n	OWM	s	Computed t value	Critical t value	Decision	Interpretation
Teachers	20	3.83	0.34	0.00	2.02	Fail to reject the H_0	Not significant
Experts	20	3.83	0.33				

As shown in Table 16, the computed t value of 0.00 is less than the critical t value of 2.02. At the 5% significance level, this leads that the null hypothesis cannot be rejected. Hence, there is no significant difference between the evaluations of the two groups of respondents on the developed Numeracy Mobile Game in Operations of Integers in terms of musical scores. It implies that they have the same view that the musical score plays an important role in the game.

Table 17 depicts the test of significant difference in the evaluation of the two groups of respondents on the developed Numeracy Mobile Game in Operations of Integers as to content and skills.

Table 17. Test of significant different in the evaluation of the two groups of respondents on the developed numeracy mobile game in operations of integers as to content and skills

Respondents	n	OWM	s	Computed t value	Critical t value	Decision	Interpretation
Teachers	20	3.87	0.29	0.89	2.02	Fail to reject the H_0	Not significant
Experts	20	3.78	0.33				

Table 17 exhibited that the computed t value of 0.89 is lower than the critical t value of 2.02. Thus, the statistical decision is not to reject the null hypothesis. At a 5% level of significance, this indicates that there is no significant difference between the evaluations of the two groups of respondents on the developed Numeracy Mobile Game in Operations of Integers in terms of content and skills. Therefore, the respondents strongly agreed that the game encapsulates the needed content and skills in operations of integers.

Table 18 illustrates the summary of the test of significant difference in the evaluation of the two groups of respondents on the developed Numeracy Mobile Game in Operations of Integers.

As gleaned in Table 18, the evaluations of teachers and the expert respondents on the developed Numeracy Mobile Game in Operations of Integers regarding game mechanics, visual aesthetic design, narrative design, incentive system, musical scores, and content and skills do not indicate significant differences as presented in the respective computed t values, which are below the critical t value. This concludes that the respondents' evaluations are similar.

Table 18. Summary of the test of significant difference in the evaluation of the two groups of respondents on the developed numeracy mobile game in operations of integers

		Teachers		MT's		$t_{computed}$ value	Decision	Interpretation
		OWM	s	OWM	s			
a	Game mechanics	3.82	0.24	3.82	0.33	0.06	Fail to Reject the H_0	Not Significant

		Teachers		MT's		$t_{computed}$ value	Decision	Interpretation
		OWM	s	OWM	s			
B	Visual aesthetic design	3.76	0.32	3.82	0.29	0.63	Fail to Reject the H_0	Not Significant
c	Narrative design	3.79	0.37	3.88	0.23	0.93	Fail to Reject the H_0	Not Significant
d	Incentive system	3.80	0.33	3.79	0.32	0.12	Fail to Reject the H_0	Not Significant
e	Musical scores	3.83	0.34	3.83	0.33	0.00	Fail to Reject the H_0	Not Significant
f	Content and skills	3.87	0.29	3.78	0.33	0.89	Fail to Reject the H_0	Not Significant

Note: α = 5% df = 38 Critical t value = 2.02

It implies that the two groups of respondents strongly agreed that the Numeracy Mobile Game in Operations of Integers has very acceptable criteria and indicators that are needed for a numeracy mobile game that will enhance the performance of junior high school students in operations of integers.

Performance of the Junior High School Students during the Pretest and Posttest in Operations of Integers

Tables 19 to 22 exhibit the level of performance of the junior high school students based on the pretest and posttest in Operations of Integers.

Table 19 shows the performance of the Grade 7 students in the pretest and posttest in Operations of Integers.

Table 19. Performance of grade 7 students in the pretest and posttest in operations of integers

Score	Description	Grade 10 performance			
		Before		After	
		Frequency	Percentage	Frequency	Percentage
36-40	Highly Proficient	0	0	2	10
30-35	Proficient	0	0	5	25
20-29	Nearly proficient	11	55	13	65
10-19	Low proficient	5	25	0	0
0-9	Not proficient	4	20	0	0
	Total	20	100	20	100
	Mean	18.15		27.80	
	Standard Deviation	5.08		5.25	
	interpretation	Low Proficient		Nearly Proficient	

As depicted in Table 19, 55% or 11 Grade 7 students got a score under the nearly proficient, 5 or 25% on low proficient, and 20% or 4 on Not Proficient in the pretest. On the posttest, 2 or 10% of the Grade 7 students got a score under Highly Proficient, 5 or 25% under Proficient, and 13 or 65% under Nearly Proficient.

This means that there is an improvement in the performance of Grade 7 students after using the developed Numeracy Mobile Game.

Table 20 presents the performance of the Grade 8 students in the pretest and posttest in Operations of Integers.

Table 20. Performance of thegrade 8 students in the pretest and posttest in operations of integers

Score	Description	Grade 8 performance			
		Before		After	
		Frequency	Percentage	Frequency	Percentage
36-40	Highly Proficient	0	0	2	10
30-35	Proficient	0	0	4	20
20-29	Nearly proficient	9	45	12	60
10-19	Low proficient	8	40	2	10
0-9	Not proficient	3	15	0	0
	Total	20	100	20	100
	Mean	17.25		26.45	
	Standard Deviation	7.39		6.17	
	interpretation	Low Proficient		Nearly Proficient	

It is illustrated in Table 20, in pretest, 9 or 45% of Grade 8 students got a score under the Nearly Proficient, 8 or 40% on Low Proficient, and 15% or 3 on Not Proficient. When posttest was administered, 2 or 10% of the Grade 8 students got a score under Highly Proficient, 4 or 20% under Proficient, 12 or 65% under Nearly Proficient, and 2 or 10% under Low Proficient. This implies that the performance of Grade 8 students improved after utilizing the developed Numeracy Mobile Game in Operations of Integers.

Table 21 depicts the performance of the Grade 9 students in the pretest and posttest in Operations of Integers.

Table 21. Performance of grade 9 students in the pretest and posttest in operations of integers

Score	Description	Grade 9 performance			
		Before		After	
		Frequency	Percentage	Frequency	Percentage
36-40	Highly Proficient	0	0	1	5
30-35	Proficient	2	10	8	40
20-29	Nearly proficient	3	15	10	50
10-19	Low proficient	15	75	1	5
0-9	Not proficient	0	0	0	0
	Total	20	100	20	100
	Mean	17.90		28.15	
	Standard Deviation	5.90		6.05	
	interpretation	Low Proficient		Nearly Proficient	

As gleaned in Table 21, 2 or 10% of Grade 9 students had a proficient score, 3 or 15% had a Nearly Proficient score, and 15 or 75% had a Low Proficient score in the pretest. For the scores of the posttest, 1 or 5% got a Highly Proficient, 8 or 40% got a Proficient, 10 or 50% got Nearly Proficient, and 1 or 5% got a Low Proficient. It can be inferred that the performance of Grade 9 students increased after utilizing the developed Numeracy Mobile Game in Operations of Integers. Table 22 shows the performance of the Grade 10 students in the pretest and posttest in Operations of Integers.

Table 22. Performance of grade 10 students in the pretest and posttest in operations of integers

Score	Description	Grade 10 performance			
		Before		After	
		Frequency	Percentage	Frequency	Percentage
36-40	Highly Proficient	0	0	2	10
30-35	Proficient	3	15	10	50
20-29	Nearly proficient	5	25	8	40
10-19	Low proficient	12	60	1	5
0-9	Not proficient	0	0	0	0
	Total	20	100	20	100
	Mean	19.65		29.85	
	Standard Deviation	6.89		5.26	
	interpretation	Low Proficient		Nearly Proficient	

As shown in Table 22, 3 or 15% Grade 10 students got a score under Proficient, 5 or 25% on Nearly Proficient, and 12 or 60% on Low Proficient in the pretest. In the posttest, 2 or 10% of the Grade 10 students got a score under Highly Proficient, 10 or 50% under Proficient, and 8 or 40% under Nearly Proficient.

This means that the performance of Grade 10 students got better after using the developed Numeracy Mobile Game in Operations of Integers.

Table 23. Summary of performance of the junior high school students in the pretest and posttest in operations of integers

Year level	test	Mean score	Standard deviation	Interpretation
Grade 7	Pretest	18.15	5.08	Low proficient
	Posttest	27.80	5.25	Nearly Proficient
Grade 8	Pretest	17.25	7.39	Low Proficient
	Posttest	26.45	6.17	Nearly Proficient
Grade 9	Pretest	17.90	5.90	Low Proficient
	Posttest	28.15	6.05	Nearly Proficient
Grade 10	Pretest	19.65	6.89	Nearly Proficient
	Posttest	29.85	5.26	Proficient

Table 23 presents the summary of performance of the Junior High School students in the pretest and posttest in operations of integers.

As shown in the table, Grade 7 students gained a mean score of 18. 15 in the pretest and 27. 80 in the posttest, with 5.08 and 5. 25 as the standard deviation, and verbally interpreted as Low Proficient and Nearly Proficient, respectively. Grade 8 students earned a mean score of 17. 25 in the pretest and 26. 45 in the posttest, with 7.39 and 6.17 as the standard deviation, and verbally interpreted as Low Proficient and Nearly Proficient, respectively. Grade 9 students earned a mean score of 17. 90 in the pretest and 28.15 in the posttest, with 5.90 and 6.05 as the standard deviation, and verbally interpreted as Low Proficient and Nearly Proficient, respectively. Grade 10 students got a mean score of 19. 65 in the pretest and 29.85 in the posttest, with 6.89 and 5.26 as the standard deviation, and verbally interpreted as Nearly Proficient and Proficient, respectively.

Test of Significant Difference between the Pretest and Posttest Mean Scores of the Junior High School Students

The statistical data results of the difference between the pretest and posttest mean scores of the junior high school students in operations of integers are shown in Tables 24 to 27 and the summary in Table 28.

Table 24. Test of significant difference between the pretest and posttest mean scores of grade 7 students

	n	OWM	s	Computed t value	Critical t value	Decision	Interpretation
Pretest	20	18.15	5.08	9.64	2.09	Reject the H_0	Significant
Posttest	20	27.8	5.25				

Note: Significant level α= 5% Degrees of freedom, df = 19

Table 25. Test of significant difference between the pretest and posttest mean scores of grade 8 students

	n	OWM	s	Computed t value	Critical t value	Decision	Interpretation
Pretest	20	17.25	7.39	15.90	2.09	Reject the H_0	Significant
Posttest	20	26.45	6.17				

Table 24 shows the test of significant difference between the pretest and posttest mean scores of Grade 7 students

It can be checked in Table 24 that the computed t value of 9.64 is greater than the critical t value of 2.09 with 19 degrees of freedom. Thus, this led to the rejection of the null hypothesis. At the 5% level of significance, this shows that there is a significant difference between the pretest and posttest mean scores of the grade 7 students. This means that there is an improvement in the performance of Grade 7 students after using the developed Numeracy Mobile Game.

Table 25 reveals the test of significant difference between the pretest and posttest mean scores of Grade 8 students.

As reflected in Table 25, the computed t value of 15.90 is higher than the critical t value of 2.09. At a 5% significance level, this indicates that the null hypothesis can be rejected. Therefore, there is a significant difference between the pretest and posttest mean scores of the grade 8 students.

This entails that the performance of Grade 8 students increased after utilizing the developed Numeracy Mobile Game in Operations of Integers.

Table 26 presents the test of significant difference between the pretest and posttest mean scores of Grade 9 students.

Table 26. Test of significant different between the pretest and posttest mean scores of grade 9 students

	n	OWM	s	Computed t value	Critical t value	Decision	Interpretation
Pretest	20	17.90	5.90	17. 28	2.09	Reject the H_0	Significant
Posttest	20	28.15	6.05				

Based on Table 26, the computed t value of 17.28 is above the critical t value of 2.09. So, at a 5% significance level, the statistical decision is to reject the null hypothesis. This shows that there is a significant difference between the pretest and posttest mean scores of the grade 9 students. This implies that the performance of Grade 9 students improved after using the developed Numeracy Mobile Game in Operations of Integers.

Table 27 depicts the test of significant difference between the pretest and posttest mean scores of Grade 10 students.

Table 27. Test of significant different between the pretest and posttest mean scores of grade 10 students

	n	OWM	s	Computed t value	Critical t value	Decision	Interpretation
Pretest	20	19.65	6.89	16.17	2.09	Reject the H_0	Significant
Posttest	20	29.85	5.26				

As is apparent from Table 27, the computed t value of 16.17 is more than the critical t value of 2.09. This leads to the statistical decision to reject the null hypothesis at the 5% significance level. Consequently, there is a significant difference between the pretest and posttest mean scores of the grade 10 students. This means that the performance of Grade 10 students got better after using the developed Numeracy Mobile Game in Operations of Integers.

Table 28 presents the summary of the test of significant difference in the evaluation of the two groups of respondents on the developed Numeracy Mobile Game on Operations of Integers. It is directed in Table 28 that the pretest and posttest mean scores of junior high school students indicate significant differences, as shown by the corresponding computed t values, which are above the critical t value. Therefore, the posttest mean scores are higher than the pretest means scores of the students.

Table 28. Summary of the test significant difference in the evaluation of the two groups of respondents on the developed numeracy mobile game on operations of integers

Year level	Pretest		Posttest		$t_{computed}$ value	decision	interpretation
	Mean	s	Mean	s			
Grade 7	18.15	5.08	27.80	5.25	9.64	Reject the H_0	Significant
Grade 8	17.25	7.39	26.45	6.17	15.90	Reject the H_0	Significant
Grade 9	17.90	5.90	28.15	6.05	17.28	Reject the H_0	Significant
Grade 10	19.65	6.89	29.85	5.26	16.17	Reject the H_0	Significant

It concludes that the Numeracy Mobile Game in Operations of Integers can enhance the performance of junior high school students in performing operations of integers.

This is aligned to the study of Satiada (2020) that using a Proballader computer game can improve students' learning and assist students to understand mathematics as an interesting and useful subject. Every student can be provided with another opportunity to learn and make use of other methods.

Feedback of the Junior High School Student Participants after Playing of Numeracy Mobile Game in Operations of Integers

The comments and suggestions of the JHS students after playing the Numeracy Mobile Game in Operations of Integers were as follows: a) It is an excellent game to enhance and refresh our minds pertaining to integers; b) The game was so good. It was made for students to help them enhance their knowledge and skills; c) This isn't your average game. It's a learning experience; d) The game is enjoyable; You will continue playing because you will learn a lot and it is fun; and e) It is challenging, and there are some things to improve, like the time limit and controls.

Comments and Suggestions of the Respondents to Improve the Numeracy Mobile Game in Operations of Integers

The comments and suggestions of the two groups of respondents to improve the numeracy mobile game in Operations of Integers were as follows:

Comments:

a) The game is fun and enjoyable; b) It is an engaging and exciting way of presenting the content and skills on signed numbers; c) The game is creative and useful, particularly at this time; d) It motivates students to master the skills of performing integer operations; and e) Students will enjoy playing while learning.

Suggestions:

a) The user interface of the game might require some improvements, such as the controls for the up and down arrows; b) Enhance the tutorial section before starting the actual game or at the beginning of each level; c) The aesthetics of the game could use some improvement; d) It would be more interesting if players received an item for every level they completed; and e) Add more character customization possibilities.

Conclusion

Based on the results of the study, the following conclusion was derived:

1. Numeracy Mobile Game in Operations of Integers was highly acceptable to experts and math teachers.
2. Utilizing Numeracy Mobile Game in Operations of Integers in Old Boso-Boso National High School enhanced the performance of the JHS students on operation of integers.

Recommendation

Based on the findings and conclusions drawn, the following are recommended:

1. The utilization of Numeracy Mobile Game in the operation of integers is recommended to increase students' performance.
2. Other schools from the City Schools Division of Antipolo are encouraged to use and develop other digital learning materials in teaching.
3. Teachers and future researchers are advised to conduct parallel studies in other subject areas and modify the game-based learning materials according to the needs of the students.
4. Teachers and future researchers are encouraged to enhance the Numeracy Mobile Game.
5. Teachers and future researchers are encouraged to attend seminars and training on the development of game-based learning materials.

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