Global Scientific JOURNALS

GSJ: Volume 12, Issue 11, November 2024, Online: ISSN 2320-9186
www.globalscientificjournal.com

DEVELOPMENT OF ALTERNATIVE INSTRUCTIONAL MATERIALS IN MATHEMATICS 10

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Key Words
Content, Development, Instructional Materials, Mathematics, Relevance, Timeliness, User-friendly

ABSTRACT

The study was conducted to determine the effectiveness of the developed alternative instructional material in Mathematics 10 in Janosa National High School during the school year 2021-2022.

The study utilized a one-group pretest-posttest research design which utilized a researcher-made questionnaire checklist to see the validity of the developed instructional material and a pretest and posttest to identify the effectiveness of the developed alternative instructional material. The instructional material covered the Least Mastered Skills of the third grading period namely: identifying permutations and combinations, deriving formulas for the permutations and combinations, differentiating permutations and combinations, and solving problems regarding permutations and combinations.

Thirty (30) IT experts and Mathematics Teachers were selected using random sampling from the Division of Rizal to evaluate the developed alternative instructional material in Mathematics 10 which was found to be Very Much Acceptable in terms of Content, User-friendly, Relevance, Timeliness, and Appropriateness.

Furthermore, the developed alternative instructional material in Mathematics 10 was utilized by the 47 learners from the pilot section to determine its effects on the teaching and learning process, using researcher-made pretest and posttest, and it came out to be Outstanding.

MAIN PAPER STARTS HERE...

Chapter 1
THE PROBLEM AND ITS BACKGROUND

This chapter deals with the introduction, background of the study, statement of the problem, hypothesis, scope and limitation of the study, theoretical and conceptual frameworks, and definitions of terms.

Introduction

Education has a crucial part in attaining success. Considering the current COVID19 Pandemic situation, the quality of education is being challenged more importantly to those who utilized distance learning particularly Modular Distance Learning (MDL). Teaching Mathematics with this setup is more challenging than having the learners in the four corners of the classroom. Given that, the subject itself requires the teacher's guidance to fully understand the concept of every topic. With this, teacher should be flexible enough to achieve learning so that no students would be left behind.

The job of an educator is to give quality education to the learners. Learning shouldn't be limited and dependent into the provided modules. It is now time to think out of the box and develop new instructional materials that will be helpful and interesting on the part of both leaners and teachers. With this, the researcher aimed to help in making new instructional materials that will be useful and is based on:

Republic Act No. 10533, Section 5e which states that:

The curriculum shall use pedagogical approaches that are constructivist, inquiry-based, reflective, collaborative, and integrative.

DepEd Memorandum No. 130, series of 2018, section 2.1 states that:

Capacitate educators for effective application of technology in teaching content and pedagogy.

As seen in section 5e, the curriculum implementers are tasked to have different strategies that the learners may benefit. Applying different teaching approaches is a must to be able to come up with positive feedback from the learners. Considering this new set of strategies, the researcher's focus is on the developing an application that can be used as an instructional material in teaching Mathematics for grade 10.

Meanwhile, in the DepEd Memorandum No. 130, series of 2018, section 2.1 there is the realization that the Department is doing their part in pushing the teachers to utilize technology in teaching through series of trainings. In this view, it can be said that applying technology in educating the learners plays vital role in achieving learning goals. Just like the current manuscript, the researcher aimed to apply new instructional materials to catch the interest of the 21st century learners and eventually motivate them and develop good study habits.

It is mentioned in the work of Zhang (2012) that traditional education better suits the problems including Mathematics. For graph related concepts, computer-assisted hybrid teaching proves more effective. In terms of different student characteristics, computer-assisted hybrid education benefits medium and low-performing students the most. Traditional education better suits high-achieving students.

This signifies that to enhance students' performance and to raise the quality in teaching mathematics, teachers must utilize different learning strategies that will suit the learners knowing that their characteristics, interests, and behavior may differ from time to time.

In addition to this, many researchers who have attempted mathematics teaching have demonstrated that their games can improve performance, enjoyment, and self-efficacy. Many students lack confidence in their ability to learn mathematics, which may drive them to abandon their efforts to learn more mathematics. Game-Based Learning (GBL) has recently gained popularity as technique in boosting students' self-esteem. The study found that low ability pupils in collaborative condition improved their calculation abilities in the greatest according to Ku et al. (2014).

This clearly emphasized that game-based learning is one big help in boosting not only students' confidence but also their interests in the subject. Improving the students' performance in mathematics would be impossible if the learner themselves is not interested in the subject that is why educators should put extra effort to overcoming the said problem.

The researcher saw how the teachers in Mathematics suffered from lock of interest to the subject because of their mentality that Math is a difficult subject. It is hard to gain the attention and interest of the learners who prefer to have technology-oriented classroom set up since they are used to having mobile phones. With this scenario, the researcher wanted to help her colleagues by developing new set of instructional materials that will help them in the classroom.

In order to attain the quality education, which is relevant nowadays, one must put effort in discovering possible tool to reach this goal. Helping learners to have interests in the subject which is the job of a teacher. Thus, it is indeed in the hand of educators to have quality education.

Teachers will be more effective in terms of teaching and students would be more interested and confident in the subject/s that may lead them to produce more responsible people in the society.

Background of the Study

The diversity of learners and change in the curriculum setup are considered challenges in teaching Mathematics. It is an eye opener seeing the report from PISA 2018 International (OECD 2019) that the Filipino students achieved the average of 353 points which is lower than the Economic Co-operation and Development average which is 489 points, and it is classified as lower than Level 1 proficiency. With this, it is clearly stated that Filipino students need help to achieve at least level 1 proficiency in Mathematics. This is also a turning point for Mathematics teachers to improve their techniques, discover new strategies and offer unique way of teaching in which it will suit the level of all the students.

Teachers must offer well - developed learning activities and relative experiences that are aligned with the learning competencies of students. It is a call to have new sets of instructional materials that will cater the demands of the education and the learners. Remember that education is a tool to achieve success.

Janosa National High School, at Talim Island in Binangonan, Rizal conducted an assessment to rank the subjects with the use of students grades for the first quarter. In the said assessment, Mathematics got the lowest rank in grade 10 with 81.83 average and school level with an average of 80.18 in Junior High School. Considering the average grades of the pilot section of grade 10, Mathematics still on the last rank with 88.00 average. With this, the researcher will try to develop a new set of classroom strategies and unique techniques that will try to cover the problem in that particular situation. It will also be a big help to the educators in the higher level if the students are well equipped in the subject since it is also a hindrance when a learner locks at a competency knowing that the K-12 Curriculum utilizes spiral progression of learning.

Modular Distance Learning really challenged the intellectual ability of the learners. It was proven that even pilot section finds it difficult to understand and answer their module not to mention that there are some factors affecting their study habits. This is the primary reason why the researcher conducted the study, to help the learners to be back on tract, to be motivated and interested in the subject.

According to Paun 2015, Math is primarily a competition with yourself to discover the science's roots. Teaching Mathematics is difficult because to make these roots understandable, we must return to make beginnings when mathematics and art are one. An old story, a work of art, and some music will assist the students in gasping some tough mathematical concepts.

The researcher developed an alternative instructional material that will help them in attaining the learning objective. It is envisioned

to provide a new learning resource that can be used in a classroom, and which will catch the attention of the learners. The developed application will test their knowledge and solving skills.

In the event of the Covid19 Pandemic, most of the learners utilized modular distance learning to continue their studies. The students of Janosa NHS really found it difficult in learning under the said modality. Even the pilot section strived hard to find resources to understand fully the lessons in the given module since all the topics are discussed with very limited examples. That there are students who have internet connections and can afford to buy loads to have data to search for additional information regarding the topics. This is the primary reason why the researcher developed an off-line mobile phone application with a minimal memory capacity to make it gadget friendly. The said mobile application will serve as new learning resource for the learners.

Scope and Limitation of the Study

This study aimed to determine the effectiveness of the developed alternative instructional material in Mathematics 10 for the school year 2021-2022.

The Instructional Material covered the teaching-learning process in Mathematics in the pilot section of grade 10 learners. The following topics/competencies are indicated in the developed application: Identify, derive formula, differentiate and solve problems on permutations and combinations.

These competencies were selected from the least mastered skills of the learners based on their performance in mathematics in the third quarter of the school year 2019-2020.

The subjects of the study were the 47 learners who belong to pilot section of the Janosa National High School. They were chosen to be the first one to utilize the instructional material developed by the researcher.

The researcher used pre-test and posttest which undergo certain content validity. It was composed of 10 items per topic. The pre-test served as their diagnostic test for the third quarter, while the posttest was given after the utilization of the developed instructional material.

Statement of the Problem

The study aimed to develop and determine the acceptability and effectiveness of Alternative Instructional Material in Mathematics 10.

Specifically, it sought the answers to the following questions:

1. How is the Alternative Instructional Material in Mathematics 10 developed?
2. What is the level of acceptability of the developed instructional material with respect to the following criteria:
2.1. content;
2.2. user-friendly;
2.3. relevance;
2.4. timeliness; and
2.5. appropriateness?
3. What is the level of performance of the Grade 10 Learners before and after exposure to the instructional material with respect to the following competencies:
3.1. identify permutations and combination;
3.2. derive formula for permutations and combination;
3.3. differentiate permutations and combinations; and
3.4. solve problems regarding permutations and combination?
4. Is there a significant difference in the level of performance of the Grade 10 learners before and after exposure to the instructional material with respect to the above-cited competencies?
5. What is the level of effectiveness of the developed alternative instructional material as revealed by the test results before and after utilization?
6. What are the experiences of the learners in the utilization of the developed alternative instructional material in Mathematics 10?

Hypothesis

The study tested the null hypothesis that there is no significant difference in the level of performance of the Grade 10 learners before and after exposure to the developed instructional material.

Theoretical Framework

The study was based on the theory of Game-Based Learning (GBL). According to Pho (2015), game-based learning (GBL) is the process of taking specific game principles and applying them to real-world situations in order to engage people. The motivating psychology involved in game-based learning isn't just about making games for students to play; it is also about establishing learning activities that may gradually introduce concepts and lead users to a desired outcome. Competition, points, rewards, and feedback loops can all be incorporated into traditional games. As a technique to engage students in studying, these notions have grown increasingly popular in higher education and libraries.

The Game-Based Learning Theory is in line with the study since it points to incorporating games as an instructional material in teaching to have a meaningful learning. This explains how games will help the teaching-learning process be more lively, effective, and goal-oriented. Also, this includes how a learner actively participated in the lesson whether giving incentives and additional points

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or simply making it as competition which learners nowadays easily cope.

With diversified learners today, they learn in several ways. With this thinking, GBL learning suits the needs of the present learners. The teachers must know the common grounds of their students so that they will be able to produce a way of learning that is an eye-catch to the learners so, they will participate actively. The researcher believed that this theory really shows what is needed. Incorporating mobile games as an instructional material might be a tool in achieving the necessary learning outcomes. With this masterpiece, the GBL was tested and proven.

The masterpiece of Duchesne et. al., 2014 states that behaviorism is a theory that sees learning as a cause-and-effect process in which external events induce a reaction, which then becomes a learned behavior over time.

One of the most essential parts of being an educator is that you understand the behavior of your students. How do they react on a certain thing? How will you catch their attention? What do they want? What do they dislike? These are some questions that we teachers try to answer during the teaching -learning process. We should learn how learners behave from one thing to another so that we can summarize it and create a new style of teaching.

Knowing the behavior of students isn't easy and according to Duchesne, it is a cause-and-effect mechanism. We must give them proper example so that it will give a positive impact on them. In this study, the researcher tried to identify the interest of the students and combine it with the chosen competencies to create an activity that will suite the learners in that way those mathematically challenged students will give their attention to the subject and provide the necessary outcomes.

The two cited theories are related to the development of the instructional material of the researcher. This instructional material will apply the concept of GBL which is putting a game principle to a learning setup that will eventually lead into real-life situations which is more important in the current situations. Behaviorism theory is also related to the study since in the game, the way how the students will react to it will be considered. Knowing most of the students are showing low interest in modular distance learning, the researcher aimed to improve their behavior towards learning Mathematics with the help of the developed instructional material. Furthermore, both theories focused on helping the students in any way possible for them to be more lively, and active in terms of studying.

Conceptual Framework

The figure on the next page is a researcher-made conceptual model used in the study. Thus, the model shows the steps made by the researcher to come up with an output.

The first box is the identification of the least mastered kills since such served as the guideline in making the pretest and posttest and the instructional material itself. Then, the construction of pretest and posttest and questionnaire checklist. At the same time, designing, and preparation of the instructional material.

The pretest and posttest were validated by the mathematics teachers to test its reliability. In terms of instructional material development, the researcher sought support from an information technology expert to prepare the mobile application.

After the conceptualization of pretest, posttest, and instructional material, the study underwent data gathering procedure. First step was the administration of the pretest, followed by the utilization of the instructional material and the administration of posttest. At the same time, the questionnaire checklist was administered simultaneously to the mathematics experts and end-users. Such

was followed by the analysis of data at the statistical center and interpretation by the researcher. Lastly, the finalization of the developed, modified, and improved instructional material.

Figure 1
Conceptual Model for the developed Alternative Instructional
Material in Mathematics 10

Definition of Terms

In order to have clear understanding on this study the following terms are conceptually and operationally defined:

Appropriateness. According to Cambridge Dictionary, 2015, this means the quality of being suitable or right for a particular situation or occasion.

Behaviorism. According to Oxford Languages, 2020, this is a theory that human behavior can explained in terms of conditioning, without appeal to thoughts or feelings, and that psychological disorders are best treated by altering behavior patterns.

Content. According to Merriam Webster, 2015, this means something contained.

Instructional Material. It is software designed to increase motivation to learning by adding games rules and/or competition to learning activities. They are also a Learning tool used during teaching and learning.

Relevance. This means the quality or state of being, closely connected or relevant to oneself. To measure if something is relevant one

must consider all aspects of evaluation.
Timeliness. This is with accordance with the current situation. This can be measured as the time between information is expected and when it is readily available.
User-Friendly. This refers when a device or something can be used quickly or deal with even it is new to someone.

Chapter 2
REVIEW OF RELATED LITERATURE AND STUDIES

This chapter presents the foreign literature, local literature, foreign studies, and local studies relevant to the study.

Variables

The following are the variables that are found to have bearing on the conduct of the study such as content, user-friendly, relevance, timeliness, and appropriateness. These chosen variables led the research to better outcome since they served as guide in understanding the results provided.

These literatures and studies are helpful in providing justifications on the outturn of the study. Having relevant and clearly stated studies will give the readers benefits for a smooth understanding of the research.

Literatures

The following are the variables of the study with reviewed literature both local and foreign.

Content

In the writing of Habgood and Ainsworth (2013), the core of the user engagement that digital games produced is the idea of intrinsic motivation. However, despite this, educational software has historically tried to use games as an external motivator by employing them as a gloss over academic material. In order to improve the interaction between educational games' learning material and game play, this article explores the idea of intrinsic integration. According to the findings, kids spent seven times, more time playing the intrinsic version of the game during free time as they did during set time constraints. Together, these studies provide proof of the intrinsic approach's real worth in producing successful educational games. These discoveries' theoretical and business ramifications are examined.

Conforming to the statement of Yeh et al. (2019), most math courses in Taiwan still mostly use traditional teacher-led instruction. This paper explains how they created Math-Island, a game-based learning environment, by incorporating the controls of a knowledge map game of construction management. In this experiment, students were instructed to use their own tablets to learn with Math-Island in addition to teacher-led instruction in the classroom. As a result, it was discovered that children are performing better in math, particularly when it comes to calculations and word problems. Students in the experimental school who struggled in word problems performed better than their counterparts in the control school. Additionally, in the experimental school, both the high achievers and the poor achievers retained a fairly high level of interest in mathematics and the system.

The cited studies of Habgood and Ainsworth and Yeh et al. are related to the current study since both of them are focused and gave importance to the main content of instructional material developed. It can be reflected in the studies that one of the most important aspects of developing game-based instructional material is assuring that the content suites the learners or the target users.

User-friendly

The developed game of Muntean et al., (2019) which is Count With Me! is described in this research-to-practice essay, an innovative and engaging computer-based instructional game that teaches counting fundamentals. The impact of the game on information acquisition and learning is examined and discussed in the study. The case study involved 24 first-year undergraduate students. Before and after the students engaged in the instructional game, knowledge tests were given. Although the high school students had already studied the areas of addition, multiplication, factorial, and permutation, the results of the pre-test revealed that certain students had trouble with such subjects. Analysis of the post-test data revealed statistically substantial knowledge gains and high levels of student interest in both the game and the concepts being studied.

As been mentioned from the essay of Muntean, having useful and user-friendly concept of a game-based instructional material is important in achieving learning goals just like the current research which is focused in developing user-friendly games so that it will attain positive feedback from the learners.

According to Kartika et al, (2019), the use of education game technology as an interactive learning media is one of the right ways to improve students' creative thinking skills. This education game is expected to eliminate boredom and fear to learn math and facilitate the learning process in geometry material of Senior High School (SMA/MA). The purposes of the research were to produce an educational game computer-based to improve the students' creative thinking ability on the geometry material and describe the impact of teaching materials by using adventure games as a media on the geometry instruction. To develop math adventure educational games by using android hand phone and give feasibility test in using math adventure educational game as a media in learning Geometry (the second year on the research target).

The collaborative work of Kartika and her colleagues is relevant to the study since the center of developing instructional material is to help learners for a better understanding of the lesson by providing and applying easy access instructional material which are suited to the learners through android phone or mobile games.

Relevance

The work of Callaghan (2017) mentioned that as increased emphasis is focused on creating digital educational games that are aligned

with schools' academic goals, issues arise about how professional development (PD) might support instructors' use of games for instruction and how such integration can affect students' accomplishment. Some said they used integrative approaches to identify troubled pupils, while others said it was difficult to integrate. In our OLS analysis, teachers' reordering of game objectives to fit with lessons and consumption of game-based PD films were linked to improved student math achievement.

Both current research and the above cited literature of Callaghan give emphasis on the importance of relating the developed instructional material to a certain learning goal which are aligned to the target learning competencies.

According to Heshmati et al. (2017), the design and implementation of the Cover-up and Un-cover games, two manipulative-based fraction games- were investigated in this study. Using lesson videos, it was investigated how fraction topics were integrated into the game design and the nature of teacher-student interactions during games. It revealed that interactions were primarily focused on game progress, rules, and turn- taking, with little attention paid to strategy or underlying mathematics. The purpose of this study was to compare the quality of teacher-student relationships during games to the quality of interactions during instructional activities. Additional curricular support and training for teachers may be beneficial in implementing games as rich mathematics learning opportunities.

With this, it is clearly stated that the study of Heshmati is relevant to the current study since both studies are focused on the development of an instructional material which is favorable for the learners and students.

Timeliness

According to Nadolny and Halabi (2016), in higher education, the use of game-based learning methodologies has showed promise in terms of increasing student motivation and achievement. Although research into arranging classes as a game has begun, little is known about who gains the most from this type of learning environment. The fact that a lecture course developed with game-based learning on participation and achievement was investigated in this study. Narrative, missions, points, feedback, and badges were all included in the game.

In the masterpiece of Malamed (2012), it was included that learning experts are having success developing education using game-based sensibilities. It shows how to match different game methods to different types of learning content for the best learning results, as well as how gamification approaches may be utilized in a number of settings to promote knowledge learning, retention, and application. The book shows how combining instructional design thinking with game concepts can create engaging and interactive learning experiences across a variety of media, from online to face-to-face, and is backed up by peer-reviewed studies and examples from corporations that have successfully implemented game-based learning.

The masterpieces of Nadolny and Halabi and Malamed are both related to the current work because such both mentioned that it is just timely to implement game-based instruction in coping up the needs of today's generation of learners.

Appropriateness

In accordance with the work of Mayer (2019), it is said that visionaries make compelling arguments for the educational value of video games, but it is important to put such arguments to the test through rigorous scientific study and to firmly establish them in theories of how people actually learn. Modality, personalization, pre-training, coaching, and self-explanation are five promising characteristics that should be included in instructional computer games, according to value-added research. Two promising strategies for cognitive training with computer games are suggested by cognitive consequences research: using first person shooter games to train perceptual attention skills and using spatial puzzle games to train two-dimensional mental rotation abilities. Science, mathematics, and second-language learning are three areas where games may be more effective than traditional media, according to study on media comparison. The cognitive, motivational, affective, and social mechanisms that underlie learning with educational computer games need to be further studied.

The study of Mayer is connected to the research since it also prioritizes the appropriateness of the developed material to the main goal of the learning process and the ability of the learners.

It is said by Tokac et al. (2019) that this meta-analysis looked at how arithmetic achievement in PreK–12th grade pupils was affected by studying video games as opposed to conventional classroom education. In addition, moderator analyses that looked at effect-size heterogeneity among effects utilizing factors such as grade level, instrument type, duration of game-based intervention, country, publication type, and study year were mixed in terms of statistical significance. Overall research shows that using video games to teach math to students in Pre to K–12 grades is a marginally effective instructional technique.

The work of Tokac et al. and the current study are interconnected in the sense that both studies focused on effectiveness of the developed instructional material and giving emphasis on the appropriateness of its content to the learners.

Studies

The following are the variables of the study with related studies both local and foreign.

Content

As said in the study of Eck (2015), many people argue that using digital games to solve school-related issues is a good idea, yet there is conflicting evidence on how well these games foster problem-solving, critical thinking, and 21st century skills. In this chapter, I argue that the issue is not with digital games per se, but rather with how we conceptualize problem-solving and critical thinking in general, and how transfer of these skills occurs in particular with games. Digital games' strength comes not from the medium's inherent magic,

but rather from embedded theories (such as contextual learning and problem-centered instruction) and effective instructional design (the principles of learning and teaching to which all good instruction must adhere).

Stated in the work of Russo et al. (2021), teachers in Australia frequently use mathematical games to supplement mathematics training. Teachers in Australia completed a survey to learn more about their experiences with mathematical games in the classroom, including motivation for and frequency of game use, game execution within lesson routines and structures, and assessments of game efficacy in achieving pedagogical goals. Games were used in a variety of ways in the classroom, including as a 'warm-up' activity, to teach new mathematical ideas, to reinforce skills and knowledge, and to develop fluency. Teachers thought games were a great way to get kids interested in arithmetic.

Both studies of Eck and Russo et al. are relevant to the study since in developing a certain instructional material, both emphasize the importance of its content and developing critical thinking skills of the learners.

User-friendly

Upon looking at the work of Ardani et al. (2018), the goal of this study was to find out how students and teachers felt about using edutainment instructional material in mathematics classes. The data for this study was gathered by a survey that included questions from the research model. The findings revealed that the majority of students have good attitudes about using edutainment instructional media in mathematics learning, and that they prefer games to other types of edutainment instructional media. Furthermore, while majority of teachers held positive views, some argued that edutainment instructional media could not replace the teacher in facilitating learning.

In accordance with the work of Ardani, this is just the same as the result of the current study, they both mentioned the importance of developing a simple game-based instructional material so that all of the learners can easily cope up and will serve as entertainment also.

As we can reflect on the study of Akman and Cakir (2020), virtual reality seems to be progressing quickly lately. Virtual reality usage for education, on the other hand, is still in its infancy. According to studies, adopting virtual reality in the classroom can enhance students' learning opportunities. The impact of the instructional virtual reality game "Keşfet Kurtul" on fourth-grade pupils' proficiency with fractions and interest in mathematics was examined in this study. The study discovered that the instructional virtual reality game "Keşfet Kurtul" improved academic performance and kept students' interest in mathematics at a high level. In terms of academic accomplishment and student involvement, it was found that the experimental method has the same impact as the strategy used in the comparison group at the school.

The study of Akman and Cakir is related to the research since it also focused on the improvement of the academic performance of the learners with the use of a user-friendly instructional material.

Relevance

The result is related to the study of Conte (2017) which states that the main goal of the study is to introduce the effectiveness and acceptability of the educational games as it contributes to attaining higher scores in Mathematics among Filipino pupils. The relevance of the study of the educational games to the learning process in Mathematics of the pupils show significantly different after applying it. There is an improvement in the performance of the pupils after utilizing it.

In the discussion of Conte, it was said that relevance of the game-based learning in the teaching process is well manifested by the pupils as they shown improvements. Relevance of the instructional material to the lesson is one of the keys in improving quality of education in Mathematics.

In the study of Plass et al. (2015), they first define gamification and game-based learning, and then talked about theoretical frameworks that characterize learning through games, making the case that playfulness is unrelated to learning theory. The design of games that support learning by encouraging students' cognitive, behavioral, emotive, and sociocultural engagement with the subject is then discussed. Finally, it was reviewed that the most important theories from education and psychology that are relevant to game-based learning and described empirical research on learning with games that had been or should be conducted. This discussion then is focused on the cognitive, motivational, affective, and socio-cultural foundations of these design elements. It was concluded that in order for game design and game research to completely comprehend what games have to offered, a synthesis of cognitive, motivational, emotional, and sociocultural perspectives is required.

The work of Plass et al. discussed that the game-based instructional material should be relevant to the cognitive skills and socio-cultural perspective of the learners so that it can secure positive response of the students just like the current study.

Timeliness

According to Chang et al. (2015), their study looked at how The Math App, a learning game, affected middle school pupils' ability in Mathematics. Such subject used an application as an intervention for investigation over a nine-week period. The paper-and-pencil control condition and the game intervention treatment condition were given to the students. Students that participated in the game intervention condition used ted he Math App to master fractional concepts. Prior to the intervention, the math skills of the pupils were considered in the analysis. According to the findings, pupils in the game intervention group were more proficient in math than those in the paper-and-pencil group. Particularly among 7th graders and inclusion groups, the intervention groups' significantly higher performance was observed. The reported study's experimentally generated findings may be useful in the field of educational videos.

The research made by Chang and colleagues are connected to the study since the timeliness of the instructional games is

proven particularly on its concepts in order for the students to easily understand the developed material.
The goal of this experimental study of Kim (2017) was to determine whether adding game elements to a virtual reality (VR) learning environment supported by Open Simulator could enhance students' mathematical performance. Both the experimental and control received the same math problem-solving assignments in the VR learning environment. The experimental group was given tasks that included game-like challenges, a plot, instant rewards, and the incorporation of gameplay into the lesson material. When compared to non-GBL in the VR environment, game-based learning (GBL) in the VR environment significantly improved performance on the math knowledge exam, according to an analysis of co-variance with the achievement test results.
In the current study the punctuality of the developed instructional material is important just like in the work of Kim since we all know that there is a need to cover up the knowledge and interests of the new generation of learning at the same time to ensure quality education.

Appropriateness

Siew (2018) states that in today's education, technological applications, particularly the usage of multimedia courseware, has been more popular, driving creative teaching and learning methodologies. The use of multi -media technology and digital games provided an alternative method of instruction as interest in integrating information and communication technologies (ICTs) into learning and teaching grew. Because of their potential to establish a virtual environment for learners to successfully acquire knowledge, multimedia items play a significant role in the classroom. This paper covers a portion of the findings of a study that looked into the benefits of multimedia technology and digital game-based learning. The effectiveness of using multimedia and game-based approaches to motivate mathematical learning is also discussed in this paper.

The work of Siew is related to the current study since the appropriateness of multimedia technology is well evident. The educators need to develop certain instructional material that will satisfy both learners and the curriculum.
It is said in the study of Gros (2017) that electronic games have become more prevalent in children's and adolescents' lives in recent years. Children learn digital literacy on their own through play, and neither schools nor other educational institutions give enough consideration to this crucial factor. The most potent elements of interactive multimedia design and the most successful theories of electronically mediated learning, in our opinion, should be combined in multimedia design for training and education. Analyzing the key contributions and traits of game-based learning environments can be done by looking at how video game design has changed through time. At the same time, it talked about the principal hurdles and barriers in using games for learning.

The work of Gros and the current study are related since both emphasized the positive impact of instructional material in the learning outcomes of the students, furthermore, such also mentioned that the multimedia to be developed should also be based on the situations to give way to its appropriateness with the users.

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Chapter 3
RESEARCH METHOD AND PROCEDURE

This chapter will discuss the research method and design, setting, subject and procedure of the study, sources of data, sampling and data gathering procedure and the statistical treatment.

Research Method and Design

The research method used was one-group pretest-posttest research design. According to Allen (2017), it is the most often used by behavioral researchers to identify the effects of the intervention on a given sample. This is characterized by two features, first is the use of single group participants; in this feature, all participants were chosen according to one condition and given the same treatments and assessments, the second is a linear ordering that requires the assessment of a dependent variable before and after implementing the chosen treatment or intervention.

In this research design, the respondents were the grade 10 learners, pilot or first section of Janosa National High School. The respondents answered pretest and after assessing the result of the said test, the learners utilized the researcher’s developed instructional material. And then, posttest was given to determine whether the instructional material was effective. To determine the acceptability of the developed instructional material, the researcher asked the mathematics experts and end-users to evaluate it using research -made questionnaire checklist.

Setting of the Study

The study was conducted at Janosa National High School which was established in 1969. It is part of Binangonan District and is located at Barangay Janosa, Talim Island, Binangonan, Rizal at the back of St. Dominique Church. It caters to 10 barangays of talim island, from Kinagatan to Ginoong Sanay. It was first named as Janosa Barangay School, then Janosa High School and from then until present it is being addressed as Janosa National High School.

It has 60 teaching personnel and 14 non-teaching personnel who are helping hand in hand for the betterment of the institution most importantly in this time of pandemic. Different ways to relate with learners in form of distance learning are evident in this school. Utilizing Modular Distance Learning does not give satisfaction to a math teacher to identify if the learners really learned the lesson. As part of the learning continuity plan, Math teachers conduct an activity which they called "Project : Math-Tuto" which was recently awarded in the Gawad Kampilan. In this project, the teachers went to different barangays to teach mathematics and used gymnasium as their classroom. In this way, it is assured that learning from the book is well kept in the learners' mind.

For the level of acceptability, it covered the Division of Rizal Mathematics teachers. Thirty of them were selected randomly to check the validity of the instructional material. The said division conducted different activities to make sure that learners are doing well in terms of mathematics.

Figure 2
Vicinity Map of Janosa National High School

Subject of the Study

The respondents of the study were the 47 students of the pilot section from the grade 10 level of Janosa National High School. The grade level was composed of 6 sections with a total of 295 learners. They were chosen to be the respondents of the study since the instructional material developed was new to the learners hence, determined first the advantages and disadvantages of the software and the points to be developed before utilizing it to wider respondents.

Evaluating the result of the examination, the sections really found difficulty in their Mathematics subjects. Considering that they are the brightest section in grade 10, they only got a mean score of 88 unlike the other subjects which are all 90s. Their study habits and mathematical ability are really affected by the current situation since their focus is on the accomplishment of the module that's why understanding the lesson was also considered.

Thirty teachers from the Division of Rizal were chosen randomly to evaluate the developed instructional material by the researcher. They were asked to answer the researcher-made questionnaire checklist to validate the content of the application.

Procedure of the Study

The study aimed to determine the effectiveness of utilizing the developed alternative instructional material in mathematics 10. The researcher identified the least mastered skills of the grade 10 learners from the school year 2020-2021 and such were the bases of the third grading competencies included in the pretest and posttest composed of 40 items divided equally according to competency. Such was also the bases of the developed instructional material.

After the construction of pretest, posttest and instructional material it was validated by mathematics experts while the researcher asked permission from the Principal of the Janosa National High School to administer the pretest and posttest to the chosen respondents.

After the permission has been approved, this was followed by the gathering of data through utilization of pretest and posttest and the developed instructional material of the researcher to the chosen group of respondents. Here, the pretest was given first and after evaluating the result the developed instructional material was given to them, then after all the discussion, posttest will be given to the same set of respondents. Simultaneously, the questionnaire checklist for the acceptability of the developed instructional material was answered by the mathematics experts and end-users.

This was followed by data interpretation and analysis by the researcher to come up with an alternative instructional material in mathematics 10.

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Sources of Data

To determine the level of performance of the Grade 10 Learners before and after the utilization of the developed instructional material, researcher made pretest and posttest was used.

The forty (40) item pretest and posttest were to be analyzed and validated by the experts in the field of teaching Mathematics to determine the reliability of the two sets of tests.

To identify the level of acceptability of the developed instructional material for the grade 10 learners, the researcher presented the developed application to Mathematics experts to verify and evaluate the said game according to chosen variables such as content, user-friendly, relevance, timeliness, and appropriateness. The five (5) point scale will be used to evaluate the level of acceptability of the instructional material in Mathematics 10.

The following scale was used to evaluate the developed alternative instructional material in Mathematics 10.

5 - Very Much acceptable
4 - Acceptable
3 - Moderately Acceptable
2 - Undecided
1 - Not Acceptable

The scale below was used to evaluate the result of the pretest and posttest.

8.00-10.00	-	Outstanding
6.00-7.99	-	Very Satisfactory
4.00-5.99	-	Satisfactory
2.00-3.99	-	Moderately Satisfactory
0.00-1.99	-	Unsatisfactory

The scale below was used to determine the mean percentage increased.

80-100	-	Very Much Effective
60-79.99	-	Moderately Effective
40-59.99	-	Effective
20-39.99	-	Slightly Effective
0-19.99	-	Ineffective

Data Gathering Procedure

To gather the data, the researcher sent letters seeking permission from the school superintendent of the Division of Rizal and from the school principal of Janosa National High School.

After the letters were assured, the pretest and posttest, questionnaire-made checklist, and developed alternative instructional material were constructed and utilized.

The subject of the study were the students from the pilot section while the respondents of the study was chosen through random sampling.

As all needed data were gathered, the researcher proceeds to the analysis, tabulation, interpretation, and presentation of the collected data.

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Statistical Treatment

The results were analyzed using the following statistical tool.

On the development of instructional materials, qualitative discussion was used;

To determine the acceptability of the developed alternative instructional material with respect to content, user-friendly, relevance, timeliness and appropriateness, mean scores was used;

To determine the level of performance of the Grade 10 Learners before and after the utilization of developed alternative instructional material for grade 10 learners for the following competencies: identify permutations and combinations, derive formula for the permutations and combinations, differentiate permutations and combinations and solve problems regarding permutations and combinations, pretest and posttest means scores was used;

To identify if there is significant difference on the level of performance of the Grade 10 Learners before and after the utilization of instructional material in the teaching of Mathematics that will be seen in the pretest and posttest scores, dependent t-test was applied;

To determine the level of effectiveness, mean percentage increased was used;

On the experience of the learners after the utilization of the developed instructional material, qualitative discussion was used.

Chapter 4
PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

This chapter presents the analysis, interpretation, discussion, and implication of the data of the study.

Development of Alternative Instructional Materials in Mathematics 10

The development of instructional material to be used in a classroom is not that easy. There are a lot of things to be considered. From the competencies down to design it should be well planned. The topics that were included to the instructional material were based on the Most Essential Learning Competencies (MELCs) that can be seen through Learners' Packet (LeaP). They were chosen according to the least mastered skills from the school year 2020-2021.

After the learning competencies were identified, planning and preparation of the game-based instructional material followed. The researcher chose the simplest designs of an application that would be easy for the learners to utilize. There are a lot of things that have been considered in making the instructional material. To lessen the burden, the researcher put lectures on the material but instead of having a video tutorial, it became a written tutorial so that it will not consume greater memory capacity considering that

not all learners have high-memory phone capacity. Also, talking about work under pressure that boosts the mental ability of a person, the application has its own timer in every quiz so that the learners will be able to assist themselves in answering the quizzes. Lastly, the application has no sound, this is because some learners get distracted with sounds so, the researcher decided to not put sound in it. These ideas were incorporated in the development of the instructional material with the help of an IT expert who use Android Studio software to create the mobile application. After the utilization of the said instructional material, it was found effective and useful on the learners' perception.

Level of Acceptability of the Developed Alternative Instructional Materials with respect to Content, User-Friendly, Relevance, Timeliness and Appropriateness

Table 1 on the next page presents the level of acceptability of the developed instructional material with respect to content.

Table 1

Level of Acceptability of the Developed Instructional Material with respect to Content

A. Content	Mean	Verbal Interpretation
1. Discussion/notes of the topics are presented.	4.70	Very Much Acceptable
2. There are examples provided.	4.70	Very Much Acceptable
3. Topics are related to real life situation.	4.73	Very Much Acceptable
4. Quizzes are in line with the topic being presented.	4.80	Very Much Acceptable
5. The application helps the learners in solving mathematical problems.	4.67	Very Much Acceptable
Overall	4.72	Very Much Acceptable

As appeared on the table above, upon evaluation of the mathematics teachers and end users the developed alternative instructional material for grade 10 learners is very much accepted and got the mean score of 4.72.

It can be said that the content of the alternative instructional material was highly acceptable for the teachers and end users. With the highest mean score of 4.80 it was well evident that quizzes in the game were in line with the topic being presented while the application helps the learners in solving mathematical problems got the lowest mean of 4.67 but still very much accepted.

As the findings implicate, it is important that the instructional material is properly prepared and aligned from the topic being presented to the learners to avoid confusions. Having proper alignment will lead the learners to proper understanding. The instructional material may serve as a supplementary material in imparting mathematics knowledge to our students. Properly aligned material may serve as motivation for the students and eventually catch their interest in that way, learning is assured.

Stated in the work of Russo et al., (2021), teachers in Australia frequently use mathematical games to supplement mathematics training. Teachers in Australia completed a survey to learn more about their experiences with mathematical games in the classroom, including motivation for and frequency of game used, game execution within lesson routines and structures, and assessments of game efficacy in achieving pedagogical goals. Games were used in a variety of ways in the classroom, included as a 'warm-up' activity, to teach new mathematical ideas, to reinforce skills and knowledge, and to develop fluency. Teachers thought games were a great way to get kids interested in arithmetic.

Table 2 presents the level of acceptability of the developed instructional material with respect to user-friendly.

The data on the next page reflects that the developed instructional material in the teaching of grade 10 learners is user-friendly since upon the evaluation of the mathematics teachers and end users, it has overall mean of 4.72 and verbally interpreted as very much accepted.

Table 2

Level of Acceptability of the Developed Instructional Material with respect to User-Friendly

B. User-Friendly	Mean	Verbal Interpretation
1. The developed instructional material application is applicable in any type of learner.	4.63	Very Much Acceptable
2. The developed instructional material application is user and gadget friendly.	4.63	Very Much Acceptable
3. The developed instructional material application is easy to manipulate.	4.80	Very Much Acceptable
4. The mechanics of the developed instructional material is easy to understand.	4.83	Very Much Acceptable
5. The developed instructional material is useful in both teacher and learners.	4.70	Very Much Acceptable
Overall	4.72	Very Much Acceptable

With respect to being user-friendly, it is said that the mechanics of the developed instructional material is easy to understand by the learners since it has the highest mean score of 4.83 and very much accepted. On the other hand, with the same mean of 4.60, being applicable to any type of learners and user and gadget friendly got the lowest rank but still very much accepted.

The result indicates that a developed instructional material like mobile games should be more user-friendly. The setting of the game should allow all types of learners to easily adopt it as a tool in learning. Also, the specs should fit all types of gadgets that a learner should have so that all learners can use it.

Upon looking at the work of Ardani et al., (2018), the goal of this study is to find out how students and teachers feel about using edutainment instructional material in mathematics classes. The data in this study was gathered thru a survey that included questions from the research model. The findings revealed that the majority of students have good attitudes about using edutainment instructional media in mathematics learning, and that they prefer games to other types of edutainment instructional media. Furthermore, while majority of teachers have positive views, some argued that edutainment instructional media could not replace the teacher in facilitating learning.

Table 3 presents the level of acceptability of the developed instructional material with respect to relevance.

Table 3

Level of Acceptability of the Developed Instructional Material with respect to Relevance

Relevance		Mean	Verbal Interpretation
1.	The developed instructional material is relevant to the subject matter.	4.73	Very Much Acceptable
2.	The developed instructional material is contextualized according to MELCs.	4.83	Very Much Acceptable
3.	The developed instructional material is applicable to the content standard.	4.73	Very Much Acceptable
4.	The developed instructional material is suitable to needs of the learners.	4.73	Very Much Acceptable
5.	The topics of the developed instructional material are interconnected.	4.73	Very Much Acceptable
Overall		4.75	Very Much Acceptable

It can be gleaned from table 3 that the developed instructional material is relevant to the subject and topic it is being referred to. It is clearly evaluated, and the result says that in terms of relevance, the instructional game is very much accepted with an overall mean of 4.75.

As it was evaluated by the mathematics teachers and end users, the said instructional material is relevant to the subject matter and learning competencies. Also, it is contextualized according to Most Essential Learning Competencies (MELCs) that is why, it has the highest mean score of 4.83, verbally interpreted as Very Much Acceptable. The rest have the same mean scores of 4.73.

The result implies that instructional material should be interconnected with the learning competencies to be more effective. It should be relevant in all aspects in teaching and learning process so that it can be used as a learning resource material and can be helpful to both teachers and learners. This should target the learning goals of a certain topic or subject so that it will be a key in attaining positive response from the clientele.

The work of Callaghan (2017) mentioned that as increased emphasis is focused on creating digital educational games that are aligned with schools' academic goals, issues arise about how professional development (PD) might support instructors' use of games for instruction and how such integration can affect students' accomplishment. Some said they used integrative approaches to identify troubled pupils while others said it was difficult to integrate. In our OLS analysis, teachers' reordering of game objectives to fit with lessons and consumption of game-based PD films were linked to improve student math achievement.

Table 4 presents the level of acceptability of the developed instructional material with respect to timeliness.

Table 4

Level of Acceptability of the Developed Instructional Material with respect to Timeliness

Timeliness		Mean	Verbal Interpretation
1.	The developed instructional material matters to the learners' perception.	4.67	Very Much Acceptable
2.	The developed instructional material is punctual to the current situation.	4.73	Very Much Acceptable
3.	The developed instructional material suits to the interests of the learners.	4.83	Very Much Acceptable
4.	The developed instructional material is timely.	4.77	Very Much Acceptable
5.	The developed instructional material can be a "go to" reference for the 21st century learners.	4.60	Very Much Acceptable
Overall		4.72	Very Much Acceptable

As table 4 shows, it can be said that the mathematics experts think that the instructional material is timely. As we all know, today's generation of learners are more technology- oriented, they are more interested in technology rather than the traditional way. With the mean score of 4.72, mathematics experts accept the fact that integrating technology to learning is considered today's trends.

As you can see, math teachers and end users really think that the developed instructional material is helpful for learners since as the result of the survey says, it suits their interest knowing that nowadays learners are more on technology which results to the highest mean score of 4.83 and is Very Much Accepted. On the other hand, the developed material maybe enhanced so that it will suit more

as additional reference to the 21st century learners since it has the lowest mean score of 4.60 but still verbally interpreted as Very Much Accepted.

As the table implied, learners really change from time to time. Teachers should be able to identify their needs so that each one can be more effective and efficient educator. Considering technology as one tool in imparting knowledge to our learners is one big help in coping their needs and suiting their interest so that teachers can assure quality education. It should be noted that being timely is necessary.

According to Nadolny and Halabi (2016) , in higher education the use of game-based learning methodologies has showed promise in terms of increasing student motivation and achievement. Although research into arranging classes as a game has begun, little is known about who gains the most from this type of learning environment. The fact of being a lecture course develop with game-based learning on participation and achievement was investigated in this study. Narrative, missions, points, feedback, and badges were all included in the game.

Table 5 presents the level of acceptability of the developed instructional material with respect to appropriateness.

Table 5
Level of Acceptability of the Developed Instructional Material with
respect to Appropriateness

Appropriateness	Mean	Verbal Interpretation
1. The developed instructional material suited to the target learners	4.77	Very Much Acceptable
2. The developed instructional material provides information that is needed by the learners	4.77	Very Much Acceptable
3. The developed instructional material serves as alternative instructional material	4.73	Very Much Acceptable
4. The developed instructional material provides correct and appropriate choices/options	4.73	Very Much Acceptable
5. The developed instructional material is properly designed.	4.53	Very Much Acceptable
Overall	4.71	Very Much Acceptable

Since, learner is the center of educative process, teachers were challenged to have instructional material which is appropriate to them. It should be suited to target learners and provide the needed information of the learners because this two got the highest mean scores of 4.77, very much accepted. On the other hand, a teacher should secure developed material be properly designed, this got the lowest mean score of 4.53 but still Very Much Accepted.

Assuring appropriateness, instructional material is necessary in attaining quality education. As shown in the table, this implies that in order to gain the necessary learning of the students, one must secure that all learning materials are appropriate to learners and the topic itself. This clearly emphasized that planning to executing lessons, materials and techniques in teaching should be properly aligned with each other.

It is said in Siew (2018) that in today's education, technological applications, particularly the usage of multimedia courseware, have grown more popular, driving creative teaching, and learning methodologies. The use of multimedia technology and digital games provided an alternative method of instruction as interest in integrating information and communication technologies (ICTs) into learning and teaching grew. Because of their potential to establish a virtual environment for learners to successfully acquire knowledge, multimedia items play a significant role in the classroom. This paper covers a portion of the findings of a study that looked into the benefits of multimedia technology and digital game-based learning. The effectiveness of using multimedia and game-based approaches to motivate mathematical learning is also discussed in this paper.

Table 6 presents the composite table on the level of acceptability of the developed instructional material.

Table 6
Composite Table on the Level of Acceptability of the Developed
Instructional Material

Variables	Overall Mean	Verbal Interpretation
A. Content	4.72	Very Much Acceptable
B. User-Friendly	4.72	Very Much Acceptable
C. Relevance	4.75	Very Much Acceptable
D. Timeliness	4.72	Very Much Acceptable
E. Appropriateness	4.71	Very Much Acceptable
Grand Mean	4.72	Very Much Acceptable

Table 6 shows the summarized findings of the study. After the evaluation by the mathematics and IT experts, the developed instructional material got the grand mean score of 4.72 and verbally interpreted as Very Much Accepted. This result clearly states that mobile application is highly appreciated and accepted in today's classroom setup.

The result of the survey says that the developed instructional material is relevant in terms of learners, topics and design since it has the highest mean score of 4.75, followed by content, user-friendly and timeliness with the mean scores of 4.72. On the other hand, the appropriateness of the instructional materials should be developed since it has the lowest mean score of 4.71 but still, all of them are verbally interpreted as very much accepted.

The result of the survey implies that before utilizing a certain instructional material, it should be well evaluated and tested so that it will result to a positive feedback from the learners. Relevance tops the rank, meaning to say that the evaluators found the

instructional game developed is considered in the current curriculum and relevant to the learners' point of view.
In the study conducted by Lazuna (2020) , it was said that integration of fun while learning helps improve students' performance in Mathematics. Also, it defines that the relevance of the topic into modified games is the connection to Gamification Technique (GT) to every concept that the teacher is trying to imply. Also, it sought to identify the relationship of the mathematics performance in four areas GT such as academic achievement, cooperation, behavior, and familiarization of non-Virtual Modified Filipino Games. The significant relationship of the integration of GT and the four areas are being tested. The study concluded that the use of GT is a way in innovating teacher's instruction in increasing the quality of performance among the students. However, still there should be limitation in using gamification technique.

Level of Performance of the Grade 10 Learners Before and After Exposure to the Instructional Material with Respect to Different Competencies

Table 7 presents the level of performance of the grade 10 learners before and after their exposure to the instructional material.
As seen in table 7, upon utilization of the researcher made pretest, the students got the mean of 20.30 and verbally interpreted as Satisfactory and after utilizing the instructional material, the students got the mean score of 32.47 and interpreted as Outstanding.

Table 7
Level of Performance of the Grade 10 Learners Before and
After Exposure to the Instructional Material

Competencies	Before			After		
	Mean	Sd.	VI	Mean	Sd.	VI
1.	Identify Permutations and Combination			6.09	1.91	Very Satisfactory
2.	Derive formula for Permutations and Combination			4.53	1.85	Satisfactory
3.	Differentiate Permutations and Combinations			4.64	1.75	Satisfactory
4.	Solve problems regarding Permutations and Combination			5.04	1.89	Satisfactory
Overall	20.30	4.73	Satisfactory	32.47	2.29	Outstanding

8.02	1.38	Outstanding	
8.11	1.45	Outstanding	
8.06	1.47	Outstanding	
8.28	1.31	Outstanding	

The result implies that the instructional material plays a vital role in attaining high scores of the students in the posttest. It can be said that there is a positive response from the students after the utilization of the developed instructional material. As we can see from the table, all the mean scores improved after the utilization of the developed instructional material.

The findings showed that students perform well when the learning process is added with a twist like mobile games which is instructional and is related to their study. Also, having outstanding grade in the posttest implies that the developed instructional material is effective and can improve students' mathematical performance.

The result is related to the study of Conte (2017) which states that the main goal of the study is to introduce the effectiveness and acceptability of the educational games as it contributes to attainment of higher scores in Mathematics among Filipino pupils. The relevance of the study of the educational games to the learning process in Mathematics of the pupils show significantly different after applying it. There is also an improvement in the performance of the pupils after utilizing it.

Significant Difference on the Level of Performance of the Grade 10 Learners Before and After Exposure to the Developed Alternative Instructional Material

Table 8 presents the significant difference on the level of performance of the grade 10 learners before and after exposure to the developed alternative instructional material.
It can be seen on the table on the next page that there is sufficient evidence at 0.05 level of significance to show that there is significant difference on the level of performance of the grade 10 learners before and after exposure to the developed instructional material since the obtained p-value did not exceed the 0.05 level of significance, hence the null hypothesis is rejected.

It can be seen from the table that in all the chosen topics, there are significant differences with the result. The second topic which is derived formula for Permutations and Combination has the highest mean difference of 3.574 however, the first topic which is Identify Permutations and Combination has the lowest mean difference of 1.936. to sum it up, all topics have significant difference, thus the null hypothesis is rejected.

Table 8
Significant Difference on the Level of Performance of the Grade 10
Learners Before and After Exposure to the Developed
Alternative Instructional Material

Competencies	Test	Mean	Sd	df	t-value	p-value	HO	VI
1. identify permutations and combination	Before	6.09	1.91	46	6.970	.000	R	S
After	8.02	1.38						
2. derive formula for permutations and combination	Before	4.53	1.85	46	11.270	.000	R	S
After	8.11	1.45						
3. differentiate permutations and combinations	Before	4.64	1.75	46	12.941	.000	R	S
After	8.06	1.47						
4. solve problems regarding permutations and combination	Before	5.04	1.89	46	10.175	.000	R	S
After	8.28	1.31						
Total	Before	20.30	4.73	46	22.642	.000	R	S
	After	32.47	2.29					

Legend: Sd- Standard Deviation, Ho-Null Hypothesis, VI-Verbal Interpretation R-Reject, S-Significant

As been evident from the last table, the application of different techniques in teaching is necessary for today's 21st century learners. Technology is one key in attaining new knowledge which is timely and relevant for the teaching and learning process. We must adopt new media in order for us to attain the said quality education. Using instructional material in teaching mathematics really makes different to the learner's performance. As an educator, one may develop more of this so that it is assured that we are not left behind.

According to Heshmati et al., (2017), the design and implementation of the cover-up and un-cover games, two manipulative-based fraction games, were investigated in their study. Using lesson videos, we investigated how fraction topics were integrated into the game design and the nature of teacher-student interactions during games. It revealed that interactions were primarily focused on game progress, rules, and turn taking, with little attention paid to strategy or underlying mathematics. The purpose of this study was to compare the quality of teacher-student relationships during games to the quality of interactions during instructional activities. Additional curricular support and training for teachers may be beneficial in implementing games as rich mathematics learning opportunities.

Effectiveness of the Developed Instructional Material as Revealed by the Test Result Before and After Utilization

Table 9 presents the effectiveness of the developed instructional material as revealed by the test results before and after utilization.

Table 9

Effectiveness of the Developed Instructional Material as Revealed by the Test Results Before and After Utilization

Competencies	Test	Mean	Mean Difference	Mean Percentage Score (MPS)	VI
1. identify permutations and combination	Before	6.09	1.93	31.69	Effective
After	8.02				
2. derive formula for permutations and combination	Before	4.53	3.58	79.02	Moderately Effective
After	8.11				
3. differentiate permutations and combinations	Before	4.64	3.42	73.70	Moderately Effective
After	8.06				
4. solve problems regarding permutations and combination	Before	5.04	3.24	64.29	Moderately Effective
After	8.28				
Total	Before	20.30	12.17		
	After	32.47			

It can be seen from the table that the competency derived formula for permutations and combinations got the highest mean percentage score of 79.02% and identify permutations and combinations goes the lowest MPS of 31.69%.

As the table implies, the use of the developed alternative instructional material in Mathematics 10 really helped the learners in attaining the desired outcome of the competencies since the effects of its utilizations appears positively according to the results.

The findings suggests that educators might use these kinds of instructional material to facilitate learning. It says that in proper utilization and guidance, technology would have positive impact in both teachers and learners. Lastly, it can promote the positive use of mobile phone in teaching and learning process.

The result agrees with the masterpiece of Callaghan (2017) which says that we can increase our focus on creating digital educational games that are aligned with schools' academic goals, issues arise about how professional development (PD) might support instructors' use of games for instruction and how such integration can affect students' accomplishment.

Experiences of the Learners in the Utilization of the Developed Alternative Instructional Material in Mathematics 10

After the focus group discussion regarding the students' perceptions on the utilization of the developed alternative instructional material in Mathematics 10, the material got positive response from the learners who used it.

According to 47 learners, the developed instructional material helped them a lot in answering the module/LeaP since the

game is anchored and relevant to their current topics in Mathematics 10. Also, 14 learners mentioned that aside from being helpful, the instructional material was also user-friendly since such can still be used even in their old model mobile phones. According to Lara "Mam, nakatulong po talaga sa akin ang application na ito dahil may mga tanong po ako na sa written turorial ko po nakikita ang sagot. Madali rin po i-manipulate ang application saka pwede po siya sa aking cellphone kahit medyo low specs na ito."

On the other hand, 12 of them said that it was just appropriate for them since the content of the mobile application suites their capabilities and really answers some of their questions knowing that the material given to them was limited too. Bolante mentioned that "Maganda ang application Mam. Bagay lamang po ito sa aming kakayahan dahil Grade 10 palang naman po kami. Madali po naming nasagot ang mga tanong dahil nasa tutorial po ang guide para masagot ang mga ito." Sherie also mentioned that "Napagaan po nito ang aming pagsasagot ng module, nagging guide din po kasi ito dahil talagang related siya sa aming topic at sakto sa aming kaalaman ang mga nakalagay dito."

Since learners are different from one another, some got pressured by the timer but still 9 of them appreciate it. In fact, they also mentioned that the timer helps their brain cells function rapidly and the pressure boosted their ability to answer the task. As stated by Bree, "Yung timer po na nakalagay ay malaking tulong po sa akin para mas mapabilis ang aking pagsasagot. Mas naging attentive po ako pagbabasa kasi nape-pressure po ako in a nice way." According to Elma, "Yung timer po talaga ang dahilan bat mabilis ko siyang nasasagot dahil gusto ko po mas konti lang ang time ko para ako po ang may prize or hindi po ako mabigyan ng consequences kung ako man ang nahuli."

Most of the learners asked to apply sound in the application but 5 of them said that it is better not to put background music because it might cause destructions. Xian said that "Mas OK po sa aking ang walang tunog ang application kasi po mas nakakapag-focus ako sa pagsasagot kung tahimik ang paligid. Pero po kung gusto po ng mga kaklase ko ang may tunog siguro po ay mas OK kung may option po na on/off ang sound para lahat happy."

Before the focus group discussion ended, 7 of the learners said that they have problem in downloading the application since the signal in their respective barangays is not strong enough, luckily, they have classmates to pass it to them with the use of other applications. Cedie mentioned that "Mahina po talaga ang signal dito sa aming lugar, buti nan ga lang po ay offline ang application hindi po kami nagkaproblema pagsasagot. Saka salamat na rin po kay Kian kasi naipasa nalang po niya sa akin gamit ang Share It."

It can be reflected from the students' perceptions that applying modern trends in teaching really helps them in coping up in today's 21st century learners. Technology really helped a lot in boosting interests, motivating learners and most importantly, making teaching-learning process more effective.

The discussion falls on the study of Plass (2015) which states that game-based learning and its theoretical frameworks which characterize learning through games, making the case that playfulness is unrelated to learning theory. The design of games that support learning by encouraging students' cognitive, behavioral, emotive, and socio-cultural engagement with the subject is then discussed. Finally, we review the most important theories from education and psychology that are relevant to game-based learning and describe empirical research on learning with games that has been or should be conducted. This discussion then focuses on the cognitive, motivational, affective, and sociocultural foundations of these design elements. We conclude that for game design and game research to completely comprehend what games have to offer, a synthesis of cognitive, motivational, emotional, and sociocultural perspectives is required.

Chapter 5
SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of findings, conclusions, and recommendations of the study.

Summary of Findings

Based on the tabulated result from the previous chapter, the following are the findings of the study.

1. On the Development of Alternative Instructional Material in Mathematics 10

The alternative instructional material in Mathematics 10 was developed after identifying the third quarter least mastered skills from the most essential learning competencies in grade 10 mathematics. With the help of mathematics teachers, they were able to plan and design a mobile application that will suit the capabilities of learners. To create the mobile application, the researcher consulted an IT expert who utilized Android Studio software. This was followed by the validation of the different mathematics teachers. After its validation, the suggestions were incorporated into the application followed by its pilot testing.

2. On the Level of Acceptability of the Developed Alternative Instructional Material with Respect to Content, User-friendly, Relevance, Timeliness and Appropriateness.

After the evaluation of the mathematics experts and end-users, the developed alternative instructional material was found very much acceptable with respect to the chosen variables. Relevance tops the rank which means that the content of the developed instructional material is related to the learners and the curriculum itself.

3. On the Level of Performance of the Grade 10 Learners Before and After Exposure to the Instructional Material with Respect to the cited Competencies

After tabulating the result of the pretest and posttest for the developed instructional material, it was found that after its utilization the

performance of the learners become outstanding from the satisfactory rating before its utilization. The increase in the learners' performance level is a sign that the developed instructional material is effective and useful.

4. On the Significant Difference in the Level of Performance of the Grade 10 Learners Before and After Exposure to the Instructional Games with Respect to the Cited Competencies.

The study found that there is a significant difference in the learner's performance before and after exposure to the developed instructional material. Since the result did not meet the 0.05 level of significance thus, the null hypothesis was rejected.

5. On the Effectiveness of the Developed Instructional Material as Revealed by the Test Results Before and After Utilization

The developed instructional material was found moderately effective after its utilization. All competencies improved after its utilization which clearly manifest the learners' improved performance in Mathematics 10.

6. On the Experiences of the Learners in the Utilization of the Developed Alternative Instructional Material in Mathematics 10

After conducting a focus group discussion, the learners agreed that the material was helpful in answering the module or learner's pocket since it served as another source of information. Also, they mentioned that the developed alternative instructional material is a user-friendly and have appropriate application that can be used in their study since they were able to experience that its utilization is hassle-free.

Conclusion

Based on the findings of the study, the following conclusion has been made.

The mathematical performance of the grade 10 learners improved after the utilization of the developed alternative instructional material. This was explained by the Game-Based Theory of Pho, 2015, which states that incorporating games as instructional material in teaching will eventually help learners achieve the desired outcome. Its effects were to motivate and make students livelier and more attentive to the topic discussion.

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Acknowledgment

The researcher wishes to extend her sincerest and deepest gratitude to all persons who shared their knowledge and encouragement in the accomplishment of this study:

Dr. NANCY T. PASCUAL, President of the University of Rizal System for her untiring support and understanding to the graduate studies students;

Dr. ALLAN E. CONDE, Vice-president of the University of Rizal System for his valuable support to the students of graduate school;

Dr. MARVIN P. AMOIN, Dean of the Graduate School for his undying support and encouragement to pursue this study;

Dr. WILFREDO P. MARIÑO, her research adviser for the guidance, worthy comments and suggestions, nonetheless, words of encouragement towards the achievement of the study;

Dr. RICARDO R. ARISTON, her Panel Chairperson for sharing his expertise on thesis writing which helped the researcher in improving her manuscript;

Dr. MARISSA F. REGALARIO and Dr. ISABELITA S. BACUD, her panel members, in providing comments and suggestions for the betterment of the manuscript;

Dr. JOSE E. BINALUYO JR., her statistician and one of the panel members, for sharing knowledge and providing comments and suggestions;

Dr. LENI AVECILLA and Dr. JANNIE MANIMTIM, her thesis professors, for imparting knowledge and unending encouragement towards the accomplishment for the study;

To her parents, EDITH S. ARAGONES and the late ZALDY V. ARAGONES, for endless support and words of encouragement to finish the study;

To her siblings, GENESIS, MATHEW, JOHN ROMANO and ESTHER MELODY, for their concern during the conduct of the study;

To her husband RUSSEL JON C. PILLAS, for the unending love, support, and encouragement to finish the study. Your hard work is now paid off.

To her daughter-in-law RHIAN FATE, and son ZERJON VERYG, which serve as the inspiration of the researcher to finish her study.

To MARK JEZREEL BLANQUISCO, JOHN MARK CERTEZA, ARVIN CASINSINAN and MIGS BUNYI, her batchmates and friends for the constant support and encouragement to finish the study;

And above all, to our GOD ALMIGTY, to the strength, wisdom, and guidance for making this manuscript possible.

-The Researcher

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