Research Article

# *Development and Validation of a Gamification-Based Mathematics Curriculum for Senior High School*

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Raymund R. Molano
*Correspondence:*
raymund.molano@deped.gov.ph

Pangasinan School of Arts and Trades, Pangasinan, Philippines

0000-0002-2346-3943

**ABSTRACT**

The purpose of this study was to develop as well as to determine the acceptability and the effectiveness of a Gamification-Based Mathematics Curriculum for Senior High School students with the end in view of upscaling their critical, analytical, and creative thinking skills geared towards improved mathematical competence and performance. A combination of descriptive-developmental and true experimental design was employed in this study. The participants in this study were consists of seven master teachers, five experts in the field of curriculum development and mathematics education, and eighty Grade 11 learners who are enrolled in General Mathematics for the School Year 2021-2022 under the online distance learning. Formal structured interviews, survey questionnaire and achievement test were used as research instruments. The researcher used thematic analysis, weighted mean, and t-test to analyze and interpret the gathered data in the study. Moreover, all statistical computations in this study were done using the Statistical Package for Social Sciences (SPSS). The findings of the of the study revealed that the expert-participants of the study assessed the Gamification-Based Student Portfolio and lesson plans as highly acceptable. Also, the experiment conducted revealed that there is a significant difference between the posttest scores and gain scores of the control and experimental groups in General Mathematics. Moreover, there is a significant difference between the pretest and posttest scores of the experimental group in General Mathematics.

**KEYWORDS**

*Development, Validation, Gamification, Curriculum, Mathematics, Senior High School*

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## INTRODUCTION

The concept of curriculum is as dynamic as the changes that occur in society. In a broader sense, a curriculum is defined as "all the learning experiences or educational programs planned for students under the auspices of the school". Based on this definition, curriculum involves programs of study which are academic offered, program of activities comprising interscholastic and intramural activities, and career development. Furthermore, the modern concept of curriculum includes the method of teaching employed in each subject. Hence, curriculum development involves the planning of these learning experiences, the aims of which are to bring about some significant change in the students and the assessment of the extent to which these changes have taken place. One can perhaps bring to bear here, the argument that the development of a curriculum is but one form of improvement intended to bring transformation in the educational system (Festus & Kurumeh, 2015).

No curriculum will be perfect, a finish product cast in stone, or free from criticism, but to be valid it must be accepted by experts and effective to students (Alsubaie, 2016). According to Festus & Kurumeh (2015), many curricula have failed in the past because many of them are approved based on the subjective judgment of the curriculum developers. Thus, a curriculum should be submitted to various types of experts to pass judgment and indicate any specific modification that is necessary.

Moreover, the curriculum development cycle ends and then begins again with a careful evaluation of the effectiveness and impact of the program. So, curriculum developers need to gather data that represents overall student performance that is linked closely to instruction. The detailed review and analysis of quantitative and qualitative information on the impact of program now forms the foundation for the development and improvement of the curriculum (Gamarli & Abdullayeva, 2017).

In school, the importance of mathematics to human has accounted for its inclusion in curriculum as a compulsory subject for every child of school age to acquire the appropriate mathematical skills that will enable him or her cope with life challenges (Golji & Dangpe, 2016). However, according to studies has reported that students often view mathematics as a set of isolated procedures, failing to see real-life applications for their learning outside of the classroom (Riley et al., 2015).

Researchers have found that mathematics curricula and individualistic nature of mathematics, whereby students work independently, actually discourages learning. Therefore, improving student enjoyment in learning mathematics is a key strategy to address subject disengagement. Innovative teaching methods like gamification that provide positive mathematical learning experiences could help to enhance students' achievement in mathematics (Hammond et al., 2019).

In today's generation, gamification has become a popular tactic to encourage specific behaviors and increase motivation (Serpe, 2017). Gamification, as a concept, is defined as an innovative approach using game mechanics in a non-gaming environment in order to give it a game-like feel (Deterding et al., 2011). Then Zichermann (2011), a leading gamification proponent, enhances the definition by describing gamification as a process of using game thinking and game mechanics to solve problems and engage users.

He also states that the main purpose of gamification is to help people achieve their personal mastery by engaging with a complex, learnable game system.

Students' engagement in a gamification-based learning activity can result in a better learning outcome (Kuo & Chuang, 2016). Various gamification techniques have been used in learning experiences such as points, prizes, and badges (Kim et al., 2016). Applying gamification techniques in a curriculum can help provide a more inclusive activity through its effect on students' sense of competition, interaction, and motivation (Davis, et al., 2018).

Based on the 2018 Program for International Student Assessment (PISA) results in mathematics, Asian countries came out on top in where China ranked first where 98% of students in China attained level 2 or higher in mathematics. At a minimum, these students can interpret and recognize, without directions, how a (simple) situation can be represented mathematically. Also, 44% of students in China scored at level 5 or higher in mathematics. These students can model complex situations mathematically, and can select, compare, and evaluate appropriate problem-solving strategies for dealing with them (Organization for Economic Cooperation and Development, 2018).

In Singapore, the second ranked on the 2018 PISA result in mathematics, also led to several changes in the curriculum in mathematics where problem solving became the primary goal of learning the subject (OECD, 2018). In response to the changes in Singaporean Mathematics Curriculum, teachers are using gamification to their lessons which contain activities like novel and games using non-routine problems. In addition, the Ministry of Education in Singapore initiated the Teach Less, Learn More which aims to reduce the curriculum content further and engage students in more thinking and problem-solving tasks using gamification (So & Seo, 2018).

According to OECD (2018), Hongkong who is ranked four in the 2018 PISA result in mathematics has also undergone significant reform with a focus on student learning through gamifying the curriculum, pedagogy, and assessment. Teachers in Hongkong are more aware of problem-solving approaches to teaching mathematics where they lead students on more open gamified investigation and exploration of mathematical ideas with playful elements using iPads and other tablet devices (Miao & Reynolds, 2017).

In the Philippine education system, mathematics is one of the top priorities in terms of hours allocated per class in all grade levels. The Department of Education (DepEd) mandated 1 hour for 4 days for the K to 12 Curriculum. Mathematics is also one of the subjects included in assessing one's achievement in terms of national level competency like the National Achievement Test and Basic Education Exit Assessment (Santos et al., 2015).

Given the attention that the Philippine education system is dedicating to mathematics, there are still various issues and difficulties arising in teaching and learning the subject. This agrees with the statement of Alkan (2013) who said that ever since the introduction of mathematics in the curriculum, the subject has always been viewed as a problem area for Filipino students. It has been reported that during the 2018 PISA results, the Philippines ranked near the bottom where majority of Filipino students (80.70%) were classified as having Proficiency Levels below Level 2, with 54.4% below Level 1 proficiency. Also, only 1 out of 5

Filipino students (19.7%) attained Proficiency Levels 2 to 4 and only 0.01% students performed with Proficiency Levels 5 and 6.

Additionally, the mean score for Mathematical Literacy of students in private schools was 395 points, significantly higher than the mean score of students in public schools, 343 points. The average score of students from private schools reached Proficiency Level 1, while the typical student from a private school can answer straight forward math problems, while an average student from a public school may have difficulty doing the same tasks.

In terms of average scores in Mathematical Literacy by administrative region, Region 3 (Central Luzon), Region 4A (CALABARZON), Region 7 (Central Visayas), National Capital Region (NCR), and Cordillera Administrative Region (CAR) achieved average scores higher than the national average of 353 points. Excluding Region 3, these regions were at Proficient Level 1. The rest of the regions including Region I (Ilocos Region) fell below Level 1 proficiency.

Adding to the problem of the Philippine Education System is that the country and the rest of the world has been dealing with the impact of the coronavirus disease 2019 (COVID-19) pandemic. Consequently, numerous offline activities have been controlled or restricted. However, as there is a need to ensure continued education among Filipino learners despite the pandemic, new methods of learning mathematics have been introduced. The solution so far has been online learning. With online learning, teachers and students do not meet at school for mathematics classes. Instead, they interact virtually through computers and smartphones from their own homes (Park & Kim, 2021).

However, online learning has had certain drawbacks. For example, learners and teachers experienced stress while transitioning from offline to online learning (Moawad, 2020).

Sathish et al. (2020) found that gamification is effective for the online teaching methods being used during the COVID-19 era, and they presented the necessity of a method that promotes learning through learner-to-learner interactions. Furthermore, gamification reduces online learning-related stress experienced by learners and enhances their concentration (Park & Kim, 2021).

Thus, amid the COVID-19 pandemic, this study purported to develop as well as to determine the acceptability and the effectiveness of the Gamification-Based Mathematics Curriculum for Senior High School students with the end in view of upscaling their critical, analytical, and creative thinking skills geared towards improved mathematical competence and performance.

Specifically, it sought to answer the following questions:

1. How is the development of the Gamification-Based Instructional Package for General Mathematics Curriculum in terms of the following phases:
    a. Needs Assessment;
    b. Design;
    c. Implementation; and
    d. Evaluation?
2. What is the extent of acceptability of the developed Gamification-Based Instructional Package for General Mathematics Curriculum as assessed by experts on the basis of the following criteria:

a. Format, language, and content for the student portfolio; and
b. Objectives, content, format, language, presentation, and usefulness for the lesson plans?

3. What is the extent of effectiveness of the Gamification-Based Instructional Package for General Mathematics Curriculum on the significance of the difference between and among the pre and post (scores) performances of the control and experimental groups of students?

## METHODOLOGY

A combination of descriptive-developmental and true experimental design was employed in this study. Descriptive research is a type of research that is mainly concerned with describing the nature or condition and the degree in the detail of the present situation. This method was used to describe the nature of a situation, as it existed at the time of the study and to explore the cause/s of a particular phenomenon (Kabir, 2016). With this type of research, it is essential that the researcher already has a clear view or picture of the phenomena being investigated before the data collection procedure is carried out. In addition, descriptive method is advantageous due to its flexibility which can use either qualitative or quantitative data or both, giving the researcher greater options in selecting the instrument for data gathering.

The developmental research, as opposed to simple instructional development, has been defined as the systematic study of designing, developing, and evaluating instructional programs, processes, and materials that must meet criteria of internal consistency and effectiveness. This involves collaboration and explanation while solving real world problems (Tutor, 2021). The researcher used the ADDIE model in developing the Gamification-Based Mathematics Curriculum which is a systematic methodology for curriculum design that includes analysis, design, development, implementation, and evaluation. This model has been claimed to be an effective, systematic model that can be adapted by curriculum developers to design, implement, and evaluate the effectiveness of critical work functions (Danks et al., 2011).

Meanwhile, the true experimental design was used in determining the effectiveness of the Gamification-Based Instructional Package for General Mathematics Curriculum. In a true experimental study, a control and an experimental grouped are used. The dependent variable in each group (performance) is observed before the introduction of the independent variable (Gamification-Based Instructional Package for General Mathematics Curriculum). Then only the experimental group is introduced to the independent variable. Observations of the dependent variable are made for both groups after the exposure of the experimental group to the independent variable (Abdul, Adom, & Adu-Agyem, 2022).

**Context.** The participants in this study were consists of teachers, experts, and students. The teacher-participants of this study were the seven master teachers selected using purposive sampling who used gamification in their mathematics classrooms from the mega schools in Pangasinan. They were chosen as the participants of this study because Master Teachers served as mentor, curriculum leader/ developer, and experts in the school.

Also, one of the participants of this study were the five experts in the field of curriculum development and mathematics education who assessed the acceptability of the Gamification-Based Instructional Package in General Mathematics. A purposive sampling technique was used in selecting the expert-participants. They were chosen as experts because of their broad and deep competence in terms of knowledge, skills, and experience through practice and education in the field of curriculum development and mathematics education. The expert-participants of this study were all doctorate degree holders in mathematics and mathematics education. They are also authors and editors of different mathematics books and modules used by their respective institutions. They were also chosen because of their at least 5 years of experience and advanced trainings in assessing the quality assurance of institutions and/ or programs in their respective institutions.

Moreover, the student-participants of this research were the 40 Grade 11 – Automotive and 40 Grade 11 – Cookery who are enrolled in General Mathematics at Pangasinan School of Arts and Trades for the School Year 2021-2022 under the online distance learning. The two sections of Grade eleven students were randomly selected.

A complete enumeration of students in the two sections was employed. The researcher ensures the equivalency of the two groups of participants and using heterogenous group of students as the experimental and controlled group.

In selecting the participants in the control group and experimental group, the researcher used the grades of student-participants in Grade 10 mathematics using pairwise comparison and it was revealed that the performance of the assigned controlled group who are the 11-Automotive students and the assigned experimental group, the 11-Cookery has no significant difference.

**Instrument.** Formal structured interviews about the development of the Gamification-Based Instructional Package for General Mathematics Curriculum were conducted for each teacher-participant at the beginning of the study. Each participant's interview lasted approximately thirty minutes each. The interviews were conducted at the convenience of the teacher-participants.

Furthermore, the researcher used a survey questionnaire in gathering a pertinent data as an instrument to know the extent of acceptability of the experts-participants on the Gamification-Based Instructional Package for General Mathematics Curriculum. The said survey questionnaire was adapted by the researcher from Funa & Ricafort (2019).

The first part of the survey questionnaire focused on the profile of the expert-participants based on their designation and experiences on curriculum development.

The second part of the survey questionnaire focused on the extent of acceptability of the expert-participants on the Gamification-Based Instructional Package for General Mathematics Curriculum on the basis of the following criteria: (a) Format, language, and content for the student portfolio and (b) Objectives, content, format, language, presentation, and usefulness for the lesson plans.

The third part of the survey-questionnaire is the suggestions that the expert-participants can give that will help to enrich the improvement of the Gamification-Based Instructional Package for General Mathematics Curriculum. The results of the survey were tallied and analyzed to address the improvement of the proposed curriculum.

The researcher tested the validity of the instrument to the five educators who are experts in the field of research, curriculum development, and mathematics education. They were chosen because they possessed an extensive knowledge, credentials, training, education, and related educational qualification sufficient for the researcher to rely on their expert opinion. Further, they checked and approved the validation of the instrument. Content Validation Index (CVI) was used to check the content validity of the questionnaire. The computed CVI of 1.00 indicates that there was complete agreement by the evaluators that the items in the questionnaire are appropriate. We can conclude that the content validity of the items reflected the content of the domain of interest.

Cronbach's alpha was used to measure the internal consistency of the survey questionnaire and the researcher tried-out group into three Mathematics Master Teachers and two College Professors. The computed Cronbach alpha reliability of 0.94 implies that the instrument used in this study is 94% reliable.

Another instrument used in this study was the achievement test given in the pretest and posttest which consists of 10 items that measured the effectiveness of the Gamification-Based Instructional Package. This was given to the student-participants of the study. The table of specification was prepared to ensure that the topics, and the cognitive process involved will be proportionately in the test. The items were generated based on the topics of the K to 12 Senior High School Curriculum in General Mathematics.

The researcher prepared problem sets which comprised of 20-word problems that sought to measures learner's mathematical problem-solving skills. The problems were open-ended or free response to allow the students to explore different solution strategies rather than limiting them to use one-way methods of the textbook. The tests were given to one supervisor, two head teachers, and two master teachers in mathematics who had been experienced to evaluate the appropriateness of the test items. The tests were then pilot tested to a sample of twenty grade 11 students who were not included on the actual participants of this study.

For the item analysis, there were two criterion groups, the top 27 percent and the bottom 27 percent based on the scores. The performance of the two groups on each of the items were analyzed to determine whether the item is acceptable or not. A table for the index of discrimination and difficulty was prepared to tally the findings.

After getting the degree of difficulty of the item, the discriminating power (the degree by which the item discriminates the high group from the low group) was computed and evaluated the items based on the acceptable level of difficulty and discrimination.

The reliability of the word problems was established by analyzing the discrimination and difficulty indexes and correlated using Kuder-Richardson Formula 20 (KR20) for the relationship of the accepted instrument or problems. The Kuder-Richardson method was chosen because aside from less time consuming, the method requires only the administration of a single test and does away with any bias that might arise when a test is split any one of a number of ways in the split-half method (Machisi, 2013).

With the computed KR20 values of 0.74 and 0.71 which means the pretest and posttest are good for a classroom test. It goes to illustrate that the test is reliable and acceptable for use since the reliability coefficients exceeds 0.60 for the reliability and validity tests (Gay, Mills, & Airasian, 2012).

The accepted problems were evaluated using the Content Validity Ratios to establish or judge if the accepted problems were essential to the students for the study or not. The test of validity was done by the experts in the field of mathematics and assessment of learning. The experts were asked to independently judge if the items reflected the content domain of the study. The researcher then calculated the content validity ratio of the problem set. The Content Validity Index (CVI) for the whole test is the mean of the CVR values of the retained items (Molano, 2020). A CVI value of 1.0 was obtained in the problem set used in this study. This indicated that there was a complete agreement among the judges that the set of word problems reflected the content domain of the study.

**Data Collection.** The development of the Gamification-Based Mathematics Curriculum started with the needs analysis or the needs assessment phase. In this phase, the researcher gathered information about the knowledge, skills, and attitudes the student needs to achieve and the least learned competencies that need to be taught in General Mathematics. A certification of the least learned competencies in General Mathematics was secured from the office of the Education Program Supervisor in Mathematics of Schools Division Office I Pangasinan.

In the design phase, the researcher prepared the research instruments, pre and posttest to be used in the study and the instructional materials for the Gamification-Based Mathematics Curriculum which includes student portfolio and lesson plans. Selection of game elements such as game mechanics, badge types, power cards, journal logs, character's level, character's profile, and scoring board of the instructional package was done in this phase.

For the implementation of the curriculum, the researcher asked for the approval of the school principal of PSAT to gather the needed data from the students enrolled in General Mathematics for the school year 2021-2022. Upon the approval of the school principal, the researcher sent letters to parents explaining the conduct of the study and requesting parental consent. The researcher distributed 80 letters, of which all were returned. Also, during the retrieval of the parental consents, the Gamification-Based Student Portfolio was also distributed to the student-participants through their parents.

After getting the consent from the parents, the researcher administered the pretest using google forms to the student-participants of the study. Students were given the entire length of the period which is 60 minutes to complete the test. All of the 80 student-participants were present during the test via zoom platform.

After the administration of the pretest, the researcher assigned students using simple random sampling to the control and experimental groups and started the experiment after a week. The experiment of the study was implemented every Friday of October, November, and December 2021. The control group was scheduled from 9:00AM to 10:00AM while the experimental group was scheduled from 11:00AM to 12:00NN. Both the control and experimental groups used zoom platform in the delivery of lessons. The lessons or topics discussed and facilitated by the researcher who is the teacher of both groups are the following: solving problems involving rational functions, rational equations, rational inequalities, inverse functions, exponential functions, exponential equations, exponential inequalities, logarithmic functions, logarithmic equations, and logarithmic inequalities. The researcher facilitated every lesson in General Mathematics for 60 minutes to both groups of

the study. Also, the researcher also used the 7E type of lesson plan to both groups and the same references for the subject. The researcher makes it a point that quizzes, questions, and learning conditions were exactly the same for both groups except the use of the proposed Gamification-Based Instructional Package for General Mathematics Curriculum.

Evaluation phase is the centerpiece of the process of the development of the Gamification-Based Mathematics Curriculum. In this phase, the researcher looked for experts who will assess the material to determine its extent of acceptability. The researcher handover the survey questionnaire with the Gamification-Based Instructional Package in General Mathematics using google forms to the selected expert-participants of the study.

Also, in this phase, the researcher administered the posttest using google forms to both control and experimental groups of the study. Students were also given the entire length of the period which is 60 minutes to complete the test. Also, all of the 80 student-participants were present during the test via zoom platform. The scores were evaluated and compared to determine the effectiveness of the Gamification-Based Instructional Package for General Mathematics Curriculum.

After the experts accomplished the survey questionnaire for the extent of acceptability of the Gamification-Based Instructional Package for General Mathematics Curriculum and determined the effectiveness through experimentation, the researcher gathered and consolidated the data for analysis and interpretation and the researcher affixed the suggestions of the experts and result of the experimental study to improve the proposed Gamification-Based Instructional Package for General Mathematics Curriculum.

**Analysis.** The following tools were used by the researcher to analyze and interpret the gathered data in the present study.

For specific sub-problem number 1, thematic analysis was used. The researcher closely examined the data to identify common themes – topics, ideas, and patterns of meaning that came up repeatedly.

For specific sub-problem number 2, descriptive statistics was used. Computed mean was utilized by the researcher to determine the acceptability of the Gamification-Based Instructional Package for General Mathematics Curriculum by the expert-participants.

In order to interpret the computed mean on the acceptability of the proposed gamification-based instructional package, the following scale was used to interpret the data:

| Scale | Limits of Scale | Qualitative Description |
|---|---|---|
| 5 | 4.21-5.00 | Highly Acceptable |
| 4 | 3.41-4.20 | Moderately Acceptable |
| 3 | 2.61-3.40 | Acceptable |
| 2 | 1.81-2.60 | Slightly Acceptable |
| 1 | 1.00-1.80 | Not Acceptable |

For specific sub-problem number 3, the researcher used inferential statistics. The independent sample test (t-test) was employed to determine the significant difference of the student-participants' pretest and posttest scores particularly on the effectiveness of the proposed curriculum. This is a test for analyzing the data obtained from two different groups of participants to determine whether the group mean difference is so large that it could be attributed to chance.

All statistical computations in this study were done using the Statistical Package for Social Sciences (SPSS).

## RESULTS AND DISCUSSIONS

### Development of the Gamification-Based Instructional Package for General Mathematics Curriculum

Tanghal (2019) points out that a gamification-based curriculum is structured in such a way its learning opportunities are aligned with the attainment of the set learning goals. Relative to the development of the Gamification-Based Instructional Package for General Mathematics Curriculum, the responses of the participants brought out patterns which served as themes alongside assessment, design, implementation and evaluation, discussions of which follow:

### Needs Assessment Phase

After various phases of theme development, the researcher identified two (2) important themes each on the needs assessment phase of the Gamification-Based Instructional Package for General Mathematics Curriculum. The following themes are presented as follows:

*Improving the Least Learned Competencies*

According to Zarate et al. (2020), the primary goal of teaching is to provide appropriate and effective instruction to students. Thus, a teacher must consider the needs of students and their approaches to learning. Moreover, according to Taghal (2020), developing Gamification-Based Mathematics Curriculum play an integral role in the teaching-learning process and it has strong relationship with improving the least learned competencies of students in Mathematics.

Teacher Vincent shared during the interview that in his experience in teaching mathematics, students at all levels tend to have difficulties with inequalities. Some students treat inequalities as equalities. Other have a narrow understanding of the terms more or less and some students have major difficulties interpreting inequality solutions. He added that the errors in solving the word problem are largely due to their inability to understand and interpret sentences before facing the process and skills coding. It causes students making other mistakes as they have experiences difficulties in understanding the meaning of the questions.

Teacher Gemma corroborated this when she said that solving problems involving rational functions, rational equations, rational inequalities, inverse functions, exponential functions, exponential equations, exponential inequalities, logarithmic functions, logarithmic equations, and logarithmic inequalities must be treated for students to cope with higher mathematics. For this reason, it is good that the researcher came up

with the development of a Gamification-Based Mathematics Curriculum for Senior High School to help learners, teachers, and the school administration to understand the needs and find a reason to take possible steps to get contentment of all concern.

On the other hand, Teacher Nancy stressed how selection of lessons for gamification anchored on the learning objectives make for effective gamification. She claimed that as reflected in the developed curriculum clearly showed least learned competencies played part in the selection of lessons to be gamified. Consequently, the learning and behavior goals address the expected competencies the learners are supposed to master. Therefore, it is very important that lesson selection for gamification should always take into consideration the learning objectives involved.

Undeniably, in needs assessment, curriculum developers should consider the total make-up of the learner by improving the least leaned competencies in Mathematics. Tanghal (2019) underscores this when he pointed out how learning goals help guide the gamified learning experience and to the attainment of the lesson's behavior goals. It is apparent how the developed curriculum met this criterion as affirmed by the master teachers cited herein.

*Reinforce Learning and Promote Knowledge-Transfer*

According to Gallo (2019), gamification has the power to reinforce key concepts, behaviors, and skills that, when applied, proved to be effective in engaging a wide variety of learners. In fact, the 2018 Gamification Survey found that 84% of the respondents feel that gamification makes them more engaged, 87% feel it makes them more productive and 82% feel it makes them happier at doing the tasks. It seems that the developed mathematics curriculum has the potential to yield similar results given the responses of the participants relative to the curriculum reinforcement of learning as evaluated in terms of its selection of lessons. The collective responses of the participants brought to the fore this theme of affirming the developed Gamification-Based Mathematics Curriculum reinforcement of learning and promotion of knowledge transfer.

As Teacher Hernando claimed that gamification is a real game changer for the students especially those who are familiar with the Minecraft or Mobile Legends. It is for sure that mathematics lessons fused with game elements can increase student engagement, create active learners, and prevent student stress. And this aspect of gamification is effective in reinforcing in learning as it helps ensure that the learners are ready to apply what they have learned in the consequent learning tasks they have to do.

Equally, Teacher Moises shared that as a Mathematics teacher, his review of the developed Gamification-Based Instructional Package for General Mathematics Curriculum was made more enriching by the fact that he saw how its selection of lessons contributed to the reinforcement of learning and transfer of knowledge. Since the math-based games were incorporated into the existing curriculum by inserting them into relevant lessons to replace less engaging content, the developed gamification-based mathematics curriculum has the essential elements that will keep the students motivated and engaged.

Meanwhile, Teacher Julius upholds the same observation when he pointed out that transfer of learning occurs when the student is motivated by the topic, motivated to learn, has previous knowledge on the subject,

and know how to connect the new information to existing information. The Gamification-Based Mathematics Curriculum has the necessary component that makes its development effective.

For improved learning outcomes, Baldeon (2016) maintains that gamification in mathematics lessons should always take into consideration knowing where the learners are before choosing what game-based activities shall suit them best. This takes into focus pinpointing the learners' weaknesses or least mastered competencies and coming up with activities that will not only engage them but will also ensure that learning objectives are met; thereby resulting to reinforcement of learning and promotion of knowledge transfer. All in all, the developed learning material has become the platform for achieving learning goals and reinforcing learning as evidenced by the participants' responses.

**Design Phase**

Two themes emerged from the pattern of responses of the participants relative to the design phase of the development of the Gamification-Based Instructional Package for General Mathematics Curriculum.

*Preparation for the development of the material*

Any material developed in aid of instruction adheres to a prescribed format (Villanueva & De Vera, 2020). The developed gamification-based instructional package for mathematics curriculum is no exemption to this. Urbano (2020) posits that in designing gamification lessons in mathematics, certain elements come into play which serve as the framework of the material. For the research participants, a review of the Gamification-Based Instructional Package for General Mathematics Curriculum showed how it has conformed to standards or format of game design and development of the material. According to them, the Gamification-Based Instructional Package for General Mathematics Curriculum has the framework that revolved around mechanics and dynamics.

To this end, Teacher Vincent explained that mechanics used in the material are related to the game's components, control, and courses while dynamics used describes how the mechanics run in the game based on player or learner input and its relationship with other mechanics. These two components of the gamified lessons are very important; that is why it is equally important that the students are guided well on how the activity or game is done and how they can progress from it.?

Meanwhile, Teacher Paul has this advice for those wanting to design their own gamified lessons in math per his evaluation of the developed Gamification-Based Instructional Package for General Mathematics Curriculum. He shared that Gamification is not just about incorporating any games in the lesson. As reflected in the Gamification-based Instructional Package for General Mathematics Curriculum, it is important that its incorporation anchors itself on the most essential learning competencies (MELCs) and that its mechanics and dynamics are carried out in the phases of the lesson such as content presentation and/or assessment.

Taking stock of the responses of the research participants brings to the fore Chen's et al. (2018) observation that the preparation of material should take into account the right combination of game mechanics and learning opportunities. Thus, it is crucial that the gamified lessons give students the opportunity to choose additional skill tasks, readings, and experiments or real problems.

Ventayen, Salcedo, & Ventayen (2019) contends that gamification has the potential to reinforce content and engage all learners in new ways. This was clearly noted by the research participants in their evaluation of the Gamification-Based Instructional Package for General Mathematics Curriculum as their responses brought to the fore their observations that it exemplifies differentiation in terms of meeting the needs of diverse students when it was prepared or conceptualized. To cite, Teacher Gemma mentioned that as a mathematics teacher who also makes use of gamification in the math lessons, she had observed how the developed Gamification-Based Mathematics Curriculum adheres to the diverse needs of the learners and tap into the kind of engagement that results to higher participation and motivation. The curriculum allows for differentiation as the students can choose which of the additional elements they will take on.

On the other hand, Teacher Vincent shared that the game aspect itself in the Gamification-Based Mathematics Curriculum itself already allows for differentiated instruction and formative assessments and being fun at the same time. He said that for him, the curriculum allows students to work at their own pace and be at the right level for their individual abilities which makes a big difference in their motivation."

Teacher Hernando supported those observations made by Teacher Vincent when he simply said that the developed Gamification-Based Curriculum has this element or feature that can differentiate what skills students are assigned.

From the responses, it can be gleaned that the Gamification-Based Mathematics Curriculum has been well thought of at the onset in terms of preparation for its development as it incorporated the very elements that allow for differentiated activities or accommodate the diverse needs of the students. Schleicher (2018) pointed this out when she said that the main consideration curriculum planners and developers should bear in mind is meeting the needs of diverse learners. Moreover, she stressed that while incorporating more gamification into their math lessons to encourage critical thinking skills, the material should also allow learners to learn at their own pace and meet their learning needs as well thus, differentiation is the key to ensuring the gamified lesson works for all students.

*Engaging and Interactive Game Elements*

Gamification elements are often considered as crucial components of designing a curriculum because they help to engage students by presenting learning content in integration with game elements in a motivating way. According to Dabrowski (2018), motivation always leads to engagement. This was what was common among the observations made by the participants upon evaluation of the gamified math curriculum in terms of its design. The interplay of the elements and how it was integrated into the entirety of the work or output were assessed to be commendable, if not, effective by the research participants.

Relative to this, Teacher Hernando shared that since it is a gamification-based curriculum, the usual elements of a curriculum should be there such as the learning goals, learning opportunities and assessment. What makes this output different is the innovation put into it which is the incorporation of gamification to the Mathematics Curriculum. Also, the impact of the images used in the cover pages of the instructional package and power cards where all inspired by Mobile Legends and Yu-Gi-Oh! added to the interest of the students to

learn Mathematics. All in all, the design was made engaging for the students while integrating at the same time.

Teacher Moises supported what Teacher Hernando shared by way of saying that design does not only refer to aesthetics like visuals or interactive capability of the games; rather, it refers to the different components that made up the whole gamified curriculum and how these contributed to making it engaging and integrative. Character's Profile for example which is one of the parts of student's portfolio where students can play with their creativity and imagination. In this part of the portfolio, players have to create the appearance of their character, its name, age, weaknesses, powers, and description. The name of their character serves as their pseudonym. The use of pseudonym may prevent competition among students, rather promote competitions within themselves. Further, it makes the leaderboards and ranking more mysterious and exciting.

Moreover, the use of Journal Logs in the student portfolio where students can freely write their feelings, thoughts, and suggestions on the lesson and the game. It empowers students by expressing their own selves. Moreover, it is a venue for teachers to collect each of their student's ideas. Through this, teachers can improve the way they deliver the lessons and the game based on the students' responses. This serves as a venue for communication between the teacher and the students.

From the responses of the participants, it can be gleaned that their evaluation of the Gamification-Based Mathematics Curriculum in terms of its design runs parallel to what Ghani & Daud (2018) claim about the ADDIE model which was integrative and contributes to the whole process. Likewise, the findings corroborate the study made by Alexander, Cruz, & Torrence (2019) which highlighted how the elements of the developed material come into play in contributing to the attainment of its learning goals.

**Implementation Phase**

After various phases of theme development, the researcher identified theme on the implementation phase of the Gamification-Based Mathematics Curriculum to Senior High School students.

*Relevant Landmarks in the Actual Implementation Process*

Smiderle et al. (2020) maintains that the effectiveness, relevance, and implementation of a gamification-based curriculum can always be tested on what it purports to do or achieve. Through a test of its acceptability and effectiveness vis-à-vis its implementation, the participants commonly assessed or found the gamification-based mathematics curriculum in terms of its implementation as relevant landmarks in the actual implementation process. As Teacher Gemma pointed out that by subjecting the developed Gamification-Based Mathematics Curriculum to a test of its acceptability and effectiveness in achieving learning goals as well as addressing students' learning needs just like in the developed curriculum, its evaluation and implementation shall serve as fundamental concepts and principles in the planning and actual implementation process.

Alongside the response of Teacher Gemma, Teacher Julius commented that the results ng initial status of implementation of the gamification-based math lessons or curriculum will be a big help in assessing what works and does not work in terms of its components.

On the other hand, Teacher Nancy attested that all in all, the implementation phase and the process involved in it shall ultimately serve as guiding principles in improving the material. That is why the developed Gamification-Based Mathematics Curriculum needs to undergo the test of acceptability and effectiveness.

Undeniably, the responses drawn from the patterns of the participants' responses affirm what Reno et al. (2020) claims that designing principles come into play in the planning and actual implementation process at it becomes the yardstick in the success of the material.

**Evaluation Phase**

A theme emerged from the pattern of responses of the participants relative to the evaluation phase of the development of the Gamification-Based Instructional Package for General Mathematics Curriculum.

*Strategic Mapping Process*

According to McLaren et al. (2017), one advantage of a gamification-based curriculum or lesson for that matter is its modifiable content. This appears to be the case in point with regards to how the developed gamification-based mathematics curriculum has been assessed by the participants in terms of evaluation.

Teacher Moises shared that when materials have been used as part of the instructional process, the materials themselves should be assessed for their relevancy, practicality, and usefulness in the lesson or unit. If the curriculum is developed by the teacher for the first time in a classroom, then the teacher is responsible for determining how effective it is and changing them appropriately before they used again. This is what he saw in the evaluation phase of the development of the Gamification-Based Mathematics Curriculum where the researcher chose experts to evaluate the acceptability of the curriculum in terms of its format, language, objective, content, presentation, and usefulness of the curriculum then later test its effectiveness to the student-participants of the study.

Such insight or observation was duly noted by Teacher Paul who stressed that the evaluation of the Gamification-Based Mathematics Curriculum subjected its components or elements to a test of its acceptability as well as of its effectiveness. In turn, the results of such test or evaluation shall become the basis in mapping out a strategic process by which the material can be enhanced for it to achieve its purpose.

Notably, the findings of the study ran parallel with the study of Gustiani, Widodo, & Suwarma (2016) which highlighted how the findings of the evaluation of a proposed or developed curriculum serves as a guide in modifying the elements of the material to accommodate what have been raised as concerns or areas for improving it.

**Extent of Acceptability of the Developed Gamification-Based Instructional Package for General Mathematics Curriculum**

This part of the study addresses the third specific problem. This pertains to the extent of acceptability of the developed Gamification-Based Instructional Package for General Mathematics Curriculum as assessed

by experts on the basis of the following criteria: (a) format, language, and content for student portfolio and (b) objectives, content, format, language, presentation, and usefulness for the lesson plans.

The order of the presentation is sequenced accordingly such that the discussion of the extent of acceptability of the gamification-based student portfolio come first then followed immediately of that by the gamification-based lesson plans.

**Gamification-Based Student Portfolio**

Tables 1 and 2 present the extent of acceptability of the developed Gamification-Based Student Portfolio for General Mathematics Curriculum along the aspect format, language, and content.

*Format and Language*

Table 1 shows the data and results of the assessment of the Mathematics and Curriculum experts on the format and language of the Gamification-Based Student Portfolio for General Mathematics Curriculum.

It can be noted that the items with the highest weighted mean of 4.80 are the following: layout of the portfolio is arranged in a logical and sequential order, the instructions are clear and well-emphasized, the font size and the font style are readable, the illustrations, pictures, and captions are properly laid out, and the student portfolio is generally formatted in a convenient manner considering the paper size. This means that the format of the Gamification-Based Student Portfolio is highly acceptable and excellent to the experts.

Moreover, it can also be noted that the item, the language used is easy to understand has the lowest weighted mean of 4.20. This means that the language used in the student portfolio is moderately acceptable. This is due to technical terms used in the material. That is why the developer defined and described those terms for the readers to easily understand the terms used in the student portfolio.

Overall, the experts rated the student portfolio along the aspect of format and language as highly acceptable with an overall weighted mean of 4.62. This means that the student portfolio is excellent in terms of its format and language.

The result is parallel to the study of Funa & Ricafort (2019) that the format and language of a curriculum must be properly laid out, motivating, and easy to understand.

**Table 1. Extent of Acceptability of the developed Gamification-Based Student Portfolio for General Mathematics Curriculum along the Aspect Format and Language**

| Items | Weighted Mean | Rank | Verbal Interpretation |
|---|---|---|---|
| 1. The layout of the portfolio is arranged in a logical and sequential order. | 4.80 | 3 | Highly Acceptable |
| 2. The instructions are clear and well-emphasized. | 4.80 | 3 | Highly Acceptable |
| 3. The font size and the font style are readable. | 4.80 | 3 | Highly Acceptable |
| 4. The symbols are well-defined. | 4.40 | 9.5 | Highly Acceptable |

| | | | |
|---|---|---|---|
| 5. The tables/ diagrams are well-presented and easy to understand. | 4.60 | 7 | Highly Acceptable |
| 6. Key points and key concepts are well-highlighted to focus attention while reading. | 4.60 | 7 | Highly Acceptable |
| 7. Titles and subtitles in the Portfolio are clearly defined. | 4.40 | 9.5 | Highly Acceptable |
| 8. Illustrations, pictures, and captions are properly laid out. | 4.80 | 3 | Highly Acceptable |
| 9. The student portfolio is generally formatted in a convenient manner considering the paper size used. | 4.80 | 3 | Highly Acceptable |
| 10. The language used is easy to understand. | 4.20 | 11 | Moderately Acceptable |
| 11. The language used is clear, concise, and motivating. | 4.60 | 7 | Highly Acceptable |
| **Overall Weighted Mean** | **4.62** | **Highly Acceptable** | |

**Legend:**

| Scale | Limits of Scale | Verbal Interpretation |
|---|---|---|
| 5 | 4.21-5.00 | Highly Acceptable |
| 4 | 3.41-4.20 | Moderately Acceptable |
| 3 | 2.61-3.40 | Acceptable |
| 2 | 1.81-2.60 | Slightly Acceptable |
| 1 | 1.00-1.80 | Not Acceptable |

*Content*

Table 2 illustrates the extent of acceptability of the developed Gamification-Based Student Portfolio for General Mathematics Curriculum along the Aspect of Content.

As shown in table 2, the experts assessed the content of the developed Gamification-Based Student Portfolio for General Mathematics Curriculum as highly acceptable based on the overall weighted mean of 4.30.

It can be noted that only four out of the ten indicators were claimed to be highly acceptable: the game can motivate students to finish the activities on time (4.60); the illustrations/ captions can help in following the game's instructions (4.60); the styles of illustrations and written expressions are appreciable (4.60); and the lesson is enjoyable until the end (4.60).

**Table 2. Extent of Acceptability of the developed Gamification-Based Student Portfolio for General Mathematics Curriculum along the Aspect Content**

| Items | Weighted Mean | Rank | Verbal Interpretation |
|---|---|---|---|
| 1. Objectives of the game are easy to understand. | 4.00 | 9 | Moderately Acceptable |
| 2. Game mechanics are easily understandable. | 3.80 | 10 | Moderately Acceptable |

| | | | |
|---|---|---|---|
| 3. The game can motivate students to finish the activities on time. | 4.60 | 2.5 | Highly Acceptable |
| 4. The ideas and concepts of the game are clearly understandable. | 4.20 | 6.5 | Moderately Acceptable |
| 5. The illustrations/ captions can help in following the game's instructions. | 4.60 | 2.5 | Highly Acceptable |
| 6. The game could help students understand fully the lessons. | 4.20 | 6.5 | Moderately Acceptable |
| 7. The styles of illustrations and written expressions are appreciable. | 4.60 | 2.5 | Highly Acceptable |
| 8. Reading and accomplishing the portfolio is enjoyable. | 4.20 | 6.5 | Moderately Acceptable |
| 9. It is easier to study General Mathematics using game elements. | 4.20 | 6.5 | Moderately Acceptable |
| 10. The lesson is enjoyable until the end. | 4.60 | 2.5 | Highly Acceptable |
| **Overall Weighted Mean** | **4.30** | **Highly Acceptable** | |

**Legend:**

| Scale | Limits of Scale | Verbal Interpretation |
|---|---|---|
| 5 | 4.21-5.00 | Highly Acceptable |
| 4 | 3.41-4.20 | Moderately Acceptable |
| 3 | 2.61-3.40 | Acceptable |
| 2 | 1.81-2.60 | Slightly Acceptable |
| 1 | 1.00-1.80 | Not Acceptable |

The remaining indicators turned out to be moderately acceptable: objectives of the game are easy to understand (4.00); game mechanics are easily understandable (3.80); the ideas and concepts of the game are clearly understandable (4.20); the game could help students understand fully the lessons (4.20); reading and accomplishing the portfolio is enjoyable (4.20); and it is easier to study General Mathematics using game elements.

It is apparent from the results that there are elements alongside the aspect of content that needed to be looked into to ensure that the developed material will be relevant and effective and will serve its purpose where addressing educational outcomes and learner engagement in Math is concerned. It brings into the fore the principle espoused by Gustiani, Widodo, & Suwarma (2016) about modifying content/s based on the material's elements.

**Gamification-Based Lesson Plan**

Tables 3 to 7 shows the data and results of the assessment of the Gamification-Based Instructional Package in General Package along the aspects of objectives, content, format and language, presentation, and usefulness.

*Objectives*

Table 3 reflects the experts' assessment as regards to the aspect on objectives of the Gamification-Based Lesson Plan for General Mathematics Curriculum.

**Table 3. Extent of Acceptability of the developed Gamification-Based Lesson Plan for General Mathematics Curriculum along the Aspect Objectives**

| Items | Weighted Mean | Rank | Verbal Interpretation |
|---|---|---|---|
| 1. The objectives are clearly stated in behavioral form. | 4.40 | 3 | Highly Acceptable |
| 2. The objectives are well-planned, formulated, and organized. | 4.00 | 5 | Moderately Acceptable |
| 3. The objectives stated are specific, measurable, and attainable. | 4.40 | 3 | Highly Acceptable |
| 4. The objectives are relevant to the topics of each lesson. | 4.80 | 1 | Highly Acceptable |
| 5. The objectives take into account the students' needs. | 4.40 | 3 | Highly Acceptable |
| **Overall Weighted Mean** | **4.40** | **Highly Acceptable** | |

**Legend:**

| Scale | Limits of Scale | Verbal Interpretation |
|---|---|---|
| 5 | 4.21-5.00 | Highly Acceptable |
| 4 | 3.41-4.20 | Moderately Acceptable |
| 3 | 2.61-3.40 | Acceptable |
| 2 | 1.81-2.60 | Slightly Acceptable |
| 1 | 1.00-1.80 | Not Acceptable |

It can be seen in table 3 that the experts assessed the Gamification-Based Lesson Plans as highly acceptable as evidenced by the overall weighted mean, 4.40. This can be attributed to the four indicators which were assessed as highly acceptable: the objectives are clearly stated in behavioral form (4.40); the objectives stated are specific, measurable, and attainable (4.40); the objectives are relevant to the topics of each lesson (4.80); and the objectives take into account the students' needs (4.40).

However, it can be viewed, too, that one out of the five indicators were claimed to be moderately acceptable: the objectives are well-planned, formulated, and organized. This aspect of the objectives upholds what Cassie (2018) stressed when setting learning goals or objectives as this aspect clearly spells out what competencies are to be addressed in the Gamification-Based lessons. Thus, the study can anchor its modifications of learning goals on this principle upheld by Cassie (2018) relative to objectives.

*Content*

Along the aspect of content, the developed Gamification-Based Lesson Plans for General Mathematics Curriculum turned out to be highly acceptable as shown in table 4 by the overall weighted mean of 4.32.

It can be seen from the data that the content of each lesson is directly relevant to the defined objectives (4.80) and each topic is given equal emphasis in the lesson (4.60) were indicated to be highly acceptable. On the other hand, the same data reveal that indicators pertinent to, the content of each lesson is simple and easy to understand (4.00), the content of each lesson is fully discussed (4.00); and the topics are supported by illustrative examples and the practice tasks are suited to the level of the students (4.00) were noted to be moderately acceptable. Consequently, these aspects of content can serve as basis for its modification. The results of the study affirm what Dicheva & Dichev (2017) underscored about how content is crucial to the attainment of the learning goals set to be achieved in the Gamification-Based lessons.

**Table 4. Extent of Acceptability of the developed Gamification-Based Lesson Plan for General Mathematics Curriculum along the Aspect Content**

| Items | Weighted Mean | Rank | Verbal Interpretation |
|---|---|---|---|
| 1. The content of each lesson is directly relevant to the defined objectives. | 4.80 | 1 | Highly Acceptable |
| 2. The content of each lesson is simple and easy to understand. | 4.00 | 4.5 | Moderately Acceptable |
| 3. The content of each lesson is fully discussed. | 4.00 | 4.5 | Moderately Acceptable |
| 4. The topics are supported by illustrative examples and the practice tasks are suited to the level of the students. | 4.20 | 3 | Moderately Acceptable |
| 5. Each topic is given equal emphasis in the lesson. | 4.60 | 2 | Highly Acceptable |
| **Overall Weighted Mean** | **4.32** | **Highly Acceptable** | |

**Legend:**

| Scale | Limits of Scale | Verbal Interpretation |
|---|---|---|
| 5 | 4.21-5.00 | Highly Acceptable |
| 4 | 3.41-4.20 | Moderately Acceptable |
| 3 | 2.61-3.40 | Acceptable |
| 2 | 1.81-2.60 | Slightly Acceptable |
| 1 | 1.00-1.80 | Not Acceptable |

*Format and Language*

Table 5 presents the extent of acceptability of the developed Gamification-Based Lesson Plan for General Mathematics Curriculum along the aspect of format and language.

The noteworthy overall weighted mean (4.48) attributed by the experts to the developed Gamification-Based Lesson Plan for General Mathematics Curriculum along the aspect of format and language which translates to highly acceptable goes to show how it well it has been crafted or well-thought of in this regard. Specifically, it has been found to be highly acceptable in the following indicators: the format/ layout is well-organized which makes the lessons more interesting (4.40); the language used is clear, concise, and motivating (4.40); the symbols are well-defined (4.60); and the instructions in the Lesson Plan are concise and easy to

follow (4.80). Still, the Gamification-Based lesson plans should be looked into the area where the experts claimed that it's moderately acceptable, the language used is easy to understand.

According to the study of Carolino & Queroda (2018), lesson plans must be carefully planned, selected, organized, refined, and used in a course of the maximum effect. Hence the format and language of the lesson plan should take into consideration so that student learning is optimized.

**Table 5. Extent of Acceptability of the developed Gamification-Based Lesson Plan for General Mathematics Curriculum along the Aspect Format and Language**

| Items | Weighted Mean | Rank | Verbal Interpretation |
|---|---|---|---|
| 1. The format/ layout is well-organized which makes the lessons more interesting. | 4.40 | 3.5 | Highly Acceptable |
| 2. The language used is easy to understand. | 4.20 | 5 | Moderately Acceptable |
| 3. The language used is clear, concise, and motivating. | 4.40 | 3.5 | Highly Acceptable |
| 4. The symbols are well-defined. | 4.60 | 2 | Highly Acceptable |
| 5. The instructions in the Lesson Plan are concise and easy to follow. | 4.80 | 1 | Highly Acceptable |
| **Overall Weighted Mean** | **4.48** | **Highly Acceptable** | |

**Legend:**

| Scale | Limits of Scale | Verbal Interpretation |
|---|---|---|
| 5 | 4.21-5.00 | Highly Acceptable |
| 4 | 3.41-4.20 | Moderately Acceptable |
| 3 | 2.61-3.40 | Acceptable |
| 2 | 1.81-2.60 | Slightly Acceptable |
| 1 | 1.00-1.80 | Not Acceptable |

*Presentation*

Table 6 depicts the extent of acceptability of the developed Gamification-Based Lesson Plan for General Mathematics Curriculum along the aspect of presentation.

Per evaluation of the Gamified-Based Lesson Plans for General Mathematics Curriculum along the aspect of presentation, the overall weighted mean of 4.56, equates into highly acceptable.

Like the data in the previous table, though it's been said to be highly acceptable in terms of presentation with regards to the following indicators: the topics are presented in logical and sequential order (4.80); the lessons are presented in a unique and original form (4.60); the learning activities are presented clearly (4.60); and, the presentation of each lesson is attractive and interesting to the students (4.60); adequate examples are given to each topic turned out to be moderately acceptable, 4.20. Consequently, this very indicator serves as the area that needs modification. It upholds Smiderle et al. (2018) take on the importance of the interplay of elements that make up the presentation of the developed gamified lessons.

*Usefulness*

The table 7 shows the extent of acceptability of the developed Gamification-Based Lesson Plan for General Mathematics Curriculum along the aspect of usefulness.

Just the same, that indicator which shows that the material allows the students to use their time more efficiently (4.00) turned out to be moderately acceptable should be looked into and duly addressed and modified. Meanwhile, the experts assessed the following indicators relative to usefulness as highly acceptable: the material motivates the students to study General Mathematics (4.80); the material helps to master the topics in time (4.40); the material develops the analytical thinking and reasoning skills of students (4.80); and the instructional material serves as a supplementary material that can cater the needs of the students (4.80).

**Table 6. Extent of Acceptability of the developed Gamification-Based Lesson Plan for General Mathematics Curriculum along the Aspect Presentation**

| Items | Weighted Mean | Rank | Verbal Interpretation |
|---|---|---|---|
| 1. The topics are presented in logical and sequential order. | 4.80 | 1 | Highly Acceptable |
| 2. The lessons are presented in a unique and original form. | 4.60 | 3 | Highly Acceptable |
| 3. The learning activities are presented clearly. | 4.60 | 3 | Highly Acceptable |
| 4. The presentation of each lesson is attractive and interesting to the students. | 4.60 | 3 | Highly Acceptable |
| 5. Adequate examples are given to each topic. | 4.20 | 5 | Moderately Acceptable |
| **Overall Weighted Mean** | **4.56** | **Highly Acceptable** | |

**Legend:**

| Scale | Limits of Scale | Verbal Interpretation |
|---|---|---|
| 5 | 4.21-5.00 | Highly Acceptable |
| 4 | 3.41-4.20 | Moderately Acceptable |
| 3 | 2.61-3.40 | Acceptable |
| 2 | 1.81-2.60 | Slightly Acceptable |
| 1 | 1.00-1.80 | Not Acceptable |

**Table 7. Extent of Acceptability of the developed Gamification-Based Lesson Plan for General Mathematics Curriculum along the Aspect Usefulness**

| Items | Weighted Mean | Rank | Verbal Interpretation |
|---|---|---|---|
| 1. The material motivates the students to study General Mathematics. | 4.80 | 2 | Highly Acceptable |
| 2. The material helps to master the topics in time. | 4.40 | 4 | Highly Acceptable |

| | | | |
|---|---|---|---|
| 3. The material allows the students to use their time more efficiently. | 4.00 | 5 | Moderately Acceptable |
| 4. The material develops the analytical thinking and reasoning skills of students. | 4.80 | 2 | Highly Acceptable |
| 5. The instructional material serves as a supplementary material that can cater the needs of the students. | 4.80 | 2 | Highly Acceptable |
| **Overall Weighted Mean** | **4.56** | **Highly Acceptable** | |

**Legend:**

| Scale | Limits of Scale | Verbal Interpretation |
|---|---|---|
| 5 | 4.21-5.00 | Highly Acceptable |
| 4 | 3.41-4.20 | Moderately Acceptable |
| 3 | 2.61-3.40 | Acceptable |
| 2 | 1.81-2.60 | Slightly Acceptable |
| 1 | 1.00-1.80 | Not Acceptable |

The results only show that the Gamification-Based Instructional Package for General Mathematics Curriculum is highly acceptable to the expert-participants of his study which satisfied Camara (2016) and Funa & Ricafort (2019) claim that a learning material should include objectives which are described to be specific, measurable, attainable, reliable, and timebound. A learning material should contain activities which are manageable, logically, and properly sequences, and useful in helping learners to understand and apply concepts in the subject area and evaluation which can reinforce learners' mastery of concepts and reflects behavioral objectives in each activity. Moreover, the use of language which is clear and the discussion for each lesson is simple enough (Molano, 2020).

**Extent of Effectiveness of the Gamification-Based Instructional Package for General Mathematics Curriculum**

This part of the study addresses the fourth specific problem of this study which pertains to the extent of effectiveness of the developed Gamification-Based Instructional Package for General Mathematics Curriculum on the (scores) performances of the control and experimental groups of students. The gathered data were summarized on the succeeding tables.

*Comparison of the Pretest Scores of the Control and Experimental Groups in General Mathematics*

Tables 8 shows the data and results based on the comparison of the pretest scores of the control and experimental groups in General Mathematics.

The data in table 8 indicated that the mean pretest scores of the control group in General Mathematics was 25.25 with a standard deviation of 7.715 while the experimental group was 24.82 with a standard deviation of 8.102. Even though the control group had a slightly higher mean, there is no significant difference in the mean pretest scores of the students in the control and experimental groups in General Mathematics. This is because the computed p-value of .811 is greater than 0.01 level of significance. Thus, the null hypothesis is

not rejected. These indicate that both of the control and experimental groups have the same mathematical ability before the start of the experiment.

**Table 8. Significant Difference Between the Pretest Scores of the Control and Experimental Groups in General Mathematics**

| Group | Size | Mean | SD | p-Value | Decision | Remarks |
|---|---|---|---|---|---|---|
| Control | 40 | 25.25 | 7.715 | .811** | Do not Reject Ho | Not Significant |
| Experimental | 40 | 24.82 | 8.102 | | | |

**Significant at 0.01 level

*Comparison of the Posttest Scores of the Control and Experimental Groups in General Mathematics*

As shown in table 9, the mean scores of the control and experimental groups in the posttest in General Mathematics were 26.80 and 30.48 respectively. An analysis of the posttest scores of the control and experimental groups in General Mathematics indicated that the experimental group achieved statistically significantly higher mean scores than the control group. This can be attributed to the computed p-value of .004, which is lesser than 0.01 level of significance. Thus, the null hypothesis is rejected. This implies that there is a significance difference between the posttest scores of the control group and experimental groups in General Mathematics which can be associated with the usage of the Gamification-Based Instructional Material to the experimental group.

**Table 9. Significant Difference Between the Posttest Scores of the Control and Experimental Groups in General Mathematics**

| Group | Size | Mean | SD | p-Value | Decision | Remarks |
|---|---|---|---|---|---|---|
| Control | 40 | 26.80 | 5.671 | .004** | Reject Ho | Significant |
| Experimental | 40 | 30.48 | 5.440 | | | |

**Significant at 0.01 level

*Comparison of the Gain Scores of the Control and Experimental Groups in General Mathematics*

The data in table 10 reveal that there is a significant difference between the gain scores of the control and experimental groups in General Mathematics as evidenced by the p-value of .000, which is lesser than the threshold value which was set at 0.01. This means that the null hypothesis is rejected. This shows that the learning material designed based on gamification positively affects students' performance.

**Table 10. Significant Difference Between the Gain Scores of the Control and Experimental Groups in General Mathematics**

| Group | Size | Mean | SD | p-Value | Decision | Remarks |
|---|---|---|---|---|---|---|
| Control | 40 | 1.55 | 3.734 | .000** | Reject Ho | Significant |

| | | | |
|---|---|---|---|
| Experimental | 40 | 5.65 | 4.923 |

**Significant at 0.01 level

*Comparison of the Pretest and Posttest scores of the Control and Experimental Group in General Mathematics*

The data in table 11 calculated the difference between the observed means representative of the pretest and posttest results of the control and experimental groups in General Mathematics. A significance value (p-value) and 99% confidence interval are shown, too.

As shown in the tabular data, the experimental group performed significantly better on the posttest than the pretest with the p-value lesser than the threshold value which was set at 0.01. By examining the mean difference of the group, it can be seen that the experimental group improved more on their performance in General Mathematics. However, it can be seen also on the table that the pretest and posttest scores of the control group has no significance difference because the computed p-value of 0.012 is greater than the 0.01 level of significance. Hence, the control group has no improvement in their performance in General Mathematics.

**Table 11. Significant Difference Between Pretest and Posttest of the Control and Experimental Groups in General Mathematics**

| Group | Category | Size | Mean | SD | p-Value | Decision | Remarks |
|---|---|---|---|---|---|---|---|
| Control | Pretest | 40 | 25.25 | 7.715 | .012** | Do not Reject Ho | Not Significant |
| | Posttest | 40 | 26.80 | 5.671 | | | |
| Experimental | Pretest | 40 | 24.82 | 8.102 | .000** | Reject Ho | Significant |
| | Posttest | 40 | 30.48 | 5.440 | | | |

**Significant at 0.01 level

The result is parallel to the study of Funa & Ricafort (2019), Huang & Hew (2018), Yildirim (2017), and Sakai & Shiota (2016) where gamification utilized in teaching yielded positive effects on students' performance. Thus, the utilization of the Gamification-Based Instructional Package for Mathematics Curriculum is effective in upscaling students' critical, analytical, and creative thinking skills geared towards improved mathematical competence and performance.

Sakai & Shiota (2016), Yildirim (2017), Jagust et al. (2018), and Ismail et al. (2018) also gathered similar findings that gamification as a teaching strategy is effective in improving the academic performance of students in Mathematics. Also, it has positive impact upon the student achievement and student's attitudes towards lessons in Mathematics. Students are more motivated and concentrated.

## CONCLUSIONS

Based on the foregoing findings, gamification in mathematics curriculum should always take into consideration knowing where the learners are before choosing what game-based activities shall suit them best. Moreover, the curriculum developers should focus on the learners' weaknesses or least mastered competencies

and come up with activities that will not only engage them but will also ensure that learning objectives are met. Furthermore, to deliver better education, it is imperative that the developed Gamification-Based Mathematics Curriculum must undergo validation to ensure quality by determining its extent of acceptability and effectiveness.

Although experts found out that the Gamification-Based Instructional Package for General Mathematics Curriculum have limitations like being time-consuming and noise-inducing, the Gamification-Based Mathematics Curriculum was effective in motivating and engaging students to learn which results to the improvement of their performance in General Mathematics over a traditional and a non-Gamification-Based Mathematics Curriculum.

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