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Effectiveness of the Matheladder as a Review Material on the Achievement and Motivation Levels of Grade 9 Learners in Trigonometry

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Abstract
This study aimed to look into the effectiveness of the Matheladder as a review material for grade 9 learners' achievement and motivation level in learning trigonometry. The study was administered to grade 9 learners on the fourth quarter from Acelo C. Badelles Sr. Memorial High School who were selected through purposive sampling. This study employed mixed method of research which used quasi-experimental design as the quantitative method. Quantitative and qualitative data was utilized from the achievement test, motivation questionnaire and interview guide questions. Findings revealed that the experimental groups have significantly higher achievement level compared to the control group. It also reveals that all experimental groups have significantly different motivation levels than the control group. The experimental groups, in particular, had a higher level of motivation than the control group. The drawn insights of the learners revealed that some learners demonstrated an interest in trigonometry and appreciated the game's value in helping them comprehend the teachings in an enjoyable way. Furthermore, the game's Question-and-Answer component, as well as the concept of winning the game, is one of the most captivating parts of the game. The participants had difficulty in answering the test due to the lack of sufficient knowledge, of how hard it is to understand the topics, unfamiliarity with the problem-solving process, and the negative notion of trigonometry. Following are some recommendations based on the foregoing conclusions: (1) Conduct the study in a longer span of time and with larger sample. (2) Encourage the use of the Matheladder game as a formative assessment instead of using it as a review material. (3) Contextualize and incorporate Matheladder in mathematics activities. (4) Replicate the study in the Grade 9 level in order to know the reasons behind the low achievement level in trigonometry. (5) Students and teachers need to focus on conceptual learning rather than rote memorization for meaningful understanding in trigonometry.
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1. Introduction

Mathematics is an integral part of education and is a required subject across all levels of the basic education curriculum. At the secondary level, Mathematics requires more than just performing the four fundamental operations in mathematics or using a formula to find an answer to a given problem. One of its main goals is to make students become effective problem solvers (SEI-DOST & MATHTED, 2011). Mathematics is an essential part of the educational curriculum, as it is used in both daily life and the study of other disciplines. However, it is commonly believed that the majority of students despise mathematics due to a variety of factors including instruction, learners' cognitive, emotional, and psychomotor characteristics, subject matter, and learning environment (Gafoor & Kurukkan, 2015).

Moreover, trigonometry is one branch of mathematics that high school students still find difficult, despite the fact that it has been taught since elementary school (Gur, 2009). Students frequently make mistakes when solving trigonometric questions, such as using incorrect equations, sequences of operations, inappropriate use of sines and cosines, misinterpretations of languages, illogical conclusions, distorted definitions, and technical error computations (Tuna, 2013).

The COVID-19 pandemic has wreaked havoc on education systems around the world, affecting almost 1.6 billion students across 190 countries and continents. The distance learning method is thought to be the most applicable to the COVID-19 pandemic condition. It is surely not simple to implement because it involves the preparation of facilities that support instructors, institutions, and students (Cortez, 2020). This

crisis, on the other hand, has sparked innovation in the education sector. We've seen some innovative methods to ensure the continuity of education and training (UNESCO, 2020). Remote learning at home is becoming more than a trend; it is becoming a necessity to ensure that education continues. According to recent research conducted by Mak (2021), the pandemic has affected children's motivation to learn. It is as frustrating as it is for teachers who are working incredibly hard to engage their students via new platforms in this new normal. For many students, playing games and discussing about games was clearly more essential than remotely completing homework (Miller, 2021).

As a result, every concerned educator is looking for solutions to the problem. One method is to improve the teaching process by including instructional aids just like mathematical games. Mathematical games have been used to teach mathematics and science in many countries, including here in the Philippines. This is a result of the usefulness of games in the educational process. A study conducted by Veray (2016), which aimed to determine the effectiveness of engaging students through board games, revealed that the experimental group who was exposed to the board games has higher academic performance. The study also recommends engaging students in board games as part of improving their academic performance. Games can facilitate the mathematical environment as they release boredom, tension and establish a friendly atmosphere which allows for the growth of skills and knowledge.

It has long been known that board games can be used as instructional materials for math-related disciplines. This study is a continuation of the undergraduate thesis conducted by Guadiario & Dela Cruz (2019) entitled “Development and Validation of Matheladder as an Enrichment Activity on Basics of Trigonometry”. Matheladder is a developed and validated board game that was patterned from the Snakes and Ladders game but with the infusion of Trigonometry on it. Furthermore, the board game was tried out on Grade 9 learners in Mindanao State University - Iligan Institute of Technology Integrated Developmental School (MSU-IIT IDS) on the fourth quarter of S.Y. 2018-2019. Results showed that Matheladder is creatively made and is well designed. It has no construction errors and sharp edges that can cause injury and it is very easy to use. The rules are also understandable and clear enough that all could easily participate. However, its effectiveness has not been explored. One of the recommendations of the study is to implement the board game. Hence, in this present study, the researcher looked into the effectiveness of the Matheladder as a review material on the learners’ achievement level and motivational level.

2. Methods

2.1 Research Design

The researcher used the Mixed method of research which is an intellectual and practical synthesis based on the combination of quantitative and qualitative research. The experimental design was used under the quantitative research design. The quasi-experimental research approach was used for the quantitative data. Specifically, the researcher used the posttest-only group design where the learners are grouped into the experimental group and the control group. The control group had their traditional review session while the experimental groups received the intervention by utilizing the Matheladder board game as a review material through a series of trials. The achievement test was then given to both groups that shows the difference between the achievement levels of the students from the control and experimental groups. Furthermore, the qualitative data was obtained from the insights of the learners through the interview guide questions.

2.2 Research Setting and Participants

This study was conducted at Acelo C. Badelles, Sr. Memorial High School. It is a government owned school of the Department of Education that provides junior and senior high school education. It is located at Purok 6, Tipanoy, Iligan City.

2.3 Participants of the Study

The participants of the study are the Grade 9 learners in Acelo C. Badelles, Sr. Memorial High School which will be selected through purposive sampling. The selection for the control and experimental group was also done purposively. The chosen section in Grade 9 was divided into two groups as per direction of the school and as one of the protocols in implementing the limited face-to-face classes. There are 42 learners in the section but only 40 students were considered. The mean grades of the learners were used to show the comparability of the participants.

2.4 Research Instruments

The study will use the following research instruments:

2.4.1 Achievement Test

This is a 40-item multiple choice test questionnaire made by the researcher following the Most Essential Learning Competencies stipulated by Deped, and Table of Specification. The coverage of the test includes all the

topics discussed for the whole duration of the study which are: illustrates the six trigonometric ratios, finds the trigonometric ratios of special angles, illustrates angles of elevation and angles of depression, uses trigonometric ratios to solve real-life problems involving right triangles, illustrates laws of sines and cosines, and solves problems involving oblique triangles. The achievement test was given to both experimental and control groups. The test questionnaire was pre-evaluated by two in-service teachers and the section adviser/resource teacher. A dry-run was conducted with 30 learners in the Grade 10 level at Iligan Capitol College due to the availability and considering the online modality of the school. In addition, an item analysis was done where eleven of the questions out of forty items were revised and rest is to be retained. The researcher used the suggestions received during the pre-evaluation to finalize the instrument and make it ready for use.

2.4.2 Motivation Questionnaire

The researcher adapted the motivation questionnaire which was developed by Fiorella et al., (2021) to assess learners' motivation toward trigonometry in both the control and experimental groups. It is modified accordingly for it to be suited to the study. This questionnaire contains several statements aim at investigating the level of learners' motivation towards Trigonometry. This is composed of 19 Likert-scale questions that are indicated into five latent factors: intrinsic value, self-regulation, self-efficacy, utility value, and test anxiety. Intrinsic Value pertains to the student's feeling that learning trigonometry is personally valuable. Self-regulation refers to a student's tendency to engage in behavioral learning strategies. Self-efficacy is a student's belief that they have the necessary competence and capability to perform well in trigonometry. Utility value is a student's perception that trigonometry is personally relevant to their lives or future careers. Lastly, test anxiety refers to a student's feeling of anxiety toward being assessed in trigonometry or compared with others. All items were on a five-point Likert-type instrument where students will assess their level of agreement in every statement. A dry-run was conducted to the students of Iligan Capitol College in Roxas Avenue, Iligan City. To identify the internal consistency of the motivation questionnaire, the Cronbach's alpha was computed. It resulted with an overall Cronbach's alpha of 0.808 which implies that the internal consistency of the motivation questionnaire exceeds the acceptable reliability. Therefore, the instrument is reliably good.

2.4.3 Interview Guide Questions

The interview guide questionnaire is made by the researcher that consists of open-ended questions relevant to the study. This interview questionnaire serves as a reference for assessing the learners' experiences with Matheladder and to get their insights after playing the Matheladder board game. These guide questions were evaluated by two in-service teachers and the resource teacher.

2.5 Data Gathering Procedure

The following procedure was undertaken by the researcher to conduct the study.

a.) Asking for Permission

To guarantee the credibility of the research process before collecting data, a letter had been prepared addressed to the Department of Education asking for permission to conduct the study in the chosen school. A formal letter addressed to the School Principal of Acelo C. Badelles, Sr. Memorial High School was also presented along with the letter from the DepEd in order to gain permission in entering and utilizing some school facilities during the conduct of the study. Consent letters addressed to the parents of the learners will also be given. Upon the approval of the school, a section from the Grade 9 level was selected as the participants of the study. The learners were grouped accordingly so as to form the desired groups.

b.) Orientation

The researcher introduced herself and explained the purpose of the visit. All participants were asked to join the orientation to be held at the school, bringing with them the consent letter signed by their parents or guardian. The concept of the Matheladder board game was introduced only to the experimental group to make the learners aware of what the game is all about, thus preparing them for the actual game. Prior to the conduct of the orientation and/or the study, certain protocols are observed including protective measures, hygiene practices, safety procedures, and necessary documents for the school and other stakeholders.

c.) Implementation

The experimental groups were able to utilize the Matheladder board game as review material before taking the achievement test while the control group was given the traditional way of review. This was conducted by batch due to the current pandemic situation and a series of trials was made. Groups 1, 2, and 3 was considered the trials 1, 2, and 3 respectively. This is to see if there is a consistency of the results from all the trials conducted. Upon completion of the activity, the achievement test and the motivation questionnaire were given which concludes the gathering of quantitative data. For the qualitative data, the researcher conducted an interview based on an interview guide question and provided a feedback slip for the insights of the learners.

d.) Intervention

Given the pandemic situation, the resource school has implemented a progressive limited face-to-face class. Following the Operational Guidelines on the Implementation of Face-to-Face Learning Modality, the chosen

section in Grade 9 was divided into two. The researcher is required to follow the guidelines so as the original schedule of the Grade 9 learners that is, the other half is following the MWF schedule while the other half is following the TTh schedule. The selected section has 42 learners but only 40 of them was considered as the participants of the study due to some absences. There are 20 learners for the MWF schedule and another 20 learners for the TTh schedule, both utilizing the 7:30am-9:30am classes.

d.) Conducting the Posttest

Upon completion of the review, the achievement test and the motivation questionnaire were given to both the experimental and control groups. The conduct of the posttest was done on Friday for the learners following the MWF schedule. On the other hand, the conduct of the posttest for the learners following the TTh schedule was on Friday afternoon, this is with regards to the special agreement between the researcher, resource teacher and the assistant principal.

2.6 Data Analysis

The study's participants' achievement and motivation levels were determined using both quantitative and qualitative methods. The achievement test and Motivation Questionnaire provided quantitative data, while interview results provided qualitative data. The tables below are used for the interpretation of data. These serve as basis to classify and determine the description of the intervals they belong to.

Table 2

Achievement Level Classification

Score Range	Rating	Classification
36-40	90% above	Outstanding
34-35	85% - 89%	Proficient
32-33	80% - 84%	Approaching Proficient
30-31	75% - 79%	Developing
29-0	Below 74%	Beginning

Note: From *https://www.ciit.edu.ph/k-to-12-grading-system/*

With a passing average of 75 percent, the table indicates the achievement test score ranges, percentages, and achievement level classification. This is based on the K-12 curriculum grading system approved by the Department of Education. The score ranges are set based on the number of items on the achievement test given with the lowest interval 0-29 classified as 'Beginning' and the highest interval of 36-40 classified as 'Outstanding'. This table is used to determine the classification of the learners 'achievement level from the result on their achievement test scores.

Table 3

Description and Interpretation of the Different Levels of Motivation

Score	Interpretation	Description
4.51 – 5.0	Very Highly Motivated	Always feel motivated towards trigonometry.
3.51 – 4.50	Highly Motivated	Often feel motivated towards trigonometry.
2.51 – 3.50	Moderately Motivated	Sometimes feel motivated towards trigonometry.
1.51 – 2.50	Lowly Motivated	Rarely feel motivated towards trigonometry.
1.00 – 1.50	Very Lowly Motivated	Never feel motivated towards trigonometry.

Note: Adapted from the study "Online Learning and Students' Mathematics Motivation, Self-Efficacy, and Anxiety in the "New Normal" by L. Mamolo, 2022. From *https://doi.org/10.1155/2022/949634*

Table 3 shows the description and interpretation of the different levels of motivation from the study of Mamolo (2021). The researcher made modifications that suited the present study. This is used to determine the classification of the learner's motivation level based from their responses to the motivation questionnaire.

2.7 Statistical Tools

The researcher will use the following statistical tools to analyze the gathered data.

a. Mean and Standard Deviation

This is used to measure the average achievement level of the respondents and to determine the index of variability or the dispersion of the students' scores in the motivation questionnaire and achievement test.

b. ANOVA

This is used to compare the collected data from the experimental group and the control group and to determine if there is a difference between the two. It was computed using a licensed SPSS and tested at 0.05 level of significance.

c. Thematic Analysis

Thematic analysis was used in the analysis of qualitative data which came from the interview and insights of the students after the implementation of the study.

2.8 Coding of Data

The data gathered during the implementation of the study was coded accordingly. Since the study is comprised with two groups namely, experimental group and control group, it was coded as EG and CG respectively. Following the coding of each group, "EG1" was used to represent '*Experimental Group 1'*, and "CG1" for '*Control Group learner 1'.*

3. Results and Discussions

Objective 1: Determine the achievement level of the Grade 9 learners in trigonometry.

Table 4

Learner's Achievement Level in Trigonometry (n=40)

Group	Mean	Std. Dev.	Interpretation
1 (Experimental Group 1)	29.6 (~30)	1.26	Developing
2 (Experimental Group 2)	29.9 (~30)	1.79	Developing
3 (Experimental Group 3)	29.4	1.84	Beginning
4 (Control Group)	19.1	2.77	Beginning
Total	27.0	5.00	Beginning

Table 4 presents the achievement level of the Grade 9 learners in trigonometry. Based on the calculated mean score of 19.1 for control group, it shows that the learners under this group exhibit "beginning" level of achievement in trigonometry. This is much lower when compared to the learners under the experimental groups. Two out of three in the experimental group obtained an average rating of 75%-79% with a mean score of approximately 29.6 and 29.9 which is interpreted as "Developing". Moreover, the third group obtained a mean score of 29.4 which has the interpretation as "Beginning" but it doesn't show much difference on the other experimental groups. It can be observed that the calculated mean of the experimental groups is on the range of 29.4 – 29.6 which shows a consistent result among the three trials conducted that is higher than the control group. On average, learners regardless of the intervention, still has low achievement level since it is only in the developing level. This indicates that the groups don't have much difference in terms of their learning ability. However, it is still worthy to note that though they do have generally low achievement levels, it still shows that the experimental groups have higher achievement levels than the control group.

As such, there was an improvement from the control and experimental group. It is clear enough that the learners in the experimental group have higher achievement levels compared to the control group. With this, it appears that the matheladder is an effective review material in learning trigonometry for the Grade 9 learners.

Objective 2: Determine the learners' motivational level towards Trigonometry.

The researcher adapted a motivation questionnaire that was given to the participants as part of the posttest after playing Matheladder.

Table 5

Learners' Motivational Level toward Trigonometry (n=40)

Group	Mean	Std. Dev.	Description	Interpretation
1 (Experimental Group 1)	3.71	0.24	Often feel motivated towards trigonometry.	Highly Motivated
2 (Experimental Group 2)	3.90	0.15	Often feel motivated towards trigonometry.	Highly Motivated
3 (Experimental Group 3)	4.08	0.21	Often feel motivated towards trigonometry.	Highly Motivated
4 (Control Group)	3.15	0.15	Sometimes feel motivated towards trigonometry.	Moderately Motivated
Total	3.71	0.40		

Table 5 presents the motivational level of the Grade 9 learners toward trigonometry for both control and experimental groups. The three experimental groups got a "High" remark while the control group has "Moderate" remark. Again, it can be observed that the control group obtain a lower mean score level of motivation when compared to the experimental groups. Clearly, Grade 9 learners who experienced the matheladder exhibit much higher motivational level compared to those learners who are not exposed to matheladder. That is, learners under experimental groups often feel motivated toward trigonometry while those learners from control group only sometimes feel motivated towards trigonometry. It shows that the matheladder is an effective review material for improving the motivational level of the Grade 9 learners towards trigonometry.

Objective 3: Compare the mean scores in the achievement level of the learners between the experimental and control group.

Table 6

ANOVA Table on the Mean Score Difference in Learner's Achievement Level

Source	SS	df	MS	F	Sig. (P-value)
Between Groups	833.4	3	277.8	70.13	0.0001*
Error Variance	142.6	36	3.96		
Total	976	39	25.03		

Table 6 presents the result of one-way analysis of variance (ANOVA) in testing the significant mean score difference of learner's achievement level among groups. As observe, the computed p-value is lesser than the alpha level (0.0001<0.05). Therefore, there is sufficient evidence to believe that the mean score of the learner's achievement level is significantly different among groups. This means that the achievement level of the learners under for experimental groups is higher compared to control group. This shows that the matheladder is an effective review material for improving the achievement level of the Grade 9 learners toward trigonometry.

Table 7

Post Hoc Analysis: Bonferroni Comparison Test

Groups	Mean		Mean Dif. (Control-Trial)	Sig.
1(Experimental Group 1)		29.6	-10.5	0.0001*
2(Experimental Group 2)		29.9	-10.8	0.0001*
3(Experimental Group 3)		29.4	-10.3	0.0001*
4 (Control Group)	19.1			

* Significant at 5% α level (if p<0.05)

Now, to see which among the groups differ significantly, the Bonferroni comparison test is used. Based on the result of Bonferroni multiple comparison test, it reveals that all experimental groups have significantly higher achievement level compared to the control group.

Objective 4: Compare the mean scores in the motivational level of the learners between the two groups.

Table 8

ANOVA Table on the Mean Score Difference in Learner's Motivation Level

Source	SS	df	MS	F	Sig. (P-value)
Between Groups	4.87	3	1.62	44.99	0.0001*
Error Variance	1.30	36	0.04		
Total	6.17	39	0.16		

Table 8 presents the result of one-way analysis of variance (ANOVA) in testing the significant mean score difference of learner's motivation level among groups. As presented in the table above, there is enough data to conclude that the mean score of motivation level for both control and experimental groups varies significantly. This means that matheladder is also an effective review material in improving the motivation of the Grade 9 learners toward trigonometry.

Table 9

Post Hoc Analysis: Bonferroni Comparison Test

Groups	Mean		Mean Dif. (Control-Trial)	Sig.
1(Experimental Grp1)		4.21	-0.978	0.0001*
2(Experimental Grp2)		4.24	-1.002	0.0001*
3 (Experimental Grp 3)		4.30	-1.062	0.0001*
4 (Control Group)	3.24			

* Significant at 5% α level (if p<0.05)

Moreover, the result of Bonferroni comparison test shows that all groups under experimental have significantly different motivation level compared to control group. Specifically, the experimental groups have statistically higher motivation level than the control group.

Objective 5: Draw insights from the learner's experience after playing Matheladder.

After the conduct of the activity, a semi-structured interview was conducted to the learners under the experimental group. Here are some of the responses of the learners on the given questions.

1.) The use of Matheladder affected the participants' feelings towards trigonometry.

From the responses of the participants, seven out of thirty participants find Matheladder as fun and exciting. Positive feelings are also evident as it allows them to be comfortable with the lessons and have relived their boredom and anxiety. Furthermore, five participants responded that Matheladder helps in understanding the lessons in trigonometry more and in recalling the basics of trigonometric values. Though one participant is not much affected, there are some participants who showed some

liking towards trigonometry.

2.) Performance on the Matheladder game.

The performance of the participants in playing the Matheladder turned out to be good. Nine participants claimed to have done better, some had fun and find it an exciting and amazing experience amidst the nervousness. Some were also delighted for winning the game. Moreover, EG18 also find it nice and worthy to be shared to others if given a chance.

3.) The participants' experiences with their classmates when playing Matheladder.

Ten out of thirty participants described their experience while playing the Matheladder with their classmates as happy and enjoyable. Twelve participants also find their experience fun and exciting. It showed how they enjoyed their time playing the Matheladder board game and also how challenging it was. Many have responded about how they had fun and learn at the same time.

4.) Comparing their enjoyment of trigonometry before the use of matheladder?

Most of the participants have responded that they find trigonometry challenging before, but with Matheladder, they have realized that trigonometry can be fun and interesting while still challenging. In addition, four participants have mentioned again the helpfulness of the game in understanding the lessons in a fun way.

5.) The participants' favorite aspect of the game.

The Question-and-Answer portion of the game is one of the most likeable parts based on the responses of the participants. They find it more challenging on their end since the player can't move to his/her next move if the question will be answered correctly. EG7 also pointed it out to be a good thing so as to know if he/she really learned something. Additionally, EG20 also mentioned that even though he/she didn't get the correct answer, he/she still learned from it also because of the answers of the other players. It shows that sharing of ideas is present even if this game is not necessarily a group effort type of game. Three participants also like the part of winning which is a vital result of the game. Throwing and rolling the dice also sparked an interest in the other five participants. The overall game experience is also of the liking of the other six participants which highlighted their enjoyment in playing and meaningful company with their classmates.

4. Conclusions

The main purpose of this study is to delve into the effectiveness of the Matheladder as a review material for Grade 9 learners in trigonometry. Findings reveal that the Matheladder is an effective review material. The learners in the control group are said to have a "beginning" level of achievement in trigonometry. This is considerably lower than the "developing" achievement level of the experimental group. There is enough information to conclude that the mean score of the learners' achievement level differs significantly between groups. This suggests that the experimental groups' learners' achievement levels are higher than the control group. It also reveals that all experimental groups have significantly higher achievement level compared to the control group.

Furthermore, the experimental group's participants provided more positive answers to the motivation questionnaire. As can be seen, the control group had a lower mean motivation score than the experimental group. The learners under the control group only sometimes feel motivated towards trigonometry, whereas learners in the experimental groups often feel motivated towards trigonometry. There is enough evidence to establish that the mean motivation level score for both the control and experimental groups varies significantly. It also reveals that all experimental groups have significantly different motivation levels than the control group. The experimental groups, in particular, had a statistically higher level of motivation than the control group.

Lastly, the drawn insights of the learners revealed that the Matheladder is fun, enjoyable, exciting, challenging, as well as helping in a better understanding of the lessons and recalling trigonometric values. Some learners also demonstrated an interest in trigonometry and appreciated the game's value in helping them comprehend the teachings in an enjoyable way. The majority of the participants also recognized that with Matheladder, trigonometry can be both fun and challenging. Additionally, the game's Question-and-Answer component, as well as the concept of winning the game, is one of the most captivating parts of the game. Furthermore, the participants had difficulty in answering the test due to the lack of sufficient knowledge, of how hard it is to understand the topics, unfamiliarity with the problem-solving process, and the negative notion of trigonometry.

References:

Amr, Kannan, "Learning through Games: Essential Features of an Educational Game" (2012). *Instructional Design, Development and Evaluation - Dissertations.*Paper 56.

Boocock, Sarane S. and E. 0.Schild (eds.). 1968. Simulation games in learning. Beverly Hills, Sage Publications. p. 279

Cavanagh, S. (2008). Playing games in classroom helping pupils grasp math.*Education Week, 27*(35),10.Retrieved from https://search.proquest.com/docview/202716701?accountid=141440

Chinazzi, M., Litvinova, M., Vespignani, A., Ajelli, M., Davis, J., Merler, S., et al. (2020). The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak. *Science* , pp. 395-400.

Cortez, C. P. (2020, May 17). Blended, Distance, Electronic and Virtual-Learning for the New Normal of Mathematics Education: A Senior High School Student's Perception.*Semantic Scholar* .Dennis, J. M. & Stewart, J. (1979).Instructional Games and Computer using Teacher. Eric Document No. ED 183 0 189

Deterning, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From Game Design Elements to Gamefulness: Defining Gamification. *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments* (pp. 9-15). New York: ResearchGate.

Festus, A. B., &Adeyeye, A. C. (2012).Mathematical Theory and Modeling.*The Development and Use ofMathematical Games in Schools*, Vol. 2, No. 8.

Freebase (2018). Board game.*Definitions.net.* Retrieved November 25, 2018, from https://www.definitions.net//board+game.

Gafoor, K. A., & Kurukkan, A. (2015). Why High School Students Feel Mathematics Difficult? An Exploration Of Affective Beliefs. *Pedagogy of Teacher Education: Trends and Challenges.* Kerala, India: ResearchGate.

Gee, J. (2003). *Good Video Games and Good Learning*. Retrieved from https://academiccolab.org/resources/documents/Good_Learning.pdf

Guadiario, F. L., & Dela Cruz, C. O. (2019). Development and Validation of Matheladder as an Enrichment Activity on Basics of Trigonometry.

Nachiappan, S., Abd.Rahman, N., Andi, H., &Zulkafaly, F. M. (2014).Snake and Ladder Games in Cognition Development on Students.In *Review of Arts and Humanities* (pp. Vol. 3, No. 2, pp. 217- 229).American Research Institute for Policy Development.

ObiomaG.O.,&Ukeje (1992). ―*The Philosophy and Instruction of Mathematical Games*‖. A Working Paper Presented at the Workshop on the Development of Prototype Mathematical Games by National Mathematical Centre, Abuja.

Oldfield B.J.(1991). ―Games in the Learning of Mathematics.‖ *Mathematics in Schools.Vol. 20, No l.*

Rapini, S. (2012). *Beyond Textbooks and Lectures:Digital Game-Based Learning in STEM Subjects*. Retrieved from https://silo.tips/download/beyond-textbooks-and-lectures-digital-game-based- learning-in-stem-subjects

Suan, J. S. (2014). *Factors Affecting Underachievement in Mathematics.* Retrieved February 27, 2022, from http://conference.kuis.edu.my/icomm/5th/images/eproceeding2018/IC009.pdf

Taspinar, B., Schmidt, W., &Schuhbauer, H. (2016).Gamification in Education: A Board Game Approach to Knowledge. *International Conference on Knowledge Management.* Vienna,Austria.

Tomaso, P. (2014). *A quantitative assessment of the effect of games on learning* (Order No. 3628697).Available from ProQuest Central. (1560885980). Retrieved from https://search.proquest.com/docview/1560885980?accountid=141440

Treher, E. N. (2011). *Learning with Board Games: Tools for Learning and Retention.* Retrieved November 2018, from The Learning Key, Inc.: http://www.thelearningkey.com/pdf/Board_Games_TLKWhitePaper_May16_2011.pdf

Tuna, A. (2013). *A Conceptual Analysis of the Knowledge of |Prospective Mathematics Teaches about Degree and Radian.* World J Educ.

UNESCO. (2020). *Education: From Disruption to Recovery UNESCO*. Retrieved March 2, 2022, from UNESCO: https://en.unesco.org/covid19/educationresponse

Veray, J. (2016). *Engaging Students through Board Games: Measuring Its Effectiveness on Academic Performance.* Retrieved March 27, 2022, from ResearchGate https://www.researchgate.net/publication/317032619_Engaging_Students_through_oad_Games_Meas uring_Its_Effectiveness_on_Academic_Performance