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Electronic Game Based Learning: An Interactive Tool to Enhance Students' Performance in General Mathematics

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ABSTRACT

This paper aims to determine the performance of Grade 11 TVL students in General Mathematics through the use of Electronic Game Based Learning as an interactive tool. The researcher hopes to delineate the ways on how to bridge the learning gaps experienced by the TVL students and General Mathematics. Using the descriptive method of research with the questionnaire as the main tool in gathering the data, it is thought to be the most suitable for the purpose of showing evidence concerning the existing current condition by describing the responses of the subject under the study. The result reveals that TVL students found Functions and their graphs as the most difficult component of the learning competencies in General Mathematics. The result suggests that effective implementation of the Game Based Learning will enhance the performance of Grade 11 students in the different learning competencies in General Mathematics. Furthermore, the research serves as a reflective reference among SHS teachers to constantly re-evaluate and assess the performance of the TVL students in General Mathematics.

CONTEXT AND RATIONALE

In the era of digital knowledge and virtual reality today, almost all facets of life are being encompassed by electronic media like business, entertainment and even academe. Its rapid growth has drawn the society predominantly the youth in the use of the electronic media in various utilities from travel to on line shopping, on line learning and electronic gaming. The latter, electronic gaming which taken the seat of the forefront market has penetrated the not only the popular business and commerce but also the world of education which gives vast array of opportunities far from the negativities of gaming addiction but the positive potential of blending games into learning and instruction. Meanwhile, mathematics as a core subject, still plays a pivotal role in assessing the performance and determining the placement of the Philippines in the global academic arena, business and in technical-vocational industries.

For decades, the value of Mathematics cannot be contested as a subject in which proficiency and literacy is being demanded or stipulated across all professional strands and career tracks.

Yet, the country's placement in various global, international and local competitiveness ranking shows a confirmation and alarming reality of the need for its improvement.

Recognizing this need for the improvement of the country's performance in Mathematics and its relationship to career and employability, the government mandated the concretization of the K to 12 curriculum, an education system that allows two years to be added to Basic Education.

It seems that proficiency in Mathematics is being cultivated in its subdivisions with concentration on Academic Track designed for students to prepare for college, a growing concern for numerical literacy is surfacing out with other track predominantly TVL which owns greater number of enrollees.

To aid this concern, General Mathematics as a core subject has been stipulated by the government to be included in the circular package and is being taken across all strands /tracks.

This subject is subdivided into three major topics such as Functions and Their Graphs, Business Mathematics and Logic. The subject accounts for developing knowledge and skills needed by the learners whether they may pursue college or work.

Yet, even with the advent of K to 12, the realization of its aim to accelerate the speed of numerical literacy and proficiency in the country still daunted by the poor performance in the academic subjects.

More styles in teaching are as well being practiced since the "old-school lecture type" technique in teaching does not suffice anymore for the learners of digital natives. With the advent of computer and internet to facilitate easier access to learning materials and aligning the teaching and learning environment with that foreign countries, new studies are eyeing on maximizing the full potential of computer-based technologies in teaching.

Furthermore, new practices that involve the use of educational electronic games or E games are becoming the new trend. These are interactive games operated by computer as an educational tool. This may include pictures, text, videos, applications crafted to generate a game that concentrates on a single or multiple learning competencies that must be attained upon accomplishment of the game .E-games can aid students who struggle with mathematics learning regardless of their motivation, their past instructions and mathematical knowledge.

As a growing number of researches suggest that there is a difference in the students' academic performance when he/she is engaged and participative, it is indeed undeniable that game-based math learning will actually boost students' ability to reason, understand and underlying concepts and even find solution to a more complex problems.

In the Article of Shanun Duncan" Four Reasons to Promote Success through Games" claimed beneficial learning opportunities that one can get through game based learning:

- Improved mind body connections as games facilitates connection in the neuron of the brain to help the processing and retention of new information
- Personalized games that do not encourage learning by groups leveled ability fosters the constant connection without the feeling of segregation
- Established rapport between learners and learning math since learners are continuously being immersed in an active and engaging environment.
- Professional growth for teachers as they discover personal learning curves, strengths and limitation.

In the light of all these, it can be therefore assumed that the indispensability of math as a knowledge, skill competency subject or discipline is but incontestable as it being demanded in the academe, business and technical vocational industries. With the effort of the government to introduce the core subject General Mathematics embedded in the form of computer based games or E games is an imperative to be generated, utilized and improved so that the alignment of educational theories and instructional practice will be assured thereby facilitating effectively seamless learning that will directly influence the nation's academic achievements across all level and areas.

With this, the study hopes to determine the full potential of games based math learning or E-games in the holistic development of a TVL student as evidenced by their academic performance in General Mathematics.

INNOVATIONS AND STRATEGIES

Electronic game based learning is conceptualized and designed to aid the teacher provide the Grade 11 TVL students the needed support to make progress in studies particularly in General Mathematics.

These will increase and deepen the skills, knowledge and understanding of the student in various subject areas not only in Mathematics but also including various learning areas in the curriculum. E-games can give the opportunity to explore various ideas and concepts that would enrich their understanding of varied subject matters that sharpen their competencies.

Furthermore, E- games tend to reteach the lessons which are not so much clear to the students and to help them gain mastery of the skills. In addition, the goal, role, structure and design of the electronic game based learning will be considered and interactive that is why a lot of teachers are encouraged to use them in the teaching-learning process.

The use of E-games enhances the teaching and learning process thus benefiting the learners specifically in the target subject of concern. In Mathematics, E-games are very useful to help them understand how the different concepts in which they find difficulty could be solved and understood easily. It is in the use of E-games that the teachers would have the knowledge whether the concepts they have taught are really mastered by the learners.

The E-games developed by the researcher focused mainly on topics under General Mathematics which greatly helped TVL learners in coping up with all the difficulties they encountered.

RESEARCH QUESTIONS The study aims to enhance the performance of the TVL students in General Mathematics in Alitagtag Senior High School. Specifically, it sought answers to the following questions:

1. What is the status of General Mathematics instruction among TVL students in with reference to:
   1.1 curriculum;
   1.2 instructional materials; and
   1.3 methods and strategies?
2. How may E-games be used in teaching General Mathematics?
3. What learning contents in General Mathematics are identified most difficult as assessed by the respondents?
4. What electronic game based learning was developed to improve students' performance in general mathematics?

METHODS

Descriptive method of research with the questionnaire as the main tool in gathering the data was used in identifying the performance of 45 Grade 11 TVL students as the respondents of the study. It is thought to be the most suitable for the purpose of showing evidence concerning the existing current condition by describing the responses of the subject under the study. According to Shuttleworth (2009), the descriptive method is believed to be the most appropriate type of research since it is a valid method for researching specific subject and as a precursor to more studies. Information's are gathered from websites, books, dictionary, journals and unpublished theses in the field of education in Mathematics. The instrument used in gathering the data was the questionnaire. The data gathered will be recorded, tallied and tabulated for better presentation and interpretation of the results. The statistical treatments that will be used are frequency, ranking, and weighted mean. Frequency was used to determine the number of occurrences a respondent chose the specific indicator with respect to the status of general mathematics instruction and learning content identified most difficult. Ranking was used to determine which among the indicators has the lowest and highest frequency. Weighted mean was used to identify the general responses in each item in the questionnaire.

RESULTS AND DISCUSSION OF RESULTS

Table 1. Status of General Mathematics Instruction among TVL Student with reference to Curriculum.

CURRICULUM	WEIGHTED MEAN	VERBAL INTERPRETATION	RANK
• Component of objectives encompasses previous objectives and requires the student to integrate and then apply certain knowledge, skills, and attitudes in order to demonstrate achievements of the standard.	3.53	Great Extent	6.5
• Continuously evolving.	3.53	Great Extent	6.5
• Reflects the needs of the learners and society as well.	3.57	Great Extent	5
• Provides continuity of experience.	3..8	Great Extent	2
•Provides proper instructional equipment and meeting places that are often most conducive to learning.	3.7	Great Extent	3
•Often to revision and development to meet the demands of globalization.	3.93	Great Extent	1
• Time bounded	3.67	Great Extent	4
COMPOSITE MEAN	3.67	Great Extent	

The table showed that the status of General Mathematics instruction among TVL students with reference to curriculum is of great extent. The composite mean of 3.67 is an indication that the curriculum of General Mathematics is of quality, organized and structured.

Table 2. Status of General Mathematics Instruction among TVL Student with reference to Instructional Materials.

INSTRUCTIONAL MATERIALS	WEIGHTED MEAN	VERBAL INTERPRETATION	RANK
-Meter stick	3.13	Preferred	8
-Ruler	3.47	Preferred	5
-Chalk and Board	3.76	Very much preferred	2.5
-Worksheets/chart	3.76	Very much preferred	2.5
-Textbook	3.73	Very much preferred	4
- Graphing board	2.07	Sometimes preferred	9
-Graphing Calculator	1.74	Not preferred	10
-Projector	2.76	Preferred	6.5
-Models	2.76	Preferred	6.5
-Laptop/Television/Cellphone	4.0	Very much preferred	1
COMPOSITE MEAN	3.12	Preferred	

It can be noted from the table that chalk and board, worksheets and charts, textbooks and laptop/television/cellphone are very much preferred by the students in teaching General Mathematics. Laptop/television/cellphone obtained a weighted of 4 which ranked first among the ten items. It was also revealed in the table that graphing calculator with a weighted mean of 1.74 is not preferred. As a whole, the result showed students' preferences of the instructional materials with a composite mean of 3.12.

Table 3. Status of General Mathematics Instruction among TVL Student with reference to Methods and Strategies.

STRATEGIES/METHODS	WEIGHTED MEAN	VERBAL INTERPRETATION	RANK
Discussion	3.76	Very much evident	2
Mind mapping	3.5	Very much evident	4
Paired-approach	3.13	Evident	6
Reflective	2.23	Sometimes evident	10
Integrative	3.03	Evident	8
Inquiry-based	3.33	Evident	5
Active learning	3.03	Evident	8
Collaborative learning	3.6	Very much evident	3
Integration of technology	3.86	Very much evident	1
Lecture/Direct instruction	3.03	Evident	8
COMPOSITE MEAN	3.25	Evident	

As reflected in the table, the teacher applied discussion, mind mapping, collaborative learning and integration of technology in teaching General Mathematics with a weighted mean of 3.76, 3.5, 3.6 and 3.86 respectively. Among the strategies applied, integration of technology ranked first with a weighted mean of 3.86 and reflective ranked last with a weighted mean of 2.23. It can be noted that the different methods and strategies are evident with a composite mean of 3.25.

Electronic Game Based Learning used in teaching General Mathematics

E-games are to familiarize, practice and aid learners in gaining mastery on various General Mathematics concepts specifically appertaining to Functions and their graphs, Business Mathematics and Logic, to attain necessary competencies and elevate performance of TVL students in the target area. The game is composed of different questions based on the three main topics. The task of the student is to answer each of question in various stages and unveil the last phase of the game. Teachers may upload additional learning materials as reference whenever the need arises. The user must perform all procedures, follow system patterns and solve all the problems accurately to be able to finish all the games. This will allow learners to enjoy learning by involving themselves to higher order thinking environment that provides individualized and collaborative learning experience even without the supervision of the teachers.

Table 4. Learning content in General Mathematics identified most difficult as assessed by the respondents.

CONTENT	WEIGHTED MEAN	VERBAL INTERPRETATION	RANK
A. Function and their Graphs			
• Key conception of functions	3.53	Difficult	5
• Evaluation of function	3.57	Difficult	4
• Operation on Function	3..76	Difficult	2.5
• Graphs of Function	3.76	Difficult	2.5
• Word problem involving rational function, inequalities and equations	3.83	Difficult	1
COMPOSITE MEAN	3.69	Difficult	

It was revealed from the table that the contents in Functions and their Graphs were considered difficult by the respondents with a composite mean of 3.69. Word problem involving rational function, inequalities and equations ranked first with a weighted mean of 3.83 and Key concepts on functions and graph of functions ranked last with a weighted mean of both 3.53.

Table 5. Learning content in General Mathematics identified most difficult as assessed by the respondents.

CONTENT	WEIGHTED MEAN	VERBAL INTERPRETATION	RANK
B. Basic Business Mathematics			
• Concept of simple and compound interest, simple and general annuities	3.07	Average	7.5
• Computation of interest, maturity value, future value, and present value of both simple annuities and general annuities	3.07	Average	7.5
• Problem solving involving simple and compound interest	3.33	Average	4
• Future and present value of both simple and general annuities	3.33	Average	4
• Calculation of fair market value and period of deferral of annuity	3.57	Difficult	1.5
• Illustration of stocks and bonds	3.07	Average	7.5
• Interpretation of the theory of efficient markets.	3.33	Average	4
• Illustration of business and consumer loans	3 .07	Average	7.5
• Problem solving involving business and consumer loans.	3.57	Difficult	1.5
COMPOSITE MEAN	3.27	Average	

Table 6. Learning content in General Mathematics identified most difficult as assessed by the respondents.

CONTENT	WEIGHTED MEAN	VERBAL INTERPRETATION	RANK
C. Logic			
• Concept of prepositional logic, syllogisms and fallacies	3.07	Average	6.5
• Illustration of proposition	3.33	Average	4.5
• Symbol of proposition	3.07	Average	6.5
• Operation on propositions	3.33	Average	4.5
• Truth values of proposition	3.57	Difficult	1.5
• Forms of conditional propositions	3.36	Average	3
• Types of tautologies and fallacies	3.57	Difficult	1.5
• COMPOSITE MEAN	3.33		Average

Calculation of fair market value and period of deferral of annuity and problem solving involving business and consumer loans are considered difficult with a weighted mean of both 3.57 while the rest of the topics such as concept of simple and compound

interest, future and present value of simple and general annuities, illustration of stocks and bonds, interpretation of the theory of efficient markets and illustration of business and consumer loans are considered average. It seemed that topics in Business Mathematics are assessed average by the respondents with a composite mean of 3.27. Chapters on Business Mathematics tackling problem solving maybe the learner's first opportunity to be exposed to topics related to financial literacy. When asked for reason, students responded that they do not memorize the long formula for each problem, thus they were not able to solve the problem correctly and found it difficult learning content in General Mathematics identified most difficult as assessed by the respondents.

Almost all topics are considered average by the respondents with a composite mean of 3.33. Topics about types of tautologies and truth values propositions ranked first with a weighted mean of 3.57 while concept of prepositional logic and symbol of proposition ranked last among the average topics listed with a weighted mean of 3.07.

Developed e-games

The developed e-games uses 3 dimensional user interface and can be played through Android phones. It is divided into three phases such as Functions and their graphs, Business Mathematics and Logic.

At the beginning of game phase 1, the player approaches a virtual door, the Function and their graphs gamer entrance which is opened as default to allow the player freely navigate and manipulate the game interface. As game feature add –on, a player is entitled to use a tutorial book that can aid the player in answering and going through all the game phases. The player is free to maximize using this add-on every time the need arises.

Moreover, as game protocol, a player is entitled to three lives per session which is diminished upon committing a failure to do the task or answering the question. In the event that the player used all the powers during the game session, player will be directed to the beginning phase. At this point, a different set of questions with the same target competency is to be employed by the system to refrain players from memorizing the answers in sequential order.

Meanwhile, the player can only advance to another stage, Business Mathematics and Logic if all the tasks or questions are accomplished accurately and completely. Upon getting through with all the stages, the player shall receive a badge or medal to indicate that the game has been successfully completed.

Part of the feature of the developed e-games android application is a set of supplementary materials which can be accessed via link at any given time.

CONCLUSION

1. The status of General Mathematics instruction among TVL students with reference to curriculum, methods and strategies and instructional materials is remarkably evident.
2. E-games or electronic games are any interactive game operated by computer circuitry and is used as an educational tool. It is being played may or may not include internet but are operated using computers or android phones. This will allow learners to enjoy learning by involving themselves to higher order thinking environment that provides individualized and collaborative learning experience even without the supervision of the teachers.. Teachers may upload learning materials as part of the feature of the game.
3. Word problem involving rational function, inequalities and equations under Functions and Their graphs are found difficult. Calculation of fair market value and period of deferral of annuity and problem solving involving business and consumer loans under Business Mathematics are preferred difficult. Topics on Logic are considered average where types of tautologies truth values propositions considered difficult.
4. Developed e-games is a computerized animation and interactive tool that places special emphasis on electronic android application. The full potential of the game addresses better understanding of the learning competencies in General Mathematics maximizing the engagement of the learners and can be accessed with or without the presence of internet.

RECOMMENDATIONS

1. Mathematics teachers may conceptualize and conduct more authentic and varied instructional materials and pedagogical strategies, capitalizing on the use of electronic games.
2. Both teachers and students are encourage to familiarize about the features, essence and process of e-games utilization.
3. The use of technology and media forms must be encouraged to promote optimum learning
5. Further utilization of the developed e-games may be considered to serve as conduit into determining the strengths and

limitations of the said developed instructional material.

6. Similar study on electronic game android application for other core and specialized subjects may be developed.

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