A DIGITAL GAME FOR LEARNING BASIC CALCULUS: A CONCEPT PAPER

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ABSTRACT

The COVID-19 pandemic has caused many teachers around the world to abruptly switch from face-to-face to online teaching. Digital games can provide the context and environment in reinforcing the learning of basic calculus in class. The game strategy makes learning meaningful, varied and fun. This study is unique as it seeks to integrate appropriate elements of a digital game design with that of calculus education; thus, making learning fun, engaging and consequential. The purpose of this article is to discuss the feasibility of utilizing open distance learning to extend educational opportunities for pre-diploma students enrolled in institutions of higher education. This paper explores the benefits of using digital games to deliver an inclusive education to pre-diploma students and makes recommendations based on the findings of a literature research.

Keywords: digital game, fun learning, calculus.

1. INTRODUCTION

As a dualistic discipline, mathematics comprises both processes and calculations as well as conceptual structures that link these two aspects together [1]. Mathematical thinking is a comprehensive method that analyzes the patterns that arise from the breakdown of things to their numerical, structural, or logical essentials. Concerns about students' inability to reason and think mathematically cannot be taken lightly. What is challenging to the students is their attempt to make appropriate connections amongst mathematical concepts. A long list of terms to memorize and complex calculations to complete is not enough.

Educators need to provide a more meaningful and realistic environment for them to practice their mathematical skills and reinforce understanding. The game board strategy makes learning meaningful, varied and fun. Other than the traditional way of teaching, educators or educational researchers have used other ways since there are many game applications such as video, simulation and online. Games and simulations are educational initiatives that foster the acquisition of knowledge across subjects and disciplines by students [2]. These applications have been used as instructional tools in a variety of disciplines such as biochemistry, psychology, biology, etc. These methods have increased students' positive effects, namely the development of social and soft skills, emotional skills, the empowerment of collaboration with peers, and the promotion of interaction and feedback [2]. Moreover, crossword puzzles and Jeopardy-like games have been used for assignments and review sessions resulting in a positive impact on examination results and students' learning skills [3]. [4] also believed that puzzles, scenarios, or word puzzles can trigger students' critical thinking if the activity goals are clear and understandable by students.

Based on the previous research, students' attitudes toward mathematics mostly include anxiety, cynicism, fear, and contempt. Control in performing, positive math attitudes, beliefs about math, and adaptive perfectionism were all linked to better math achievement [5]. Math anxiety and maladaptive perfectionism, on the other hand, were linked to lower math achievement. These attitudes may have an effect on their math learning process. It might impact how well students learn math, how efficiently they apply what they learn outside the classroom, and their intention to continue taking further math classes. According to [6], teachers found technology to be useful in fostering mathematical thinking and communication. While a number of active learning techniques exist, games are becoming an increasingly popular tool used to encourage student involvement with the course material [3]

Many students today struggle to make connections between similar subjects within a single field of study. In most cases, students just recall the formula to assist them in solving common issues. Mathematics can be more easily learned through the use of an interactive learning tool which makes studying meaningful and enjoyable by utilizing a digital gaming approach. According to [7], a principal component analysis using the Varimax rotation approach identified six domains as motivation, novelty, enjoyable learning, commercialization, product attributes, and eco-friendliness. The findings suggested that these six critical criteria were considered while evaluating a learning tool and its potential for teaching any tough subject in an engaging and fascinating manner while retaining rigor.

The purpose of this research is to ascertain the effectiveness of digital games in terms of memorization and comprehension of fundamental differentiation concepts, as well as to identify the characteristics of digital games that influence the learning of introductory calculus among pre-diploma students at a public university. This article is structured as follows: Section 2 discusses the proposed methodologies for developing and accessing digital games as a tool in teaching differentiation strategies to pre-diploma students, and Section 3 concludes the research.

2. EXPERIMENTAL DESIGN AND PROPOSED METHODOLOGY

Data will be collected qualitatively and quantitatively. A set of pre-prepared guided questions will be used in the interviews. All interviews will be videotaped or recorded to provide qualitative data. In general, students' interviews will last for about 45-60 minutes. The transcriptions will then be qualitatively analyzed by comparing the similarities and differences between students and supported by quotations from their oral responses. Apart from that, the students will be given a pre-test, post-test and three quizzes to provide quantitative data (see Figure 1). The figure below shows the design for the proposed data collection.

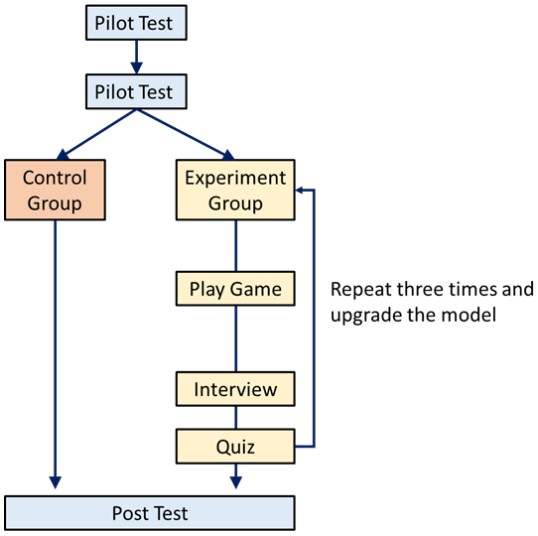

Figure 1: Proposed research design for data collection

[8] suggested the following data analysis procedures: (1) read the data several times, (2) develop an overall understanding, (3) describe the case(s) in detail and establish a context for them, (4) develop issues or themes about the case(s), and (5) consider a within-case analysis followed by a cross-case analysis when studying multiple cases. Creswell (2009) proposed a more precise data analysis model, as illustrated in Figure 2.

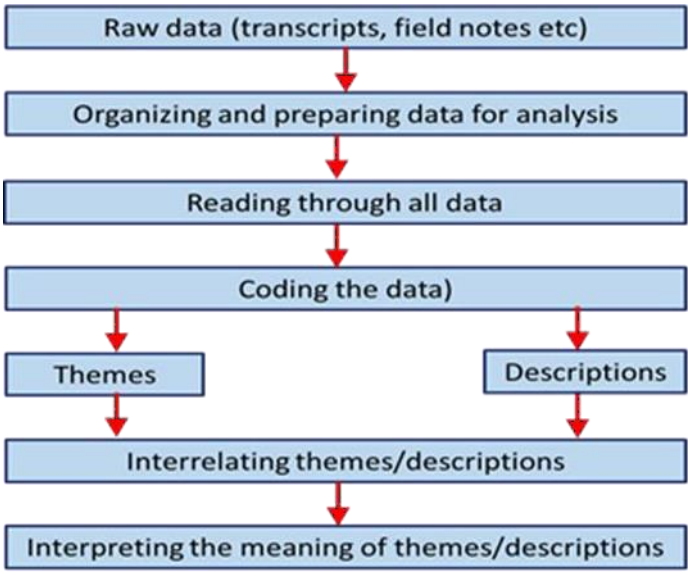

Figure 2: A proposed model of data analysis in qualitative research [9]

3. CONCLUSION

Students can gain a better understanding of theoretical concepts when games are employed in conjunction with standard lecture-based courses [2].This research aims to identify the features of games that have an effect on the learning of introductory calculus among pre-diploma students at a public university. The importance of the issue that is studied is to understand the learning ability of students in basic calculus. As such, this research report attempts to provide an approach for learning basic calculus that is meaningful, varied, and enjoyable. In addition, games enable teachers to gain a better understanding of their students' learning abilities in an inclusive education to enhance their teaching skills and competency. Finally, the review found that students' attitude towards a particular subject is important for learning success. Once students have confidence in their abilities, they will progress to a higher level with minimal guidance from the teachers, as what Vygotsky has termed as Zone of Proximal Development [10]

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