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EXAMINING THE IMPACT OF MATHEMATIC GAMIFICATION ON PRIMARY SCHOOL STUDENT'S ATTITUDE TO MATHEMATICS HOMEWORK

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Abstract

Technology has increasingly been integrated into the educational systems of developing nations, including Nigeria. The trend has contributed immensely to the development of many learning institutions and individual capacity building. The primary school system represents the beginning of learning and reflects a prime period to develop learning attitudes. Teachers use homework to augment classroom learning and improve performance. However, indications suggest that primary school students avoid mathematics homework. The present study examined the effect of a math game app (Prodigy) on students' math homework behavior. A quasi-experimental design was adopted, and the samples were grouped into experimental groups (N=58), exposed to the prodigy app, and control group (N=55), taught in conventional circumstances. The experiment consisted of 24 sessions stressed over three months. Participants were engaged in two sessions per week, lasting about 50 minutes. The findings indicated a mean difference (MD = 12.71) between the post-test study groups. Also, the result revealed a significant difference between the experimental and control group on homework behavior t (111) = 6.132, p = .001. The result has implications for mathematics development.

Keywords: *Homework behavior, prodigy, gamification, students, primary school*

INTRODUCTION

Given the growing technological innovations, the contemporary education ecosystem appears to be increasingly transforming into a science-based system. Remarkably, the trend in science and technology and its complementary influence on the development of humanity make this time a critical period for developing an integrated vision for improved science teaching. Science-based education is generally measured among the essential element in contemporary education (Kalogiannakis et al., 2021) and promoted from the early learning stages (Tavares et al., 2021). Probably, there is a growing demand for improvements in the educational system of every culture (Tajudin et al., 2018). Also, the global recognition of science, technology, engineering, and mathematics (STEM) as an integrated effort to advance science education in the international educational scene points to the position of science-based education. Equally, STEM education is increasingly becoming the foundation for a series of modifications in the school system worldwide (Liu et al., 2020). Indeed, the advent of STEM echoes the rising gap in science-related knowledge and the increasing necessity to meet the demand for systematic development (Fomunyam, 2019). Notably, there are insinuations that pupils' exposure to STEM-based content creates a pathway to a science and technology-driven setting (Banks & Barlex, 2020).

Mathematics is the foundation for all other scientific disciplines (Widiati & Juandi, 2019), and it is an integral part of STEM education (Etuk & Bello, 2016; Festus, 2014; Josiah & Olubunmi Adejoke, 2014; Musa & Dauda, 2014). It is ingrained in educational systems (Agashi & Adeniyi, 2021) and plays a crucial role in pursuing emerging sustainable development goals (Lafuente-Lechuga et al., 2020). Mathematical abilities are essential for various occupations (Li & Schoenfeld, 2019) and are an important element of the toolkit necessary for modern society's employability. More importantly, arithmetic success has been connected to future job chances (Hemmings et al., 2011). Similarly, mathematics talents play an important role in any country's automation (Maloney et al., 2013).

Mathematics is integral to the school curriculum in Nigeria (Aguele & Usman, 2007) and plays an important part in the educational system (Adebule & Ayoola, 2015; Asikhia, 2021; Eze, 2013; Olaitan, 2017; Oribhabor, 2020; Oyinloye & Popoola, 2013; Ugodulunwa & Okolo, 2015). It gives students the ability to describe, examine, and modify their surroundings. There is a wealth of literature that emphasizes the importance of mathematics in society (Ajayi et al., 2011; Akinoso, 2018; Akinsanya, 2011; Andrews, 2007; Charles-Ogan, 2015; Gengle et al., 2017; Kachapova, 2014; Kusmaryono, 2014; Obadara, 2012). However, there is rising worry about the deterioration in student mathematical achievement. (Abdullahi & Sirajo, 2020; Ayinde, 2014; Ishaq et al., 2019; Makinde & Yussuf, 2018; Maliki et al., 2009; Olatunde, 2010; Ozughalu, 2012; Sa'ad et al., 2015; Sule, 2018). Homework is a critical approach used by instructors to improve students' attitudes, interests, dedication, and performance in mathematics. Homework is an after-school task that is used to supplement classroom learning.

Homework encourages success in all parts of school life by establishing a connection between the home and school environment. Homework conduct refers to how much time a student spends working on a particular homework assignment and how hard they work to finish it (Flunger et al., 2017). Homework is an essential exercise for students to practice the many maths concepts they have learned in school. Homework activities have been highlighted in recent research (Dettmers et al., 2019; Rosario et al., 2019), and their link to academic accomplishment has been widely explored. The way students feel about homework affects how they do it and how committed they are to finishing it. Students are increasingly concerned that they will engage in off-task activities to avoid homework responsibilities (Hawkins & Axelrod, 2008) or will not put up sufficient effort to finish assignments. Furthermore, many students face motivational issues when doing assignments (Flunger et al., 2017). In terms of mathematics, the tendency imposes a limit on knowledge progress. A previous study has found that having parents help with math homework improves students' conduct and well-being (Silinskas & Kikas, 2019). (Dettmers et al., 2019). However, the present study examines gamification as a technological tool to enhance students' attitudes towards math homework.

Over the past decades, researchers have emphasized technological use in mathematics education. The ubiquity of mobile devices and their potential to bridge classroom learning to the real world have added a new angle to contextualizing mathematics learning (Fabian et al., 2018). It offers a pathway to enhancing students' motivation and interest in math (Yussop et al., 2019). Indeed, technological devices are essential in early learning (Schenke et al., 2020). As a result, rules, goals, and competition against other players or individual scores are standard in interactive, immersive math fun games. Perhaps explicit norms and objectives are essential because they help young students define their aims. Students, in particular, experience problems and must employ methods when playing to solve an issue. Embedding math-related structures and logical operations into a puzzle game-like interface is mathematics embedded gamification (Tan et al., 2017). Gamification has been used in various studies to boost student performance and motivation in mathematics. (Bartoschek et al., 2013; Boulton et al., 2018; Coelho et al., 2019; Godejord et al., 2017; Rienow et al., 2020; Santiago et al., 2019; Savehana, 2019; Siew et al., 2016; Simsek, 2016; Spieler et al., 2018). Gaming has been used in numerous mathematical domains, such as critical geometry abilities (Yang & Chen, 2010), reasoning skills (Bottino et al., 2007), and arithmetic procedures (Moreno & Duran, 2004). Thus, educational mathematics apps delivered on touch-screen tablets offer an opportunity for students' math practice.

Hypothesis: *mathematics gamification would positively predict students' attitudes towards mathematics homework.*

Method

(experimental and control). The study's participants were primary school children from Enugu State. One hundred and thirteen (n = 113) kids, including males and females, between the ages of 7 and 11, with a mean age of (M=9.13) and (SD= 1.21), were randomly recruited as research participants from several public primary schools in Enugu State. The children were mostly from primary 5 and 6 classrooms, and they were divided into two groups, one for the experimental group and the other for the control group. The math homework behavior scale was used to examine students' math homework behavior (pre-test) before the main experiment began. After the post-test, the experimental group (group A) was exposed to a math game app (Prodigy Math). Prodigy is a free, adaptive gaming software that incorporates fundamental math principles into a fantastical setting. The game is popular in the United States, where it is utilized as a part of a math curriculum (NCT03706144, 2018). In the post-test research, participants in the control group were exposed to mathematical tasks other than gamification. The students' attitudes toward mathematics were then assessed further.

The Mathematics Homework Conduct Scale (MHBS), which was created to measure students' homework behavior, was used to assess math homework behavior. The Ozcan and Erktin (2013) scale was customized and adjusted to fit the current situation. The tool is a 15-item Linkert-form rating scale with a 5-point response format ranging from "often (5), frequently (4), sometimes (3), rarely (2), and never (2)." (1). The scale's original internal consistency coefficient was.92. In this investigation, however,.83 was reported.

Result

After the pre-test and post-test studies, the mean and standard deviation scores were analyzed below. In the pre-test research, group A had a mean score of M = 33.16 and a standard deviation score of SD = 3.18, as shown in Table 1. In the pre-test research, group B had a mean score of M = 32.98 and a standard deviation score of SD = 2.71. As a result, there is no significant difference in homework conduct between the two groups. Similarly, the post-test research revealed that group A had a higher mean and standard deviation score of M = 48.89, SD = 9.78. In the post-test study, a mean and standard deviation score of M = 36.18 and SD = 5.19 was observed for group B, as shown in Table 2 below. Therefore, the result showed a mean difference of *MD = 12.71*, which means that the mean and standard deviation scores of group A increased significantly following their exposure to the Prodigy Math game app.

Table 1:

Table shows mean and standard deviation scores of the students' math homework behavior for experimental and control groups.

Group	N	Mean	SD
Group A	58	33.16	3.18
Group B	55	32.98	2.71

Table 2:

Table showing the mean and standard deviation scores for experimental and control groups in the Post-test study

Group	N	Mean	SD
Group A	58	48.89	9.78
Group B	55	36.18	5.19

Table 3:

Table showing the t-test comparison of the groups.

Source of variation	N	Mean	SD	df	*t*	Sig
Group A	58	48.89	9.78			
Group B	55	36.18	5.19	111	6.13	001

The independent-samples t-test conducted to determine whether there would significant differences between the groups on homework behavior in the post-test study, revealed a positive significant difference between the experimental and control groups on homework behavior t (111) = 6.132, p = .001.

Discussion

The present study examined the role of the math game apps in enhancing attitudes toward homework among primary school students. Ninety-three participants were recruited for the study. A pre-test and post-test quasi-experimental design were employed. The experimental and control group's mean and standard deviation scores indicated that the prodigy app significantly increased group A's math homework behavior (*M* = 48.89, *SD* = 9.78) compared to the control group (*M* =

36.18, *SD* = 5.19) with *MD* = 12.71. Regarding the hypothesis, an independent t-test conducted to determine the differences in both groups relating to homework behavior established a positive difference between the groups on homework behavior t (111) = 6.132, p = .001. Thus, the finding presupposes that group A's attitude increased relatively due to their exposure to the technology-driven gamification. The result affirmed the hypothesis that mathematical gamification would positively predict attitudes towards mathematical homework. The result corroborates the previous findings (Hung et al., 2015; Yussop et al., 2019). For example, evidence has shown that students who participated in the game intervention group showed higher mathematics proficiency than those in the control group (Chang et al., 2015). The probable reason for this result may be attributed to the increasing advancement in mobile innovation that has reached every angle of society and has attracted the attention of many children who enjoy playing games with mobile devices. The conventional classroom teaching methods have been in use for a long and could seem monotonous to most learners. An increase in basic math skills can only be achieved by motivating the learners using technological innovations such as gaming (Batzogiannis et al., 2018). Gamification may be an opportunity for many students to compete in the mathematics environment.

Additionally, the result provided evidence that gamification in the math classroom will positively influence students' homework behavior. Indeed, positive behaviors are acquired through various means and, when formed, can direct behavior in many ways. Similarly, gaming apps have the potential to shape young learners' mathematical capabilities and change their overall perception of the subject (Schenke et al., 2020). Thus, the present result presupposes that gaming apps, especially the Prodigy math app, could be a pathway to increasing students' commitment to completing their math homework and building effective relationships with mathematics.

Limitations, strengths, and future directions

The study encountered some limitations that are necessary to report. First, due to the small sample size utilized in the study, the generalization of the result becomes a concern. More so, the self-reported homework behavior may encourage biases. Nevertheless, the present study contributes to the mathematic homework behavior literature by revealing the Prodigy math game app as an effective alternative to enhancing math homework behavior in the Nigerian primary education system. Thus, the result broadens our knowledge about the positive impact of technological devices in the learning environment. Moreover, this study seems to be the first to test the Prodigy math app on Nigerian participants. Hence, justifying the current research. Future researchers should attempt to employ more comprehensive samples and utilize data from multiple sources to minimize false reports.

Conclusion

The present study investigated the effect of math game apps on students' math homework behavior in a sample of primary school students. The result revealed a significant difference between students that learned with a math game app and those that did not. Thus, it was concluded that a math game app is an indispensable tool in building a more committed mathematics homework behavior in primary school students. Given the importance of math homework in enhancing performance (Fernández-Alonso et al., 2016; Maltese et al., 2012; Mousavi et al., 2012), gamification should be embedded in the school curriculum. More so, instructors should be trained to adopt technological devices in teaching.

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