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RESEARCH ARTICLE

ROLE OF MATH GAME APPS ON ATTITUDE TOWARDS MATHEMATICS AMONG PRIMARY STUDENTS IN KOGI STATE

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Abstract

Mathematics is an essential part of the Nigerian education vision. Mathematics is widely perceived as a tedious and challenging subject to learn. Thus, math avoidance behavior is a trend that cuts across culture and is pervasive among young learners. Research has pointed the relevance of computer games in learning mathematics. Therefore, the current study is aimed to examine the role of math game apps on the attitude of primary school students in Kogi State of Nigeria towards mathematics. A quasi-experimental design with pre-test and post-tests and two groups (experimental and control) were adopted. Primary school students in Kogi State made up the population of the study. Eighty-three ($n = 83$) students comprising males and females within the age range of 7 – 11 years and mean age of ($M=9.12$) and ($SD= 1.22$) were randomly pooled from selected public primary schools in Kogi State as the study participants. The students were assigned to groups, with group A as the experimental group, while group B represents the control group. Before the main study's commencement, student's attitude towards mathematics was established (pre-test) using an attitude towards mathematics questionnaire. In the post-test study, the treatment group student (group A) was exposed to a math game app (Prodigy Math). The result showed that the gaming app significantly influenced the experimental group's attitude towards mathematics ($M = 43.81$, $SD = 9.54$) compared to the control group ($M = 32.15$, $SD = 5.27$). An independent t-test conducted to determine the group differences in attitude towards mathematics established that math gaming apps influenced the participants' attitude towards mathematics at $MD = 11.66$ (95% CI, 7.92 to 15.16), $t(81) = 6.317$, $p = .001$. The study recommends that the use of gaming app should be embedded in the school curriculum.

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Introduction:-

The primary school level represents the basis upon which the rest of the educational system is built (Awofala, 2017). Mathematics is the foundation for any nation's economic and technological development (Etuk & Bello, 2016; Festus, 2014; Josiah & Olubunmi Adejoke, 2014). It is an essential part of the Nigerian vision (Charles-Ogan, 2015). Competent knowledge of mathematics and its related skills are vital in preserving society (The Education

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Committee, 2021). Perhaps, achieving the science, technology, engineering mathematics (STEM) objectives is dependent on practical mathematical skills (Musa & Dauda, 2014). However, mathematics is a compulsory subject in the Global educational system, including Nigeria (Adebule & Ayoola, 2015). It is perceived as a complex subject (Okafor & Anaduaka, 2013; Karimah et al., 2018; Li & Schoenfeld, 2019). The probable explanation for this perception may be attributed to the thinking and reasoning required in mathematics. Nevertheless, learning mathematics involves thinking and reasoning and depends on the learners' attitudes towards learning and mathematics (Anthony & Walshaw, 2007). However, the subject's state in Nigeria's primary education is not encouraging (Adedeji, 2018), and the instructors are saddled with a vital task (Newman, 2020). Achieving mathematical competence entails inculcating its relevance to beginners (Murni & Ruqoyyah, 2020). Previous studies have emphasized mathematics's relevance to society (Akinoso, 2018; Andrews, 2007; Kachapova, 2014; khasim, 2012; Kusmaryono, 2014; Lai et al., 2011; Obadare-Akpata, 2017).

Mobile technology can enhance primary students' motivation and interest in learning math (Yussop et al., 2019). Technological intervention is fundamental in early learning (Schenke et al., 2020). Research indicates that the effects of games on students' mathematics performance in classroom settings are still unclear (Chang et al., 2015). Interactive, immersive games can consume children's attention for hours while providing practical instruction and an engaging learning experience. Mathematics gamification is the process of embedding mathematical concepts and including logical manipulations in a puzzle game-like setting aided by computing technologies (Tan et al., 2017). Games have been widely adopted to enhance children's mathematics motivation and performance in various domains (Bartoschek et al., 2013; Boulton et al., 2018; Coelho et al., 2019; Godejord et al., 2017; Rienow et al., 2020; Santiago et al., 2019; Sarvehana, 2019; Siew et al., 2016; Simsek, 2016; Spieler et al., 2018). Games have been used in various mathematical domains, such as in strategic and reasoning abilities (Bottino et al., 2007), critical geometry skills (Yang & Chen, 2010), and arithmetic procedures (Moreno & Durán, 2004). Hulse et al. (2019) reported that low-performing students gained more by completing more problems and engaging more with those problems.

Attitude is a socio-psychological construct referring to an individual's like or dislike of any aspect of their world. Attitude is an important determinant of human response and can affect motivation and learning outcome. Students' success in mathematics depends upon their attitude towards mathematics. Kazmagambet et al. (2020) concluded that students' attitudes toward mathematics improved using an active learning strategy. Bakar and Ayub (2020) reported an association between attitude and mathematical problem-solving achievement. Therefore, this study intends to examine the role of gaming app on student's attitudes towards math.

The present study

Math avoidance behavior is a trend that cuts across culture and is pervasive among young learners. Mathematics is widely perceived as complex (Okafor & Anaduaka, 2013) and a tedious subject to learn, especially for children. This assertion may be linked to the perceived unfavorable attitudes related to the subject. However, children enjoy playing games (Berger et al., 2000). Thus, to enhance the youngsters' morale and inculcate a positive attitude in relation to mathematics, we intend to determine if gamification would increase primary school student's likability for math. Although game apps have been widely used, the trend is novel in the Kogi State of Nigeria. Therefore, this study's primary purpose is to explore math game apps as a moderating variable that positively influences primary school students' attitudes towards mathematics.

Hypothesis

This study hypothesized that game app would significantly influence primary school students' attitudes towards mathematics.

Method:-

A quasi-experimental design with pre-test and post-tests and two groups (experimental and control) were adopted in this present study. Primary school students in Kogi State made up the population of the study. Eighty-three ($n = 83$) students comprising males and females within the age range of 7 – 11 years and mean age of ($M=9.12$) and ($SD=1.22$) were randomly pooled from selected public primary schools in Kogi State as the study participants. The students chosen primarily from primary 5 and 6 classes were assigned to groups, with group A as the experimental group. In contrast, group B represents the control group. Before the main study's commencement, students' attitude towards mathematics was established (pre-test) using an attitude towards mathematics questionnaire. In the post-test study, the treatment group student (group A) was exposed to a math game app (Prodigy Math). Prodigy is a free-to-

use and adaptive game app that integrates basic math concepts into a fantasy-style game. Prodigy is widely used in the US and has been implemented as part math curriculum (NCT, 2018). Students in the control group were exposed to other mathematical activity excluding the game app in the post-test study. After that, the student's attitude towards mathematics was further assessed.

Result:-

Table 1:- Table shows mean and standard deviation scores of the students' mathematics performance for groups A and B.

Group	N	Mean	SD
Group A	41	21.19	3.11
Group B	42	21.31	2.91

The table above shows a mean score of 21.19 and 21.31 for groups A and B and standard deviation scores of 3.11 and 2.91. This indicates that no significant difference was recorded in the mean score for both groups in the pre-test study. Thus, it means that the students have the same level of attitude towards mathematics.

Table 2:- Table showing the mean and standard deviation scores of the two groups (A and B) following the Post-test study.

Group	N	Mean	SD
Group A	41	43.81	9.54
Group B	42	32.15	5.27

The above table shows indicate that the obtained mean scores for both groups were 43.81 and 32.15, respectively, in the post-test study. The data established a high mean score for the experimental group (43.81) compared to the control group (32.15). The standard deviation scores also revealed an increased score of 9.54 for the study group and a lower score of 5.27 for the control group. Thus, it indicates that the mean scores increased significantly following the exposure to the Prodigy Math game for group A.

Table 3:- t-test comparison of the attitude towards mathematics.

Source of variation	N	Mean	SD	df	t	Sig
Group A	41	43.81	9.54			
Group B	42	32.15	5.27	81	6.317	.001

An independent-samples t-test was conducted to determine if there were differences between the experimental and the control groups' attitudes towards mathematics in the post-test study. The result of the analysis established an increased positive attitude towards mathematics for the experimental group (43.81 ± 9.54) when compared to the control group (32.15 ± 5.27), a statistically significant difference of 11.67 (95% CI, 7.92 to 15.16), $t(81) = 6.317$, $p = .001$.

Discussion:-

This study was conducted to determine whether the use of a game apps would moderate primary school students' attitudes towards mathematics. Following a pre-test, post-test study, the mean and standard deviation score showed that the gaming app significantly influenced the experimental group's attitude towards mathematics in the post-test study ($M = 43.81$, $SD = 9.54$) compared to the control group ($M = 32.15$, $SD = 5.27$). The result of an independent t-test conducted to determine the differences in both groups relating to attitude towards mathematics established that math gaming apps influenced the participants' attitude towards mathematics at $MD = 11.66$ (95% CI, 7.92 to 15.16), $t(81) = 6.317$, $p = .001$. Thus, the result affirmed the study's expectation that gamification would influence primary school students' attitudes towards mathematics. The result is in line with previous findings (Hung et al., 2015; Yussop et al., 2019). Chang et al. (2015) reported that students in the game intervention group showed higher mathematics proficiency than those in the paper-and-pencil group. The probable explanation for this finding could be attributed to the increasing innovation in mobile technologies that have reached every corner of society and have attracted the attention of children who enjoy playing games with smartphones. The conventional classroom teaching strategy has been in use for a long and could seem monotonous to young learners. An increase in basic math skills can only be accomplished by motivating the students using technological innovations such as games (Batzogiannis et al., 2018). Games could present an opportunity for the student to compete in the mathematics setting.

Furthermore, the result provides evidence that the utilization of math gaming apps in teaching mathematics will effectively shape students' attitudes positively. Indeed, attitudes are acquired through various means, and when formed, can influence behavior. In other words, Games will enhance the youngsters' mathematical capabilities and change their overall attitude towards the subject. (Schenke et al., 2020)the results suggest that apps can be designed to help children learn essential mathematics skills

Conclusion:-

In response to the study hypothesis, the result revealed, in line with (Chang et al., 2015),that gaming app predicted the variance in student's mathematical performance. Thus, it was concluded that a math game app is an indispensable tool in mathematics in primary school. The study contributes to the mathematics literature by supporting the use of games in enhancing student's performance in mathematics in Nigeria. Nevertheless, the present research encountered a particular limitation that needs to be pointed out. First, the sample size was small and may not be reliable for generalization. Also, the design of the study did not allow for cause-effect determination. Future researchers are advised to include more representative samples and adopt pure experimentation to ascertain cause-effect relationships. However, we recommend that teachers be regularly trained on the use of gaming applications in the classroom. The use of gaming app should be embedded in the school curriculum.

Ethical consideration

The researchers ensured that the study procedures involving human participants were done following the institution's ethical standard.

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