EFFECT OF WHATSAPP USAGE ON PRE-SERVICE TEACHERS' LEARNING OUTCOMES IN BASIC GENERAL MATHEMATICS IN COLLEGES OF EDUCATION, OYO, OYO STATE

[1]Abidemi Florence ODELEYE & [2]P.O. YARA

[1] Department of Mathematics Education, Faculty of Science Education
Emmanuel Alayande University of Education, Oyo, Oyo State, Nigeria
[2]Department of Science Education, Faculty of Education
Lead City University, Ibadan, Oyo State, Nigeria

Abstract

Pre-service teachers' performances in Basic General Mathematics over the years have not been encouraging even as the course is a core course at all levels in Colleges of Education. This may be due to many factors such as, students' attitude, use of appropriate learning strategy and other factors. This study examined the effects of WhatsApp Usage on Pre-service teachers' Basic General Mathematics Learning Outcomes in Colleges of Education, in Oyo State. A quasi-experimental research design was adopted and the population of the study comprised all 1601 pre-service year two teachers in the two Colleges of Education selected, while simple sampling technique was used to select190 samples for the study. Analysis of Covariance (ANCOVA) was used to analyse the hypotheses at 0.05 level of significance. Basic General Mathematics Achievement Test (BGMAT) and Pre-service Teachers' Attitude Questionnaire (PTAQ) was the tools used for data collection. A reliability index of 0.76 for BGMAT using split-half reliability method and reliability coefficient of 0.88 for PTAQ using cronbach alpha . It was revealed from the results that, there was a significant main effect of WhatsApp Usage on pre-service teachers' academics achievement ($F_{(1, 152)} = 5.565, p < 0.05$) and attitude ($F_{(1, 152)} = 315.342, p < 0.05$) in Basic General Mathematics in Colleges of Education in Oyo State, It was concluded that WhatsApp Usage improved pre-service teachers' achievement and attitude toward Basic General Mathematics in Colleges of Education in Oyo State.

Keywords: Basic General Mathematics, Students Academics Achievement, Students' Attitude, Pre-service Teacher, WhatsApp Usage.

Introduction

Mathematics is a key subject at all levels of education, starting from the primary level to tertiary level. It a subject that is applicable to every aspect of human life. The knowledge of Mathematics is

indispensable for building and sustenance of a productive standard of living, be it domestically or nationwide. Both literates and illiterates are engaging Mathematic in their daily activities.

Mathematics is subject that has played crucial role in all human activities up to the present. It is the study of numbers, their relationships, combinations, generalisations, and spatial abstractions, as well as configurations, their structures, measurements, and transformations (Elefteriou, 2023). Due to its importance, Mathematics has become an integral part of the school curriculum with the goal of equip students with the knowledge and abilities necessary for today's rapidly evolving technological environment (Hassan et.al., 2023).

The subject was developed by counting, estimation, careful examination of the shapes and motions of actual objects. It encompasses the study of issues like quantity (numerical theory), structure (algebra), space (geometry), and change (analysis) (Elefteriou, 2023).

Mathematics is applicable in everyday activities; it consists of the body of knowledge and application derived from the theories of individuals from all over the world. Due to its high level of abstraction, emphasis on interrelated notions and reliance on symbol manipulation, Mathematics has not caught the interest of many students despite its importance and relevance on a worldwide scale (Khaleduzzaman, 2020).

Mathematical proficiency directly correlates with economic prosperity in societies, it is essential for nations' scientific and technological development (Helmenstine, 2019). This is because knowledge of mathematics is necessary to comprehend other subjects, including engineering, the sciences, social sciences, and even the arts. The significance of mathematics in science and technology is diverse; therefore make mathematics to be commonly used in all areas of Science, Technology, and Business.

Mathematics is the cornerstone of the Nigerian educational system, both for basic education and post-basic education, while Colleges of Education are the institution mainly for teachers' preparation; it is a place where elementary school teachers are being trained in Nigeria. According to information in the National Policy on Education, a Nigerian Certificate in Education (NCE) is the minimal requirement for the teaching profession in the country (Minimum Standards for NCE Teachers 2020). Therefore, NCE holders must work as teachers in elementary or junior secondary schools. The National Commission for Colleges of Education (NCCE) was created by an act of the Federal Ministry of Education in 1989 and was saddled with the responsibility of laying down standards for all programmes of Teacher Education, to monitor and control quality among Colleges of Education, accredited certificates, academic awards and approved guidelines for accreditation. With the above objective, NCCE has a document, which spells out the curriculum for the NCE programme. The document is called "Minimum Standards for NCE Teachers."

In the reviewed NCE Minimum Standard, relevant subject such as Mathematics, English and Computer Education are made compulsory for all NCE students. The disclosure of students to these subjects supposed to enable them to teach the subject effectively at the primary school and junior secondary level. The subjects are designed in the NCE curriculum in form of General Studies Education (GSE). GSE are core courses and must be passed by every prospective NCE holder.

The name given to General Mathematics in Colleges of Education is Basic General Mathematics. Pre-service teachers in Colleges of Education from 100 level to 300 level are required to offer this course. The course is categorised as follows:

i. GSE 113 & 122 (Basic General Mathematics I and Basic General Mathematics II) for 100 level students.
ii. GSE 212 & 222 (Basic General Mathematics III and Basic General Mathematics IV) for 200 level students.
iii. GSE 322 (Basic General Mathematics V) for 300 level students.

The course contents were extracted from both Junior and Senior Secondary School General Mathematics curriculum. The Course contents in Basic General Mathematics are:

- GSE 113 (Basic General Mathematics I): 100 level students first semester, we have Number Base, Set Theory, Mathematical Operation on Fractions, Decimal and Whole Numbers, Indices and Logarithm, and Surds
- GSE 122 (Basic General Mathematics II) for 100 level students, second semester, we have Expansion and Factorization of Simple Algebra, Simple Algebra and Method of Solution, Simple word problem, Ratio, Percentages, Simple and Compound Interests and Variation (Direct and Inverse)
- GSE 212 (Basic General Mathematics III): For 200 level first semester, course contents are: Change the Subject of the Formula, Unit of Measurement, Area and volume of Plane shape, Area and volume of Solid Shapes,
- GSE 222 (Basic General Mathematics IV): For 200 level second semester, we have Data Collection, Data Presentation and Angles.
- GSE 322 (Basic General Mathematics V): For 300 level, the course contents are: Frequency Distribution, Measure of Central Tendency, Range, Quartile, Mean Deviation, Variance and Standard Deviation, Simple Probability and Application (Minimum Standard for NCE, 2020).

Learning Outcomes in Basic General Mathematics are what describing what students must know, be able to do, or be able to demonstrate after completing a course in Basic General Mathematics. It is a student action that must be observable, measurable, and demonstrateable. Students' learning outcomes in this research involve their achievement and their attitude toward Basic General Mathematics.

All of the course contents in Basic General Mathematics are offering in Secondary School Mathematics, in which it is expected of all NCE pre-service teachers to have acquired basic knowledge of the subject matter, however, reverse was the case. The pre-service teachers in their secondary schools education have learned most of the contents in Basic General Mathematics, but their learning outcomes (academic achievements and attitudes) in the course demonstrate that they still have a low level of achievement and a negative attitude toward the subject.

Change of Subject of the Formula is one of the course contents to be taken by 200 level students in first semester. This topic deals with making a variable out of a given formula the subject of the formula, that is, to express a variable in terms of others variable. From my own observation, most students found it difficult to express a variable in terms of others, which is one of the reasons they were unable to substitute any given variable correctly in any mathematical equation and solve for the unknown. Despite the fact that the topic is not new to the students, their academic achievement and attitude in the course over time shows that they lack the necessary understanding of how to manipulate variables and distinguish one subject variable from the others. Knowledge of subject of formulae is applicable to almost all of the remaining contents in the course, students who do not understand basic rudiment for solving mathematical problems will always perform low in the course.

Low achievement in Basic General Mathematics is an element of cross-factors connected with students, educators and schools. It has been observed that students' attitudes are of significant factors that determine students' performance in mathematics. A person's learned tendency to respond positively or negatively to an object, situation, idea, or another person is referred to as their attitude (Animasahun & Akinsola, 2019). Out of a number of factors affecting students' learning and performance in mathematics are students' attitude towards the subject, teachers' instructional practices, and school environment (Mazana et. al, 2019). Attitudes can change and develop over time; however, a negative attitude affects the learning outcome and prevents effective learning (Mazana et. al, 2019). These include the student's self-confidence in their ability to solve mathematics, their anxiety or phobia regarding mathematics, their enjoyment of mathematics, and their perception of the utility of mathematics.

Good teaching and student comprehension of the topic taught are also factors that aids positive attitude of students toward Mathematics. While students' dislike of Mathematics is related to things like boring teachers, inability to solve mathematics problems, a lack of understanding of the material covered, being distracted during lectures by talking or playing on their cell phones, and receiving a poor grade in an examination.

In Mathematics education, teacher competency ought to be closely linked to student thinking, comprehension and learning. It is important not to undervalue the role that teachers play in assisting students to learning. With the help of the teachers, students may be eager to learn and gained mathematical knowledge. The primary responsibility of the educator in the classroom is to establish an appropriate learning environment in which students can engage in mathematical thinking, activities and view mathematics as a subject that demands exploration, conjecture, representation, generalisation, verification, and reflection (Sun, 2023).

How to provide instructional resource, conducive environment, methods, and solutions are very important for effective teaching and learning of Mathematics, therefore to ensure that students are successful learners, innovative teaching methods and approaches should be developed (Sam-Kayode, 2023). Realising these elements will empower the instructors to actually utilise accessible assets and time more to improve student learning ability. The use of WhatsApp for efficient teaching and learning of Basic General Mathematics is an intermediary between teachers and students.

In Nigeria, virtually all households and young people are glued to social media, particularly WhatsApp, and this consumes more than half of their daily time. It is thusly vital to consider such medium which the students have a lot of acquainted with and generally depended on, be changed into learning gadgets and conditions to appropriately draw in them scholarly exercises as opposed to social use only (Gamji & Salman, 2019). The utilization of social media, particularly WhatsApp is so prevalent among young people in schools. That is why this article focus is on pre-service teachers in colleges of education, one of the places with the most social media users.

Nowadays, social media play a significant role in daily life. It gives an unfathomably extended course to data conveyance, trade, and cooperative commitment among individuals and innovation that is not restricted by geography (Akhalaf et al, 2018). People, particularly young people, spend more time online than in the "real world" for the majority of their daily activities. The WhatsApp platform has the potential to be transformed into a mobile classroom in which all students can register to participate in learning activities due to its widespread use and popularity among Nigerian youths.

WhatsApp has a few instruments like live recordings, photograph occasions, documents, collections, declarations, and watch parties among different elements which are reasonable for classroom activities Arijeniwa, A.F. (2023). This makes it easier and faster for teachers to communicate with their students. It also assists students to learn better in any given environment. The gathering talk elements can be utilized to organize learning both inside and outside the school premises to deliver instruction that could be paid attention to at students' recreation, and keep in touch with students beyond the classroom (Alqurashi, 2019).

Students may be able to develop skills in teamwork and communication as well as create an environment for self-directed learning when they are encouraged to participate in learning and research through social networks (Agui, 2018). WhatsApp is a tool for unlimited, free messaging that can be used both inside and outside of the classroom. Teachers can easily and effectively manage large classes by using WhatsApp groups. It may also assist students in gaining confidence (Gamji & Salman 2019). This setting can be made into an academic learning environment that works well with mobile classrooms, virtual classrooms, e-learning, and remote learning.

Mathematics instruction necessitates a manipulative and constructive approach that makes concepts tangible and applicable. Because of this, innovative approaches like the use of social media and the electronic classroom are gaining ground in Nigerian classrooms (Baishya & Maheshwari, 2020).

Stakeholders in education such as students, teachers, parents, college administrators, the government, and the general public, have expressed concern about the declining general performance of students in Basic General Mathematics courses taught in educational institutions. This poor performance could be result from various factors such as gender, availability of instructional resources, student attitudes, and quality of the educator. Numerous efforts have been made to enhance student learning ability, including the development of a more effective teaching method. This review, subsequently, needs to research on the effects of WhatsApp Usage on Pre-service teachers' Basic General Mathematics Learning Outcome in Colleges of Education, Oyo.

Research Questions

1. What are the frequency distribution count and bar chart representation of pre-service teachers' pretest and posttest scores in BGMAT?

Hypothesis

The following hypotheses were tested in the study at 0.05 level of significance:

Ho1: There is no significant main effect of WhatsApp Usage on Pre-service Teachers' academic achievement in Basic General Mathematics in Colleges of Education in Oyo State.

Ho2: There is no significant main effect of WhatsApp Usage on Pre-service Teachers attitudes towards Basic General Mathematics in Colleges of Education in Oyo State.

Methodology

Research Design

A quasi – experimental research design of pretest and posttest non-equivalent control group was used for the study. The population for the study consisted of all the one thousand six hundred and one (1601) year two pre-service teachers in two colleges of education in Oyo State. The sample of the study consisted of one hundred and ninety (190) 200 level students from school of languages, out of five schools in each college of education through random sampling technique.

The research instruments used were Basic General Mathematics Achievement Test (BGMAT) and Pre-service Teachers' Attitude Questionnaire (PTAQ) adapted from the modified Fennema-sherman Mathematics Attitude scale which was designed to measure students' confidence, students' perception and usefulness. The BGMAT contained twenty (20) multiple choice items with four (4) options A,B,C and D while PTAQ contained twenty (20) items with four point likert scale (SA, A, D, SD). The BGMAT and PTAQ were administered to pre-service teachers (sample for the study) as pretest and posttest, Lesson plan was also prepared by the researcher to guide the teaching of a content in Basic General Mathematics III, the content is ' Change of Subject of the Formula'. The research instrument was validated by the experts and this enhanced face, content and construct validity of the instrument. The pilot study was conducted at School Education in Emmanuel Alayande College of Education, Oyo, A reliability coefficient of 0.76 was obtained for BGMAT with forty (40) 200 level pre-service teachers using split-half reliability method while Cronbach alpha was used to determine the reliability coefficient of PTAQ which was 0.88. Percentage frequency count was used to analysed the research question and the hypotheses formulated for the study were tested using analysis of covariance (ANCOVA) at 0.05 level of significance.

Result

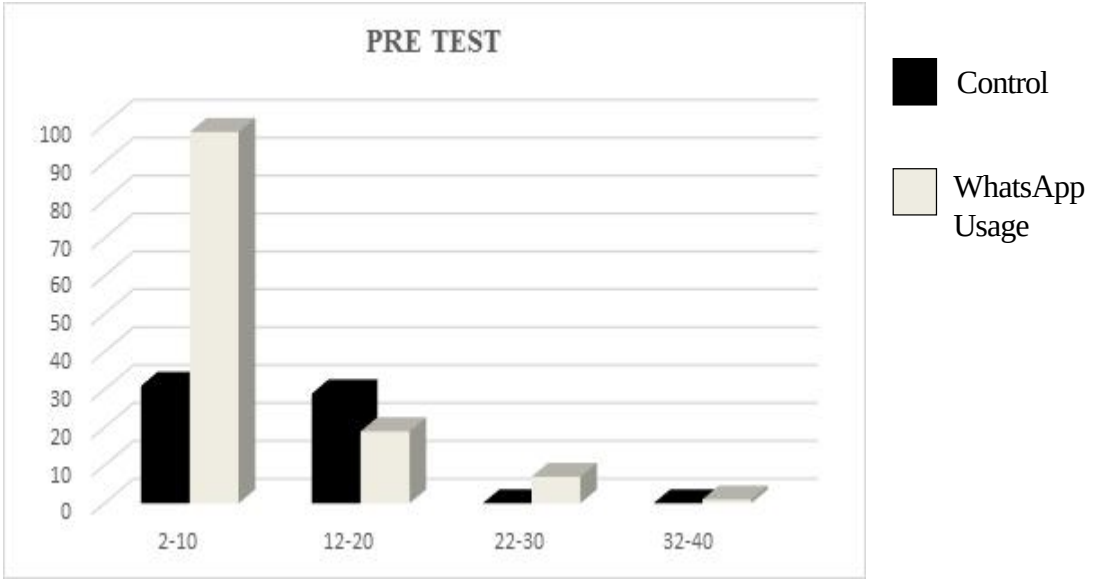
The research question raised for the study was answered using frequency count table and Composite Bar Chart for data presentation. The frequency distribution and bar chart presentation of the Pre-Service Teachers' Basic General Mathematics Achievement Test for Pretest and Posttest are presented below:

Table 1. Frequency count and percentage of Pre- Service Basic General Mathematics Achievement Test (Pre-test Score)

Pretest Score	Control	Percentage	WhatsApp Use	Percentage
2-10	31	51	98	74.4
12-20	29	49	19	15.2
22-30	0	0	7	5.6
32-40	0	0	1	0.8

Source: Author's Compilation from E-view Output

Figure 1: Bar Chart of Pre-Service Teachers' Basic General Mathematics Achievement Test (Pretest score) in Colleges of Education in Oyo State.



Source: Researcher's Fieldwork 2023

The result revealed the pretest score of Basic General Mathematics Achievement Test of 200 level students in the control group. The total number of students in the control group were sixty (60), total number of students that scored from 2-10 marks were thirty-one (31) and twenty-nine (29) students scored from 12-20, none of the student score between 22-30 and 32-40. Also, for WhatsApp Usage, One hundred and thirty (130) students was the sample that supposed to attempt the Basic General Mathematics Achievement Test but one hundred and twenty-five, (125) submitted, ninety-eight (98) students scored from 2-10marks, nineteen (19) scored from12-20marks, seven

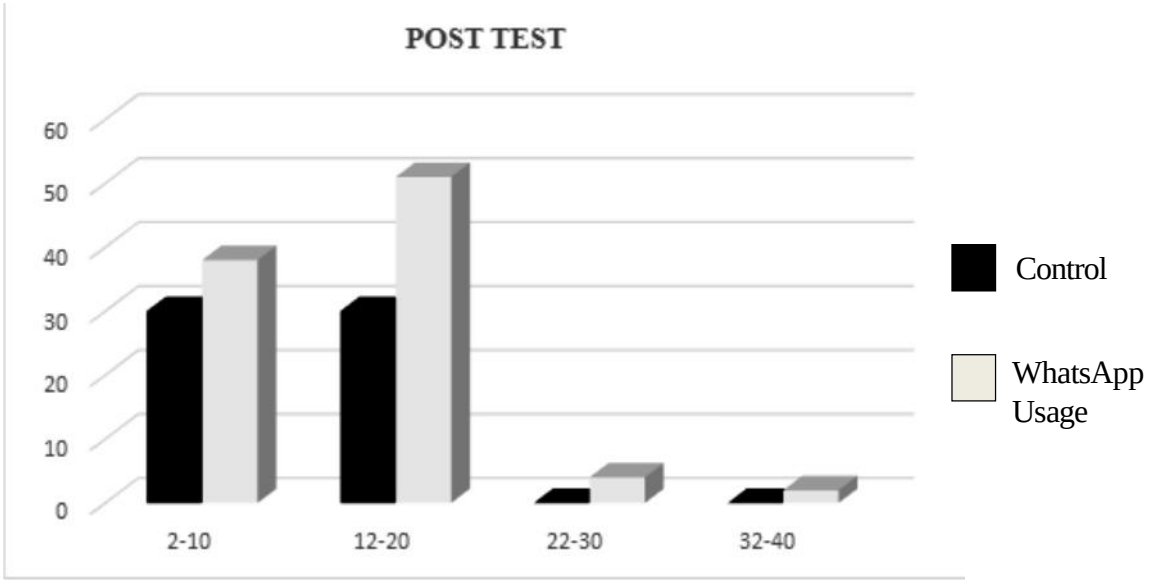
(7) students scored from 22-30 marks and lastly, one(1) student scored from 32-40 marks. These results showed, that students academics achievements in Basic General Mathematics were low.

Table 2: Frequency distribution of Pre- Service Basic General Mathematics Achievement Test (Posttest Score).

Control Group	Post-test Scores	Percentage %	WhatsApp Usage	Percentage %
30	2-10	50	38	40
30	12-20	50	51	53.7
0	22-30	0	4	4.2
0	32-40	0	2	2.1

Source: Author's Compilation from E-view Output

Figure 2: Bar chart of Basic General Mathematics Achievement Test (Post-test score) in Colleges of Education in Oyo State.



Source: The Researcher's Fieldwork 2023

The table and the chart above revealed the posttest score of Basic General Mathematics Achievement Test of 200 level pre-service teachers in colleges of Education, Oyo State. The total number of students in the control group were sixty (60), total number of students that scored from 2-10 marks were thirty (30) which is and thirty (30) students scored from 12-20, none of the student score between 22-30 and 32-40. In WhatsApp Usage group, Ninety-five (95) students submitted the test , thirty-eight (38) students scored from 2-10 marks, fifty-one(51) scored from12-20 marks, four (4) students scored from 22-30 marks and two(2) students scored from 32-40 marks.

Hypothesis Testing

$H0_1$: There is no significant main effect of WhatsApp Usage on Pre-Service teachers' Academic Achievement in Basic General Mathematics in Colleges of Education, Oyo State

Table 3: Analysis of Covariance Statistics of the main effect of WhatsApp Usage on Pre-Service Teachers' Academic Achievement in Basic General Mathematics Model Summary.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	256.250[a]	2	128.125	3.802	.024	.048
Intercept	5451.805	1	5451.805	161.788	.000	.516
Treatment_groups	187.511	1	187.511	5.565	.020	.035
pre_ach_score	17.290	1	17.290	.513	.475	.003
Error	5121.970	152	33.697			
Total	**31288.000**	**155**				
Corrected Total	**5378.219**	**154**				

a. R Squared = .048 (Adjusted R Squared = .035)

The result in Table above reveals that there is significant main effect of WhatsApp Usage on pre-service teachers' academics achievement in Basic General Mathematics in Colleges of Education in Oyo State ($F_{(1, 152)} = 5.565$, $p < 0.05$), therefore null hypothesis was rejected.

Table 4: The Estimated Marginal Score of the Effect of WhatsApp Usage on Pre-Service Academic Achievement in Basic General Mathematics

Treatment groups	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
WhatsApp	13.839[a]	.605	12.643	15.035
Control	11.488[a]	.768	9.970	13.006

The mean score of WhatsApp group was higher (13.839) than the mean score of the control group (11.488). Therefore, the significant main effect was as a result of the differences in the post achievement mean score of WhatsApp Use that was higher than that of the control group.

$H0_2$: There is no significant main effect of WhatsApp Use on Pre-Service teachers' Attitude towards Basic General Mathematics in Colleges of Education in Oyo State.

Table 5: Analysis of Covariance Statistics of the main effect of WhatsApp Usage on Pre-Service Teachers' Attitude in Basic General Mathematics Model Summary

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	39632.126[a]	2	19816.063	161.785	.000
Intercept	4250.857	1	4250.857	34.706	.000
treatmet_groups	38624.291	1	38624.291	315.342	.000
pre_att_scores	20.292	1	20.292	.166	.685
Error	18617.513	152	122.484		
Total	**361506.000**	**155**			
Corrected Total	**58249.639**	**154**			

a. R Squared = .680 (Adjusted R Squared = .676)

The result in the table above reveals that there is significant main effect of WhatsApp Usage on pre-service teachers' attitude towards Basic General Mathematics in Colleges of Education in Oyo State ($F_{(1, 152)} = 315.342$, $p < 0.05$), therefore, null hypothesis two(i) was rejected.

Discussion

From the percentage frequency count of pretest and posttest scores of pre-service teachers' achievement test, it reveals the level of performance of pre-service teachers in colleges of education. Tested hypotheses revealed that, the use of WhatsApp platform improved pre-service teachers' academic achievement and attitude towards Basic General Mathematics in Colleges of Education, Oyo, Oyo State. This may be owing to the fact that majority of the students are prone to appreciate new strategy of learning especially WhatsApp that is commonly used by students for merely social activities. This study is in agreement with a finding, which recommended that the WhatsApp Group Learning Platform should be used to improve students' performance in STM based on the result of the findings (Ajayi & Olajide, 2022).

This research also correlate with findings by Oriji A. & Anikpo F (2019), who looked into classroom communication technologies, claim that they give teachers and students insightful feedback on how well their pupils grasp the material and whether they can apply it in new situations. This study found that when students used technology-rich settings like WhatsApp, their attitudes toward learning improved and their self-esteem grew positively with persistent trends. Research indicates that integrating technology into educational settings that adhere to constructivist pedagogy has the capacity to stimulate innovative approaches to teaching and learning.

Likewise in this study, achievement and attitude of pre-service teachers towards Basic General Mathematics was improved with the use of WhatsApp Platform. Therefore, WhatsApp Platform Usage strengthened achievement and attitude of pre-service teachers toward Basic General Mathematics in Colleges of Education in Oyo State, Nigeria.

Recommendations

Based on the findings, discussions and conclusion drawn from this research, the following recommendations were made:

i. Pre-service teachers should make judicious use of their various WhatsApp Platforms to discuss related and useful topics rather than mere fun on social media, so as improve their achievement and attitude in Basic General Mathematics.

ii. Teachers are to employ the use WhatsApp Platform to enhance students' achievement and attitudes towards the learning of Basic General Mathematics.

References

Agui, U.O. & Ogwueleka, F.N., (2018) Impact of Social Media on Students' Academic Performance. *International Journal of Scientific and Engineering Research* 9(3), 1-10.

Ajayi, L. F. & Olajide, I.E. (2022) Effects of WhatsApp Group Learning Platform on Senior Secondary Schools Students' Learning Outcomes in Science, Technology, and Mathematics (STM) in Ekiti State, Nigeria. *Educational Research and Reviews* 17(8), 213- 218.

Animasahun I. A. & Akinsola M. K. (2019), Lecturers' Attitude, Perception to Teaching and Learning Experience as Correlates of Mathematics Achievement in Colleges of Education In South-West, Nigeria. Paper presented at the Annual Conference of Science Teacher Association of Nigeria, Oyo State branch held at Faculty of Education, University of Ibadan, Ibadan.

Alkhalaf A.M., A.Tekian & Y.S. Park, (2018). The Impact of WhatsApp Use on Academic Achievement among Saudi Medical Students. *Medical Teacher*, 40 (1), 10 - 14

Alqurashi E. (2019). Effects of Traditional Teaching Methods and Modern Teaching Aids on Students' Learning Outcomes in Mathematics. *International Journal of Emerging Technologies in Learning,* 14(24), 89-103.

Andamon, J. C., & Tan, D. A. (2018). Conceptual Understanding, Attitude and Performance in Mathematics of Grade 7 Students. *International Journal of Scientific & Technology Research*, 7(8), 96-105.

Arijeniwa, A. F. (2023). A Study of Social Media Usage on the Academic Performance of Secondary School Students in Benin Metropolis. PGDE Project Submitted to National Teachers' Institute, Kaduna.

Arthur, B. E., Yarkwah, C., & Twum, R. (2020). Effectiveness of the Use of WhatsApp in the Learning of Mathematics among University Students. *The International Journal of Science & Technoledge,* 8(11), 45 - 56.

Baishya, D., & Maheshwari, S. (2020). WhatsApp Groups in Academic Context: Exploring the Academic uses of WhatsApp Groups among the Students. *Contemporary Educational Technology*, 11(1), 31-46.

Elefteriou, K.(2023). High School Mathematics Teachers' Conceptions of Nature of Mathematics (NOM) and How Prior Learning Environments Affect These Conceptions. PhD. Dissertation, Illinois Institute of Technology.

Gamji, M. B. U., & Salman, J. H. (2019). Use of WhatsApp as a Learning Tool in Today's Generation: A study of Undergraduate Students. International Journal of Information Processing and Communication, 7(1), 11 - 23

Helmenstine, A. M. (2019). Why Mathematics is a Language. Thought Co.(Last visited on October 5th, 2022): https://www. Thought co. com/whymathematics-is-a-language-4158142.

Khaleduzzaman M.D. (2020), Problems of Teaching Mathematics at Secondary Level in Bangladesh. Journal of Research & Method in Education (IOSR-JRME) 10(6),13-21 www.iosrjournals.org

Mazana, Y. M., Suero Montero, C., & Olifage, C. R. (2019). Investigating Students' Attitude towards Learning Mathematics. International Electronic Journal of Mathematics Education, 14(1), 207-231. 10.29333/iejme/3997.

Mutange R.E. (2020), Influence of Problem Solving Approach on Secondary School Students' Mathematics Achievement by School Type in Kenya. International Journal of Scientific and Research Publications. 10(9), 117-130 http://dx.doi.org/10.29322/IJSRP. 10.09.2020.p10515 www.ijsrp.org p10515.

Hasanah, N., Inganah, S., & Maryanto, B. P. A. (2023). Learning in the 21st Century Education Era: Problems of Mathematics Teachers in the Use of Information and Communication Technology-Based Media. JEMS: Journal Edukasi Matematika dan Sains, 11(1), 275-285.

NCCE, Federal Republic of Nigeria. National Commission for Colleges of Education, Minimum Standards for NCE Teachers 2020 Edition

Ngonso, B. F. (2019). Effect of Social Media on Teenagers and Youths: A Study of Rural Nigerian Teenagers and Youths in Secondary Schools. Global Media Journal, 17(3), 1-6.

National Education Policy 2020. (2023, August 18). In Wikipedia. https://en.wikipedia.org/wiki/National_Education_Policy_2020

Oriji, A., & Anikpo, F. (2019). Social media in teaching-learning process: Investigation of the use of Whatsapp in teaching and learning in University of Port Harcourt. European Scientific Journal, 15(4), 15-39.

Sam-Kayode, C. O. (2023), Virtual Learning and Undergraduate Students' Academic Achievement in Mathematics During Covid-19 Lockdown in Ibadan, Oyo State. International Journal of Research and Scientific Innovation. 4(2), 23 - 45

Sinthu, S., Kaviya, P., Geetha, M., & Seetha, S. (2022). Appreciating the Contribution of Modern Mathematical knowledge to Societal Improvement. International Journal of Early Childhood Special Education, 14(4), 51 - 64

Sun, L. (2023). Effective Use of Technology for Teaching in STEM. In Technology Integration and Transformation in STEM Classrooms *IGI Global* , 4, 40-55.