International Journal of Mathematics and Statistics Studies, 13 (2), 34-42, 2025
Print ISSN: 2053-2229 (Print),
Online ISSN: 2053-2210 (Online)
Website: https://www.eajournals.org/
Publication of the European Centre for Research Training and Development -UK

Fostering Pedagogical Updates for the 21st Century Mathematics Classrooms: The Digital Inclusion

Comfort Oluwasesan Akinwamide
Bamidele Olumilua University of Education, Science and Technology,
Ikere, Ekiti State, Nigeria

doi: https://doi.org/10.37745/ijmss.13/vol13n23442 Published June 10, 2025

Citation: Akinwamide CO (2025) Fostering Pedagogical Updates for the 21st Century Mathematics Classrooms: The Digital Inclusion, *International Journal of Mathematics and Statistics Studies*, 13 (2), 34-42

Abstract: *The periodic updating of the teaching and learning of Mathematics as a core subject in both the basic and secondary school levels for the generation upcoming is a necessity born out of its importance. To uphold this idea, the magnitude of the teachers' computer usage in the teaching of Mathematics is quite germane, especially for a twenty-first century educators in which every human activity is coated with technology. Hence, this research seeks to investigate the extent of the involvement of Mathematics teachers in the use of technology in the teaching and learning of Mathematics and to establish the impact of digitalization on the performance of students in Mathematics. The population for the study consists of all the Senior Secondary School II (SSSII) students in Ekiti State and their Mathematics teachers. The design adopted a mixed approach of qualitative and quantitative techniques, these are; survey and quasi of pretest, posttest control groups designs. The sample consists of all the SSSII Mathematics teachers of the selected schools numbered to 11 with the 101 selected SSSII students across the three Senatorial Districts. Multistage sampling was adopted to select the schools and the students. Self-prepared questionnaire tagged "Teacher's Technological Involvement Inventory (TTII) was used to collect data from the teachers. Mathematics Performance Test (MPT) was administered on the learners to generate data. The instruments were validated by experts in the field of Test and Measurement and also in the field of Mathematics education before usage. Observation showed that a large number of teachers in secondary schools did not digitalise the teaching of Mathematics. Also, it was revealed that the use of technology in the teaching of Mathematics as experimented improved students' performance in Mathematics. Hence, it was recommended that in-service training should be organized for teachers on the digitalizing teaching. Teachers should be encouraged to teach Mathematics using mobile phones.*

Keywords: mathematics, mathematics teachers, digitalising pedagogy, mobile phones, 21st century

INTRODUCTION

Mathematics is significant in education and is paramount in the overall development of the citizenry because there is no area of life of which Mathematics is less significant. Balogun 2014) described

Mathematics as the key to success, and that the importance and contributions of Mathematics to the modern culture of science and technology state that without Mathematics, there is no science; without science, there is no modern technology and there is no modern society. Jayanthi, (2019) concluded that a society that gives weightage to the knowledge of mathematics, makes tremendous progress. Ehwarieme and Ogbogbo (2008) described Mathematics as a precision tool used by mankind in their search for a clear understanding of the physical world. Without Mathematics, we cannot survive scientifically, technologically, socially, politically and economically. It is the study of numbers, symbols, sizes, shapes, patterns, generalization, measurements, models, qualities, relationship and functions (Okafor & Adeleye 2011). Mathematics is at the central of human existence, it is being practiced either consciously or otherwise by every human being. As a global communication tool, it improves accountabilities, this fine-tune individual's financial accuracy and foster economic buoyancy. Employment opportunities in the area such as Finance, Science, engineering, technology, architecture, financial analysis and data analysis are easily accessible for job seekers. Children can learn how to manage money for future purposes. Mathematics helps us to develop our accountability knowledge, especially at a time like this in which there is economy recession, mathematics will help us to manage our earnings as people do one-to-one mapping, no extravagancy, individual buys what she/he needs exactly. Mathematics fosters critical thoughts as it equips individuals with analytical skills that can be applied to other real-life situations through analytic thinking. On daily basis, mathematics is involved in practices. This is noticeable in the frequent human endeavours such as budgeting, measurement of food stuffs, doctors' measuring the quantity of drug that will be injected into a patient, distant calculation, proportions, timing and counting.

Some of these practices are carried out even by illiterates without the consciousness of the fact that mathematics is being practiced. Every human being has catalogue of confronting and competing issues that agitate for attention, problem solving-teaches how to break complex issues into smaller and manageable parts that can be solve easily with consideration on the degree and order of urgency. Mathematics improves the three domains of education; the cognitive, affective and psycho-motor domains (Hartmann, Siegert, Gluge, Wendemuth, Kotzyba & Demi, 2012). The impact of mathematics teachers in the sustainability of the subject and its benefits for the upcoming generation is a pivotal. The sustainability of this subject of worth to individuals, communities and every nation of the world in this era of digitalization highly depend on mathematics teachers' dispositions to the teaching of the subject. Teachers' orientation and practicability in terms of digitalization is a connecting chain between the present and the future. Also, it is a strong determinant to the performance of students in mathematics especially in this era of technology, hence, teachers are described as the agent of change (Alsina &Silva-Hormazabal 2023). For mathematics teachers to blend into the global digitalization, the level at which the teachers are connected should be considered for more exposure to the 21st century era of technology and the preparation and preservation of mathematics for the future generation.

Also, Vasquiez, Alsina, Seckel, & Garcia- Alonso, (2023) emphasized the need to train mathematics teachers to update their knowledge in the educational needs of 21st century as to promote education based on competency for sustainable development. The nature of mathematics as a subject of unique characteristics commands that the teachers should be evaluated often to determine how current they are

since the mathematics is dynamic. Integration of sustainability into the teaching and learning of mathematics education by reviewing the teaching and learning of the subject in relation to digitalization is paramount. (Vasquiez, Alsina, Seckel, & Garcia- Alonso, 2023)

Objective of the study

The objectives of this study are to:

1. establish the degree of involvement of mathematics teachers in the use of technology in the teaching of mathematics.
2. determine the effect of involving technology (mobile phones) in the performance of students in mathematics
3. suggest means for improvement where necessary

Research Question

What is the extent of involvement of mathematics teachers in the use of technology in the teaching of mathematics?

Research Hypotheses

1. There is no significant difference in the performance mean scores of students in the Experimental and Control groups before treatment
2. There is no significant difference in the performance scores of students in the experimental and control groups after treatment
3. There is no significant difference between the pre-test and post-test mean scores of students exposed to Mathematics through the use of mobile phones and those exposed to Conventional Method.

METHODOLOGY

The population for the study consists of all the Mathematics teachers and Senior Secondary School II (SSSII) students in Ekiti State. The design adopted is a mixed approach of qualitative and quantitative techniques, these are; survey and quasi of pretest, post-test control groups designs. The mathematics teachers used as sample were purposively selected likewise the students. It was purposive because not all the students in the selected schools own or have access to smart mobile phones. 101 Senior Secondary School II students selected were from the three senatorial districts in the State. Two self-developed instruments were used for data collection, namely (i) Self-prepared questionnaire tagged “Teacher’s Technological Involvement Inventory (TTII) and (ii) Mathematics Performance Test (MPT). The instruments were subjected to intensive screening by a consortium of experts: Two seasoned Mathematics teachers that set and mark Junior WAEC & NECO examinations and an expert in the field of Tests and Measurement. The Contents and face validity were accessed.

TTII contains ten items of Likert scales style. This was administered on the Mathematics teachers, data collected were analysed descriptively using mean and percentage. Mathematics Performance Test (MPT) contained two sections: A and B. *Section A* solicited for demographic variables of the student while *section B* contained 20 multiple choice objective questions of which the student made choice of correct answer to each question. The performance of the students that were used for the study were established by pre-tests conducted on both the experimental and the control groups to ascertain homogeneity while post-tests after the treatment were used to measure improvement in the two groups. 49 students were in the experimental group while 52 students were in the control group. Experimental group was taught using WhatsApp chatting and messaging while the control group was exposed to conventional strategy of teaching. Data collected were analysed using Analysis of Covariance (ANCOVA).

RESULTS

Table 1: Descriptive analysis showing Mathematics Teachers Accessibility and Usage of Technological Devices in the Teaching of Mathematics

S/N	***Statement***	***YES***	***NO***	***REMARK***
1.	Do you have a Computer Laboratory in the school?	5(45.45%)	6(54.55%)	negative
2.	Do you have a smart phone?	11(100%)	0(0%)	positive
3.	Do you have a laptop?	4(36.36%)	7(63.64%)	negative
4.	Do you use Phone/Computer to teach Mathematics?	1(9.09%)	10(90.91%)	negative
5.	Do you have a functioning generator in the school?	3(27.27%)	8(72.73%)	negative
6.	Do you conduct Computer Based Test/Examination for your students?	(0%)	11(100%)	negative
7.	Do you give online assignment to your students?	0(0%)	11(100%)	negative
8.	Do you interact with people on mobile phones platforms?	11(100%)	0(0%)	positive
9.	Do you experience boredom whenever you have flat battery?	6(54.56%)	5(45.45%)	positive
10	Do you have mathematics applications on your phone	2(18.18%)	9(81.82%)	negative

From table 1, all the respondents numbered to 11 have mobile phones as revealed in the response to item 2 which showed 100%. Item 4, with 90.91% showed that a large number of mathematics teachers did not teach mathematics with technology devices (phones). Item 6 is 100% negative showing that none of the teachers ever conducted Computer Based Examination. Likewise, Item 7 is 100% negative indicated that mathematics teachers were not giving online work to the students. The response to item 10 showed that 81.82% of the mathematics teachers do not have mathematics applications in their mobile phones. Response to item 9 showed that teachers were active in using their phones.

Test of Hypotheses

Hypothesis 1: There is no significant difference in the performance mean score of students in Mathematics in experimental and control groups before the treatment.

Table 2: t-test analysis showing difference in the performance mean scores of students in experimental and control groups before the treatment

Variations	**N**	**Mean**	**SD**	**df**	**t_{cal}**	**P**
Experimental	49	24.01	3.47	99	0.876	0.383
Control	52	24.62	3.44			

p>0.05

Table 2 showed that the t-cal value of 0.876 is not significant because the P value (0.383) > 0.05. This implies that null hypothesis is rejected. Hence, there is no significant difference in the performance mean score of students in Mathematics in experimental and control groups before the treatment. This implies that students' performances in the two groups before treatment were equal and ascertained the homogeneity of the two groups.

Hypothesis 2: There is no significant difference between the performance mean scores of students exposed to Mathematics through mobile phones learning platforms and those exposed to conventional method

Table 3: t-test analysis showing difference in the performance mean scores of students in experimental and control groups after the treatment

Variations	**N**	**Mean**	**SD**	**df**	**t_{cal}**	**P**
Experimental	49	76.39	7.00	99	22.159*	0.000
Control	52	50.58	4.51			

*p<0.05

Table 3 showed that the t-cal value of 22.159 is significant because the P value (0.000) < 0.05. This implies that null hypothesis is rejected. Hence, there is significant difference between the performance mean scores of students exposed to Mathematics through the use of mobile phones and those exposed to conventional method. Students exposed to digitalisation had better performance in Mathematics than those exposed to conventional method.

Hypothesis 3: There is no significant difference between the pre-test and post-test mean scores of students exposed to Mathematics through mobile phones and those exposed to Conventional Method.

Table 4: Analysis of Covariance (ANCOVA) for Pre – test and Post – test Mean Scores of Students under the Groups :

Source	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	16858.483[a]	2	8429.242	246.809*	.000
Intercept	6781.325	1	6781.325	198.558*	.000
Pre-test	43.262	1	43.262	1.267	.263
Groups	16835.275	1	16835.275	492.938*	.000
Error	3346.984	98	34.153		
Total	422380.890	101			
Corrected Total	20205.467	100			

a. R Squared = .834 (Adjusted R Squared = .831) * P < 0.05

The result presented in table 4 showed that there is a significant difference in the pre – test and post – test mean scores of students in the experimental and control groups as P= 0.000<0.05. There is a strong evidence to reject the null hypothesis which states that there is no significant difference between the pre-test and post-test mean scores of students exposed to Mathematics through the use of mobile phones and those exposed to conventional method. This result led to the rejection of the null hypothesis. By implication, there is significant difference between the pre-test and post-test mean scores of students exposed to Mathematics through mobile phones and those exposed to conventional method. In order to find out the more probable effective strategy, Multiple Classification Analysis (MCA) was carried out. The result is shown in Table 5.

Table 5: Multiple Classification Analysis (MCA) of students' performance in Mathematics by treatment

Grand Mean = 63.10					
Variable + Category	N	Unadjusted Dev'n	Eta^2	Adjusted for Independent + Covariate	Beta
Experimental (Mobile phones Learning Platforms)	49	13.29	.83	13.22	.09
Control	52	-12.52		-12.61	
Multiple R					.913
Multiple R^2					.834

The result in Table 5 shows the Multiple Classification Analysis (MCA) of students' performance in Mathematics by treatment. It reveals that, with a grand mean of 63.10, students exposed to digitalisation had higher adjusted mean score of 76.39(63.10+13.29) than their counterparts in the control group 50.58(63.10+(-12.52)). This means the use of mobile phones was the more effective strategy of teaching Mathematics. There was a very high multiple relationship (R= 0.913) between the two groups and academic performance of students in Mathematics. The two treatment strategies can also account for 91.3%

variability in academic performance of the students in Mathematics. It means there is a need for other researchers to find other teaching strategies (other than the two strategies under consideration) that could account for 8.7% of the variability in academic performance of students in Mathematics.

DISCUSSION

The findings of this study showed that every mathematics teacher had a smart phone, that is, 11(100%) statistically. This was supported by Alakurt, & Yilmaz, (2021) as they established the fact that mobile phones have become an indispensable tool in the hand of teachers to access and send information. Mathematics teachers were not ignorant of the existence of technology and its value in communication. The study indicated that (9.09%) of the teachers have attempted teaching mathematics with mobile phones while (90.91%) never made attempt of teaching mathematics with the use of mobile phones. O'Bannon, Waters, Lubke, Cady & K. Rearden, (2017) itemized various activities that both teachers and students engaged their mobile phones with, these include; making calls, sending messages, checking of time, watching films, downloading apps, playing music and sending and receiving tweets without any teaching and learning related activity. Perhaps there was no enough orientation concerning the benefits of digitalizing teaching and learning. This is the lacuna filled by this study as it served as eye-opener to teachers, students and Government.

The findings of this study revealed that there was no significant difference in the pre-test mean score of students in Mathematics exposed to the use of mobile phones in the learning of mathematics and the control group. This finding established the homogeneity of the two groups involved in the study prior to the experiment. In other words, it could be said that the knowledge baseline for the two groups involved in the study are equal. Consequently, any significant difference recorded afterwards would not be ascribed to chance, but to the specific treatment applied.

The findings of the study showed that there was significant difference between the performance mean scores of students exposed to Mathematics through digitization and those exposed to conventional method. Students exposed to the use of mobile phones in the learning of mathematics had better performance in Mathematics than those exposed to conventional method. This finding agrees with the research findings of O'Bannon, Waters, Lubke, Cady & Rearden, (2017) that mobile phones learning platform is an antidote for students' poor academic performance in mathematics.

The study also revealed that there was significant difference between the pre-test and post-test mean scores of students exposed to Mathematics through mobile phones and those exposed to conventional method. This was premised on the theory of pretest and posttest of Dimitrov & Rumrill, (2003) that described pretest and posttest as a reliable measure to ascertain the resulting from experimental treatment and it is in conjuncture with the reason for adopting the design in this study. Students exposed to mobile phones learning experience had higher adjusted mean score than their counterparts in the control group. This presents mobile phones learning method as the more effective strategy of teaching Mathematics. There was a very high multiple relationship between the two groups and academic performance of students in

Mathematics. This was supported by the research carried out by Spandi, Ariyanto, Usumaningsh, & Aini, (2018), titled Mobile Phone Application for Learning Mathematics in which it was found out that the use of mobile phones increased students' performance in mathematics.

CONCLUSION

Conclusively, this study established the fact that a large number of mathematics teachers are not digitalising their teaching processes which could be traceable to lack of knowledge of the benefits of including technology in teaching and learning. Teachers in the 21st century should not be myopic concerning the benefits of technology in teaching and learning of mathematics. Teaching mathematics with the use of phones will encourage the involvement of some mathematics applications that enhance mathematics for sustainability, this will help students to dive into the fields involving mathematics for sustenance. Observations have shown that students are married to pinging on phones, teaching mathematics with the use of phones will divert the attention of learners from internet irrelevances.

Recommendations

Based on the findings of this study, the following recommendations were made.

1. Students and teachers should be acquainted with the benefits of digitalising teaching and learning of mathematics
2. The use of mobile phones should be encouraged in the teaching and learning of mathematics in secondary schools for the enhancement of better academic performance of students in Mathematics.
3. Mathematics teachers should be given adequate orientation through workshops and seminars to update their knowledge on the use of mobile phones in the teaching of mathematics.
4. Authors of Mathematics textbooks should adopt e-textbook so that it could be useful on mobile phones.

REFERENCES

Alakurt, T. & Yilmaz, B. (2021). Teacher's Views on the Use of Mobile phones in Schools. Journal of Computer and Education Research. 9(18): 575-597.

Alsina, A. & Silva-Hormazabal, M. (2023). Promoting Mathematics Teachers' Education for Sustainability through a STEAM Approach. *AIEM-Advancesde Investigation on Education Mathematics.* ISSN 2254-4313, (2023) 23, 105-125/ aiemes.

O'Bannon, B.W., Waters, S., Lubke, J.K., Cady & Rearden, K. (2017). Teacher and Students Poised to Use Mobile Phones in the Classroom. Computer in Schools34(3):125-141.

Bitrus, G., (2019). The Perception of Mathematics Teachers on Sustainable Development Goals: Implication for an Economy Beyond Oil. *ABACU (Mathematics Education Series)*. 44(1); 65-74

Dimitrov, D. & Rumrill P. (2003). Pretest-Posttest Designs and Measurement of Change. Work 20(2):159-165.

Jayanthi, R. (2019). Mathematics in Society Development - A Study. Iconic Research and Engineering Journals (*IRE).* 3(3)59-64.

Spandi, S., Ariyanto, L., Usumaningsh, W., & Aini, A.N (2018). Mobile Phone Application for Mathematics Learning. Journal of Physics. 983(1):1-5

Vasquiez, C., Alsina, A., Seckel, M.J. & Garcia- Alonso, I. (2023). Integrating Sustainability in Mathematics Education and Statistics Education: A Systematic Review. *EURASIA Journal of Mathematics, Science and Technology Education.* 19(11):1-16. ISSN:1305-8223.