Advances in Social Sciences Research Journal – Vol. 10, No. 12
Publication Date: December 25, 2023
DOI:10.14738/assrj.1012.16132
Bariham, I., Wadudu, M. A., & Awolu, F. (2023). Impact of ICT Training on Junior High School Teachers' Performance in Teaching Mathematics in Tamale Metropolis. Advances in Social Sciences Research Journal, 10(12). 407-418.

Impact of ICT Training on Junior High School Teachers' Performance in Teaching Mathematics in Tamale Metropolis

Iddrisu Bariham
ORCID: 0000-0002-5027-7003
Department of Humanities and Social Science Education,
University for Development Studies, P. O. Box TL 1350, Tamale

Mohammed Abdul Wadudu
Tamale Presby Junior High School, Tamale

Fusheini Awolu
Department of Mathematics and ICT Education,
University for Development Studies, P. O. Box TL 1350, Tamale

ABSTRACT

This study employed a quasi-experimental research design to examine the influence of ICT training on the proficiency of mathematics educators after receiving instruction on incorporating Computer Aided Instruction (CAI) into their teaching and learning practices. The study also probed to determine if differences exist in the academic achievement of JHS students who were taught mathematics with CAI and those taught with Traditional Method of Instruction (TMI). Ten JHSs were randomly sampled where five schools served as experimental group and the remaining five as control group. Mathematics Achievement Test (MAT), Classroom Observation Schedules (COS), and questionnaires were employed to collect the data from teachers and students. Using SPSS version 20, the data was analyzed and presented in tables and graphs. The study's findings demonstrated a noteworthy enhancement in the proficiency of both teachers and students in mathematics subsequent to the ICT training. It was also discovered that ICT training had a statistically significant effect on the mathematics performance of both teachers and pupils, leading to a good conclusion. Lastly, teachers in the study area encountered obstacles such as a scarcity of ICT laboratories, the nonexistence of internet connectivity, and insufficient ICT resources. The study recommends the establishment of regional centers to train mathematics teachers on how to teach with ICT, supply laptops and computers to JHSs using the PPP model, and equip JHSs with digital content to support teaching and learning with technology.

Keywords: Computer Aided Instruction, Traditional Method of Instruction, Mathematics Achievement Test (MAT), Training Needs Assessment.

INTRODUCTION

In this era of digitalization, considerable advancements in technology worldwide are propelled by significant investments in educational technology, encompassing computers, software, and internet connectivity to improve students learning outcomes in schools. These advancements,

embraced by households and educational institutions, hold the potential to transform traditional classrooms into digital environments, fostering enhanced student engagement (Garavaglia, Garzia, & Petti, 2013). The incorporation of Information and Communication Technologies (ICT) into education, encompassing computers and related technology, is on the rise, expanding learning options and preparing students for the information era (Mandoga, Matswetu, & Mhishi, 2013). Developed nations, exemplified by the USA, showcase widespread utilization of computer-related technology in education, with nearly every public school equipped with computers and internet connectivity to improve teaching and learning accessibility and efficiency (Danso & Kesseh, 2016). The incorporation of these technologies has significantly enhanced the ICT skills of both teachers and students, transforming them into powerful tools that extend learning beyond physical classrooms (Peprah, 2016).

Responding to global advancements, the acquisition of basic ICT or computer-aided teaching skills has become imperative for mathematics instructors, aligning with initiatives worldwide emphasizing the importance of integrating ICTs into schools, as seen in South Africa's efforts (Amedzo, 2007). Computer-Aided Instruction (CAI), defined as the use of computers to facilitate and enhance instruction, has become commonplace, offering diverse interactive methods (Wikieducator, 2008; Iqbal, 2009; Nwafor, 2015; Encyclopedia Brittanica, 2014). Earle (2002) underscores the transformative impact of computer-aided instruction in the United States, influencing contemporary society, education, work, and daily life. Empirical studies on technology application in academic performance yield varied outcomes, with educational games showing a tendency to boost students' engagement and performance in learning activities (Ritzhaupt, Higgins, & Allred, 2011; Cannon, 2017). In Europe, research on the effectiveness of a Mathematics Learning Program Assisted by Computer indicates successful use of CAI to catch up on learning outcomes, with the pedagogical strategy proving more effective compared to traditional methods (Witte, Haelermans & Rogge, 2014). Teachers' positive embrace of technology in instruction, as studied by Wright and Wilson (2011), positively influences students' use of technology and supports their professional development in the USA.

China's outstanding performance in international examinations sheds light on mainland China's mathematics education. However, caution is warranted in global comparisons due to the specific context of Shanghai's participation in PISA tests (Carnoy & Rothstein, 2013). A quasi-experimental study by Tolbert (2015) evaluating the effects of CAI on academic performance and attitudes reveals no statistically significant difference between traditional and computer-assisted instruction approaches. In Africa, research indicates that CAI improves student learning outcomes, with achievement variations between CAI and conventional instruction groups (Julius, 2018; Adekunle, 2016). The lack of a developed infrastructure for computer-assisted mathematics instruction in Africa, as noted by NEPAD, highlights the potential of CAI to overcome barriers and enhance mathematics teaching and learning (South Africa Department of Education, 2003).

The Ministry of Education (2018) states that Ghana aims to achieve the following objectives in education: to increase fair access to and involvement in inclusive, excellent education at all levels; to improve the teaching and learning of science, technology, engineering, and maths (STEM) at all levels; and to ensure the long-term, efficient management, funding, and responsibility of education service provision. It is essential to require educational institutions

to create curriculum that enable the incorporation of ICT into teaching and learning pedagogies to improve ICT education in mathematics (Mdlongwa, 2012). To ensure the responsiveness of ICT to the evolving technological needs of students and to elevate academic performance across diverse learning domains, institutions should also focus on the training and retention of proficient ICT educators capable of effectively implementing an ICT-integrated curriculum (Mdlongwa, 2012). Ojo and Adu (2018) emphasize the necessity of policies designed to enhance technology-driven teaching and learning. These policies should articulate a clear rationale, delineate specific roles, and provide a visionary framework for effective implementation and realization. In the contemporary educational landscape, computers have become indispensable tools for instruction in many schools.

In Ghana, empirical studies on the impact of Computer-Based Instruction (CBI) on learning outcomes of students has yielded mixed findings (Agyei, 2012; Agyei, 2015; Atta, 2015; Bariham, 2019; Acheampong, 2018; Akuffu, 2020). For instance, research on CBI in Senior High School (SHS) learners' performance also indicates significant achievement in the treatment group (Sedega et al., 2017). Initiatives in Ghana, such as the New Common Core Program (CCP) Curriculum and the Discovery Learning Alliance (2016) project, aim to improve mathematics education by leveraging technology. Similarly, the One Teacher One Laptop initiative by the Government of Ghana is aimed at supporting teachers to use ICT as a teaching and learning tool to enhance research, lesson planning, teaching, and authentic learning. However, little is known about the impact of CAI on the achievement of junior high school students in mathematics in Tamale Metropolis. Also, it seems most junior high schools' teachers and students do not have access to ICT tools to facilitate effective teaching and learning. It was in view of this gap that this study was carried out to assess the impact of ICT training on the performance of Junior High School teachers in terms of lesson presentation and students' performance.

Research Questions

The research found answers to the following questions.

1. What is the impact of the ICT training on the performance of mathematics teachers in terms of lesson presentation?
2. Is there any statistically significant difference in the mean performance scores of Junior High School students taught mathematics with CAI and those taught with the TMI?
3. What challenges do teachers face when teaching mathematics with technology?

LITERATURE REVIEW

The term "gender" refers to societal expectations regarding the characteristics and behaviors considered suitable for men and women, whereas "sex" denotes the biological differences between males and females (Woolfolk, 2016). Gender role identification, which involves an individual's perception of possessing more masculine or feminine traits, is integral to one's self-concept. As children interact with family, friends, educators, and their surroundings, they gradually form gender schemas, which are structured frameworks of information defining societal expectations for males and females (Julius, 2018). Research on academic performance gaps between men and women in STEM fields produces varied outcomes. Some studies, such as those by Kador (2001) and Usman and Ubah (2007), indicate superior performance by male students, while others, like studies by Nbina (2010) and Loofa (2001), report no significant gender-based disparities. Julius (2018) observes challenges faced by girls in science and mathematics, attributing this to biases in teaching practices. Teachers often exhibit preferential

URL: http://dx.doi.org/10.14738/assrj.1012.16132

attention towards boys, particularly those deemed more challenging, resulting in fewer opportunities, reduced focus, and limited support for girls.

In Kenya, female students exhibit lower proficiency in mathematics compared to their male counterparts, influenced partly by girls' attitudes towards math and science, coupled with lower motivation. The freedom to choose subjects reveals diverse levels of engagement in math and science between genders (Julius, 2018). Yang (2010) identifies gender as a factor influencing students' low performance in science classes, with fewer female students in chemistry at secondary and university levels, contributing to an overall gender gap in academic success in sciences. Numerous theories attempt to explain the underrepresentation of females in science, such as the belief that girls lack analytical and spatial thinking abilities (Olasehinde & Olatoye, 2014). However, recent data challenges this notion, suggesting that a woman's skills do not dictate her pursuit of a scientific career. Equity and support in the instructional environment are critical, demonstrating that both genders perform equally well when provided with a fair and supportive learning atmosphere (Erinosho, 2008). This underscores the need for gender-inclusive instructional strategies to ensure equal opportunities for both boys and girls in the teaching and learning of mathematics.

In Ghana, Acheampong (2018) conducted a study to evaluate the degree to which mathematics teachers in basic schools integrate ICT into their teaching and learning of mathematics. The study employed a survey methodology as its design. Using the cluster sampling approach, a total of 148 mathematics teachers were chosen in Bibiani, a town situated in the Western Region of Ghana. The study found that elementary school math teachers possess a substantial level of technological pedagogical content knowledge (TPCK), which is a critical prerequisite for incorporating ICT into their teaching. The majority of Basic School Mathematics Teachers (BSMT) do not utilise ICT when instructing mathematics in the classroom. The present study additionally discovered that the presence of ICT tools was the primary determinant of successful ICT utilisation, with technical support ranking second, while planning and policy had the least impact on the usage of ICT in basic schools. These data facilitated the identification of the school-related factor that most accurately predicted ICT usage. In addition, primary school mathematics teachers hold a positive perspective on the use of ICT in the classroom. The efficient integration of ICT in basic school classrooms is primarily influenced by school-related issues, with teachers' knowledge and skills (TPACK) playing a secondary role. Nevertheless, the attitudes of teachers do not directly impact the effective use of ICT.Science and technology are advancing at a rapid pace, which is changing classroom interactions, teaching methods, and learning outcomes (Baxen & Green, 1998). This shows that teachers who are not up to date with technology may encounter several difficulties when attempting to use it for efficient teaching and learning. This significant shift affects classroom procedures, the larger school community, and instructors' perceptions of their duties within the new system. The traditional classroom's strong teaching presence is quickly being replaced by a modern understanding of teachers' roles as facilitators of learning rather than knowledge imparters (Bello & Iddrisu, 2023). As a result, there is a clear call for teachers to assess and choose curriculum materials based on how well they meet the requirements of individual students or groups of students as well as how appropriate they are for given outcomes (Baxen & Green, 1998 cited in Bello & Iddrisu, 2023). Bello and Iddrisu (2023) explored the availability and usage of Instructional Materials in Teaching at the Basic Schools in the Tamale Metropolis. For the investigation, a descriptive case study design was adopted. All of the basic school teachers in Tamale, the capital of Ghana's

Northern Region, were the study's target demographic. Twenty junior high schools in the city provided a random sample of 185 instructors. The findings showed that whereas many elementary schools in Tamale's metropolitan area lacked instructional resources, other schools had a wide range of resources. When instructional materials became available in elementary schools, they were kept in the ICT center, the storeroom, or the headmaster's office and used in the classrooms. It can be assumed that educators could only make formal requests to the relevant authorities in order to use these materials for instruction (Bello & Iddrisu, 2023).

METHODS

The research employed a quasi-experimental design, aimed at establishing causal relationships between independent and dependent variables (Thomas, 2022). Unlike experimental designs, quasi-experimental designs do not rely on random assignment but group participants based on non-random factors when randomization is impractical or ethically challenging (Thomas, 2022). In this study, ten Junior High Schools (JHSs) were involved, with five assigned to experimental group and the remaining five to the control group. Ten teachers in the experimental group underwent one-week intensive training on how to integrate CAI, specifically video and other software, in teaching mathematics concepts (methods of organizing and handling statistical data). Before this capacity building, Training Needs Assessments was conducted which then inform the design of the training plan. Lessons were observed and scored using the Classroom Observation Schedule (COS). Posttests were administered to both groups, totaling 120 junior high school students.

The research aligns with a positivist theoretical framework and employs a quantitative research approach, focusing on numerical data to draw general conclusions about the population (Maree, 2010). Quantitative research emphasizes objectivity, precise measurements, statistical analyses, and numerical evaluations, utilizing closed-ended information obtained through instruments like questionnaires and polls (Creswell, 2013).

The population for the study comprised all junior high school mathematics instructors and students in Tamale Metropolis. Simple random sampling selected ten schools, distributing students into control and treatment groups using a non-randomized control group pretest-posttest design. Data collection methods included questionnaires, interviews, classroom observations, and tests. Introductory letters were dispatched before data collection, and the study ensured content validity by selecting appropriate instruments. Internal validity was maintained by controlling for potential threats, and instrument reliability was ensured through pre-tests and post-tests comparing the mean performance of experimental and control groups. The intervention, involving ICT training for the experimental group, positively impacted teachers' performance in teaching mathematics, as assessed through pre-tests and posttests. The study utilized a CAI program, involving digital content relevant to mathematics, and the training aimed to transition teachers from conventional methods to CAI. A Training Needs Assessment (TNA) guided the development of the training plan, and data analysis was performed using the SPSS package version 23. The intervention's effectiveness was evaluated through various instruments, including the Mathematics Achievement Test (MAT), Classroom Observation Schedule (COS), and quationnaires.

RESULTS AND DISCUSSION

The acquired raw data was subjected to analysis using descriptive statistics, namely mean and standard deviation, to ascertain whether disparities in the performance of teachers and students in mathematics exist subsequent to their exposure to the intervention. Descriptive statistics are a form of visual representation that organises data in a manner that facilitates the understanding of the relationship between different types of data (Ballinger, 2011). Inferential statistics, specifically the independent t-test and ANOVA, were utilised to test the hypothesis and ascertain whether the disparities in the performance of teachers and students were attributable to the intervention. The primary goal of inferential statistics is to facilitate the analysis of data at a lower level and subsequently infer and draw conclusions about a broader scale of data Cresswell, 2014). Inferential statistics has various components, including elementary probability, permutations, variations, and combinations, which are integral to the computation of probabilities.

Pre-test Scores of Students Performance in Mathematics

To obtain baseline data, a pre-test was conducted for students in both experimental group and the treatment group. The researchers utilize the Mathematics Achievement Test (MAT) as the pre-test instrument to collect the data on students' competences in some mathematics topics. The results of pre-treatment test scores of students in mathematics are presented in Table 1.

Tabel 1: Descriptive and Independent t-test of Pre-test Scores of Students Performance in Mathematics

Group	Mean	Std. Deviation	df	t-value	Sig.
Experimental Group	37.25	5.445	88	-0.333	.740
Control Group	37.59	5.328			

Source: Field data (2023)

The results from Table 1 indicates that the experimental group had a mean score of 37.25 with a standard deviation of 5.445. In the same manner, the control group exhibited an average score of (M=37.59, SD=5.328). The t-test analysis indicates that the obtained p-value (0.740) exceeded the predetermined alpha value of 0.05. Consequently, this indicates that there was no substantial disparity in the average score of students' mathematical performance before the intervention, comparing the treatment group with the control group. Consequently, they were functioning at the same capacity and were prepared to undergo the intervention.

Mean Score of Mathematics Teachers Performance in Lesson Presentation after the Intervention

The mathematics teachers in the treatment schools were given intensive teacher training on how to use video and an online software to teach mathematical concept "Organizing data (mean, median, mode and range)" while the control group did not receive any capacity building. The implementation of the intervention lasted for six weeks after which the experimental schools' teachers were made to teach the same mathematics topics using CAI to their students while the control group taught the same topics using Traditional Methods of Instruction (TMI). The research utilised the standardised Classroom Observation Schedule (COS) designed by the Professional Education and Practice Unit (PEPU) of the University for Development Studies to observe the lessons of 10 teachers from both the experimental and control groups. The findings are displayed in Table 2.

Table 2: Mean Scores of Mathematics Teachers Performance in Lesson Presentation after Intervention (N=10)

Group	Mean (M)	Standard Deviation (Std)	Interpretation
Experimental Group	80.2000	1.6431	Very High
Control Group	77.4000	2.0736	Very High

Source: Filed data (2023)

The results presented in Table 2 underscore a notable disparity in the mean scores of mathematics teachers between the treatment group (M=80.2000, SD=1.6431) and the control group (M=77.4000, SD=2.0736). This discrepancy implies a superior performance in lessons presentation by mathematics teachers in the treatment group compared to their counterparts in the control group. The observed distinction in teaching effectiveness provides empirical support for endorsing the Government of Ghana's vision of digitizing education, as it is substantiated by tangible evidence suggesting that such initiatives hold the potential to elevate the learning outcomes of students in educational institutions. This alignment with the vision of digitizing education resonates with the research conducted by Lee and Tsai (2010), wherein the authors emphasized the crucial role of teachers' proficiency in harnessing web technology to enhance instructional practices. Lee and Tsai employed the Technological Pedagogical Content Knowledge-Web Survey (TPCK-W) questionnaire to evaluate instructors' confidence in delivering instruction using the internet. The study, which involved 558 instructors from elementary to high school levels, demonstrated significant associations between teachers' self-efficacy and their favourable attitudes towards web-based training. Furthermore, the study by Lee and Tsai shed light on a noteworthy aspect, indicating that teachers with more extensive teaching experience tended to exhibit lower confidence levels in utilizing the Web and integrating it into their instructional methodologies. This highlights the imperative need for continuous professional support and targeted training initiatives, particularly for educators with substantial teaching experience, to facilitate their seamless adoption of web-based instructional practices (Lee & Tsai, 2010). In summary, the current study's outcomes substantiate the viability of digitalizing education, aligning with scholarly insights and reinforcing the potential for positive educational transformations in line with Ghana's educational goals.

Post-test Score of Students Performance in Mathematics

After the intensive teacher training, mathematics teachers in the five experimental Junior High Schools taught some concepts in using CAI, where as their counterparts in the control schools taught similar concepts with traditional methods of instruction. After the implementation of the intervention, 120 students from the two cohorts took a Mathematics Assessment Test (MAT) which was marked and scored by the researchers. The scores obtained were analyzed using descriptive statistics such as mean and standard deviation. The results were presented in Table 3.

Table 3: General Post-test Score of Students' Performance in Mathematics (N=120)

Groups	Mean (M)	Standard Deviation (Std)	Interpretation
Treatment Group	50.3667	19.5178	Average
Control Group	37.6500	15.0432	Below Average

Source: Filed data (2023)

Table 3 provides an overview of the MAT results conducted for the two groups of students following the implementation of the intervention in the experimental schools. The total mean score for the experimental group was (*M*=50.3667, *SD*=19.5178), whereas the control schools recorded a mean score of (*M*=37.6500, *SD*=15.0432). This discrepancy suggests that, while the performance of students in the experimental schools was, on average, moderately successful, it surpassed the scores obtained by the control schools. Consequently, it can be inferred that the integration of CAI in teaching mathematics had a more significant impact on students' achievement compared to TMI. These findings align with Hunter's (2012) study, which investigated the effects of CAI on student achievement and attitudes towards mathematics. Hunter's study involved a sample of 62 middle school children who were categorised into three unique groups, and each group received different styles of instruction. The computer-assisted instruction (CAI) utilised in this study was a software programme named Success Maker. An assessment was conducted to examine the impact of the treatment on both mathematics proficiency and attitudes towards mathematics, use before and posttest scores. The results of this study are consistent with previous research, which emphasises the superior efficacy of CAI in enhancing students' mathematical performance compared to traditional teaching methods (Hunter, 2012). This alignment underscores the potential effectiveness of technology-enhanced learning approaches in fostering positive educational outcomes.

Challenges Teachers Face When Teaching Mathematics with ICT

Regarding the difficulties teachers face when using ICT to teach mathematics, respondents were asked to rate their agreement or disagreement with the following assertions. KEY: SA-Strongly Agree, A-Agree, N-Neutral, D-Disagree, and SD-Strongly Disagree. The results are shown in Table 4.

Table 4: Challenges Mathematics Teachers Encounter When Teaching with ICT

Challenges Teachers encounter when Teaching Mathematics with ICT	N	Mean	Standard Deviation (Std)	Interpretation
Insufficient projectors, computers, and digital and video content.	50	4.3400	1.22241	Very high
Lack of sufficient time.	50	4.0400	1.10583	Very high
Poorly furnished ICT lab	50	4.4600	1.01439	Very high
Insufficient internet access within the school	50	4.4400	1.05289	Very high
Teachers' ICT proficiency is lacking.	50	3.9000	1.14731	High
Insufficient support from management.	50	3.8400	1.01740	High
Fewer opportunities for mathematics teachers to receive ICT training.	50	4.4800	.67733	Very high
Students' inadequate use of ICT.	50	4.4200	.92780	Very high
Students do not have access to laptops, computers, and smartphones.	50	4.3400	.98167	Very high
Mathematics teachers' limited knowledge of technological pedagogical content.	50	3.2600	1.12141	High
Unfavorable GES regulations that prohibit junior high school students from bringing smartphones to school to learn with ICT.	50	4.0800	1.04667	Very high
Large class size.	50	4.2200	1.14802	Very high

Source: Field survey (2023)

Table 4 results offer insights on the difficulties instructors face when utilizing ICT to teach mathematics. For example, respondents generally agreed that they do not have enough computers, projectors, video, or digital content (Mean=4.3400, SD=1.22241), which is a relatively high percentage. The respondents strongly agreed that there was inadequate time (Mean=4.0400, SD=1.10583) and that the ICT laboratories in the schools were ill-equipped (Mean=4.4600, SD=1.01439). The schools lack internet access (Mean=4.4400, SD=1.05289), and mathematics instructors' ICT proficiency was low (Mean = 3.9000, SD = 1.14731). Moreover, there was limited opportunities for mathematics instructors to receive ICT training (Mean=4.4800, SD=.67733), insufficient assistance from school management (Mean=3.8400, SD=1.01740), students' had inadequate ICT proficiency (Mean=4.4200, SD=.92780), students' lack access to laptops, computers, and smartphones (Mean=4.3400, SD=.98167), unfavorable GES guidelines that prohibit junior high school students from bringing laptops and smartphones to school to learn mathematics using ICT (M=4.0800, SD=1.04667), and limited technological pedagogical content knowledge among mathematics teachers (Mean=3.2600, SD=1.12141). The aforementioned results were consistent with those from Bariham (2019), whose study on the application of computer-based instruction among basic school teachers in Tamale Metropolis found that teachers of social studies in basic schools were not incorporating technology into their teaching and learning because they lacked the necessary time, a dependable internet connection, a sufficient number of computers and digital content, a lack of ICT proficiency on the part of both teachers and students, a lack of support from school administration, and large class sizes. More investment must be made to provide junior high schools in Ghana with the necessary digital resources to help instructors and students use ICT to enhance student learning. A study conducted by Akuffu (2020) revealed that primary school instructors in the Tamale Metropolis faced difficulties in acquiring the necessary skills to effectively incorporate Information and Communication Technology (ICT) into their teaching methods. Furthermore, the study indicated that there was a lack of sufficient ICT tools in public primary schools, preventing all children from accessing them. Nevertheless, the majority of teachers demonstrated proficiency with ICT tools. Ultimately, the study demonstrated the beneficial effects of these technologies on teaching and learning, including enhanced student comprehension, increased student engagement, and improved school attendance.

Exploratory Analysis

In the course of this study, a combination of descriptive and inferential statistical methods was employed for data analysis. Descriptive statistics, encompassing measures such as frequency, percentages, mean, and standard deviation, were utilized to characterize the data acquired from questionnaires, interviews, and observation schedules. This approach facilitated a thorough exploration and presentation of the gathered information. In order to determine the importance of the disparities between the averages of the experimental and control groups, inferential statistics, namely t-tests and analysis of variance (ANOVA), were utilised. The statistical tests conducted provide a strong assessment of the effects of the interventions in the experimental group on the variables being studied. The data obtained from the administered exams and questionnaires were analysed using SPSS, version 23, which was the main statistical software utilised.

Moreover, to enhance transparency and provide additional insight into the data analysis strategy, the study incorporated a data analysis matrix. This matrix systematically delineated the research objectives, types of data, research instruments employed, and the corresponding

URL: http://dx.doi.org/10.14738/assrj.1012.16132

data analysis techniques applied. This comprehensive approach to data analysis was adopted to ensure the validity and reliability of the study's findings. The integration of both descriptive and inferential statistical methods, coupled with the use of a data analysis matrix, underscores the rigor employed in scrutinizing and interpreting the research data. Table 5 present the results of the findings.

Table 5: One Way ANOVA of Post-test Scores in Mathematics Achievement Test (MAT)

Paired Samples Test											
		Paired Differences					t	df	Sig.(2-tailed)		Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference						
					Lower	Upper					
Pair 1	experimental – control	16.090	19.467	1.947	12.227	19.953	8.265	99	.000	99	.000

Sources: Field survey (2023)

In the hypothesis testing conducted for this study, the null hypothesis (H_0) was that the two populations under consideration had the same mean score, while the alternative hypothesis (H_1) contended that the two populations did not have the same mean score. The chosen significance level (α) for this test was .05. Upon examining the results presented in Table 5, the obtained p-value was .000, this is below the specified significance level ($\alpha = .05$). This result indicates that there is enough statistical evidence to reject the null hypothesis and support the alternative hypothesis. Therefore, based on a significance threshold of 5%, it may be concluded that the performance of the two groups is not equal. The rejection of the null hypothesis indicates a considerable disparity in the mean scores of the two groups, implying a statistically meaningful difference in their performance.

FINDINGS AND CONCLUSIONS

The study's findings underscore the positive impact of ICT training on teachers' performance in teaching of mathematics. Specifically, the implementation ofCAI enhanced the quality of instruction and teacher engagement. Moreover, the study identified a positive correlation between the use of ICT in teaching mathematics and students' academic achievement. Despite these positive outcomes, the research also identified numerous challenges faced by mathematics teachers in integrating technology into their teaching practices which include lack of access to ICT resources and insufficient training. To address these challenges, the study recommends that policymakers and educators should provide additional support to empower teachers in effectively integrating ICT into their teaching and learning practices. The overarching implication of the study is that ICT has significant potential to enhance the teaching and learning of mathematics in junior high schools. The research contributes valuable insights into the benefits and challenges associated with the incorporation of ICT in mathematics education in the context of the Tamale Metropolis. For example, respondents generally agreed that they do not have enough computers, projectors, video, or digital content; inadequate time; poorly equipped ICT laboratories; lack of access to internet; limited ICT skills among mathematics instructors'; limited possibilities for mathematics instructors to receive ICT training; insufficient assistance from school management; inadequate ICT proficiency among

students; students' lack of access to laptops, computers, and smartphones; unfavorable GES guidelines that prohibit junior high school students from bringing laptops and smartphones to school to learn mathematics using ICT; and limited technological pedagogical content knowledge among math teachers.

RECOMMENDATIONS

The study suggests that in order to improve the quality of mathematics instruction in junior high schools in Ghana, it is recommended that the government and other stakeholders allocate resources towards the development of ICT infrastructure and teacher training. Furthermore, it is imperative for the Government of Ghana, under the auspices of the Ministry of Education, to expand dependable internet access to junior high schools across the country. This initiative aims to assist educators and students in enhancing the standard of mathematics education through the utilisation of technology, and also provide tablets and other digital resources to every Junior High School student in Ghana. This will enhance students' mathematical learning through the use of technology, enabling them to develop essential digital literacy skills that will contribute to the country's overall progress. Ultimately, the Ministry of Education ought to develop regional centres with the explicit purpose of training and enhancing the skills of mathematics instructors in effectively using technology into their teaching methods. This initiative aims to enhance the educational outcomes of pupils.

References

Acheampong, P. A. (2018). Assessing Basic School Mathematics Teachers' Information Communication Technology Integration in the Teaching and Learning of Mathematics. Unpublished Master's Thesis, University of Cape Coast, Ghana.

Adekunle, S. E. (2016). Perception of Secondary Schools' Students on Computer Education in Federal Capital Territory (FCT-Abuja), Nigeria. *International Journal of Social, Behavioural, Educational, Economic, Business and Industrial Engineering*, *10*(1), 2016.

Akuffu, G. Y. (2020). The Role of ICT Tools in Educational Delivery: A Study within the Tamale Metropolis. Unpublish Master's Thesis, University for Development Studies, Ghana.

Amedzo, E. K., (2007). Integration of Information and Communication Technology into Schools of South Africa. *A case study of Schools in Malamulele*. [Online]. Available at http//: www.scholar.sun.ac.za. [Accessed 8-8-2022].

Ballinger, Clint. 2008. Initial Conditions as Exogenous Factors in Spatial Explanation. Ph.D. Dissertation, Department of Geography, University of Cambridge. Available online at: http://www.scribd.com/full/46617327?access_key=key-1vbhnscdlxd5fdu49s74

Bariham, I. (2019). Influence of Teachers' Gender and Age on the Integration of Computer- Assisted Instruction in Teaching and Learning of Social Studies among Basic Schools in Tamale Metropolis. *Global Journal of Arts, Humanities and Social Sciences, 7*(2), 52-69.

Bello, Z. M., & Iddrisu, S. A. (2023). An Assessment of the Availability and Usage of Instructional Materials in Teaching at the Basic Schools in the Tamale Metropolise. *International Journal of Social Science Research and Review,* 6(7), 591608.

Creswell, J. W. (2013). *Research design*: Qualitative, quantitative, and mixed methods approach. Sage publications.

Department of Education. (2003). Draft white paper on e-Education. *Transforming Learning and Teaching through Information and Communication Technologies*. Pretoria: Department of Education.

URL: http://dx.doi.org/10.14738/assrj.1012.16132

Discovery Learning Alliance. (2016). *Girls Education Challenge Project completion report.* Tamale: Ghana.
Earle, R. S. (2002). The integration of instructional technology into public education: promises and challenges*. Educational Technology. 42* (1):5-13

Erinosho, Y. E. (2008). *Women and science*. 36th Inaugural Lecture, Olabisi, Onabanjo University Ago-Iwoye.

Iqbal K. (2009). Computer assisted Instruction, School Improvement Research Series, 2009. http://www.nwrel.org/scpd/sins/5/cu10.html.

Nwafor, C. E. (2015), *Computer and internet literacy*. Enugu. Jonnes Communications publishers.

Julius, K. J. (2018). *Influence of Computer Aided Instruction on Students' Achievement, Self-Efficacy and Collaborative Skills in Chemistry in Secondary Schools* of Tharaka-Nithi County, Kenya. Unpublished Thesis: Kenyatta University

Kador J. S. (2001). The effect of environment and sex on Chemistry achievement of students. National Institute for Science education.

Loofa J. K (2001). Sex, age and performance in Chemistry. Instructional Science, 18: 119

Maree, K. 2010. *First Steps in Research.* Sixth Impression. Pretoria: Published by Van Schaik Publishers.

Mdlongwa T (2012). *Information and Communication Technology (ICT) as a means of enhancing education in schools in South Africa*: Challenges, benefits, and recommendations. POLICY Brief 80:1–7. Available at http://www.ai.org.za/wpcontent/uploads/downloads/2012/10/No.-80.ICTas-a-means-of-enhancing-Education-inSchools-in-South-Africa.pdf. Accessed 07 January 2023.

Nbina, J. B. (2010). *Effect of instruction in Metacognitive self-assessment strategy on Chemistry Students self-efficacy and achievement. Academia Arena*, 2(11):1-10.

Ojo O. A and Adu, E. O (2018). *The effectiveness of Information and Communication Technologies (ICT) in teaching and learning in high schools in Eastern Cape Province*, vol.38, no2, pp. 1-9

Olasehinde, K. J. and Olatoye, R. A. (2014). Comparison of male and female senior secondary school students' learning outcomes in science in Katsina State, Nigeria. *Mediterranean Journal of Social Sciences, 5*(2), 5-17.

Ritzhaupt, A., Higgins, H., & Allred, B. (2011). Effects of modern educational game play on attitudes towards mathematics, mathematics self-efficacy, and mathematics achievement. *Journal of Interactive Learning Research, 22*(2), 277-297. Chesapeake, VA: AACE

Tolbert, E. J. (2015). *The Impact of Computer-Aided Instruction on Student Achievement*. Doctor of Education Dissertation. School of Education, Gardner-Webb University.

Usman, K. O & Uba, A. I. (2007). Improving students' achievement in further Chemistry using team teaching approach. Review of Education, 18(1), 15-21

WikiEducator (2008). *Computer Assisted Instruction (CAI).* Retrieved from http://wikieducator.org/computerassistedinstruction(CAI).

Wright, V. H., & Wilson, E. K. (2011). Teachers' use of technology*: Lessons learned from the teacher education program to the classroom*. SRATE Journal, 20(2), 48- 60. Retrieved from EBSCO host database.

Yang, D. H. (2010). *Gender and classroom learning*. Psychology in the School, 22: 208-223.