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Technology in Mathematics Teaching and Learning: An Impact Evaluation in Selected Senior Schools in Masingbi Town

Samuel Karim [1*], Exton Mohamed Zoker [2]

Faculty of Social and Management Sciences, Ernest Bai Koroma University of Science and Technology, and the College of Human Resources Development Sierra Leone [1*]
School of Integrated Sciences Education and Mathematics, Njala University[*]

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Abstract
The analysis is based on a detailed evaluation of primary data collected through case studies, questionnaires, and semi-structured interviews in Senior secondary schools in Masingbi. Mathematics education learning is explored to understand the issues surrounding Technology integration. This study shows that despite the perceived advantages of Technology integrated teaching and learning methods, there are barriers closely connected to teachers' teaching beliefs at work. Most educators admitted the lack of ongoing professional training programs and curriculum expectations as among the factors that affect their attitudes towards Technology in their respective Teaching and learning schools. Further empirical research is suggested to advance the exploration of the role of subject leaders in Technology -integrated Teaching and learning methods. This research provides an in-depth analysis of the exploration of own practice and mathematics teachers' perceptions on integrating Technology into teaching. The total sample size of respondents was sixty (60), and both simple random sampling technique was used to develop samples of Teachers and Pupils, while a purposive sampling technique was used to develop the sample for the Principals or Heads of Schools of the three selected senior schools in Masingbi as respondents.

Keywords — Impact Evaluation, Mathematics, Technology, Teaching and Learning.

Introduction

The dynamic nature of technology forced educators to re-evaluate the mathematics that students/Pupils need to determine the best methods for attaining higher levels of achievement. Many students/pupils are struggling to learn mathematics today (Foshee, 2016; Hollebrands, 2018). Some students might state that they hate math and will never use it. Campoy (2015) has remarked that technology provides a better way of teaching mathematics. Technology is the great equalizer; technology brings everyone to the same level (Misfeldt, 2016a; Sah et al., 2023; Sugianto et al., 2017). It does not matter whether the student is a high or a low achiever. Teaching and learning through technology take low and high-level students to unknown heights (Psycharis, 2018; Wawan et al., 2018).

The Sierra Leone government has committed to improving its people's Information and Communication Technology (ICT) skills and bridging the digital divide by targeting disadvantaged groups. The idea aligns with the Government's agenda of Free quality education to achieve sustainable development in the 21st century (Ministry of Education 20i8). The study focuses on the use of ICTs in

Mathematics teaching and learning and determines whether any relationship exists between the use of ICT and the learners' achievements using the Solo taxonomy.

The National Assessment of Educational Progress stated that students scored 30 points lower than their counterparts on every section of the mathematics portion of the nationwide test (Gamage et al., 2019; In'am et al., 2023; Sekaryanti et al., 2022). In the 1980s and 1990s, the achievement gap between minority and non-minority students had closed considerably. Since the year 2000, however, the achievement gap has begun to widen to the levels of the 1970s (Laub, 1999). Too many students are not grasping or learning the mathematics being taught in the classrooms of schools (Gudkova et al., 2020; Vanden Eng et al., 2015). The results of the state-mandated tests reflect that the achievement gap is widening. The released results released by schools around the country according to levels. Level Five was the highest possible score (Cankoy & Özder, 2017; Kao et al., 2018), Level Three was the lowest passing score, and Level One was the lowest possible. In Florida in 2004, Students who scored a Level One on the state-mandated examination. We need to examine the teaching methods to ensure that all students can receive a high school diploma. Lappan (2010) stated that in the Third International Mathematics and Science Study (TIMSS), students in the United States (U.S.) scored at or near the bottom in every geometry task. Usiskin (2014) stated that of all the students enrolled in high schools, only 63% can correctly identify different types of triangles, and only 30% can write proofs. Clements (2003) stated that appropriately designed geometric software is designed to have a high level of interaction (Sarifah et al., 2022; Urrutia et al., 2019). He believed students could not "hide" what they did not know using geometric software. Clements (2003) said that teachers must be ready for a significant change when they teach with geometric software. He further stated that even teachers experienced with geometric software are sometimes not comfortable using this software initially (Haviland et al., 2021; Senán-Salinas et al., 2022). These teachers stated that they were not comfortable giving up control of the classroom and control of the students.

According to Gertrude (2000), Teachers of Mathematics in most developing observed six (6) principles to assist and guide teachers in improving the content and delivery of mathematics instruction. The six principles were equity (Matuk, 2021; Tan, 2017), curriculum (Saal & Shaw, 2020; Tackett et al., 2021), teaching (Weber, 2021; Zamora, 2021), learning (Kusmaharti & Yustitia, 2022; Tarrés & Cullell, 2021), assessment (Schaufeli et al., 2020), and technology (Fasihi et al., 2019; Misfeldt, 2016b). This study focused on one of these six principles, technology. Technology in mathematics education allows students to focus less on the computational aspects and more on the applications of mathematics (Gertrude, 2000). In this study, the Internet Youtube service was the technology used. In geometry, a progression also occurs. Van Hiele (2000) stated that students must progress through five levels to understand geometry fully (Bossé et al., 2021; Yalley et al., 2021). This study aims to evaluate the impact of technology in teaching and learning mathematics in selected senior schools in Masingbi.

Research Method

The study used the Survey methodology to get data from the target population to analyze the impact of technology in teaching and learning mathematics on pupils' achievement. Survey research is a scientific social research method that involves sampling people to answer some questions. The survey design procedure integrated quantitative and qualitative approaches to get information. A fusion of data and method cross-validation was introduced to seek more information from Principals and teachers.

The study was mainly quantitative; the qualitative component constituted Key informant interviews or In-depth interviews, case studies, and Focus group discussions. The key informant interviews targeted Principals and other school authorities. As a result of the quantitative style of the study, the survey questionnaire with a structured (close-ended questions) and semi-structured (open-ended questions) approach was designed to collect information on the study variables. The study also consulted secondary data from the Internet to get a thorough insight into the topic of study. Primary data collection was divided into 2 phases. Phase one (1) included using the survey questionnaire to collect information from the sampled teachers and Principals. Phase two (2) comprised qualitative data collection through in-depth interviews and case studies. Statistical analysis of the data using EXCEL or SPSS to produce answers for the impact of technology in teaching and learning mathematics on pupils' achievement.

The targeted population of the study was Mathematics teachers and Pupils learning mathematics within the selected senior schools in Masingbi, and a population of 500 teachers and Pupils in the three selected schools was recorded. The selection of these schools was compelled by the accolades associated with these schools regarding standards. The targeted population consisted of the list of teachers and Pupils, and a sample size of sixty (60) was drawn from the frame. In a bid to ensure representativeness, five (5) Mathematics teachers and fifteen (15) Mathematics pupils with a total of 20 respondents from each of the three senior schools with a total totaling (60) were used as the sample size of the study. A random sampling technique was adopted to recruit teachers and Pupils. Data collection started from 15th August to 18th September 2020.

In order to minimize selection bias, interviewees were recruited from among the actual Mathematics teachers and pupils from each of the three senior schools. The survey also included the administrative staff of the three schools. The researcher also ensured that other school members who were not the target participants did not interfere with the recruitment process of research participants to avoid bias and conflict of interest. This is done to guarantee data quality, integrity, and validity. Data collected for this study were analyzed using frequency tables, percentages, and charts.

Results and Discussion

The use of computers in Secondary Schools is not different from any other school in developing countries (Giurgiu & Gligorea, 2017; Wong, 2019). The earlier studies of computer usage in developing countries have shown that these countries have more challenges in their ICT integration than their developed counterparts (Camacho, 2018; Schindelwig et al., 2017), which are sometimes taken for granted (Fauza et al., 2022; Rionanda et al., 2022; Yim & Gomez, 2021). These challenges will ultimately impact computer integration in developing countries' schools (Bozkurt, 2018; Cortés, 2021; Zaika, 2020).

The analysis was carried out by looking at the teacher's perceptions of technology usage of technology in Mathematics teaching and learning. Also, the analysis dwelt on the learners' frequent use of technology (Fernández et al., 2021; Herlina et al., 2021), learners' perceptions of technology benefits, and the learners' achievements in Mathematics using the SOLO taxonomy to rank the learners' achievements (Cortés Díaz et al., 2019; Lau et al., 2018). Tables, figures, and descriptions of data were used to present the findings. Occasionally inferential statistics were used concerning the population studied.

Table 1: Length of Service of Teachers

		School			Total
		Maranatha School	**Ahmadiyya school**	**Bai Kurr School**	
How Long have you been in this school?	2-3 years	20	8	8	36
	4-5 years	0	11	6	17
	5-6 years	0	0	4	4
	More than six years	0	0	3	3
Total		20	19	21	60

Source: Field Data, 2023.

From the table above, the number of years teachers have served in all three schools is recorded; 20 teachers (33%) at Maranatha school said they have spent 2-3 years there. Eight teachers each for Ahmadiyya school and Alhaji Bai Kurr, respectively, with 13% for each, said they also have 2-3 years in these two schools. Eleven teachers, 18% at Ahmadiyya School, and six teachers, 10% at Alhaji Bai Kurr School, said they had spent 4-5 years in these schools. Four teachers, 6% at Alhaji Bai Kurr, responded that they had spent 5-6 years in this school.

Qualification of Teachers teaching mathematics in the three schools

The researcher was also desirous to know about the qualifications of teachers in the three selected schools. This is shown in the data below:

Table 2. Teacher qualifications

	Frequency	Percent	Valid Percent	Cumulative Percent
Teachers Certificate	2	3.3	3.3	3.3
Higher Teachers Certificate	21	35.0	35.0	38.3
Bachelors	22	36.7	36.7	75.0
Masters	2	3.3	3.3	78.3
PhD	7	11.7	11.7	90.0
Others (Specify ---------- ---------	6	10.0	10.0	100.0
Total	60	100.0	100.0	

Source: Field Data, 2023.

The analyses above show that teachers with Bachelor's degrees in all three schools accounting for 36.7%, are in the majority, while those with Higher Teachers' Certificates account for 35. %. Trail the bachelor holders. It is to be noted that teachers with Bachelor's degrees demonstrated to be lively in their roles and are more connected with their professional roles in the respective schools. The qualifications of teachers are also vital in their professional development.

Table 3: Gender of Respondents

	Frequency	Percent
Male	44	73.3
Female	16	26.7
Total	60	100.0

Source: Field Data, 2023.

The table above records that out of the 60 mathematics teachers, including pupils interviewed from the three schools, 44 are male, accounting for 73.3%, constituted the majority spoken to as compared to their female colleagues, who constituted 26.7 % (16) of the total population interviewed. These findings could be attributed to the fact that male teachers seem involved in most of the teaching in the schools while female teachers are less in all three schools but are also involved in teaching the pupils.

This is not to say that female mathematic teachers are not active in the training of the pupils. However, male teachers, including the principals, championed most of the training. This is shown in the chart below;

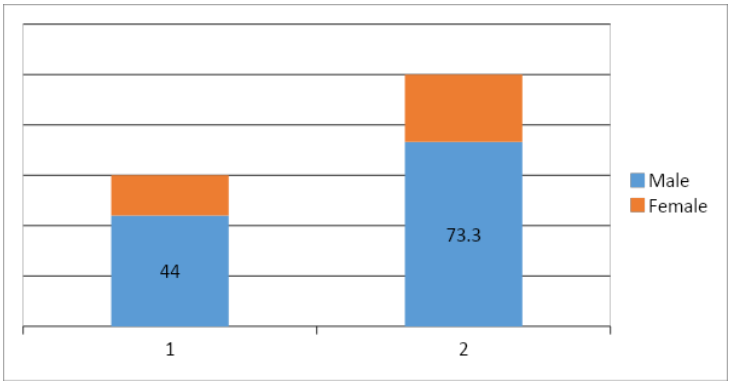

Figure 1: *Gender of respondents*

Teachers' Perception of the Use of youtube internet to Teach Mathematics

The researcher was moved by the desire to ask Mathematics teachers about how they think about teaching mathematics through internet technology, as shown in the analysis below;

Table 4: Teachers' Perception of the Internet youtube in the Teaching of Mathematics

Do you think using the internet youtube will help pupils understand Mathematics better?				
	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	47	78.3	78.3	78.3
No	13	21.7	21.7	100.0
Total	60	100.0	100.0	

Source: Field Data, 2023.

From the analyses above, 78.3% of the teachers in all three schools confirmed that Mathematics teaching through the internet youtube can make pupils understand the teaching of Mathematics better. This is reflected in the willingness and enthusiasm of teachers to respond to the interview and cooperation with teachers in these schools.

Teachers were also asked in what ways they think Mathematics teaching through the Internet and YouTube can help pupils better understand the subject's teaching.

Table 5. Mathematics Teachers' Perception of the Use of Internet Youtube

		School			**Total**
		Maranatha School	**Ahmadiyya School**	**Alhaji Bai Kurr**	
In what ways does the use of the internet Youtube help pupils understand Mathematics better	**Through better responses to questions**	0	10	3	13
	Through the understanding of formulas and examples	20	4	12	36

	By following the problem-solving steps	0	3	5	8
	Others (Specify)	0	2	1	3
Total		20	19	21	60

Source: Field Data, 2023.

From the table above, 20 teachers (33%) at Maranatha school said one of the ways the internet YouTube is facilitating Learning of mathematics in the school is through the understanding of formulas and examples. Four teachers (6.6%) at Ahmadiyya said the same thing, as well as Alhaji Bai Kurr School with a percentage of 20% (12) 3 teachers (5%) at Ahmadiyya School said one of the ways the internet Youtube is facilitating Learning is through following the problem-solving steps while five teachers (8%) at Alhaji Bai Kurr School said the same thing.

Relationship between the Use of Internet Youtube and the Performance of Pupils in Mathematics

There is a solid reason to assess the relationship between the use of internet technology and pupils' Mathematics performance. This is the reason which is why the researcher asked teachers of mathematics about this relationship, as shown in the analysis below:

Table 6. Relationship between technology use and the performance of pupils

There is a strong relationship between the use of the internet Youtube and the performance of Pupils in Mathematics				
	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Agree	14	23.3	23.3	23.3
Agree	27	45.0	45.0	68.3
Neutral	7	11.7	11.7	80.0
Disagree	7	11.7	11.7	91.7
Strongly Disagree	5	8.3	8.3	100.0
Total	60	100.0	100.0	

Source: Field Data, 2023.

It is interesting from the analyses that 27 teachers accounting for 45% in all three schools, agreed that there is a strong relationship between the use of the internet Youtube and the performance of pupils in Mathematics in these schools. This is shown in the chart below:

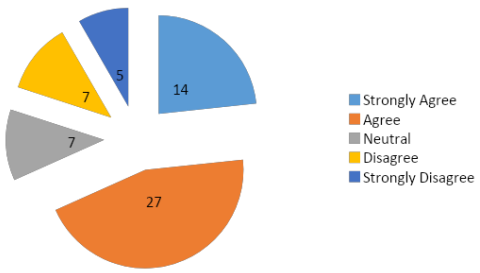

Figure 2. *Relationship between internet use and Pupils' Performance*

Pupils' Perception of the Use of Internet Youtube in the Teaching of Mathematics

Pupils in the three schools were also fundamental in the study (Jannah et al., 2018; Muhammad et al., 2023; Sugianto et al., 2023). They also asked the researchers to give their opinions about technology use in the teaching of Mathematics, as shown below:

Table 7. Youtube has made pupils understand mathematics better

Do you think the internet Youtube has made pupils understand mathematics better?				
	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	47	78.3	78.3	78.3
No	13	21.7	21.7	100.0
Total	60	100.0	100.0	

Source: Field Data, 2023.

From the analyses above, 78.3% of the pupils in all three schools confirmed that Mathematics teaching through the internet youtube can make them understand the teaching of Mathematics better. Pupils in these schools showed a willingness to use the internet and maintained the use of the internet (Darmayanti et al., 2022; Rizki et al., 2022; Wulandari et al., 2022). Youtube has helped them understand mathematics better by quickly understanding the steps and formulas used in teaching Mathematics in their respective schools.

The SOLO Levels of pupils learning Mathematics

In determining the SOLO levels of pupils learning mathematics through the internet Youtube, the researcher assessed the current level of pupils regarding the understanding of Mathematics as shown below.

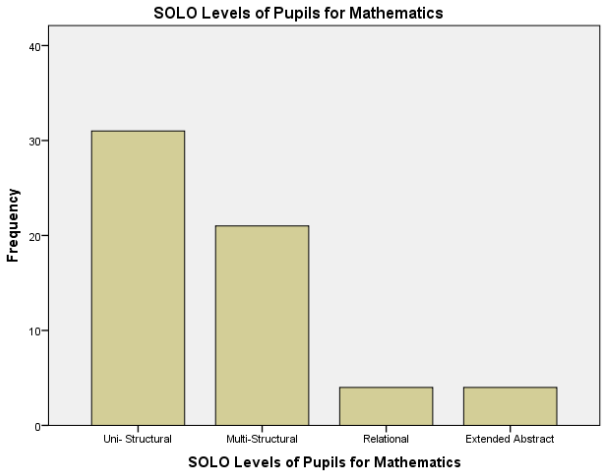

Figure 3. SOLO Levels of Pupils for Mathematics

The analysis from the above chart proved that 51.7% of the pupils in all three schools are at their Uni-structural level of learning mathematics through Youtube. This means that their level of understanding is still marginal or trimmed due to erratic internet connectivity in these schools and the inadequate number of

computers to link the technology for effective learning outcomes (Dwi Priyo Utomo et al., 2023; Manasikana et al., 2023; Rahmah et al., 2022). Additionally, 35.0% of the pupils are at their Multi Structural levels of learning mathematics through Youtube. This means that pupils could not effectively link their understanding of the lessons in mathematics because the understanding is not coherent and consistent.

Conclusion

The instructional role of technology is indeed fundamental in the teaching of mathematics. This study shows that technology could catalyze change and methods in teaching mathematics to pupils. Teachers who prioritize their roles as instructional facilitators, mentors, and leaders must be likely to succeed in fostering mathematical teaching and techniques and help pupils master mathematics in their schools, as confirmed by the study. Undoubtedly, the study discovered challenges, as highlighted above, which could affect pupils' quest to learn mathematics through technology, such as Therefore, it is prudent for policymakers to pay attention to the following recommendations primarily for the attention of the Ministry of Basic and Senior Schools.

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