MATHEMATICS TEACHERS' TECHNOLOGY INTEGRATION SELF-EFFICACY AND TECHNOLOGY USE

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Technology integration self-efficacy plays a great role in determining teachers' use of technology in teaching. This study investigated the association between mathematics teachers' use of technology and their technology integration self-efficacy. The study employed a survey design and 125 mathematics teachers participated in filling the questionnaire. Data analysis was done descriptively and inferentially and processed using Statistical Packages for Social Science version 20. Independent samples t-test and effect sizes were used. Despite teachers reporting to have a moderate level of self-efficacy, the study found a significant association between technology use and self-efficacy in technology integration. However, very few teachers reported using technology for instructional purposes. The study recommends that developing teachers' self-efficacy levels and facilitating their actual classroom technology integration may be important in enhancing technology use in mathematics education.

Keywords: *self-efficacy, technology integration, technology use, mathematics education, technology literacy*

INTRODUCTION

The increasing availability of technology especially in education has increased teachers' need to integrate them into their teaching. The need has increased with the evidence that supports the view that educational technology has the potential to transform teaching practices (Kartal & Çinar, 2018). There is evidence from the literature (Durak, 2019; Farjon, Smits, & Voogt, 2019; Hatlevik & Hatlevik, 2018) that actual technology integration practices are highly influenced by teachers' self-efficacy in using these technologies in their classrooms. Technology competence does not readily transform into classroom use unless teachers believe that they can do so (Henson, 2002). It has been reported that teachers with high self-efficacy in technology integration are more likely to integrate technology into their teaching. Those with high self-efficacy are more likely to try out new methods and technologies in their teaching (Paraskeva, Bouta, & Papagianni, 2008). Exploring the level of teachers' self-efficacy in technology integration may facilitate efforts in explaining the extent to which teachers are likely to integrate technologies in teaching.

The concept of self-efficacy is well expounded in literature. Schlebusch (2018) explains technology integration self-efficacy as one's self-evaluation of their ability to exploit technology potential in reaching their intended goals. Self-efficacy which may also be termed as confidence in what one can do (Njiku, Maniraho, & Mutarutinya, 2019). The concept derives its origin from Albert Bandura's social cognitive theory. The theory suggests that self-efficacy determines the initiation of coping behaviour, the amount of efforts used and persistence when addressing challenges (Bandura, 1977). As such the theory explains efforts to learn new technologies and use them in new contexts even when the school environment sets drawbacks. In this line of argument, it may be suggested that self-efficacy informs the extent to which teachers are likely to integrate technology education.

Self-efficacy has been documented to be related to teachers' actual use of technology. With increasing access to technology (Mtebe & Raphael, 2018), teachers are expected to have some experience in using them. Prior experience with technology is said to influence teachers' technology integration self-efficacy. Multiple studies have reported the relationship between use and self-efficacy (Giles & Kent, 2016; Kent & Giles, 2017). In some cases, the use of such technologies in education has remained administrative rather than for instructional including preparing school announcements, reports, letters and student registration (Mwalongo, 2011). In the contexts where technology use is not translated into classroom practices (Birisci & Kul, 2019), the extent to which such uses relate to self-efficacy for instructional purposes may need to be further explored. Working with pre-service teachers, Kent and Giles (2017) report high self-efficacy in technology integration across the curriculum but low self-efficacy in actual lessons they taught. In this study, we explore the extent to which teachers' use of technology is related to their self-efficacy in teaching with technology. With the focus on mathematics teachers, we explore mathematics teachers' level of technology self-efficacy and how it is related to their technology use in teaching, lesson preparation and administration. In his study, instructional use of technology included multiple presentations of concepts using software such as GeoGebra and spreadsheets, mathematics video clips, and electronic reading resources during classroom activities. Preparation for teaching includes teacher's personal study, preparing students' notes and lesson plans. Administrative uses include preparing school announcements, reports, letters and student registration (Mwalongo, 2011).

PURPOSE OF THE STUDY

The purpose of this study was to explore mathematics teachers' level of technology integration self-efficacy and the way it relates to their use of technology in education. The study responds to the research question; what is the association between teachers' use of technology and their level of self-efficacy? The study examines three key variables; teachers' use of technology for administrative activities, lesson preparation, and instruction in association with self-efficacy in technology integration.

METHODOLOGY

The study investigated mathematics teachers' technology integration self-efficacy. The study employed a survey design where a closed-ended questionnaire was used. The questionnaire was developed by the researchers. Participants were asked to rate their self-efficacy measured using 12 items against a five-point Likert scale whereby 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agreed. The questionnaire had a reliability of á=.864 Cronbach Alpha. The sample size was 125 (80 (64%) male and 45

(36%) female) mathematics teacher from Dar es Salaam – Tanzania. To respond to the research question, three hypotheses were developed:

1. Mathematics teachers who use technology for instructional purposes have the same score in technology integration self-efficacy as those who do not.
2. Mathematics teachers who use technology for lesson preparation have the same score in technology integration self-efficacy as those who do not.
3. Mathematics teachers who use technology for administrative activities have the same score in technology integration self-efficacy as those who do not.

Data were analysed descriptively using percentages, mean, and standard deviation and inferentially using t-test and processed using Statistical Packages for Social Science (SPSS) version 20. To test the assumption in the hypotheses, we used the independent samples t-test. We further calculated the effect size for each significant difference that was detected by the t-test, where .01 = small effect; .06 = moderate effect; and .14 = large effect (Cohen, 1988).

FINDINGS

The study was designed to investigate the association between technology use and mathematics teacher's technology integration self-efficacy. Using descriptive statistics, the overall mean score level of mathematics teacher technology integration self-efficacy was seen to be moderate (M = 3.58, SD = 0.8). Some items that were used to measure teachers' technology self-efficacy are as shown in table 1. The variation of teachers' scores on the self-efficacy scale was large as indicated by the large standard deviation.

Item	**Mean**	**SD**
I am confident that I can help my students to use mobile devices to learn mathematics	3.42	1.03
I am able to type mathematics notes/exam using a word processor	3.67	1.09
I am able to use mobile technologies to study mathematics	3.72	1.08
I am able to use a computer to simplify tedious mathematical work	3.39	1.18
I can learn mathematics using computer software (e.g. GeoGebra and spreadsheet)	3.36	1.15
I can learn to use mathematics software on my own	3.42	1.12
I am confident that I can use the internet to find any mathematics resources	3.87	0.94
I can learn a lot of mathematical concepts using technology	3.73	0.97
I consider myself capable of correctly incorporating technology in my teaching	3.55	0.97

Table 1: Descriptive Statistics for Mathematics Teachers' Technology Integration Self-efficacy (N = 125)

Responding to the questions about teachers' use of technology, 14 teachers reported using technology for teaching, 86 for preparation of lessons, and 78 for administrative activities. This information is illustrated in Figure 1.

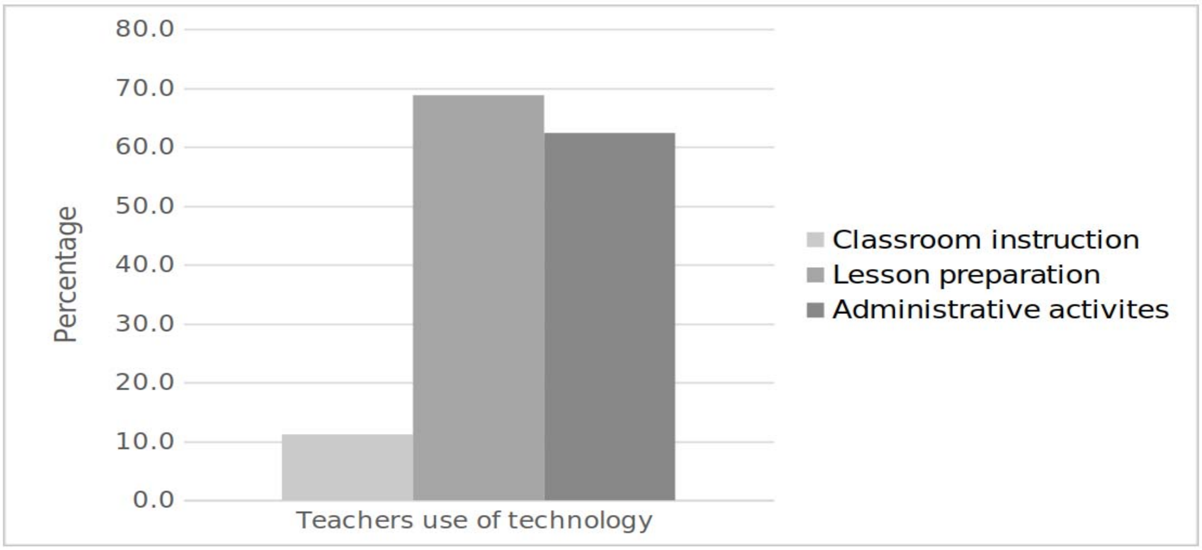

Figure 1: Mathematics Teachers' Use of Technology

In responding to the research question, the study tested the three assumptions made in the hypotheses. An independent samples t-test was used to examine if any significant differences existed between users and non-users. Furthermore, to explain the magnitude of such differences, eta squared statistic was used for effect sizes.

Hypothesis 1

Mathematics teachers who use technology for instructional purposes have the same mean score in technology integration self-efficacy as those who do not.

Using t-test, there was a significant difference in mean scores on technology integration self-efficacy between mathematics teachers who used technology for instructional activities (M = 4.34, SD = .57) and those who did not (M = 3.48, SD = .77; $t(123) = 4.04$, $p < .05$). The eta squared = .12 was seen to explain the effect size of the difference between the two groups. This indicates that mathematics teachers who used technology for instructional purposes scored substantially higher than those who did not.

Hypothesis 2

Mathematics teachers who use technology for lesson preparation have the same mean score in technology integration self-efficacy as those who do not.

There was a significant difference in mean score of technology integration self-efficacy between mathematics teachers who used technology for lesson preparation (M = 3.72, SD = .70) and those who did not (M = 3.27, *SD* = .92; *t* (123) = 2.99, $p < .05$). When the effect size was calculated, an eta squared =.07 was obtained. This indicates that mathematics teachers who used technology for lesson preparation scored significantly higher than those who do not. However, the effect size explaining this difference was moderate.

Hypothesis 3

Mathematics teachers who use technology for administrative activities have the same mean score in technology integration self-efficacy as those who do not.

The mean score in technology integration self-efficacy of mathematics teachers who used technology for administrative activities (*M* = 3.71, *SD* = .77) was significantly different from the mean score of those who did not (*M* = 3.36, *SD* = .81; *t* (123) = 2.44, $p < .05$). The magnitude of this difference was explained by a calculated eta squared = .05. Despite findings showing that mathematics teachers who used technology for administrative activities scored significantly higher than non-users, the effect size explaining the difference was small.

DISCUSSION

This study was designed to investigate the association between mathematics teachers' use of technology and their technology integration self-efficacy. Using descriptive statistics, it was found that most teachers did not use technology for instructional purposes. This suggests that despite the increased access to technology (Mtebe & Raphael, 2018) teachers are still reluctant to use them in facilitating their classroom practices. However, the majority of teachers reported using technology in their personal reading as they prepare for lessons. These findings are also supported by Mwalongo (2011) who found that most teachers did not use technology for instructional purposes but rather for administrative purposes. In contrast to these findings, a study by Giles and Kent (2016) found that 93% of teachers reported to use technology in their teaching. The Tanzanian context in which this study was done would account for the low uptake of technology in actual classroom teaching as technology integration is still in the early stages.

Teachers scores on the self-efficacy scale was moderate (*M* = 3.58, *SD* = 0.80). However, deviation from the mean was large for every item ranging from 0.94 to 1.18. This indicates that the variance of teachers' scores on the self-efficacy scale was large, where some scored very high and others very low.

The study also found that all the three variables, use of technology: for instruction, for lesson preparation, and administrative activities were significantly related to mathematics teachers' self-efficacy in technology integration. This may suggest that either the use affected mathematics teachers' self-efficacy or self-efficacy affected mathematics teachers' use of technology. When the effect sizes were calculated, a large effect size of 12% was seen to explain the difference in the first hypotheses, and a moderate effect size of 6.8% was used to explain the difference in the second hypothesis. However, in the third hypothesis, there was a low effect size of only 4.6%. The relationship between technology use and technology integration self-efficacy has also been discussed in various studies. Li, Garza, Keicher, and Popov (2018) reported that teachers' self-efficacy was a significant predictor of their use of technology in education. Using the TAM model, Joo, Park, and Lim (2018) found out that teachers' intentions to use technology were influenced by their levels of self-efficacy. This may suggest that mathematics teachers with high self-efficacy in technology integration are more likely to use technology in their teaching practices.

LIMITATION OF THE STUDY

This study employed survey design to obtain information from mathematics teachers in selected schools from Dar es Salaam. Also, the study collected background information such as experience in years as categorical data. This limited the range of statistical analysis techniques that would be used for the data especially in explaining how it relates to technology integration self-efficacy. Future studies may explore such variables using a scale so as to obtain continuous data for more statistical analyses. Furthermore, the nature of the data being quantitative limited the analysis to statistical interpretation. Future studies may seek to understand in detail the subject by collecting qualitative information.

CONCLUSION

The study was designed to examine the association between technology use and technology integration self-efficacy for mathematics teachers. The study found a link between the use and self-efficacy with regard to technology integration. The overall self-efficacy in technology integration was seen to be moderate. Also, whereas many (68.8%) teachers were found to use technology for lesson preparations, very few (11.2%) of them reported to use technology for instructional purposes. It may be concluded that efforts are needed to develop teachers' self-efficacy in technology integration and facilitate their actual classroom technology integration.

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