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Exploring Mathematics Teachers' Technology Integration Self-Efficacy and Influencing Factors

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Abstract: This study explores the level of mathematics teachers' technology integration self-efficacy and the extent to which some background variables influence this self-efficacy. The study adopted a survey design and collected data from 125 mathematics teachers in Dar es Salaam, Tanzania. Data analysis was done using a t-test, effect size, and one-way between-groups ANOVA. Teachers were found to have a moderate level of self-efficacy. Furthermore, findings suggest that gender and teacher training in technology integration both in college training and as part of professional development are important in influencing teachers' self-efficacy in teaching with technology. The study recommends technology integration and gender to be mainstreamed in teacher education in order to develop self-efficacy in technology use.

Keywords: mathematics education, self-efficacy, teacher professional development, teacher education, technology integration.

Introduction

Technology integration in education has been considered to be the driving force to the realisation of effective teaching and learning in the 21st century (Mtebe & Raphael, 2018; Wright & Akgunduz, 2018). It has been thought to possess an educational potential that fosters the transformation of the teacher's role from the traditional one as a knowledge source or provider to a facilitator of the classroom activities (Kartal & Çinar, 2018; Li et al., 2018; Paraskeva et al., 2008). In developing countries such as Tanzania, policies have been put in place to guide and regulate the integration of technology in education (Mtebe & Raphael, 2018). This involves ways of enhancing investment and capacity building and ensuring effective and safe integration. In the report by the Ministry of Education, Science and Technology (MoEST) it is shown that facilities such as computers have been introduced in many schools (31.4%) throughout the country, ranging between one and 68 computers per school (MoEST 2017). Access to the internet has also been increasing, for example, the report points out that 20% of the schools that have computers are connected to the internet. In mathematics, the development and availability of local content that match the Tanzanian curriculum has also been increasing. Programmes such as MoMath and Halostudy, have been developed. Other online applications such as O-level Math Pro, tHL, Shule Direct, and many others are readily available. These increasing new technological devices, especially smartphones, applications, and programmes, and their increasing availability have transformed education provision (Wright & Akgunduz, 2018). In Tanzania, these efforts have been invested especially in mathematics to improve the teaching and

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learning of the subject. The subject has received considerable attention because students have been persistently performing poorly in their mathematics examinations for many years (Education Sector Development Committee, 2011).

The increasing availability and access to technology resources opens opportunities for teachers to utilise them in their school practices. It has increased the demand for teachers to provide technology-integrated education (Wright & Akgunduz, 2018). However, improving the provision of education through the use of technology is not only about enormous investment in facilities such as computers, the internet, smart boards, and other technological devices but it is about facilitating students' learning through such technologies (Wright & Akgunduz, 2018). Teachers are key in the realization of technology integration in teaching and learning (Li et al., 2018). If policy, programmes, and investment in technology keep teachers out of the integration process, pedagogical use of technology will be hampered (Akturk & Ozturk, 2019). However, the use of technology in education remained very low for years even in developed countries (Durak, 2019). Nevertheless, the situation has changed following the COVID-19 pandemic which necessitated the shift to online learning in many countries. Factors such as the availability of technology devices and internet access are probable causes in developing countries where they appear to be scarce (Mtebe & Raphael, 2018). Teacher factors including knowledge (Koehler & Mishra, 2009; Wright & Akgunduz, 2018) and attitudes (Durak, 2019) are also inhibitors. In developing countries such as Tanzania, teacher knowledge (Kafyulilo et al., 2015; Kafyulilo et al., 2013; Mtebe & Raphael, 2018) has been widely investigated.

While there is substantial research on the knowledge for technology integration, the affective domain seems to have received little attention. When investigating factors that influence technology integration in teaching, consideration should be given not only to cognitive aspects but also to affective aspects (Joo et al., 2018). Whereas cognitive aspects explain what teachers know about technology and technology integration, their confidence and beliefs about their ability to apply such knowledge in various contexts are very important. This belief that they possess the ability to do is referred to as self-efficacy (Njiku et al., 2019) and impacts their actual integration (Njiku et al., 2020). However, teachers' self-efficacy which has been widely discussed in the international literature to affect their use of technology in teaching (Akturk & Ozturk, 2019; Deepika et al., 2017; Durak, 2019; Giles & Kent, 2016; Joo et al., 2018; Njiku et al., 2019) has not been documented widely in developing countries such as Tanzania. For teachers to effectively use technology in the classroom, their belief about their ability to use technology is important. Expounding this view Karolčík and Čipková (2017) point out that successful integration of technology in teaching requires going beyond the building of technological infrastructure to strengthening teachers' confidence in their ability to integrate modern technologies into their specific lessons. Access to technological infrastructures and tools only helps to address the first-level barriers that provide environmental readiness (Li et al., 2018). Second-level barriers such as teachers' readiness are also important (Durak, 2019) especially in the ever-increasing access to technology tools contexts (Mtebe & Raphael, 2018). This paper examines this readiness by exploring the level of mathematics teachers' technology integration self-efficacy in Dar es Salaam-Tanzania, the factor that is important in determining the likelihood of integrating technology in their classroom. The paper intends to contribute to the literature on mathematics teachers' level of technology integration self-efficacy and explore how such self-efficacy is related to teachers' professional training background and current practices.

Conceptualising Self-Efficacy

The concept of self-efficacy originates from social cognitive theory (Akturk & Ozturk, 2019), developed by Albert Bandura (1977) who defined self-efficacy as an individual judgment about their ability to arrange and perform tasks successfully. Bandura suggests that self-efficacy determines the initiation of coping behaviour, the effort that may be employed, and the sustainability of such efforts, especially in case of challenges and hindrances. As such he explains self-efficacy as a two-dimensional construct involving efficacy expectations (having confidence that a particular behaviour will lead to particular results) and outcome expectations (having confidence that one can perform certain activities leading to a particular result). Individuals' self-efficacy determines their thinking, feelings, behaviours, and motivations (Akturk & Ozturk, 2019). Researchers such as Joyce and Kirakowski (2013), Karolčík and Čipková (2017), and Li et al. (2018) use the concept of self-efficacy as synonymous to confidence which suggests they had a focus towards efficacy expectations rather than outcome expectations. For example, Joyce and Kirakowski (2013) use the "can-do" phrase in the psychometric scale, for example, I can learn to use mathematics software on my own. The review by Njiku et al. (2019) highlights that the two concepts are used interchangeably in literature especially when measuring teachers’ attitudes towards technology integration.

Self-Efficacy in Technology Integration

Teachers' self-efficacy refers to their personal beliefs about their abilities and skills as educational practitioners (Joo et al., 2018), especially in planning and accomplishing instructional objectives (Gavora, 2010). Self-efficacy is a trait that defines teachers’ position in terms of what they believe about their ability and skills. With reference to technology use, Schlebusch (2018) defines self-efficacy as people’s self-evaluation of their ability to use technology in order to reach their targeted objectives. Self-efficacy as one of a teacher’s personality traits that is important to the integration and development of new technologies in education (Paraskeva et al., 2008). The authors also emphasise individual factors that make up teachers' personalities, including self-efficacy in developing their potential regarding not only their professional prospects but also effective integration of technologies in their normal teaching practices. Having the necessary cognitive knowledge and skills in technology integration is not a guarantee for its success. It is important that teachers feel competent and secure in technology integration so that they may work to use and integrate technologies in the teaching process effectively and efficiently (Wright & Akgunduz, 2018).

Oral (2008) points out that teachers’ self-efficacy in their ability to use computers affected their efforts to use technology in their teaching practices. In the study with pre-service teachers that examined the relationships between Technological Pedagogical and Content Knowledge (TPACK), teacher self-efficacy, perceived ease of use, perceived usefulness, and intention to use technology, Joo et al., (2018) found that teachers’ self-efficacy positively influenced their intention to use technology. In the study about the relationship between (TPACK), self-efficacy belief levels, and the usage of Web 2.0 applications, Wright and Akgunduz (2018) found that TPACK self-efficacy beliefs were positively related to the use of web 2.0 applications. In this case, self-efficacy beliefs were on more detailed teacher knowledge – TPACK, that is the extent to which teachers believed that they had the knowledge required to teach with technology. They also contend that more exposure to the use of these applications by teachers positively affects their TPACK self-efficacy. Whereas access to technology may have a low influence on the technology integration of teachers, the influence of their attitudes and self-efficacy beliefs in technology integration was high (Farjon et al., 2019). Technology integration self-efficacy has a high correlation with technological pedagogical content knowledge (Durak, 2019). As such the author suggested that to achieve effective technology integration it may be important to encourage and develop teachers' TPACK, which influences the beliefs in practices for technology integration. Another study by Li et al., 2018) reported that self-efficacy was a predictor of teachers' general use of technology and integration of technology to facilitate either student-centred or traditional instruction. They contend that teachers' confidence in technology use is directly related to their actual use of technology in teaching. Teacher education, both pre-service and in-service may influence teachers' self-efficacy in technology integration (Durak, 2019; Li et al., 2018). However, this depends on whether such programmes have technology integration elements and the intensity of such integration (Durak, 2019). Similarly, Joo et al. (2018) contend that TPACK mediated between training programmes and teachers' self-efficacy. While the importance and role of self-efficacy in technology integration are widely discussed in the literature, the level of such self-efficacy among mathematics teachers is not widely discussed especially in developing countries such as Tanzania. As such, focusing on technology integration capability beliefs, this paper is intended to answer the following research questions:

1) What is the level of mathematics teachers' technology integration self-efficacy?
2) How do teacher demographic characteristics predict mathematics teachers' self-efficacy in technology integration?
3) How do previous training experiences in technology integration relate to mathematics teachers' self-efficacy in technology integration?

Methods

The study investigated mathematics teachers' technology integration self-efficacy. The survey design was used for the study.

Instrument

The study investigated mathematics teachers' technology integration self-efficacy. The survey design was used for the study. Data was collected using a questionnaire that was designed by the researchers inspired by self-efficacy items developed by Chou (1997), Hsiao (2011), and Lokken et al., (2003). However, as the items from this literature were more focused on computers in general, items with a focus on mathematics and mobile devices that are ubiquitously available and accessible to teachers in Tanzania were also developed. The new questionnaire was made of closed-ended survey items. Participants rated their perceived ability on a Likert scale of one to five whereby 1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agreed. The questionnaire was piloted prior to the study and its calculated Cronbach Alpha reliability coefficient for internal consistency $\alpha = .864$ was obtained. The think-aloud technique was used to establish item content validity. Eleven items were dedicated to measuring teachers' self-efficacy. Background variables included gender, educational level, experiences in years, college training in technology, college training in technology integration, and professional development in technology integration. So, there were seventeen items in total.

Participants

The Dar es Salaam region was selected for the reason that it has more technology facilities in the country (Mtebe et al., 2011). The study randomly selected 38 public secondary schools in the region. Public schools were chosen because they enrol the majority of the students in the country (MoEVT 2012). The questionnaire was distributed to all mathematics teachers in the selected schools. A sample of 149 mathematics teachers received the questionnaire, of these 125 (84%) participants returned the questionnaire. Of the 125, there were 80 male (64%) and 45 female (36%) mathematics teachers who participated in the study. The experience in teaching varied as 40 (32%) had 0-5 years, 48 (38.4%) had 6-10 years, 21 (16.8%) had 11-15 years, and 16 (12.8%) had more than 15 years. Teachers' education levels were as follows; 48 (38.4%) diploma, 74 (59.2%) bachelor's degree, 2 (1.6%) master's degree, and 1 (0.8%) who was not a teacher by profession. Teachers also had different backgrounds concerning their teacher training and professional development. In teacher training, 79 teachers (63.2%) studied computer courses, and 62 (48.8%) studied a course in technology integration. At work, 25 teachers (20%) had attended at least one professional development programme in technology integration.

Data Analysis

In this study, data were analysed using the Statistical Packages for Social Science (SPSS) version 20. Descriptive statistics, independent sample t-test, and one-way ANOVA were used in analysing the data. Where significant differences were detected, the effect size was also calculated. The descriptive statistics were dedicated to responding to our first research question where mean score ≤ 2 is low, between 2 and 4 is moderate, and ≥ 4 is high. The independent sample t-test was used to determine the difference between groups such as gender, and training in technology integration that teachers had received in relation to their self-efficacy. However, in determining the difference in teachers' technology self-efficacy as a result of their education levels and experience in teaching, one-way ANOVA was used since there were more than two groups for these variables. The analysis tested the following hypotheses:

1. Male and female mathematics teachers have the same technology integration self-efficacy mean score.
2. Mathematics teachers who studied computer courses have the same technology integration self-efficacy mean score as those who did not.
3. Mathematics teachers who studied technology integration courses have the same technology integration self-efficacy score as those who did not.
4. Mathematics teachers who have participated in professional development programmes in technology integration have the same technology integration self-efficacy score as those who have not.
5. There is no significant difference in technology integration self-efficacy mean score between mathematics teachers of different teaching experiences.
6. There is no significant difference in technology integration self-efficacy mean score between mathematics teachers of different education levels.

Findings

The study was designed to investigate the level of mathematics teachers' technology integration self-efficacy. Also, it explored how teachers' background characteristics such as their education level, experience in teaching, and various pieces of training affected their technology integration self-efficacy. To address the first research question, descriptive statistics were used. The mean scores for every item were obtained as detailed in Table 1. The overall mean score was seen to be moderate (*M* = 3.58, *SD* = 0.80).

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

Item	Mean	SD
I am confident that I can help my students to use mobile phones to learn mathematics	3.42	1.03
I am able to type mathematics notes/exams using a word processor	3.67	1.09
I am able to connect a computer to a projector for a lesson	3.34	1.21
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 am able to learn mathematics using my mobile devices	3.86	0.96
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
Overall Self-efficacy	**3.58**	**0.80**

To respond to our second and third research questions, we tested six hypotheses that were obtained after breaking down the research questions. The first hypothesis assumed there was no difference between male and female mathematics teachers in their technology integration self-efficacy mean scores. An independent sample t-test was used. It was found that there was a significant difference in mean scores on technology integration self-efficacy in favour of male teachers (*M* = 3.71, *SD* = .86) compared to female teachers (*M* = 3.34, *SD* = .62), $t(123) = 2.80$, $p = .006$. This total variance in scores was explained by a magnitude of eta squared = .06 which was moderate. The null hypothesis was rejected.

The second hypothesis assumed that mathematics teachers who had studied computer courses in their teacher training have the same mean score as those who did not. An independent sample t-test was again used to test for any significant difference. There was a significant difference in technology integration self-efficacy mean scores of mathematics teachers where those who had studied computer literacy course had higher scores (*M* = 3.81, *SD* = .74) than those who did not (*M* = 3.17, *SD* = .74), $t(123) = 4.58$, $p = .000$. The effect size using eta squared was large = .15. The hypothesis was then rejected.

The third hypothesis assumed that mathematics teachers who studied technology integration courses have the same technology integration self-efficacy scores as those who did not. The study found a significant difference between mean scores for teachers who had studied a technology integration course (M = 3.85, SD = .67) and those who had not (M = 3.31, SD = .83), $t(123) = 4.02$, $p = .000$. The magnitude of the variance in scores was explained by the moderate effect size of eta squared =.12. The assumed hypothesis was rejected.

The fourth hypothesis assumed that mathematics teachers who have participated in professional development programmes in technology integration have the same technology integration self-efficacy score as those who have not. Once again, an independent samples t-test was seen as relevant to test for any significant differences. There was a significant difference in technology integration self-efficacy mean scores for teachers who had participated in professional development programme(s) (M = 4.00, SD = .66) and those who had not participated in such programmes (M = 3.47, SD = .80), $t(123)$ = 3.09, $p = .002$, with moderate effect size of eta squared = .07. The hypothesis was rejected.

The fifth hypothesis assumed that there was no significant difference in technology integration self-efficacy mean score between mathematics teachers of different teaching experiences. Since there were more than two independent groups, a one-way between-groups ANOVA with *post-hoc* tests was used. Participants were grouped according to their teaching experience in years (Group 1: 0-5, Group 2: 6-10, Group 3: 11-15, and Group 4: more than 15). The four groups were statistically significantly different at $p < .05$ [$F(3, 121) = 3.66$, $p = .014$]. The effect size calculated using eta squared was moderate = .08. *Post-hoc* comparisons were performed using the Tukey HSD test to determine which of the four groups differed significantly. Group 1 (M = 3.81, SD = .82) was significantly different ($p = .02$) from group 4 (M = 3.14, SD = 1.07). The other groups: group 2 (M = 3.46, SD = .63) and group 3 (M = 3.71, SD = .73) did not differ significantly ($p = .62$) from each other and from either group 1 ($p = .13$ and $p = .94$) or group 4 ($p = .48$ and $p = .13$). This led to the rejection of the null hypothesis.

The sixth hypothesis assumed that there was no significant difference in technology integration self-efficacy mean score between mathematics teachers of different education levels. Of the four levels: Group 1: diploma, Group 2: bachelor's degree, Group 3: master's degree, and Group 4 other qualifications that had at least one participant, the master's degree group had two participants, and the other groups had only one participant. Since *post-hoc* tests do not account for such groups because of the small number of participants, and it would not make sense to compare large groups to only two or one participant, one-way between-groups ANOVA where planned comparisons were used. The four groups were statistically different at $p < .05$ where [$F(3,121) = 2.98$, $p = .034$]. The effect size calculated using the eta squared was moderate = .07. When a comparison was done between Group 1 and Group 2 using planned comparisons, Group 1 (M = 3.34, SD = .87) was seen to be statistically different from Group 2 (M = 3.72, SD = .72). The assumed null hypothesis was rejected.

Discussion

This study was designed to investigate the level of mathematics teachers' technology integration self-efficacy. It also investigated the effect of mathematics teachers' demographic characteristics such as gender, education level, experience in teaching, and training in technology on their self-efficacy. The self-efficacy level was seen to be moderate despite the increasing access to technology. Moreover, the standard deviations were high, indicating a large spread of scores from the mean in some cases. This suggests that the variability of self-efficacy among teachers is high. Whereas access to technology increases (Mtebe & Raphael, 2018), teachers' self-efficacy has remained moderate. These findings are supported by Hsiao (2011) where most items had scores above three and below four as is the case in this study. Working with pre-service teachers, in contrast to the finding of this study, Giles and Kent (2016) and Kent and Giles (2017) found a high self-efficacy level among pre-service teachers after they received training in technology integration. Since teachers' self-efficacy is believed to have an important influence on their technology integration (Li et al., 2018), efforts in developing teachers' confidence in their ability to integrate technology in teaching through professional development programmes in technology integration may be important.

The study found that male mathematics teachers had a higher mean score of self-efficacy in teaching with technology than their counterpart female mathematics teachers. These findings are contrasted with findings by Scherer and Siddiq (2015) who found that despite male teachers having higher self-efficacy in basic and advanced computer skills, there was no significant difference between males and females in using computers for instructional purposes. Also, Keser et al. (2015) found that despite males having a higher mean score in self-efficacy than females, the difference was not significant. Evidence supporting gender differences in how people feel about using technology seems to remain conflicting (Joyce & Kirakowski, 2013). This not only suggests the need for further research but also the need to address gender parity.

Teacher training informs a lot about teaching practices at school. In this study, it was found that in mathematics teachers' training background, both courses that were taken at teacher colleges and professional development programmes may have had an influence on teachers' technology integration self-efficacy. The role of teacher education in technology integration self-efficacy as seen in this study is echoed by Deepika et al. (2017) and Kent and Giles (2017). The study by Kent and Giles (2017) that placed pre-service teachers in-field experience in classrooms found that the training in technology integration led to participants having a moderately high level of overall technology efficacy but moderate self-efficacy level for actual classroom implementation of technology integration. However, the study by Paraskeva et al. (2008) found no correlation between teacher training and their technology integration self-efficacy. The authors attributed this lack of correlation to the improper training of teachers. Therefore, teacher education both as initial training or as professional development may play an important role in increasing teachers' beliefs that they can integrate technology in their teaching.

Experience in teaching may also account for teachers' self-efficacy in technology integration. Surprising results were obtained in this study. Though teachers with less experience — Group 1 had the highest mean, Group 3 with more experience in teaching had a higher mean than Group 2. This suggests that self-efficacy neither increased nor decreased with experience. However, Group 1 significantly scored higher than group 4. Whereas Clausen (2007) argues that novice teachers often find it difficult to integrate technology in teaching, this study found their self-efficacy being higher than the rest of the groups. This may be because novice teachers are also likely to be millennials. Moore-Hayes (2011) argued that teaching experience highly informs teachers' technology integration self-efficacy. Comparing preservice teachers who had just completed courses in technology integration with in-service teachers, preservice teachers had lower self-efficacy than in-service teachers. However, the author pointed out that teachers with several numbers of teaching experiences may be challenged with rapid changes in technology in education.

Education level was also seen to influence mathematics teachers' technology integration self-efficacy. Only two groups of the four could be compared statistically since the other groups had too few participants. Teachers with bachelor's degree qualifications were seen to have higher self-efficacy in teaching with technology than those with diploma qualifications. Nevertheless, the landscape of teacher education in Tanzania is highly differentiated and this limits making conclusions simply based on the level of education. It is reported that the self-confidence experience while enrolled in college training may not authentically find utility beyond supervised contexts (Moore-Hayes, 2011). This may suggest, however, as argued by Clausen (2007) that the school context and support play a great role in determining teachers' technology integration self-efficacy. Therefore, the finding of this study may not clearly explain the nature of the training programmes themselves. It only suggests that bachelor's degree holders felt more confident about technology integration than diploma holders.

Limitation and Recommendation

This study employed a survey design to obtain information for mathematics teachers in selected schools in Dar es Salaam. It involved a sample of 125 mathematics teachers which was enough for statistical manipulation. The studies did not collect qualitative data from teachers including observation of their practices of technology integration. This limited the kind of information and analysis that would inform on-the-ground practices. Future studies may use a mixed methods approach to investigate teachers' integration of technology and various factors affecting such integration. Furthermore, the background information used, such as experience in years, was not grouped for differentiated analysis. This limited the range of statistical analyses techniques that would be used for the data especially in explaining how it relates to technology integration self-efficacy.

The findings of this study imply that for effective technology integration multiple factors need to be considered. Self-efficacy in technology integration mediated between various factors including teacher training, gender, level of education, and experience. As self-efficacy plays important role in ensuring teachers integrate technology, professional development programmes must be designed and implemented to develop technology integration self-efficacy across the identified background factors.

Conclusion

Technology integration self-efficacy is a characteristic that determines the extent to which teachers are likely to integrate technology in their teaching. In this survey study, it was found that teachers' demographic characteristics influence their teaching of mathematics with technology self-efficacy. Since conflicting evidence can be found from the literature, particularly for gender and experience, further research may need to explore these factors in-depth. For practice, it may be concluded that there is a need to readdress gender issues and technology integration courses in teacher training so that all teacher trainees obtain an opportunity to develop confidence in technology integration especially in mathematics education. Professional development programmes in technology integration may also influence teachers' self-efficacy as they continue to work and integrate technology in mathematics instruction. As various teachers' backgrounds and demographic characteristics seem to influence their self-efficacy which in turn may influence their actual use in teaching, seemingly it is important to harness these factors.

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References

Akturk, A. O., & Ozturk, H. S. (2019). Teachers' TPACK levels and students' self-efficacy as predictors of students' academic achievement. *International Journal of Research in Education and Science (IJRES), 5*(1), 283-294. https://www.ijres.net/index.php/ijres/article/view/543

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215. https://doi.org/10.1037/0033-295X.84.2.191

Chou, T.-C. R. (1997). *The relationships among computer usage, experience with the computer, computer anxiety, and attitudes toward computers for secondary agricultural education teachers in the United States* [Doctoral Dissertation, Mississippi State University].

Clausen, J. M. (2007). Beginning teachers' technology use: first-year teacher development and the institutional context's effect on new teachers' instructional technology use with students. *Journal of Research on Technology in Education, 39*(3), 245-261. https://doi.org/10.1080/15391523.2007.10782482

Deepika, M., Meera, C., Dorina, K., & Douglas, S. (2017). Examining preservice elementary teachers' technology self-efficacy: impact of mobile technology-based physics curriculum. *Contemporary Issues in Technology and Teacher Education (CITE Journal), 17*(3), 336-359. https://www.learntechlib.org/p/178190/

Durak, H. Y. (2019). Modeling of relations between K-12 teachers' TPACK levels and their technology integration self-efficacy, technology literacy levels, attitudes toward technology and usage objectives of social networks. *Interactive Learning Environments*, 1-27. https://doi.org/10.1080/10494820.2019.1619591

Education Sector Development Committee. (2011). *Education sector performance report 2010//11.* http://www.moe.go.tz/index.php?option=com_content&view=article&id=1635:education-sector-performance-report-201011&catid=1:latest-news

Farjon, D., Smits, A., & Voogt, J. (2019). Technology integration of pre-service teachers explained by attitudes and beliefs, competency, access, and experience. *Computers & Education, 130*, 81-93. https://doi.org/10.1016/j.compedu.2018.11.010

Gavora, P. (2010). Slovak pre-service teacher self-efficacy: theoretical and research considerations. *The New Educational Review, 21*(2), 17-30. https://pdfs.semanticscholar.org/f284/be870680436674ae2c02038c595e43fded01.pdf

Giles, R. M., & Kent, A. M. (2016). An investigation of preservice teachers' self-efficacy for teaching with technology. *Asian Education Studies, 1*(1), 32-40. https://doi.org/10.20849/aes.v1i1.19

Hsiao, W. Y. (2011). An analysis of in-service teachers' anxiety, attitude, and confidence toward using technology in teaching. *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 2367-2372). Association for the Advancement of Computing in Education (AACE). https://www.learntechlib.org/p/39083/

Joo, Y. J., Park, S., & Lim, E. (2018). Factors influencing preservice teachers' intention to use technology: TPACK, teacher self-efficacy, and technology acceptance model. *Educational Technology & Society, 21*(3), 48–59. https://www.jstor.org/stable/26458506?seq=1

Joyce, M., & Kirakowski, J. (2013). Measuring confidence in internet use: the development of an internet self-efficacy scale. In A. Marcus, *Design, user experience, and usability: Design philosophy, methods, and tools* (pp. 250–260). Cham: Springer. https://doi.org/10.1007/978-3-319-07668-3_25

Kafyulilo, A. C., Fisser, P., & Voogt, J. (2013). Supporting teachers' collaboration in design teams to develop technological pedagogical content knowledge: The case of science teachers in Tanzania. In R. McBride, & M. Searson (Eds.), *Proceeding of Society for Information Technology and Teacher Education International Conference, 2013.* (pp. 4692-4697). Chesapeake: VA: AACE. https://www.learntechlib.org/p/48865/

Kafyulilo, A., Fisser, P., Pieters, J., & Voogt, J. (2015). ICT use in science and mathematics teacher education in Tanzania: Developing technological pedagogical content knowledge. *Australasian Journal of Educational Technology, 31*(4), 381-399. https://doi.org/10.14742/ajet.1240

Karolčík, Š., & Čipková, E. (2017). Attitudes among chemistry teachers towards increasing personal competencies in applying ICT. *Chemistry-Didactics-Ecology-Metrology, 22*(1-2), 99-121. https://doi.org/10.1515/cdem-2017-0006

Kartal, B., & Çinar, C. (2018). Examining pre-service mathematics teachers' beliefs of TPACK during a method course and field experience. *Malaysian Online Journal of Educational Technology, 6*(3), 11-37. https://doi.org/10.17220/mojet.2018.03.002

Kent, A. M., & Giles, R. M. (2017). Preservice teachers' technology self-efficacy. *SRATE Journal Winter, 26*(1), 9-10. https://eric.ed.gov/?id=EJ1134392

Keser, H., Karaoğlan Yılmaz, F. G., & Yılmaz, R. (2015). TPACK competencies and technology integration self-efficacy perceptions of pre-service teachers. *Elementary Education Online, 14*(4), 1193-1207. http://ilkogretim-online.org.tr/index.php/io/article/view/1234

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education, 9*(1), 60-70. https://www.learntechlib.org/p/29544/

Li, Y., Garza, V., Keicher, A., & Popov, V. (2018). Predicting high school teacher use of technology: pedagogical beliefs, technological beliefs and attitudes, and teacher training. *Technology, Knowledge and Learning, 24*, 501–518. https://doi.org/10.1007/s10758-018-9355-2

Lokken, S. L., Cheek, W. K., & Hastings, S. W. (2003). The impact of technology training on family and consumer sciences teacher attitudes toward using computers as an instructional medium. *Journal of Family and Consumer Sciences Education, 21*(1), 18-32. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.499.940&rep=rep1&type=pdf

MoEST. (2017). *Feasibility study exploring e-learning initiatives at secondary schools in Tanzania mainland.* Dodoma.

MoEVT. (2012). *Basic education statistics in Tanzania (BEST), 2008 - 2012: National data.* Dar es Salaam.

Moore-Hayes, C. (2011). Technology integration preparedness and its influence on teacher-efficacy. *Canadian Journal of Learning and Technology, 37*(3), 1-15. https://www.learntechlib.org/p/42748/

Mtebe, J. S., & Raphael, C. (2018). Eliciting in-service teachers' technological pedagogical content knowledge for 21st-century skills in Tanzania. *Journal of Learning for Development, 5*(3), 263-279. https://jl4d.org/index.php/ejl4d/article/view/288

Mtebe, J. S., Dachi, H., & Raphael, C. (2011). Integrating ICT into teaching and learning at the University of Dar es Salaam. *Distance Education, 32*(2), 289-294. https://doi.org/10.1080/01587919.2011.584854

Njiku, J., Maniraho, J. F., & Mutarutinya, V. (2019). Understanding teachers' attitude towards computer technology integration in education: A review of literature. *Education and Information Technologies, 24*(5), 3041–3052. https://doi.org/10.1007/s10639-019-09917-z

Njiku, J., Mutarutinya, V., & Maniraho, J. F. (2020). Mathematics teachers' technology integration self-efficacy and technology use. *International Conference to Review Research in Science, Technology, and Mathematics*

Education (pp. 283-289). Homi Bhabha Centre for Science Education. https://episteme8.hbcse.tifr.res.in/proceedings/

Oral, B. (2008). The evaluation of the student teachers' attitudes toward Internet and democracy. *Computers & Education, 50*(1), 437–445. https://doi.org/10.1016/j.compedu.2006.07.006

Paraskeva, F., Bouta, H., & Papagianni, A. (2008). Individual characteristics and computer self-efficacy in secondary education teachers to integrate technology in educational practice. *Computers and Education, 50*(3), 1084-1091. https://doi.org/10.1016/j.compedu.2006.10.006

Scherer, R., & Siddiq, F. (2015). Revisiting teachers' computer self-efficacy: A differentiated view on gender differences. *Computers in Human Behavior, 53*, 48–57. https://doi.org/10.1016/j.chb.2015.06.038

Schlebusch, C. L. (2018). Computer anxiety, computer self-efficacy and attitudes towards the internet of first year students at a South African university of technology. *Africa Education Review, 15*(3), 72-90. https://doi.org/10.1080/18146627.2017.1341291

Wright, B., & Akgunduz, D. (2018). The relationship between technological pedagogical content knowledge (TPACK) self-efficacy belief levels and the usage of Web 2.0 applications of pre-service science teachers. *World Journal on Educational Technology: Current Issues, 10*(1), 52-69. https://eric.ed.gov/?id=EJ1196042

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