

Eliciting In-service Teachers' Technological Pedagogical Content Knowledge for 21st-Century Skills in Tanzania

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Abstract: The Tanzania Vision 2025 articulates the country's aspiration of becoming an industrialized and middle-income country by 2025. The education sector, which is the main driving force towards realizing this goal, is expected to bring about the right mix of high-quality skills for the rapid development of quality and adequate human resources. The kind of revolution needed is nevertheless impossible if teachers are not equipped with the necessary skills to bring in the desirable changes. This study adapted Technological Pedagogical Content Knowledge (TPACK) for 21st-Century skills to investigate teachers' competence levels of 21st-Century skills using self-reported survey and classroom observations from a sample of 132 teachers in 20 schools in Pwani and Morogoro regions. The study found out that many teachers have moderate self-reported confidence in all TPACK elements with technology. Conversely, teachers self-reported confidence levels in content knowledge, pedagogical knowledge, and pedagogical content knowledge was found to be high. The findings from this study provides valuable insights on how teachers use ICT to prepare students for 21-Century skills capable of supporting the country's efforts towards developing an industrial economy.

Keywords: eLearning, capacity development, education, training, professional development, ICT, educational technology, higher education, non-formal education

Introduction

The government of Tanzania is striving towards an industrial economy and aiming at becoming a middle-income country by 2025 (URT, 2014). According to the National Development Vision of 2025 and the National Long-Term Development Plan 2011/12 uphill 2024/25, the education and training sector is expected to bring about a rapid development of human resources by preparing an adequate number of the workforce to enable the country to become a competitive medium-income economy country by 2025 (URT 2014). However, for Tanzania to achieve its Vision 2025 of becoming an industrialized and middle-income country, it will need to develop the right mix of high quality skills to drive continued growth (Ndalichako, 2017); both job related technical skills and 21st-Century skills. One of the main problems that is likely going to hinder the progress to fully fledged semi-industrial economy is a massive shortage of the workforce with the necessary 21st-Century skills to contribute actively to economic development under a system where the main asset is knowledge (Sawahel, 2011; Sumra & Kataro, 2016).

The problem of skilled labor shortages is repeatedly reported in the mismatch between the skills produced in local universities and the needs of the skills industries (Bezy, 2013; McCowan, 2014). In other words, many students graduate with irrelevant skills to be absorbed in industrial markets. The problem of the skills gap becomes more critical when the prospective employees have the requisite job



skills but lack 21st-Century skills. The 21st-Century skills which are said to be scarce include communication skills, commitment to work, pro-activeness, time management, personal initiatives, coordination, and team working spirit (Sabarwal, 2013; Sumra & Katabaro, 2016; UNIDO, 2012). Other skills identified in the literature include problem solving, analytical skills, behavioral skills, and interpersonal skills (Sabarwal, 2013; UNIDO, 2012). Obviously, in order to prepare a future workforce with the required skills for the new industrial economy there is a need to equip teachers with 21st-Century competencies and become competent in supporting 21st-Century learning (Voogt, Erstad, Dede, & Mishra, 2013). In other words, the teachers' competence with technology integration is the basis for effective change (Hooker, Mwiyeria, & Verma, 2011).

In recognizing the role of teachers in ICT integration, the government and its partners have continued to improve ICT infrastructure in schools and colleges, increasing ICT awareness among teachers and learners, and increase in the use of ICT to facilitate administrative functions in schools. A recent report by the Ministry of Education, Science and Technology (MoEST) indicates that approximately 31.4% of government secondary schools (out of 3,601) have been equipped with computers, ranging from 1 to 68 computers (MoEST, 2017). The report further states that nearly 20% of these schools are connected to the Internet. Similarly, the government equipped 34 teacher training colleges with computers and Internet connections through the Swedish International Development Agency (Hooker et al., 2011). The main aim was to ensure that pre-service teachers are trained in the use of ICT for teaching and learning so that they can use these skills in secondary schools once they graduate (Kafyulilo, Fisser, & Voogt, 2016).

Similarly, there are many initiatives in developing digital content and making them available for students to access via the Internet. For instance, the College of Information and Communication Technologies (CoICT) in collaboration with Halotel Tanzania developed the Halostudy system with digital content for all science and mathematics subjects for Form 1 to Form IV (Mwakisole, Kissaka, & Mtebe, 2018). The content was enhanced with multimedia elements to facilitate self-learning and was deployed in 426 secondary schools connected with Halotel Internet. Christian Social Services Commission (CSSC) developed an eLearning platform with content for secondary schools in Tanzania (CSSC, 2014). Other initiatives that have developed content for secondary schools in Tanzania include Shuledirect (Mtebe & Kissaka, 2015), and the retooling project (Mtebe, Mbwilo, & Kissaka, 2016).

With improvement of ICT in schools, colleges and universities, the government has been implementing various initiatives to equip teachers with relevant skills for ICT integration in the classroom and the 21st-Century competences and skills. For instance, the Ministry of Education and Vocational Training (MoEVT) in collaboration with the World Bank and Global E-Schools and Communities Initiative (GESCI) developed the ICT Competency Framework for Teachers in Tanzania (Hooker et al., 2011). This initiative aimed to equip teachers in teachers' colleges with competencies and skills to be able to support students in 21st-Century skills. The initiative focused on science, mathematics, and English subjects.

Despite these efforts, studies have shown that teaching strategies for 21st-Century competencies are often not well implemented in actual educational settings (Voogt et al., 2013). Similarly, studies show that pedagogical integration of ICT in teaching and learning in secondary schools is still low (Kafyulilo, Fisser, Pieters, & Voogt, 2015; Kayombo & Mlyakado, 2016; Mwalongo, 2011; UNESCO, 2015). Moreover, the majority of studies that have investigated how teachers use ICT in teaching and

learning have focused on pre-service teachers. Consequently, this study aimed at investigating in-service teachers' competence levels of 21st-Century skills and how they apply in the classroom environment. The study adopted Technological Pedagogical Content Knowledge for the 21st-Century skills (TPACK-21) instrument developed by Valtonen et al. (2017) which have incorporated TPACK domain and 21st century skills.

A sample of 132 teachers in 20 schools in Pwani and Morogoro regions were studied using a self-reported survey followed by classroom observations using a pre-defined observation rubric tool. Understanding teachers' competence levels of 21st-Century skills and how they apply in the classroom environment provides valuable insights into the development of teacher preparation activities that would lead to more efficient use of technologies in preparing students with the requisite skills to boost an industrial economy.

Despite some consensus about what 21st-Century competencies are and how they can be acquired, results from international studies indicate that teaching strategies for 21st-Century competencies are often not well implemented in actual educational practice.

Literature Review

Rapid changes in economies brought about by the emergence of ICT in the 21st Century, makes the demands for skills in the labor market in this century different from the 20th-Century (Ananiadou & Claro, 2009; Dede, 2009). The current demand for skills and competencies are more related to the needs of the emerging models of knowledge economies than with those of the past century, which were suited to an industrial mode of production (Ananiadou & Claro, 2009). Technological and economic changes mean that companies have changed how they are organized and the way they do business (Kay & Greenhill, 2011). The changes also mean that the industries or employers need employees who have the ability to communicate, collaborate, mediate information, and solve problems with people worldwide given the existing interconnectedness of the global economy, ecosystem, and political networks (Dede, 2010; Saavendra & Opfer, 2012).

With the ICT and changes in the 21st Century, technology in education is no longer an option or a choice, but an inevitable reality. Therefore, in order to prepare future employees with these 21st-Century skills, teachers must have the necessary pedagogical skills to teach students in the new environment. Recently, Technological Pedagogical Content Knowledge (TPACK) framework for teacher knowledge has received a significant level of scholarly attention as a model that addresses the specialized set of knowledge needed to effectively integrate technology into the classroom. Koehler and Mishra (2005) argued that the heart of good teaching with technology requires three core components: content, pedagogy, and technology, plus the relationships among and between them. Figure 1 shows the TPACK framework and its knowledge components.

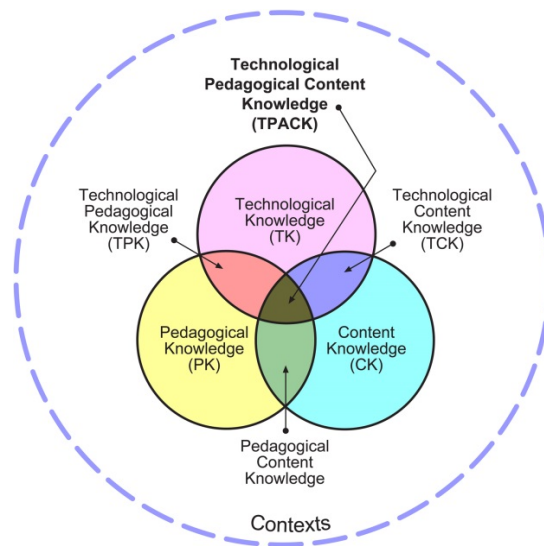


Figure 1. The TPACK framework and its knowledge components (Koehler & Mishra, 2013).

The description of each element in the TPACK domain as described by Koehler and Mishra is presented hereunder:

- Technology Knowledge (TK) is the teachers' understanding of the possibilities and constraints of a certain technology and the skills to utilize such technology efficiently in the classroom.
- Content Knowledge (CK) is teachers' knowledge about the subject matter to be learned or taught which includes knowledge of concepts, theories, ideas, knowledge of evidence and the means of inquiry in the field (e.g., biology, mathematics, etc.).
- Pedagogical Knowledge (PK) is teachers' knowledge about the processes and practices or methods of teaching and learning. It is a generic form of knowledge about the cognitive, social and developmental theories of learning as well as classroom management skills (Valtonen et al., 2017).
- Pedagogical Content Knowledge (PCK) is the knowledge of pedagogy applicable to the teaching of specific content covering the core business of teaching, learning, curriculum, assessment and reporting.
- Technological Content Knowledge (TCK) refers to teachers' knowledge about the technologies used within the content area (e.g., biology, mathematics, etc.). Teachers need to know not just the subject matter they teach but also the manner in which the subject matter can be changed by the application of technology.
- Technological Pedagogical Knowledge (TPK) is an understanding of the nature of teaching and learning with technology and of the benefits and disadvantages of various technologies for particular pedagogical practices.
- Technological Pedagogical Content Knowledge (TPACK) is an understanding that emerges from interactions among content, pedagogy, and technology knowledge.

The TPACK framework has been used extensively to measure knowledge needed to effectively integrate technology into the classroom. However, the framework faces certain difficulties, especially

in combining with 21st skills domains (Valtonen et al., 2017). In order to use TPACK in 21st-Century skills, Valtonen et al. (2017) developed an instrument by aligning with the TPACK instrument suggested by Chai et al. (2011). The instrument included 21st-Century skills namely ICT, collaboration, critical thinking, communication, and reflective thinking. These are important skills to support an industrial economy especially in the current knowledge-based economy described in many frameworks. These frameworks include the Partnership for 21st-Century skills (2006), the Metiri Group and NCREL (2003), the American Association of Colleges and Universities (2007), and the Organization for Economic Cooperation and Development (2005) (Dede, 2009). Therefore, Valtonen et al. (2017) combined these 21st-Century skills domains with TPACK elements to develop a tool that helps to understand in-service teachers' competence levels of 21st-Century skills and their application in the classroom environment.

Methodology

The research design employed both qualitative and quantitative approaches. The quantitative design involved the self-administered questionnaire using the TPACK-21 instrument. The study adapted TPACK-21 instrument proposed by Valtonen et al. (2017) with some items being re-worded to suit the context of the study. The instrument combines TPACK elements with 21st-Century skills domains. The instrument was validated using confirmatory factor analysis with a total of 267 teachers from three universities in Finland. The instrument consists of 39-items across teachers' knowledge on CK, TCK, PK, TPK, PCK, and TPACK. In addition to TPACK-21 instrument, this study used observation to complement data collected via self-administered questionnaire. Once the selected teachers filled out the self-administered questionnaire, they proceeded to teach a topic of their choice in the classroom. Using an observation rubric, teachers were observed in how they implemented 21st-Century skills in actual teaching. The rubric instrument consisted of a four-point Likert scale: 1 = Beginning, 2 = Developing, 3 = Approaching and 4 = Ideal/Target.

Schools

The study targeted 20 schools in the Pwani and Morogoro regions. The schools selected for the study were those with computers connected to the Internet (10 schools in each region). The idea behind this study was to investigate in-service teachers' competence levels of 21st-Century skills and how they apply in the classroom environment in schools where schools are already equipped with ICT facilities. Therefore, it was necessary to target schools with computers and the Internet. The selection of schools was on the basis of convenience.

Data Collection and Analysis

The data collection instrument consisted of 39 TPACK-21 items. Participants were required to answer each question using five-level Likert scales (1 = Strongly disagree 2 = Disagree 3 = Neither Agree nor Disagree 4 = Agree 5 = Strongly Agree). Prior to data collection, enumerators were trained on both TPACK-21 self-administered instrument and how they could use the rubric to conduct classroom observations. Data collection was conducted between October 2017 and February 2018. Data from questionnaires was analyzed using Statistical Package for the Social Sciences (SPSS). Analysis was undertaken by computing the necessary statistics such as means, frequencies and percentages. These were then presented in descriptive formats such as tables, graphs or narrations.

Participants

The participants in the study were 132 in-service teachers from 20 secondary schools in the Pwani and Morogoro regions. Out of 132 teachers who participated in the study, 59% were females while 41% were males. In terms teaching experience, 44% of teachers had teaching experience of 0-5 years, and 48% of teachers had teaching experience of 6-19 years. A minority of teachers (8%) had teaching experience of over 20 years. Moreover, the majority of teachers had a bachelor's degree (78%) while a few of them had a doctoral degree and a certificate of secondary education (1.1% each). It was also found that 11% of teachers had diplomas and 8.8% had master's degrees from various institutions within and outside the country.

As shown in Figure 2, the majority of teachers were English language teachers (26.4%) followed by both mathematics and chemistry (19.8%) while a few teachers (1.1%) were teaching information and computer science subjects.

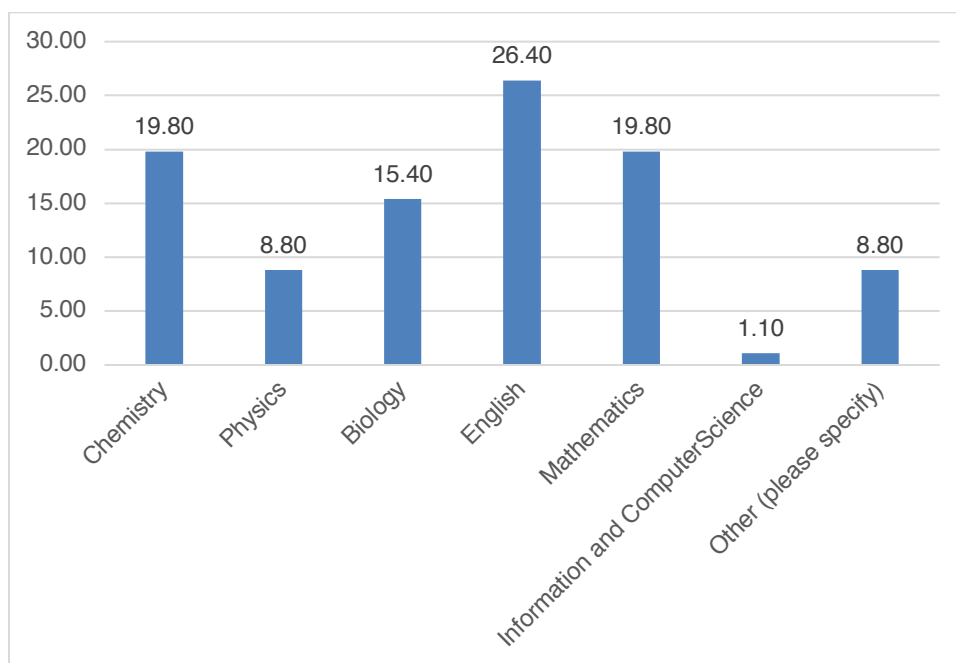


Figure 2: Distribution of teachers per teaching subject (N = 132).

Findings

Teachers' Use of Computers in Schools

Although the study targeted schools with computer connected to the Internet, the availability of computers in schools does not guarantee that the computers are going to be used in teaching and learning. Therefore, it was necessary to find out the frequency of teachers using computers in schools visited. As shown in Figure 3, the study found that more than two thirds of teachers use computers more often.

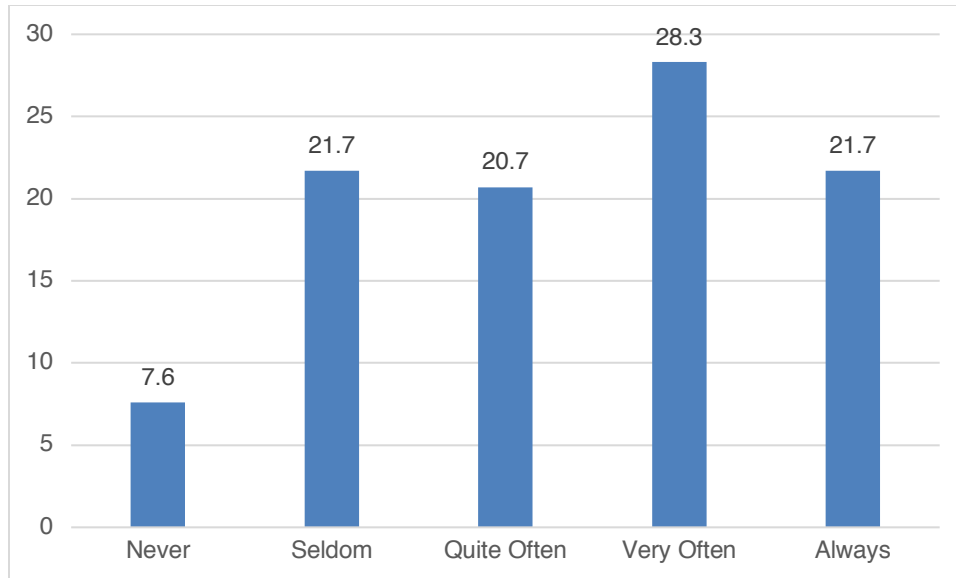


Figure 3: The distribution of the frequency of using computers (N = 132)

Then teachers were given TPACK-21 instrument to elicit teachers' self-reported confidence knowledge base needed to effectively teach with technology in the 21st Century on CK, TCK, PK, TPK, PCK, and TPACK. The mean score was used to determine teachers' levels of confidence on technology usage based on TPACK-21 elements, whereby if the mean scores of tests are between 1 and 2.33, the level of confidence is considered as "low". If mean scores of tests are between 2.34 and 3.67, the level of confidence is considered as "moderate". Finally, if mean scores of tests are between 3.68 and 5.00, the level of confidence is considered as "high" (Kabakci Yurdakul et al., 2012). The findings of each element in the TPACK domain are explained next.

Content Knowledge

Core content knowledge such as English, mathematics, science, history, and economics are considered to be the foundations upon which other 21st-Century skills are to be developed (Mishra & Kereluik, 2011). Teachers must know about the content they are going to teach and how the nature of knowledge is different in different content areas (Schmidt et al., 2009). This knowledge is as important as ever and will continue to be so into the foreseeable future (Kereluik, Mishra, Fahnoe, Terry, & Karr, 2013). Therefore, teachers' self-reported confidence in their content knowledge of the subject they teach was investigated. As indicated in Table 1, the results indicated that teachers' perceptions levels on their content knowledge of the subjects they teach was high ($M = 4.11$, $SD = 2.54$).

Table 1: Descriptive Statistics of Teachers' Responses on CK (N = 132)

| | M | SD |
|--|------|-------|
| I have sufficient knowledge in developing contents of the subjects I teach | 4.27 | 0.83 |
| I know the basic theories and concepts of the subjects I teach | 4.42 | 0.689 |
| I know the history and development of important theories in the subjects I teach | 4.16 | 0.719 |
| I am familiar with recent research in the subjects I teach | 3.57 | 0.959 |
| Overall CK (M = 4.11, SD = 2.54) | | |

Pedagogical Knowledge

The pedagogical knowledge is the form of knowledge applied to understand how students learn, general classroom management skills, lesson planning, and student assessment (Koehler & Mishra, 2013). Given the emergence of ICT, teachers need to be prepared for new pedagogical approaches that suit the 21st Century (Voogt et al., 2013). They should have skills to be able to improvise answers and facilitate dialogue in the unpredictable, chaotic flow of classroom discussion in the new 21st-Century learning environment (Dede, 2009). Therefore, it was important to investigate teachers' perceived levels of confidence on PK. The results show that teachers' self-reported pedagogical knowledge was found to be high (M = 4.23, SD = 3.50). Table 2 shows the descriptive statistics of teachers' responses on PK.

Table 2: Descriptive Statistics of Teachers' Responses on PK (N = 132)

| | M | SD |
|--|------|-------|
| I can guide students' discussions during group work (2-5 students) | 4.38 | 0.648 |
| I can support students' critical thinking during teaching process | 4.33 | 0.673 |
| I can guide students in planning their own learning | 4.17 | 0.786 |
| I can support students' reflective thinking during teaching process | 4.15 | 0.726 |
| I can guide students to make use of each other's thoughts and ideas during group work (2-5 students) | 4.16 | 0.75 |
| I can support students' problem-solving skills during teaching process | 4.28 | 0.755 |
| I can support students' creative thinking during teaching process | 4.23 | 0.64 |
| Overall TK (M = 4.23, SD = 3.50) | | |

Pedagogical Content Knowledge

Pedagogical content knowledge is the knowledge that deals with the teaching process (Shulman, 1986). In the majority of existing environment, little time is normally spent on building skills related to 21st-Century skills such as capabilities in group interpretation, negotiation of shared meaning, and co-

construction of problem resolutions (Dede, 2009). Therefore, teachers were investigated on their perceptions on PCK in teaching content in 21st-Century skills environment. The findings indicated that teachers' self-reported confidence on PCK was high ($M = 4.21$, $SD = 3.38$) as shown in Table 3.

Table 3: Descriptive Statistics of Teachers' Responses on PCK (N = 132)

| | M | SD |
|---|------|-------|
| I know how to guide students' content-related problem solving in groups (2-5 students) in the subjects I teach, | 4.28 | 0.734 |
| I know how to guide students' critical thinking in the subjects I teach, | 4.23 | 0.616 |
| I know how to guide students to make use of each other's thoughts and ideas in group work (2-5 students) in the subjects I teach, | 4.15 | 0.693 |
| I know how to guide students' reflective thinking in the subjects I teach, | 4.2 | 0.639 |
| I know how to guide students in planning their own learning in the subjects I teach, | 4.2 | 0.746 |
| I know how to guide students' creative thinking in the subjects I teach, | 4.2 | 0.659 |
| Overall TK ($M = 4.21$, $SD = 3.38$) | | |

Technology Knowledge

Teachers need to have ICT skills and competences if they have to teach with ICT in the classroom. Although many teachers have been found to use computers more often (See Figure 1), we were interested to elicit their self-reported levels of confidence in the use of computers and ICT to enhance teaching and learning. The study found that teachers' self-reported confidence in their knowledge in the use of ICT in teaching and learning was moderate ($M = 3.38$, $SD = 3.49$) as shown in Figure 4.

Table 4: Descriptive Statistics of Teachers' Responses on TK (N = 132)

| | M | SD |
|--|------|-------|
| I can solve ICT related problems when using them for teaching and learning | 3.3 | 1.118 |
| I am familiar with many new technologies and their features | 3.3 | 1.018 |
| I can use new technologies for teaching and learning | 3.52 | 1.03 |
| I know several websites and social media platforms about new technology | 3.39 | 1.046 |
| Overall TK ($M = 3.38$, $SD = 3.49$) | | |

Technological Pedagogical Knowledge

Teachers were also asked about their understanding of ICT efficacy and how using ICT may change the way they teach various subjects. Therefore, teachers need to understand how ICT and pedagogy

interact in order to be able to facilitate the development of 21st-Century competencies in their students (Voogt et al., 2013). The findings show that the overall teachers' perceptions on TPK was moderate ($M = 3.17$, $SD = 2.54$). Table 5 shows descriptive statistics of teachers' responses on TPK.

Table 5: Descriptive Statistics of Teachers' Responses on TPK (N = 132)

| | M | SD |
|--|----------|-----------|
| I know how to use ICT in teaching as a tool for students' reflective thinking | 3.35 | 1.119 |
| I know how to use ICT in teaching as a tool for students to plan their own learning | 3.26 | 1.116 |
| I know how to use ICT in teaching as a tool for sharing ideas and thinking together | 3.36 | 1.093 |
| I know how to use ICT in teaching as a tool for students' creative thinking | 3.33 | 1.059 |
| I know how to use ICT in teaching as a tool for students' problem solving in groups (2-5 students) | 3.34 | 1.069 |
| I know how to use ICT in teaching as a tool for students' critical thinking Interaction | 3.14 | 1.051 |
| Overall TPK ($M = 3.33$, $SD = 6.18$) | | |

Technology Content Knowledge

In the 21st-Century era, TCK stresses the idea of how ICT can be used within different disciplines outside schools in working life and how professionals are taking advantage of ICT in their work (Valtonen, Sointu, Mäkitalo-siegl, & Kukkonen, 2015). Therefore, in order to facilitate students' learning in 21st-Century environment, teachers need to know not just the subject matter they teach but also the manner in which the subject matter can be changed by the application of technology (Mishra & Koehler, 2006). In this study, teachers' self-reported confidence in their knowledge on TCK was found to be moderate ($M = 3.37$; $SD = 4.18$). (See Table 12) as shown in Figure 6.

Table 6: Descriptive Statistics of Teachers' Responses on TCK (N = 132)

| | M | SD |
|---|----------|-----------|
| I know websites with online materials for studying the subjects I teach | 3.61 | 1.097 |
| I know ICT-applications which are used by professionals in the subjects I teach | 3.19 | 1.211 |
| I know ICT-applications which I can use to better understand the contents of the subjects I teach | 3.36 | 1.167 |
| I know technologies which I can use to illustrate difficult contents in the subjects I teach | 3.33 | 1.207 |
| Overall TCK ($M = 3.37$; $SD = 4.18$) | | |

Technological Pedagogical Content Knowledge

Technological pedagogical content knowledge is the knowledge required by teachers for integrating technology into their teaching of content areas (Schmidt et al., 2009). To effectively teach with technology, teachers need an understanding of interactions of content, pedagogy, and technology knowledge (Koehler, Mishra, & Cain, 2013). Therefore, the study investigated teachers' self-reported confidence levels on TPACK. The findings revealed that teachers' self-reported confidence levels on TPACK was moderate ($M = 3.28$, $SD = 7.12$). Table 7 shows the descriptive statistics of the responses on TPACK.

Table 7: Descriptive Statistics of Teachers' Responses on TPACK (N = 132)

| | M | SD |
|---|------|-------|
| I know how to use ICT as a tool for sharing ideas and thinking together, in the subjects I teach | 3.33 | 1.144 |
| I know how to use ICT as a tool for students' reflective thinking, in the subjects I teach | 3.34 | 1.151 |
| I know how to use ICT as a tool for students to plan their own learning, in the subjects I teach | 3.32 | 1.168 |
| I know how to use ICT as a tool for students' problem solving in groups (2-5 students), in the subjects I teach | 3.3 | 1.152 |
| I know how to use ICT as a tool for students' creative thinking | 3.24 | 1.12 |
| I know how to use ICT as a tool in group work (2-5 students), in the subjects I teach | 3.23 | 1.152 |
| I know how to use ICT in teaching as a tool for students' critical thinking, in the subjects I teach | 3.2 | 1.157 |
| Overall TPACK ($M = 3.28$, $SD = 7.12$) | | |

Overall Results

Overall teachers' self-reported confidence in their knowledge in all elements of the TPACK domain was compared (See Figure 4). Interestingly, teachers' self-reported confidence on their knowledge on CK, PK, and PCK was high. Nevertheless, the teachers' self-reported confidence on TPACK elements that were combined with technology was moderate (i.e., TK, TPK, TCK, and TPACK).

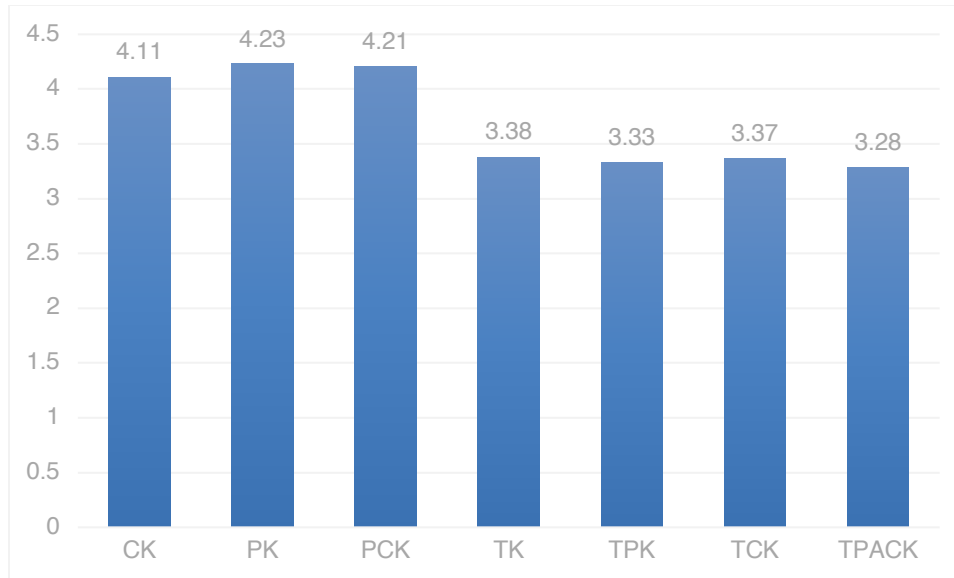


Figure 4: Descriptive Statistics of Teachers Responses on the TPACK Domains (N = 132).

Classroom Observation on Teachers' 21st-Century Competencies

The study used observation to complement data collected via a self-administered questionnaire. Once all sampled teachers completed the questionnaire, two teachers were randomly selected to proceed to teach one of the topics in the classroom while the research team was observing. The enumerators observed how teachers applied the core elements of 21st-Century skills domains in the classroom environment. These key elements included critical thinking, communication, collaboration, creativity and innovation, and use of technology. Using an observation rubric, TPACK-21 evidence was assessed in observed instructions. The rubric instrument consisted of a four-point Likert scale: 1 = Beginning, 2 = Developing, 3 = Approaching and 4 = Ideal/Target. It should be noted that if mean scores of tests are between 1 and 2.33, the level of perception is considered as "low". If mean scores of tests are between 2.34 and 3.67, the level of perception is considered as "moderate". If mean scores of tests are between 3.68 and 5.00, the level of perception is considered as "high" (Kabakci Yurdakul et al., 2012). The study found that teachers had low levels of ICT integration in the classroom of the 21st-Century skills in the lessons observed. The mean score in all 21st-Century elements in TPACK domain are below 2.0. Table 8 shows the scores on 21st-Century skills from classroom observation.

Table 8: Distribution of Scores on 21st-Century Skills from Lessons Observed (N = 40)

| Item | M | SD | Beginning (%) | Developing (%) | Approaching (%) | Ideal/Target (%) |
|---------------------------------|------|-------|---------------|----------------|-----------------|------------------|
| Critical Thinking | 1.68 | 0.749 | 60.00 | 20.00 | 20.00 | 0.00 |
| Collaboration | 1.79 | 0.713 | 20.00 | 80.00 | 0.00 | 0.00 |
| Communication | 2 | 0.943 | 25.00 | 75.00 | 0.00 | 0.00 |
| Creativity & Innovation | 1.53 | 0.905 | 100.00 | 0.00 | 0.00 | 0.0 |
| Technology use as learning tool | 1.63 | 0.895 | 100.00 | 0.00 | 0.00 | 0.0 |

Discussion

This study aimed to investigate in-service teachers' competence levels of 21st-Century skills and how they apply those skills in classrooms. The study made use of TPACK-21 instrument. The study found that more than two thirds of teachers use computers more often in their school environment. This means that the frequency of ICT usage is an important indicator that the goals of installing ICT facilities in schools will be realized (DeLone & McLean, 2003). Nonetheless, simply saying that more usage will yield more benefits is insufficient (DeLone & McLean, 2003). Teachers must observe pedagogical approaches in using ICT facilities to teach in a 21st-Century environment. Therefore, despite teachers indicating that they are using various ICT installed in their school environment, it was necessary to measure their perceived levels of confidence in applying ICT into the classroom environment.

The main finding from this study was that many teachers have moderate self-reported confidence to effectively integrate classrooms and 21st-Century skills. This was evident from the fact that all TPACK elements (i.e., TK, TPK, TCK, and TPACK) had a moderate mean score. This shows that despite teachers having access to computers and using them for various activities, their levels of knowledge on integrating them to facilitate learning in the 21st Century is moderate. This was further evident from classroom observations where the mean score of all elements in TPACK domain were below 2.0.

One possible explanation for this finding could be the fact that many universities and teachers' colleges treat ICT as a discrete stand-alone subject (Hennessy, Harrison, & Wamakote, 2010) with less focus on imparting competencies that allow teachers to pedagogically apply ICT to enhance students learning while paying attention to 21st-Century skills (Hooker et al., 2011; Niess, 2005). Teaching ICT skills alone does not adequately prepare teachers to integrate ICT into the classroom (Koehler & Mishra, 2013). Therefore, there is a need to develop professional teachers' development programs in order to equip teachers with the competence and skills to enable them to use technology effectively to equip students with 21st-Century skills.

Another unanticipated finding was that teachers' self-reported confidence in CK, PK, and PCK was found to be high. This findings contradicts previous studies such as those of Mtebe, Mbwilo, and Kissaka (2016) who found that many in-service teachers had low content knowledge and pedagogical knowledge especially in science and mathematics. A possible explanation for this finding might be that there is a significant improvement in the quality of teachers' programs in teachers' colleges and universities. Another possible explanation for this finding is the fact that more than half of surveyed teachers had teaching experience of more than five years. They had gained enough competence in content, having taught the same content for some years.

It should be noted that the adopted TPACK-21 proposed by Valtonen et al. (2017) was developed for pre-service teachers. This study adopted the same instrument for in-service teachers. The main advantage of using the TPACK-21 for in-service teachers is that the majority of teachers have good teaching experience and, therefore, they can easily understand and separate TPACK elements compared to pre-service teachers. For instance, studies conducted by Valtonen et al. (2017) and Chai et al. (2011) found that pre-service teachers faced difficulties in separating out areas of TPACK from each other because of their limited teaching and study experience at that point. Therefore, this study

has demonstrated that TPACK can be appropriately applied in understanding how in-service teachers apply technology in the classroom.

Suggestion for Future Research

The current study investigated in-service teachers' competence levels of 21st-Century skills and how they apply them in the classroom environment through adapting TPACK-21 instrument. However, the study was conducted in only 20 schools located in two regions in Tanzania with a sample of 132 teachers. Despite the findings obtained from this study, the major limitation is its small sample of teachers who participated in the study. The country has more than 40,000 secondary teachers while the findings from this study are based on 132 teachers from two out of 25 regions in Tanzania. Future studies could involve more teachers across several more regions in a bid to verify the current findings.

Another limitation could be the number of teachers who participated in the classroom observation. Only two teachers from each school participated in classroom observation due to time and budgetary constraints. The small sample size did not allow the researchers to critically observe all teachers who participated in perceived self-reported confidence evaluation. Notwithstanding these limitations, the study provides a good baseline study for understanding teachers' competence and skills in integrating ICT into classrooms to facilitate the teaching of 21st-Century skills alongside content-specific subjects.

Conclusion

In recent years 21st-Century skills have attracted significant attention among researchers. The skills are thought to be necessary to work in the current knowledge economy. The recipients of current education are future employees who will support Tanzania in achieving the intended goals of becoming a middle-income country by 2025. The need to equip the teachers with skills to better facilitate students' learning in the 21st-Century skills environment is paramount. While the government has continued to equip secondary schools with computers and other facilities, it is increasingly becoming clear that merely introducing technology into the classroom is not enough to ensure technology integration, since technology alone does not lead to change (Koehler & Mishra, 2005). Based on the findings from this study, the following are recommended:

There is an urgent need for the government and its partners to develop a comprehensive framework for professional development that will assist teachers to develop knowledge and skills about ICT integration, considering the skills needed for students in the 21st Century.

The government and partners should put emphasis on equipping teachers with competencies and skills to be able to teach students in a 21st-Century environment through various teachers' professional development training.

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