Learning Experiences and Perceived Competencies to Integrate Instructional Technology among Pre-service Teacher Trainees at Busitema University

RICHARD KASIRYE

Department of Education, Faculty of Science and Education, Busitema University, P.O. Box 236, Tororo, Uganda.

Author email: richkasirye78@gmail.com

(Accepted: 21 April 2023 and published on 5 May 2023)

https://doi.org/10.58653/nche.v10i2.10

Abstract

The purpose of this study was to establish the relationship between learning experiences and perceived competencies to integrate instructional technology among pre-service teacher trainees at Busitema University. The interest to conduct this study emerged from a concern about the low uptake of technology integration in teaching and learning. The six learning experiences at the micro level of the synthesis of qualitative document (SQD) and how they related to pre-service teacher trainees' perceived competencies to integrate instructional technology were studied. A cross-sectional survey research design using quantitative data collection methods was used. A sample of 103 respondents was drawn from 196 final-year pre-service secondary teacher trainees at Busitema University using probability sampling techniques. The participants filled self-report *questionnaires, with 80 questionnaires returned and after data cleaning, 74 were fully completed. Descriptive and inferential statistics, specifically* frequency, mean, standardised deviations and the Pearson correlation coefficient, were calculated using SPSS version 20. The study results revealed that pre-service teacher trainees neither disagreed nor agreed about the learning experiences and their perceived competencies to integrate instructional technology (overall M = 3.26, SD = .57 and M = 3.38, SD = 0.69, respectively). Calculated the Pearson correlation

coefficient revealed a moderate statistically significant positive relationship between the two variables ($r = .619$, $p < .001$). The alternative hypothesis (H_a) *that there is a statistically significant relationship between* learning experiences and perceived pre-service teacher trainees' competencies to integrate instructional technology was accepted. It is recommended that teacher education institutions (TEIs) should make more opportunities available for pre-service teacher trainees to design and teach technology-supported lessons to improve their competencies in integrating technology.

Keywords: Teacher Education; Digital Instructional Technology; Higher Institutions.

Introduction

Appropriate integration of digital instructional technology has the potential to improve lesson interactivity and promote equitable access to educational resources (UNESCO, 2015). Appropriate integration of technology only happens when students have access to technology and use it for learning purposes (Davies & West, 2014). This will subsequently result in improved quality of learning, particularly when learners are actively engaged in using technology to develop high-order thinking skills during lessons. It should be noted that what matters most is not the use of advanced technologies but how suitable technology addresses the learning outcomes. This challenges TEIs' fitness to prepare teachers who can facilitate learners' use of technology during their lessons. Thus, the teaching of educational technology in TEIs has become core to preparing teachers for the effective integration of technology with the children born in the digital era (Tondeur et al., 2013). The quality of teachers' integration of technology into the classroom is predetermined by the quality and quantity of planned technology-rich activities in pre-service teacher education (Agyei & Voogt, 2011; Taylor, 2017). However, the learning activities/experiences in TEIs to prepare teachers to fit into their new role as guides to learners in the constructive use of technology in the classroom are still underexplored. Learning experiences refer to the planning of activities to acquire the desired educational learning outcomes or behavioural change among the learners (Himanshu, n.d.). In this study, learning experiences referred to planned technology-rich activities in teacher education to prepare teachers to acquire knowledge, skills and values to teach with technology. Attempts to provide an enabling infrastructure for technology integration in teaching and learning have been made by governments and TEIs through increasing access to ICT devices and the internet but teachers' technological and pedagogical skills seem not to be well addressed (Andema et al., 2013; Ndibalema, 2014; Tondeur et al., 2018). Ugandan educational institutions and government sectors have been provided with computers (Uganda Communication Commission, 2014) and connected to the National Backbone Infrastructure (NBI) to increase internet speed to facilitate improved service delivery (Lubaale, 2020). However,

the provision of computers and improved internet speed to educational institutions may not automatically lead to transformed learning if teachers are not prepared well with the required skills (Amador et al., 2015; Kafyulilo, 2011; Namae, 2020). To address the technological and pedagogical barrier to teachers' integration of technology into the classroom, TEIs teach several core courses, particularly teaching methods and educational technology, to produce suitable teachers for the 21st-century learner (Andema et al., 2013; Kisalam & Kafyulilo, 2012; Namae, 2020). Unfortunately, these courses are compartmentalised in many institutions, whereby educational technology and methods courses focus on preparing pre-service teacher trainees with technological skills and teaching methods, respectively, with limited demonstration of how each aligns with the other during lesson presentation (Kisalam & Kafyulilo, 2012). It should be noted that effective integration of instructional technology requires pre-service teacher trainees to possess the technology, pedagogy and content knowledge (Cetin-Berber & Erdem, 2015; Karaca, 2015; Mishra & Koehler, 2006; Saltan & Arslan, 2017; Valtonen et al., 2020).

Technology plays an integral role as a learning tool but there is still a slow uptake of its integration in Ugandan schools, mainly in teaching and learning (Guloba & Atwine, 2021). This concurs with the earlier report by the Ministry of Education and Sports (2017) that ICTs were underutilised in the education sector to produce human resources with skills to compete globally. Some studies attribute the low uptake of technology integration in Ugandan education to teacher preparation limiting computer access to ICT students, and the teaching of methods and educational technology as stand-alone courses (Kisalam & Kafyulilo, 2012; Landon et al., 2013; Namae, 2020). Findings by Kisalam and Kafyulilo (2012) revealed that the mathematics and science pre-service teacher trainees of Makerere University and Dar es Salaam University College of Education would not confidently teach with technology. Nuwategeka and Odama (2020) analysed school practice with geography pre-service teacher trainees from Gulu University Facility of Science Education and Humanities for three succeeding years (2016–2018) and it was revealed that pre-service teacher trainees did not integrate technology while 12% of the planned lessons did not even have a traditional instructional material designed. All these studies indicate that pre-service teacher trainees have inadequate skills to speed up the integration of instructional technology in ways that transform learning, but the learning process of teachers presumed to determine their competencies is still underexplored. This gap is likely to affect the quality of education products that may not be in a position to collaborate with the global world using technology. Therefore, this study explains the learning experiences and perceived competencies to integrate instructional technology among pre-service teacher trainees at Busitema University.

Study Objective, Questions and Hypothesis

The main objective of this study was to examine the relationship between the learning experiences and perceived competencies to integrate instructional technology among Busitema

University pre-service secondary school teacher trainees. It, therefore, sought to answer two research questions to achieve this objective:

1. What are the learning experiences in teacher education that are intended to prepare pre-service teachers at Busitema University to integrate instructional technology?
2. What are the perceived competencies required to integrate instructional technology among Busitema University pre-service secondary teachers?

This study was also guided by one alternative hypothesis: H_a: *There is a strong statistically significant relationship between* learning experiences and pre-service teacher trainees' perceived competencies required to integrate instructional technology.

Literature Review

Learning experiences to prepare pre-service teacher trainees to integrate instructional technology

Some studies have been conducted to examine effective learning experiences for preparing teachers to confidently integrate technology into their classes. For example, Tondeur et al. (2012) reviewed qualitative studies that investigated learning experiences that prepared pre-service teacher trainees to effectively integrate instructional technology. These authors agree with Voogt et al. (2012) that role modelling by teacher educators and reflection of technology-rich lessons were the most frequently used learning experience in the reviewed literature while engaging in authentic tasks and learning by instructional design were the most effective learning experience to prepare teachers for technology integration. Tondeur et al.'s (2016) and Tondeur et al.'s (2020) findings disagree with Baran et al.'s (2017), Voogt et al.'s (2012) and Tondeur et al.'s (2012) that pre-service teacher trainees in the three TEIs in Belgium received limited reflection on technology integration while pre-service teacher trainees in TEI 1 and TEI 2 did not experience role modelling of good technology integration practices.

Tondeur et al. (2016) revealed that encouragement, learning by design and feedback from teacher educators improved pre-service teacher trainees' confidence to integrate technology, while Baran et al. (2017) revealed that modelling, learning by design and active engagement in authentic tasks were significant predictors of pre-service teacher trainees' practical knowledge about technology integration. Tondeur et al. (2016) agree with Tondeur et al. (2020), Baran et al. (2017), Tondeur et al. (2012) and Voogt et al. (2012) regarding the limited learning by technology design, feedback and scaffolding authentic technology experiences provided to pre-service teacher trainees, yet these are the most effective strategies for developing teachers' competencies to integrate technology. Tondeur et al. (2020) reported *that pre-service teacher trainees needed more support in engaging in authentic activities and designing technology-rich lessons in TEI2 and TEI3*. Saltan and Arslan (2017) support the report in TEI 3 (Tondeur et al., 2016) that due to the limited authentic practice afforded to pre-service teacher trainees, they have limited skills to integrate their technological skills with pedagogy. Tondeur et al.'s (2016) and Tondeur et al.'s (2020) reports on TEI 2 also agree with Kisalam and Kafyulilo's (2012)

revelation that the teaching of educational technology as a stand-alone course did not prepare pre-service teacher trainees of Makerere University and Dar es Salaam University College of Education to confidently teach with technology.

Other studies investigated the teaching of educational technology and teaching methods at tandem to address the limitation of stand-alone teacher education courses in preparing teachers for effective integration of instructional technology (Maandera, 2018; Wetzel et al., 2014; Zimmermannet et al., 2021). The results of these studies showed improvement in pre-service teacher trainees' ability to integrate technology in their classrooms. Sailin and Mahmor (2018) revealed that integrating meaningful learning activities into teacher education made the pre-service teacher trainees confident to integrate technology into their classrooms. All these different learning experiences showed positive results with regard to preparing teachers for technology integration depending on the context in which the study was conducted, but none investigated the learning experiences stemming from pre-service teacher education at Busitema University. Therefore, question one of this study investigated the learning experiences used at Busitema University to prepare pre-service teacher trainees for effective integration of instructional technology.

Pre-service teacher trainees' competencies to integrate instructional technology

Studies investigating pre-service teacher trainees' skills to integrate instructional technology have mainly focused on measuring their technology, pedagogy and content knowledge (TPACK). The TPACK provides a theoretical framework for the preparation of pre-service teacher trainees to effectively integrate technology by emphasising the need to possess the technology, pedagogy and content knowledge (Koehler et al., 2014). Possession of one domain of knowledge, particularly technology knowledge and skills, may be a prerequisite to the use of technology but this will not guarantee effective teaching with technology (Bilici et al., 2016). Some studies have reported that pre-service teacher trainees have low mean scores in technological pedagogical knowledge (TPK) because teacher education provides limited authentic classroom teaching opportunities (Alsharief, 2018; Saltan & Arslan, 2017). Similarly, the teaching of educational technology majorly focuses on preparing teachers with general ICT skills with limited demonstration of how TPACK supports each other during teaching (Alsharief, 2018). This negatively impacts on pre-service teacher trainees' uptake of technology integration in their classrooms since they are not exposed to good practices of technology integration in their teacher education.

Other studies have revealed that although the teaching of educational technology majorly focuses on developing pre-service teacher trainees' technology skills, the majority of them have lower mean scores in the knowledge domains related to technology, which limits their teaching using technology (Kisalama & Kafyulilo, 2012; Pozas & Letzel, 2021; Jita, 2017). On the contrary, Ciptaningrum et al. (2021) revealed that the pre-service English language teachers at a university in Yogyakarta, Indonesia had good skills in technology-related domains but fair skills in the interplay of TPACK. The findings by Ciptaningrum et al. (2021) are consistent with

those of Bilici et al. (2016) and Koehler et al. (2014) that teachers need to possess technology, TPACK to effectively integrate technology in their classrooms. Some literature shows that though pre-service teacher trainees acquire some technology skills in teacher education, many of them face challenges in planning technology-driven lessons and teaching with technology during school practice (Kisalama & Kafyulilo, 2012; Mandera, 2018; Ramazanova et al., 2021; Jita, 2018; Wetzel et al., 2014). Alsharief (2018) revealed that more than 50% of the pre-service teacher trainees at the teachers college in Gulf State did not have the required skills to confidently integrate technology into their lessons. Likewise, in a study to investigate how geography pre-service teacher trainees integrated digital instructional technology during school practice in three succeeding years at Gulu University, it was found that the majority did not use technology in their lessons (Nuwategeka & Odama, 2020).

An earlier study by Nambi (2019) had, on the other hand, proven that the history pre-service teacher trainees at Makerere University were able to design learning activities (TK) and teach with some technologies (TPK) after undergoing an intervention course in the educational technology course. However, though the findings by Nambi (2019) show promising results whereas Nuwategeka and Odama (2020) reveal a worrying situation about the integration of instructional technology, these studies were limited to one teaching subject and, therefore, may not be generalised to other pre-service teacher trainees in other teaching subjects or TEIs. Thus, since none of the reviewed literature focused on the Busitema University context, question two of this study intended to address this concern by finding out the perceived competencies required to integrate instructional technology among pre-service teacher trainees in this teacher education institution.

Learning experiences and pre-service teacher trainees' competencies required to integrate instructional technology

A study conducted by Mouza et al. (2014) revealed that integrating educational technology with methods courses and field experiences had a significantly large-size effect on the development of pre-service teacher trainees' technological, pedagogical and content knowledge compared to the stand-alone approach. This is because the studying of these courses simultaneously provided the pre-service teacher trainees with an opportunity to reflect on the interrelatedness of technology and teaching methods in their field experience. However, the quality of learning opportunities for technology integration provided in field experiences depends on the availability of the technology infrastructure within cooperating institutions and the pedagogical support given by practising teachers to the pre-service teacher trainees (Jita, 2018). Banas and York (2014) studied pre-service teacher trainees' participation in authentic learning exercises and the results indicated a moderate effect on their knowledge of technology, pedagogy and content (TPACK), and a small effect on technological knowledge (TK). This implies that though scaffolding authentic technology experiences is one of the effective strategies, there could be other experiences with more predicting power in developing pre-service teacher trainees' competencies to integrate technology into teaching and learning that need to be investigated.

Alternatively, these results point to the fact that all the six learning experiences in SQD aid one another, and when the overall relationship was calculated, it revealed a strong positive *statistically significant relationship with pre-service teacher trainees' competency to integrate technology (Tondeur et al., 2018; Tondeur et al., 2020).*

Kapici and Akcay (2020) investigated the use of a laboratory application in a science teaching course and the results showed improved pre-service teacher trainees' efficiency in integrating technology through lesson planning practice into the virtual platform. However, the evaluated lesson plans using a rubric revealed that pre-service science teacher trainees developed moderate lesson plans. This implies that there are still challenges to effective teaching with technology, which may be attributed to limited exercise in designing, reflection and collaboration during lesson planning sessions. Zimmermann et al. (2021) revealed that using seminar sessions in the chemistry methods course did not have any statistical significance in the development of pre-service teacher trainees' confidence to integrate technology in the two German universities. This explains the implementation level of seminars by the pre-service teacher educators, which was below fidelity, because these educators were not part of the designing team, whereas seminars were statistically significant to the master's group because their facilitators designed the seminars and were able to interpret them into the learning context. This further implies that the implementation of learning experiences and the learning context matters a lot when deciding the learning experiences to apply in preparing teachers to successfully integrate instructional technology.

In Uganda, a study by Kisalam and Kafyulilo (2012) revealed that the teaching of educational technology as a stand-alone course developed pre-service teachers' technological knowledge and skills but did not make them sufficiently confident to teach with technology. This confirms that knowing only technology, content or pedagogy may be a prerequisite but may not automatically translate into effective integration of technology (Angeli & Valanides, 2009; Koehler & Mishra, 2009; Namae, 2020; Uerz, Volman & Kral, 2018). Maandera (2018) revealed that pre-service teacher trainees from one of the National Teachers' Colleges, after undergoing an English methods and educational technology fused course were able to integrate some mobile technologies during school practice but, mainly, their lessons were teacher-centred. Maandera (2018) concurs with Banas and York (2014) that integrating methods and educational technology with field experiences improved teachers' ability to teach with technology. However, this may not reflect the independent decision of the pre-service teacher trainee to integrate technology into a non-examinable field experience, as borne out specifically in Maandera's study. Nambi's (2019) study proposed the application of the SQD learning experiences (Tondeur et al., 2012) by teacher educators to prepare pre-service teachers to effectively integrate emerging technologies into the teaching of history. This study was based on the SQD learning experiences in teacher education and how they relate to perceived pre-service teacher trainees' competencies to effectively integrate technology in their classrooms.

Context

This study investigated pre-service secondary teacher education at Busitema University in the Faculty of Science and Education (FSE). In this faculty, pre-service teacher trainees study several methods and educational technology courses. One stand-alone computer literacy course is taught in the first semester of year one to equip pre-service teacher trainees with the technology skills needed in the subsequent stages of teacher education. In the second semester of year two, they are taught ICT in education, general methods and teaching methods in their areas of specialisation to prepare them for school practice. In the second semester of year three, pre-service teacher trainees study teaching and learning resource development in their respective areas of specialisation. These courses are expected to ground pre-service teacher trainees in the content, experience and skills required to confidently teach with technology to the digital savvy.

Methodology

Research design

This study applied a cross-sectional survey research design using quantitative data collection methods. The design was deemed suitable to collect data on all the variables from the final year pre-service teacher trainees at one moment in time (Bhattacherjee, 2012).

Study population

The study population constituted final-year pre-service secondary education teacher trainees at Busitema University in the Faculty of Science and Technology (FSE). The target population was 196 final-year pre-service secondary teacher trainees of the 2019 intake.

Sample size and sampling technique

A sample size of 103 pre-service secondary education teacher trainees was selected because these were the only respondents who reported for the face-to-face school practice briefing. A convenience non-probability sampling technique was used to consider all 103 pre-service teacher trainees for the study since the population was manageable, accessible and had the characteristics the study was looking for (Bhattacherjee, 2012).

Data collection instruments

Final-year secondary education pre-service teacher trainees self-reported on a questionnaire comprised of three sections. Section A, with three questions, related to demographic information about the respondents. Sections B, with 19 questions, and C, with 30 questions, were adopted from the SQD scale (Tondeur et al., 2012) and the TPACK-deep scale (Kabakci-Yurdakul et al., 2012). Sections B and C comprised 19 and 30 close-ended items which collected information about the learning experiences in teacher education and pre-service teachers' perceived competencies for technology integration, respectively. Each of the items in sections A and B

was measured on a 5.00-point scale (strongly disagree = 1.00, disagree = 2.00, neutral = 3.00, agree = 4.00 and strongly agree = 5.00). Cronbach's alpha reliability coefficient of the SQD and TPACK-deep items was accepted (α=.869 and .949, respectively). The questionnaire was considered reliable because the calculated reliability coefficient was above .60 (Amin, 2005). All the 19 and 30 items adopted from SQD and the TPACK-deep scale, respectively, were considered valid since the observed Pearson correlation coefficient values were significant and greater than the critical value and (r = .335** to .808** and r = 254* to .817** > critical value = 0.232, p = 0.05, respectively).

Data management and analysis

Questionnaires were distributed to a sample size of 103 final-year pre-service teacher trainees, 80 questionnaires were returned, constituting 74%, and after data cleaning, 74 questionnaires, constituting 72%, were prepared for analysis. These were entered into the computer statistical package (SPSS 20 version) for the computation of descriptive (frequency, mean and standard deviation) and inferential statistics (Pearson correlation coefficient). The overall descriptive means of different observations were interpreted as "strongly disagree" (1.00-1.8), "disagree" (1.81-2.60), "neutral" (2.61-3.40), "agree" (3.41-4.20) and "strongly agree" (4.21-5.00).

Ethical consideration

Before data collection, ethical consideration was taken care of by requiring respondents to sign in duplicate an informed consent form before answering the questionnaire. The confidentiality of respondents was also preserved by keeping their anonymity.

Results

Demographic information

The respondents included 38 male and 36 female final-year pre-service teacher trainees who specialised in the following teaching subjects as presented in Table 1.

Table 1: Frequency distribution by gender and course combination

eng/lit		What is your course combination?						Total
		mtc/eco	bio/chem	ICT/eco	geo/ICT	mtc/ICT		
What is your gender:	Male	7	7	14	4	5	1	38
	Female	24	1	7	2	2	0	36
Total		**31**	**8**	**21**	**6**	**7**	**1**	**74**

Table 1 indicates an overall small difference between males and females who participated in the study, but the female gender dominated representation in the English language and literature combination. This composition of respondents is attributed to the selection of respondents according to accessibility and the majority of English language and literature

pre-service teacher trainees being female. The respondents were asked about the different courses that prepared them to integrate technology in their future classrooms. Their answers included learning through computer literacy, ICT in education, subject and general method courses, as shown in Table 2.

Table 2: Frequency distribution of courses preparing pre-service teachers to integrate technology into their lessons

Courses preparing teachers to integrate technology	N	Frequency
ICT literacy	74	39
Subject methods in areas of specialisation	74	26
ICT in education	74	40
General methods	74	2

Table 2 indicates that most of the respondents received learning experiences on technology integration through ICT in education and ICT literacy courses while methods courses were least mentioned. ICT knowledge is a major component in the teaching of both ICT in education and ICT literacy, which gives these two courses an edge over the methods courses which majorly focus on how to teach content.

Descriptive statistics

This section presents the mean and standard deviation of the two study variables, i.e. the learning experiences and pre-service teacher trainees' perceived competencies to integrate instructional technology.

Descriptive statistics of learning experiences of the pre-service teachers

Research question one of the study sought to cater to the learning experiences in teacher education that are intended to prepare pre-service teacher trainees at Busitema University to integrate instructional technology. Descriptive statistics of learning experiences in teacher education for effective integration of instructional technology reveal an overall mean score of 3.2570 (SD =.56643). This result shows that pre-service teacher trainees at Busitema University neither agree nor disagree that they receive technology integration learning experiences. Reflection had the highest mean score of 3.6216 (SD =.82579), indicating that pre-service teacher trainees were allowed to share their experiences about the affordances and challenges of teaching with technology. The findings of the learning experiences are presented in Table 3.

Table 3: Mean and standard deviation of the six constructs of learning experiences that prepare pre-service teacher trainees to integrate instructional technology

Learning experiences	n	Mean	Std. Deviation
Role modelling	74	3.4734	.87049

Reflection	74	3.6351	.82761
Instructional design	74	2.9223	.86496
Collaboration	74	3.6081	.75144
Authentic	74	3.0315	.88135
Feedback	74	2.8916	.98726
Overall mean score	74	3.2430	.60458
Valid N (listwise)	74		

Note: Mean range = 1–1.8 strongly disagree, 1.81– 2.60 disagree, 2.61–3.40 neutral, 3.41–4.20 agree, 4.21–5, strongly agree

The results in Table 3 indicate that although the overall mean of the six constructs (M = 3.24, SD = 0.60) lies within the neutral category (mean 2.61-3.40), some constructs are within the agreed category (3.41-4.20), specifically role modelling (Mean = 3.4734, SD = .87049), collaboration (M = 3.60, SD = 0.75) and reflection (M = 3.63, SD = 0.83) on learning experiences about technology integration. The low mean scores in receiving feedback (Mean = 2.8916, SD =.98726), engaging pre-service teacher trainees in instructional design (M = 2.9223, SD = 0.86) and authentic technology (M = 3.03, SD = 0.88) negatively affected the overall mean score. The presence of role modelling, collaboration and reflection without availing pre-service teacher trainees with sufficient opportunities to design instructional materials and experience in real classroom interaction, may not enable them to meaningfully use ICT for teaching and learning. The majority of the scores in learning experiences are close to the mean score with less than plus or minus one from the mean. This implies that the respondents' reports did not widely differ from one another. Means of specific items about the learning experiences were also calculated to find out pre-service teacher trainees' interaction with each experience, and the results are presented in Table 4.

Table 4: Mean and standard deviation of each item of learning experiences that prepare pre-service teacher trainees to integrate instructional technology

Items	n	Minimum	Maximum	Mean	Std. Deviation
ROL1: I observed sufficient ICT use in an educational setting to integrate applications myself in the future.	74	1.00	5.00	3.5270	1.14942
ROL2: I saw good examples of ICT practice that inspired me to use ICT applications in the classroom myself.	74	1.00	5.00	3.6622	1.05047

ROL3: The potential of ICT use in education was demonstrated concretely.	74	1.00	5.00	3.2297	1.12928
REF1: I was given the chance to reflect on the role of ICT in education.	74	1.00	5.00	3.4459	1.14846
REF2: We discussed the challenges of integrating ICT into education.	74	1.00	5.00	4.0541	.91997
REF3: There were specific occasions for us to discuss our general attitude towards ICT in education.	74	1.00	5.00	3.4054	1.14580
ISD1: I received sufficient help in designing lessons that integrated ICT.	74	1.00	5.00	2.6486	1.12788
ISD2: We learnt how to thoroughly integrate ICT into lessons.	74	1.00	5.00	3.1892	1.09389
ISD3: We received help using ICT when developing educational materials.	74	1.00	5.00	3.0946	1.13679
ISD4: I received a great deal of help developing ICT-rich lessons and projects to use for my school practice.	74	1.00	5.00	2.7568	1.13247
COL1: I was convinced of the importance of cooperation concerning ICT use in education.	74	1.00	5.00	3.6486	1.05249
COL2: Students helped each other to use ICT in an educational context.	74	1.00	5.00	3.5811	1.02043
COL3: Experiences using ICT in education were shared.	74	1.00	5.00	3.5946	.97810
AUT1: There were enough occasions for me to test different ways of using ICT in the classroom.	74	1.00	5.00	2.6486	1.31828
AUT2: I was able to learn to use ICT in the classroom through the internship.	74	1.00	5.00	2.8784	1.26006
AUT3: I was encouraged to gain experience in using ICT in a classroom setting.	74	1.00	5.00	3.5676	.99424
FEE1: My competencies with ICT were thoroughly evaluated.	74	1.00	5.00	2.9324	1.17428

FEE2: I received sufficient feedback on how I can further develop my ICT competencies.	74	1.00	5.00	2.8784	1.05924
FEE3: My competencies in using ICT in the classroom were regularly evaluated.	74	1.00	5.00	2.8649	1.10198
Valid N (listwise)	74				

Note: Mean range = 1–1.8 strongly disagree, 1.81–2.60 disagree, 2.61–3.40 neutral, 3.41–4.20 agree, 4.21–5, strongly agree

Table 4 shows that respondents agreed on all three items about learning through collaboration that included getting convinced about the importance of cooperation concerning ICT use in education (M = 3.65, SD = 1.05), students helping one another to use ICT in an educational context (M = 3.58, SD = 1.02) and experiences using ICT in education being shared (M = 3.59, SD = 0.98). On the contrary, the respondents neither agreed nor disagreed with all the items about learning by instructional design and feedback. Learning experiences through participating in instructional design included receiving sufficient help in designing lessons that integrated ICT (M = 2.65, SD = 1.13), learning how to thoroughly integrate ICT into lessons (M = 3.19, SD = 1.09), receiving help to use ICT when developing educational materials (M = 3.09, SD = 1.14) and receiving a great deal of help developing ICT-rich lessons and projects to use for their school practice (M = 2.76, SD = 1.13). The dominance of neutral responses from pre-service teacher trainees about learning by feedback on technology integration, participation in authentic activities using technology and designing instructions is most likely to negatively affect their integration of technology even after teacher education. This presents a worrying situation regarding teacher preparation and their ability to optimise the use of technology in their teaching.

Descriptive statistics of pre-service teachers' perceived competencies for technology integration

Question two sought to address the perceived competencies to integrate instructional technology among Busitema University pre-service secondary teacher trainees. Descriptive mean and standard deviation of the overall pre-service teacher trainees' perceived competencies for technology integration reveal that the respondents neither disagree nor agree that they possess the required competencies to integrate instructional technology (M = 3.38, SD = 0.69), as presented in Table 5. This means that these pre-service teacher trainees need more support to improve their competencies if they are to integrate technology in their future classrooms.

Table 5: Mean and standard deviation of the constructs of TPACK-deep

Constructs	N	Minimum	Maximum	Mean	Std. Deviation
Design	74	1.70	5.00	3.3851	.76779
Exertion	74	1.83	4.75	3.3423	.73541
Ethics	74	1.75	5.00	3.4932	.78292
Proficiency	74	2.00	5.00	3.4378	.74589
Overall mean score	74	1.98	4.77	3.3838	.69235
Valid N (listwise)	74				

Note: Mean range = 1–1.8 strongly disagree, 1.81–2.60 disagree, 2.61–3.40 neutral, 3.41–4.20 agree, 4.21–5, strongly agree

In Table 5, although the overall mean score lies within neither disagree nor agree on category (Mean = 3.3838, SD =.69235), the respondents agreed on the need for the ethics and proficiency items in using technology (Mean= 3.4932, SD= .78292 and Mean=3.3423, SD=.7354, respectively). This implies that teacher education needs to provide more field experiences to pre-service teacher trainees, particularly in the area of designing technology-driven lessons and teaching before mandatory school practice. Mean and standard deviation per item is also presented in Table 6 to isolate competencies that either need to be improved or maintained.

Table 6: Mean and standard deviation of each item perceived pre-service teacher trainees' competencies to integrate instructional technology

Items	N	Minimum	Maximum	Mean	Std. Deviation
DES1: I can update instructional materials (paper-based, electronic, or multimedia materials etc.) based on the needs (of students, environment, duration etc.) by using technology.	74	1.00	5.00	4.0135	.94352
DES2: I can use technology to determine students' needs related to the content area in the pre-teaching process.	74	1.00	5.00	3.3378	1.03734

DES3: I can use technology to develop activities based on students' needs to enrich the teaching and learning process.	74	1.00	5.00	3.4324	1.15961
DES4: I can plan the teaching and learning process according to available technological resources.	74	1.00	5.00	3.5000	1.07589
DES5: I can conduct a needs analysis for the technologies to be used in the teaching and learning process to increase the quality of teaching.	74	1.00	5.00	3.0541	1.03225
DES6: I can optimise the duration of the lesson by using technologies (educational software, virtual labs etc.)	74	1.00	5.00	3.3108	1.10943
DES7: I can develop appropriate assessment tools by using technology.	74	1.00	5.00	3.2162	1.12591
DES8: I can combine appropriate methods, techniques and technologies by evaluating their attributes to present the content effectively.	74	1.00	5.00	3.0676	1.16256
DES9: I can use technology to appropriately design materials to meet the need for an effective teaching and learning process.	74	1.00	5.00	3.5270	1.04976
DES10: I can organise the educational environment with the appropriate use of technology.	74	1.00	5.00	3.3919	1.10810
EXE1: I can implement effective classroom management in the teaching and learning process in which technology is used.	74	1.00	5.00	3.3784	1.19017
EXE2: I can assess whether students have the appropriate content knowledge by using technology.	74	1.00	5.00	3.1892	1.15481
EXE3: I can apply instructional approaches and methods appropriate to individual differences with the help of technology.	74	1.00	5.00	3.0811	1.09490

EXE4: I can use technology for implementing educational activities such as homework, projects etc.	74	1.00	5.00	3.7027	1.03009
EXE5: I can use technology-based communication tools (blog, forum, chat, email etc.) in the teaching process.	74	1.00	5.00	2.7297	1.44580
EXE6: I can use technology for evaluating students' achievement in related content areas.	74	1.00	5.00	3.0270	1.19328
EXE7: I can be an appropriate model in following codes of ethics for the use of technology in my teaching.	74	1.00	5.00	2.8378	1.14709
EXE8: I can guide students in the process of designing technology-based products (presentations, games, films etc.).	74	1.00	5.00	3.2838	1.10442
EXE9: I can use innovative technologies (Facebook, blogs, Twitter, podcasting etc.) to support the teaching and learning process.	74	1.00	5.00	2.7838	1.49217
EXE10: I can use technology to update my knowledge and skills in the area that I will teach.	74	1.00	5.00	3.9865	.83573
EXE11: I can update my technological knowledge to improve my teaching process.	74	1.00	5.00	3.9595	.81827
EXE12: I can use technology to keep my content knowledge updated.	74	2.00	5.00	4.1486	.63424
ETH1: I can use technology in every phase of the teaching and learning process by considering copyright issues (e.g. licence).	74	1.00	5.00	2.8108	1.23506
ETH2: I can follow the teaching profession's code of ethics in an online learning environment (WebCT, Moodle etc..).	74	1.00	5.00	3.3378	1.07623

ETH3: I can guide students by leading them to valid and reliable digital resources.	74	1.00	5.00	4.0405	.86704
ETH4: I can behave ethically regarding the appropriate use of technology in educational environments.	74	1.00	5.00	3.7838	.88007
PFY1: I can troubleshoot problems that could be encountered with online educational environments (WebCT, Moodle etc.).	74	1.00	5.00	3.1486	1.14296
PFY2: When teaching or learning using technology, I can troubleshoot any issue that may arise.	74	1.00	5.00	3.0405	1.11576
PFY3: As a teacher in the future, I can be a pioneer in integrating technological innovations into my classroom.	74	1.00	5.00	3.2703	1.11401
PFY4: I can relate to other disciplines regarding the use of technology to solve problems encountered in the process of presenting content.	74	2.00	5.00	3.7838	.88007
Valid N (listwise)	74				

Note: Mean range= 1–1.8 strongly disagree, 1.81–2.60 disagree, 2.61–3.40 neutral, 3.41–4.20 agree, 4.21– 5, strongly agree

Table 6 indicates that out of the 30 items in the TPACK-deep scale, the respondents agreed on 11 items (M = 3.43, SD =, to M = 4.15, SD = 63) and neither disagreed nor agreed on 19 items (M = 2.73, *SD* = 1.45 to M = 3.39, SD = 1.11). These results also indicated that pre-service teachers had better mean scores in those items related to updating content compared to using technology to improve interactive learning with collaborative tools such as blogs, Facebook and podcasting. Items with better mean included **EXE12:** I can use technology to keep my content knowledge updated (M = 4.15, SD = 0.63), **ETH3:** I can guide students by leading them to valid and reliable digital resources (M = 4.04, SD = 0.87) and **DES1:** I can update instructional materials (paper-based, electronic, or multimedia materials etc.) based on the needs (M = 4.01, SD = 0.94). These mean scores did not have much impact on the overall report about pre-service teachers' competencies because the items answered as "neither disagree" nor "agree" outnumbered the agreed items.

Relationship between learning experiences and pre-service teacher trainees' perceived competencies required to integrate instructional technology

To establish the relationship between the two variables, an alternative hypothesis was tested using the Pearson correlation coefficient. The hypothesis (H_a) states: *There is a strong statistically significant relationship between* learning experiences and perceived pre-service teacher trainees' competencies required to integrate instructional technology. The Pearson correlation coefficient in Table 7 indicates a moderate positive statistically significant correlation between learning experiences and perceived pre-service teacher trainees' competencies to integrate instructional technology ($r = .619$, $p < .01$).

Table 7: Pearson correlation coefficient between learning experiences and perceived pre-service teachers' competencies to integrate instructional technology

		tpack-deep	Sqd	Rol	Ref	Isd	col	Aut	fee	des	Exe	eth	Pfy
Tpack-deep	r	1											
Sqd	r	.619**	1										
Rol	r	.399**	.572**	1									
Ref	r	.317**	.629**	.445**	1								
Isd	r	.508**	.806**	.275*	.336**	1							
Col	r	.384**	.593**	.231*	.359**	.385**	1						
Aut	r	.536**	.790**	.298*	.321**	.619**	.322**	1					
Fee	r	.417**	.747**	.198	.255*	.588**	.295*	.671**	1				
Des	r	.941**	.584**	.442**	.338**	.425**	.397**	.479**	.366**	1			
Exe	r	.940**	.558**	.308**	.209	.486**	.343**	.505**	.438**	.825**	1		
Eth	r	.821**	.524**	.368**	.378**	.410**	.277*	.470**	.280*	.762**	.668**	1	
Pfy	r	.776**	.522**	.296*	.282*	.497**	.299**	.443**	.323**	.637**	.655**	.630**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Note: $r < .3$ (None or very weak relationship), $.3 < r < .5$ (Weak relationship), $.5 < r < .7$ (moderate relationship), $r > .7$ (strong relationship). Moore et al. (2013)

Table 7 further shows that all the SQD constructs had a positive statistically significant relationship with perceived pre-service teacher trainees' competencies to integrate instructional technology. Participating in technology-supported instructional design and authentic classroom activities had a greater Pearson correlational coefficient value ($r = .508^{**}$, $p < .01$ and $r = .536^{**}$, $p = < .01$) compared to the other four constructs (reflection, $r = 3.17^{**}$, $p = .006$; collaboration, $r = .384^{**}$, $p = .001$; role modelling, $r = .399$, $p < .001$; and feedback, $r = .417^{**}$, $p = < .01$). These results imply that an increase in providing pre-service teacher trainees with SQD learning experiences increases in the same direction as their competencies to design, teach, ethically conduct themselves and proficiently teach with technology. However, learning by instructional design and participating in authentic activities using technology seem to have more impact and they need to be prioritised in teacher education programmes at Busitema University.

Discussion

The results on question one agree with Tondeur et al.'s (2012), Voogt et al.'s (2012) and Baran et al.'s (2017) findings that role modelling and reflection are the most frequently used learning experience whereas feedback is the least. These results are contrary to the findings of Tondeur et al. (2018) and Tondeur et al. (2020) that there is limited reflection of technology integration in all three TEIs studied in Belgium and role modelling of good technology integration practices by the teacher educators in TEI 1 and TEI 2. Learning by instructional design, scaffolding authentic integration experiences and feedback are least used in teacher education across studies, yet they are acknowledged as the most effective learning experiences for technology integration (Baran et al., 2017; Tondeur et al., 2012; Tondeur et al., 2016; Voogt et al., 2012). In question two, pre-service teacher trainees reported as neutral their perceived competencies to integrate instructional technology (mean = 3.3838, SD =.69235). These findings agree with those of Kisalam and Kafyulilo (2012), Landon et al. (2013), Namae (2020) and Nuwategeka and Odama (2020) that pre-service teacher trainees gained limited competencies from teacher education to confidently integrate technology in their future classes. It disagrees with the findings Batane and Ngwako (2017), who reported that pre-service teachers had sufficient skills but did not integrate instructional technology because it was not assessed during school practice. Therefore, there is a need to integrate technology into all components of teacher education and to emphasise learner-centred teaching with technology for teachers to replicate interactive teaching with technology. The tested alternative hypothesis found a moderate positive statistically significant relationship between learning experiences according to SQD and pre-service teacher trainees' perceived competencies to integrate instructional technology. This disagrees with the findings of *Tondeur et al. (2018) and Tondeur et al. (2020) that there is a strong positive statistically significant relationship between SQD learning experiences and teachers' competencies to integrate technology. This moderate strength of the relationship between the two variables can be explained by the limited responses to learning experiences and pre-service teacher trainees' perceptions about integrating technology. Specific learning experiences had better correlation scores, specifically learning by instructional design and scaffolding authentic instructional experiences,*

compared to other learning experiences. These learning experiences have better-predicting power regarding developing teachers' competencies to teach with technology (Baran et al., 2017; Tondeur et al., 2012, 2016, 2020; Voogt et al., 2012). Banas and York (2014) agreed with the current study findings that authentic technology experiences moderately impacted the development of pre-service teacher trainees to integrate technology. The study findings imply that increasing learning by instructional design and authentic technology experiences improves pre-service teacher trainees' ability to effectively teach with technology and should be prioritised in teacher education.

Conclusion

The findings for question one indicated that pre-service teacher trainees at Busitema University received an overall limited learning experience in technology integration with a mean score close to 3.00, which is a neutral response. Pre-service teacher trainees agreed that they received reflection, collaboration and role modelling of technology experiences but reported neutral to feedback about technology integration, learning by instructional design and authentic technology experiences. Therefore, there is a need to give priority to learning experiences reported as neutral during professional development to improve the overall scores of learning experiences for technology integration. The results for question two indicated that pre-service teacher trainees perceived an overall neutral response regarding their competencies to integrate technology. They agreed that they had better competencies in adhering to the ethics of using ICT and could easily solve technical challenges when teaching with technology while their design and exertion were still wanting. The agreed mean scores of particular learning experiences and competencies are slightly above 3.00, which implies that a lot still needs to be done to prepare teachers to confidently integrate technology. The results of the tested hypothesis found a moderate positive statistically significant correlation between the SQD learning experiences and pre-service teacher trainees' competencies for effective integration of technology. Therefore, teacher education needs to increase opportunities for pre-service teacher trainees to engage in authentic activities involving designing lessons and learning materials using ICT.

Recommendations

Based on the findings in question one, teacher educators at Busitema University should shift from traditional teaching methods to constructive methods that actively engage the pre-service teacher trainees in using technology in authentic educational settings. Collaboration among pre-service teacher trainees or TEIs, role modelling and scaffolding of authentic technology integration experiences should be strengthened to supplement the hands-on activities. For question two, the learning experiences in teacher education at Busitema University should spell out the competencies required of a pre-service teacher trainee to effectively integrate technology. These competencies should be interwoven into the teaching of all teacher education courses for the pre-service teacher trainee to appreciate the affordances of technology and

learn how to overcome the challenges that come with them. Pre-service teacher trainees should also be attached to operating schools with ICTs to closely relate theory with field experience before going to school practice. This will help teacher trainees to gain sufficient confidence to meaningfully use technology in their lessons.

Limitations and Future Research

This study involved a small sample size of pre-service teacher trainees who were conveniently selected from one university and, therefore, these findings may not be generalisable to other TEIs apart from the context from which the sample was drawn. The study also relied on the self-reported survey, which may have limited the respondents from providing in-depth information as the research tool was closed-ended and the responses were pre-determined by the researcher. Therefore, further research involving in-service teachers or a comparative study between universities or in-service and pre-service teacher trainees will provide a more comprehensive image of the nature of teaching education and how it impacts teachers' confidence in connection with integrating technology.

References

Agyei, D., & Voogt, J. (2011). Exploring the potential of the will, skill, tool model in Ghana: Predicting prospective and practising teachers' use of technology. *Computer & Education*, 56, 91–100.

Alsharief, T. (2018). Pre-service teachers' perceptions of the barriers to ICT integration in their future instructional practice in a Gulf State (PhD thesis, University of Liverpool).

Amador, J., & Kimmons, R., Miller, B., Desjardins, C., & Hall, C. (2015). *Preparing preservice teachers to become self-reflective of their technology integration practices*. 10.4018/978-1-4666-8403-4.ch004.

Andema, S., Kendrick, M., & Norton, B. (2013). Digital literacy in Ugandan teacher education: Insights from a case study. *Reading & Writing – Journal of the Reading Association of South Africa*, *4*(1), 1–8.

Banas, J. R., & York, C. S. (2014). Authentic learning exercises as a means to influence pre-service teachers' technology integration self-efficacy and intentions to integrate technology. *Australasian Journal of Educational Technology*, *30*, 728–746.

Baran, E., Bilici, S.C., Sari, A.A., & Tondeur, J. (2017). Investigating the impact of teacher education strategies on pre-service teachers' TPACK. *British Journal of Educational Technology*, *00*(00),1–14. doi: 10.1111/bjet.12565

Batane, T., & Ngwako, A. (2017). Technology use by pre-service teachers during teaching practice: Are new teachers embracing technology right away in their first teaching experience? *Australasian Journal of Educational Technology*, *33*(1), 48–61.

Bhattacherjee, A. (2012). *Social Science Research: Principles, Methods, and Practices*.

Cetin-Berber, D., & Erdem, A.R. (2015). An investigation of Turkish pre-service teachers' technological, pedagogical and content knowledge. *Computers*, *4*, **234–250**. doi. 10.3390/computers4030234.

Ciptaningrum, D., Putro, N., Sari, N., & Hasanuddin, N. (2021). Evaluation of learning process: Knowledge of ICT integration among pre-service English language teachers. *REID (Research and Evaluation in Education), 7*(1), 46–56. doi: https://doi.org/10.21831/reid.v7i1.30521

Davis, R.S., & West, R.E. (2014). Technology integration in schools. In Spector. J.M., et al. (eds.), *Handbook of research on educational communications and technology*. doi: 10.1007/978-1-4614-3185-5_68,

Guloba, M.M., & Atwine, B. (2021). Digital technologies uptake is still low in Ugandan secondary and tertiary institutions. Towards sustainable development: Policy brief. *Economic Policy Research Centre, 142, 1–4.*

Himanshu, M. (n.d.). *Short note on concept of learning experiences*. https://www.preservearticles.com/education/short-note-on-concept-of-learning-experiences/27767

Jita, T. (2018). Exploring pre-service teachers' opportunities to learn to teach science with ICTs during teaching practice. *Journal of Education (University of KwaZulu-Natal),* (71), 73-90.

Jita, T. (2017). Pre-service teachers' competencies to teach science through information communication technologies in South Africa. *Perspectives in Education, 34*(3),15 –26. ISSN 0258-2236

Kabakci-Yurdakul, I., Odabasi, H. F., Kilicer, K., Coklar, A.N., Birinci, G., & Kurt, A. A. (2012). The development, validity and reliability of TPACK-deep: A technological pedagogical content knowledge scale. *Computers & Education* 58(3):964–77. doi: 10.1016/j.compedu.2011.10.012.

Kapici, H. O., & Akcay, H. (2020). Improving student teachers' TPACK self-efficacy through lesson planning practice in the Virtual Platform. *Educational Studies,* 1–23. doi: 10.1080/03055698.2020.1835610

Karaca, F. (2015). An investigation of pre-service teachers' technological pedagogical content knowledge based on a variety of characteristics. *International Journal of Higher Education, 4*(4),128–36. doi: 10.5430/ijhe.v4n4p128.

Kisalam, R., & Kafyulilo, A.C. (2012). Developing pre-service teachers' technology integration competencies in science and mathematics teaching: Experiences from Tanzania and Uganda. *Makerere Journal of Higher Education 3*(2), 99–113. doi: 10.4314/majohe.v3i2.9.

Koehler, M. J., Mishra, P., Kereluik, K., Shin, T. S., & Graham, C. R. (2014). Technological pedagogical content knowledge framework. In Spector, J. M., et al. (eds.), *Handbook of research on educational communications and technology*. New York: Springer Science and Business Media. Doi: 10.1007/978-1-4614-3185-5

Landon, S.N., Hite, J. S., Hite, J. S., & Mugimu, B. C. (2013). Technology and education: ICT in Ugandan secondary schools. *Education and Information Technologies, 18*(3), 515–530.

Lubaale, G. (2020). Information and communication technology in higher education of Uganda and education implications: A case of Kyambogo University. *Journal of Education and Training Studies, 8*(6), 29–41. doi: 10.11114/jets.

Maandera, B. l. (2018). *Exploring technology integration by English Language teacher trainees in Uganda* (Unpublished doctoral thesis, University of Manchester).

Ministry of Education and Sports. (2017). *Education and sports sector strategic plan, 2017/18 – 2019/20.* http://npa.go.ug/wp-content/uploads/2018/11/EDUCATION-AND-SPORTS-SECTOR-STRATEGIC-PLAN.pdf

Mishra, P., & Koehler, M.J. (2006). *Technological pedagogical content knowledge: A framework for teacher knowledge, 108*(6),1017–54.

Mouza, C., Karchmer-Klein, R., Nandakumar, R., Ozden, S. Y., & Hu, L. (2014). Investigating the impact of an integrated approach to the development of pre-service teachers' technological pedagogical content knowledge (TPACK). *Computers & Education*, *71*, 206–221.

Namae, S.M. (2020). *Status and use of information communication technology in Uganda secondary schools: Teachers' competencies, challenges, dispositions, and perceptions* (Unpublished doctoral thesis, University of British Columbia, Vancouver).

Nambi, G. (2019). *Cultivating history pre-service teachers' knowledge of fostering futures – Thinking among students through use of emerging technologies* (Issue October) [Makerere University]. http://makir.mak.ac.ug/bitstream/handle/10570/7962/Nambi - CEES-Masters. pdf?sequence=3&isAllowed=y

Ndibalema, P. (2014). Teachers' attitudes towards the use of information communication technology (ICT) as a pedagogical tool in secondary schools in Tanzania: The case of Kondoa district. *International Journal of Education and Research, 2*(4), 1–16.

Nuwategeka, E., & Odama, S. (2020). Training of geography teachers for secondary schools at university in Uganda: An analysis of Gulu University teacher trainees' teaching practice. *Advances in Social Sciences Research Journal* 7 (6), **271–279**. https://doi.org/10.14738/assrj.76.8194

Pozas, M., & Letzel, V. (2021). "Do you think you have what it takes?" – Exploring predictors of pre-service teachers' prospective ICT use. *Technology, knowledge and learning*. Springer. https://doi.org/10.1007/s10758-021-09551-0

Ramazanova, D., Togaibayeva, A., Suguraliyeva, A., Zhubatyrova, B., Biissova, G., & Anar, B. (2021). Current issues evaluation of pre-service teachers' views on their ability to use Instructional Technologies. Formation of an educational technology culture for future teachers in the university. *World Journal on Educational Technology, 13*(3), 428–36.

Sailin, S. N., & Mahmor, N. A., (2018). Improving student teachers' digital pedagogy through meaningful learning activities. *Malaysian Journal of Learning and Instruction, 15* (2),143 –173.

Saltan, F., & Arslan, K. (2017). A comparison of in-service and pre-service teachers' technological pedagogical content knowledge self-confidence. *Cogent Education*, *4*(1),1311501. doi: 10.1080/2331186X.2017.1311501

Taylor, R. L. (2017). Preparing teachers to embrace educational technology (Doctoral dissertation, Alliant International University, San Diego, California).

Tondeur, J., Aesaert, K., Prestridge, S., & Consuegra, E. (2018). A multilevel analysis of what matters in the training of pre-service teachers' ICT competencies, *Computers & Education*, 122(1), 32-44. doi: 10.1016/j.compedu.2018.03.002.

Tondeur, J., Pareja Roblin N., van Braak, J., Fisser, P., & Voogt, J. (2013). Technological pedagogical content knowledge in teacher education: In search of a new curriculum. *Educational Studies*, *39*, 239–243

Tondeur, J., Pareja Roblin, N., van Braak, J., & Voogt, J. (2016). Preparing beginning teachers for technology integration in education: Ready for take-off? *Technology, Pedagogy and Education,*1–21. doi: 10.1080/1475939X.2016.1193556.

Tondeur, J., Scherer, R., Siddiz, F., & Baran, E. (2020). Enhancing pre-service teachers' technological pedagogical content knowledge (TPACK): A mixed-method study. *Educational Technology Research Development, 68*(1), 319 – 342

Tondeur, J., van Braak, J., Sang, G., Voogt, J., Petra Fisser, P., & Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education, 59*(1),134–44. doi: 10.1016/j.compedu.2011.10.009.

Uerz, D., Volman, M., & Kral, M. (2018). Teacher educators' competences in fostering student teachers' proficiency in teaching and learning with technology: An overview of relevant research literature. *Teaching and Teacher Education,* 70, 12–23. doi: 10.1016/j.tate.2017.11.005.

Uganda Communication Commission. (2014). *Integration of ICT into education in Uganda*. Kampala, Uganda.

UNESCO. (2015). *Qingdao Declaration: International Conference on ICT and Post-2015*

Education; Seize Digital Opportunities, Lead Education Transformation. Qingdao, the People's Republic of China.

Valtonen, T., Leppänen, U., Hyypiä, M., Sointu, E., Smits, A., & Tondeur, J. (2020). Fresh perspectives on TPACK: Pre-service teachers' own appraisal of their challenging and confident TPACK areas. *Education and Information Technologies*, *25*, 2823–2842. https://doi.org/10.1007/s10639-019-10092-4

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2012). *Technological pedagogical content knowledge: A review of the literature,* 1–13. doi: 10.1111/j.1365-2729.2012.00487.x.

Wetzel, K., Buss, R. R., Foulger, T. S., & Lindsey, L. (2014). Infusing educational technology in teaching methods courses: Successes and dilemmas. *Journal of Digital Learning in Teacher Education*, *30*(3), 89–103. doi:10.1080/21532974.2014.891877

Zimmermann, F., Melle, I., & Huwer, J. (2021). Developing prospective chemistry teachers'

TPACK-A comparison between students of two different universities and expertise levels regarding their TPACK self-efficacy, attitude, and lesson planning competence. *Journal of Chemical Education*, *98*(6), 1863–1874. doi:10.1021/acs.jchemed.0c01296.