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Developing teachers' digital competence: approaches for Art and Design teacher educators in Uganda

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ABSTRACT

The aim of this study is to establish an in-depth understanding of how art and design teacher educators (TEs) develop digital competences in teacher training institutions in Uganda. The study utilizes perspectives from Jan van Dijk's resources and appropriation theory as a conceptual lens to understand how art and design TEs develop digital competence for teaching in Uganda. Based on a case study design, semi-structured interviews and non-participant observations were employed to gather qualitative data from twenty-four informants who were purposively selected. The informants included ten TEs, ten teacher trainees and four administrators from two teacher training institutions in central Uganda. The findings indicate that art and design TEs develop digital competence through formal approaches, such as *continuous professional development* and *pre-service training,* and informal approaches, such as *collaboration, self-teaching and repetition*. The empirical findings contribute to the existing body of knowledge and provide an understanding of the development of teachers' digital competence in Uganda.

Keywords: *Teachers' Digital Competence, Teacher Education, Art and Design Education, Uganda*

INTRODUCTION

The world has witnessed a rapid digitalisation of education in the past decade (European Union, 2013; Farrell et al. 2007). In particular, there has been growing interest in the integration of digital technology in education. Such interest has often been premised on the assumption that digital technologies have great potential to improve the quality of education (Toit, 2015; UNESCO, 2009; Trucano, 2005). In Uganda, this interest has resulted in investments made by the government, its development partners and private individuals to increase the availability of digital technologies in schools and to support technology-driven pedagogy in teacher education programmes (Uganda, 2014; Mutonyi & Norton, 2007; Farrell, 2007; Uganda MoES, 2006). In the context of this global technological development, traditional teaching activities are coming under intense pressure from the rapid development of digital technologies (Säljö, 2010; Mishra & Koehler, 2006). In the context of this study, art and design education, which is concerned with the process of teaching and learning how to create and produce work in the visual and performing arts (Arts Education Partnership Working Group, 1993), has been transformed at all levels by digital technologies. Davis (2002) notes that art and design-making, whether in the professional world or in schools, is often aided by computer programs that allow artists to electronically create and manipulate images. This new possibility raises aesthetic questions about the nature of art and therefore requires art and design education programmes to develop teachers' digital competence (TDC) so they can apply technology in their teaching.

Digital competence requires a set of operational, informational and strategic skills (van Dijk, 2005). In recent years, studies (Hasniza et al., 2013; Chai et al., 2013) have reported that the effective use of digital technology in teaching requires teachers to develop knowledge of technology (digital hardware and software), pedagogy (methods of teaching), content (actual subject matter to be taught), and the intersection of these. Consequently, in this study we argue that teachers´digital competence (TDC) can best be developed when teachers understand and apply knowledge generated from the relationships between technology, pedagogy and content in their practice. This compound knowledge is also known as technological, pedagogical and content knowledge (TPACK), a theoretical approach which was developed by Mishra & Koehler (2006) and forms the concept of TDC in this study.

Developing TDC is a priority for many teacher education programmes worldwide. In Europe, for instance, this is widely reflected in government education reform, polices and frameworks (Ferrari, 2012; European Commission, 2007; OECD, 2003) and a number of scientific studies (Gudmundsdottir & Vasbø, 2017; Erstad, 2015; Johannesen, Øgrim & Giæver, 2014; van Dijk, 2012). In Africa, Makoe (2012) notes that teachers must be trained in how to use new digital technologies and integrate them into their own practice, while Gudmundsdottir (2010) calls for a policy focus on addressing the severe digital inequalities within and outside of the school environment to increase digital competence. According to Gudmundsdottir (2010), the aim is to ensure that technology is perceived not as an add-on but as an integral part of the curriculum. Similarly, the Uganda National Information, Communications and Technology (ICT) Policy for education (Uganda, MoES, 2006) sets a framework of curriculum and teacher training that facilitates and guides the development and integration of digital technology in all aspects of the education sector. The policy recognises the crucial role of teachers in implementing any education reform initiative and accordingly points out that focus must be put on developing TDC in line with the curriculum that teachers are expected to follow to ensure that the best use is made of digital tools.

However, although Uganda, like other nations, has been recognised for its efforts to integrate digital technology in teacher education (UNESCO, 2015; 2014), the use is still at the embryonic stage due to a lack of effective policies, basic infrastructure (electricity, devices, Internet), financial resources and teacher capacity (Ndiwalana & Tusubira, 2012). For almost ten years, studies in Uganda continue to reveal a gap between the technology available in classrooms and teachers' abilities to use this technology in teacher education programmes (Nakintu & Neema-Abooki, 2015; Andema, Kendrick, & Norton, 2013; Luwangula, 2011; Hennessy et al., 2010; Andema, 2009).The above studies report a limited use of digital technology in Uganda's teacher education programmes. Moroever, it has also been noted that the majority of teachers cannot even use the available digital resources as instructional tools due to inadequate digital skills (Bagarukayo, 2018; Wamakote, 2010; Nakabugo et al., 2008). With specific reference to the field of art and design education in Uganda, there are hardly any documented studies on how teacher educators (TEs) develop digital competence. It is therefore important for us to investigate how art and design TEs develop digital competence (TDC) within teacher training institutions (TTIs) in Uganda given the prevailing challenges as earlier noted. In the next section, we present the existing debates on the development of TDC in teacher education.

Developing teachers' digital competence (TDC) in teacher education

Teacher education today must consider the pedagogical use of digital technology to prepare student teachers for their future practice (Krumsvik, 2014:273). Moreover,Judge and O'Bannon (2008) note that previous studies have underlined the problem of teachers' lack of digital competence, which means that they cannot act as competent mentors for their students.

Similarly, Aduwa-Ogiegbaen (2014) indicates that studies in Africa have revealed that the majority of teachers lack essential technological knowledge and need extensive professional development to apply technology in teaching. In addition, Kirschner and Davis (2003) suggest that teacher education should focus on developing TDC so new teachers do not have to spend a great deal of time and energy enhancing their digital competence when starting their careers. In Uganda, teachers often fail to relate what they have learnt about digital technologies to their own practice (Uganda MoES, 2008).

Developing TDC does not solely involve educating teachers in understanding and using various emerging technologies that are relevant to their professional practice (Lund et al., 2014; van Dijk, 2005). Lund and his colleagues submit that it involves making teachers capable of using digital technology and learning resources in productive ways to transform their knowledge into discipline-specific didactics, classroom management techniques and assessments of how students productively use available digital resources. Van Dijk (2005) concurs and adds that people should be constantly learning digital skills through practice, which he suggests as, "the breeding ground of all digital skills" (p.90). He argues that the idea that digital skills are learned or should be learned in computer classes is a fallacy, claiming that these are not the most important ways of learning computer skills but rather provide a solid basis for digital skill development.

Røkenes and Krumsvik (2014) note that, in technology training situations, two or more student teachers collaborate by engaging in a common task in which each individual depends on and is accountable to each other to maximise their own and other's learning. So and Kim (2009) and Koehler et al. (2007) add that collaborative approaches help teachers make intimate connections between technology, pedagogy and content. As active and constructive processes (Laurillard, 2009; Smith & MacGregory, 1992), collaborative practices in teacher education enable teachers to easily develop new knowledge and competences, which later are used to create new meaning. In countries like Uganda where teachers still report limited access to digital technologies (Andema, Kendrick, & Norton, 2013), collaboration remains a suitable approach to developing TDC, as teachers can collaborate and share the few digital resources available.

In addition, research indicates that teachers' experiences and practices with technology influence the successful development of TDC (Benali et al., 2018; U.S National Center for Education Statistics, 2000; Lau & Sim, 2008; Russell et al., 2003, Kaasbøll, 2014). Kaasbøll notes that when technology users are properly trained in the pedagogical use of digital technology and continue to practice through repetition, the skill becomes automated and can enhance digital competences. Similarly, the U.S National Center for Education Statistics (2000) reported that teachers with less teaching experience were more likely to integrate computers with their teaching than those with more experience. However, Lau and Sim (2008) found that the latter use computer technology in the classroom more than the teachers with less experience. Although findings from the two studies are contradictory, the primary reason could be that, in both cases the teachers' experience and continuous practice with computer technology enhanced their digital competences for pedagogical purposes. In Uganda, teacher education programmes are frequently criticised for their failure to provide teachers with the necessary hands-on training to utilise digital technologies pedagogically (Uganda, 2014; Mutonyi & Norton, 2007).

Furthermore, modelling has traditionally been used in teacher education around the world to develop digital competence (Dorgu, 2015). While the approach is criticised for hindering creativity, as the students only mimic their teacher (Dorgu, 2015), it helps students develop interest and motivation through their active participation in the teaching and learning process (van Dijk, 2005). This might be a challenge in Uganda, where there are more students than teaching resources like computers and related instructional materials like textbooks (Nakabugo, Opolot-Okurut, Ssebbunga, Maani, & Byamugisha, 2008).

Equally important, traditional teaching curricula and training programmes can enhance digital skills and help develop TDC. In particular, digital technologies enable interactions between educators and students, provide multimedia interfaces that facilitate learning and increase flexibility in the delivery of training (UN, 2018). Though this is important, many developing countries like Uganda still demand the development and integration of subject-based digital curricula into teacher education programmes (Uganda, 2014). In their study, Ndawula et al. (2013) indicate that some teachers had no ICT training component in their professional teacher education programmes. Instead, ICT as a separate subject was recently introduced to secondary education and is offered at some TTIs.

Overall, the body of knowledge presented above reflects a few approaches to developing TDC in teacher education. However, there is limited evidence on the development of TDC in teacher education in Uganda and in the field of art and design in particular. This knowledge gap, in addition to inadequate access to digital technologies, calls for further studies to establish how TDC is developed in Uganda's teacher education programmes. Thus, the following objective and research question guide this study:

Objective of the Study

To establish an in-depth understanding of how art and design teacher educators (TEs) develop digital competences in teacher training institutions in Uganda.

Research Question

How do art and design TEs develop digital competence for teaching in TTIs in Uganda?

THEORETICAL FRAMEWORK

In this study, we draw on perspectives from van Dijk (2005) resources and appropriation theory, which has previously been used to describe how multi-faceted theorizing the digital divide is (van Dijk, 2017). The core idea of the theory is the particular relationships between four circumstances (categorical inequalities, resource distribution, access to ICTs and participation in society) in a process of creating digital inequality when using digital technologies. Van Dijk (2005, p.15) summarised the relationship in the following way:

1. Categorical inequalities (personal and positional) in society produce an unequal distribution of resources. The *personal* categorical inequalities are age, gender, race/ethnicity, intelligence, personality and health, whereas the *positional* categorical inequalities include labour position, education, household and nation.
2. Unequal distributions of resources (temporal, material, mental, social and cultural) cause unequal access to digital technologies.
3. Unequal access to digital technologies also depends on the characteristics of these technologies and brings about unequal participation.
4. Unequal participation reinforces categorical inequalities and unequal distributions of resources.

In this study, we focus on "access" to digital technologies as the component of the theory that can help us understand how art and design TEs develop TDC for teaching in Uganda's TTIs. Van Dijk (2005, p.21) addresses four kinds of "access" to digital technologies as shown in Figure 1, namely:

motivational access (motivation to use digital technology), material or physical access (possession of computers and internet connections or permission to use them and their contents), skills access (possession of digital skills: operational, informational and strategic skills) and usage access (number and diversity of applications, usage time).

Subsequently, these stages are recursive, as they return, wholly or partly, with new technology or innovation.

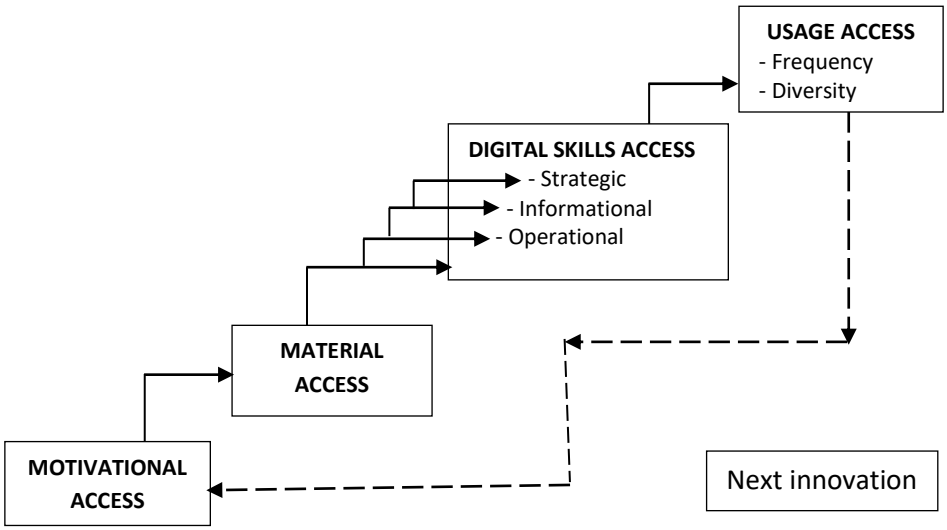

Figure 1*: Model of successive kinds of access to digital technologies*
Source: van Dijk, 2005, p.22

According to van Dijk (2005), to appropriate a new technology, one must first be motivated to use it. Motivational access relates to attitude and the intention to accept and learn the requisite skills and uses of new digital technologies. Motivation is often affected by social, cultural, mental or psychological factors, including lack of interest, time, money, skills and self-confidence (van Dijk, 2017). Van Dijk argues that, when sufficient motivation is developed, one should be able to develop physical access.

Van Dijk (2005) describes material or physical access as possession of or access to hardware, operational software or other digital technologies as well as permission to use them (for instance, user names, passwords and membership). Physical access can occur at work, school or public places such as libraries and internet cafes, as well as at home or in transit on a laptop, PDA or mobile phone. Physical access to digital technology is mostly influenced by one's income, among other factors like level of education, age and gender. According to van Dijk (2005), having material or physical access is a necessary condition for the development of the requisite digital skills to use technology.

Van Dijk (2005, p.73) defines *digital skills* as a collection of skills needed to operate digital technologies like computers and their networks: to search for and use information for one's own purposes. He divides the concept into three types of skills: operational skills (skills used to operate hardware and software), information skills (skills needed to search, select, process and evaluate information from computer and network sources) and strategic skills (capacities to use digital sources to achieve specific and general goals). Further, he acknowledges that the

development of digital skills can occur through formal and informal approaches. Formal approaches in this context refer to organised and structured training systems with learning objectives in school or the workplace. On the other hand, informal approaches denote developing digital skills from daily experiences and interest. Consequently, the development of digital skills is often a matter of learning through practice, by trial and error, and with help from peers (van Dijk, 2005).

Furthermore, van Dijk (2005) argues that, even given sufficient motivation, physical access and digital skills are necessary but not sufficient conditions for actual use. A user must also have the need, occasion, obligation, and time to actually use technology. Usage can either support or impede access and is determined by properties of digital technology related to hardware, software and content. The technological properties of digital technology related to hardware and software are complexity, expense, network effects, multiple facets and multiple functions, while those related to content are approachability, usability, information overload, culture and language, relevant information and conditional access (van Dijk, 2005, p.96-105). As a dependent factor, van Dijk (2005) argues that usage can be measured in at least four ways: usage time and frequency, number and diversity of usage applications and more or less active or creative use.

To sum up, van Dijk's emphasis on digital skills development through formal and informal approaches is useful to this study as it allows us to analyse how art and design TEs develop TDC. In particular, knowledge informed by van Dijk's scientific perspectives on the kinds of digital skills access (operational, informational and strategic) can illuminate how different types of digital skills and forms of learning play a role in developing TDC.

METHODS

This study explores how art and design TEs from two TTIs, Kabwohe and Sheema (pseudonyms) in central Uganda develop TDC for teaching. A case study design (Yin, 2014) is preferred in addressing the research question because it allows detailed data collection even within small samples, which would not be possible with other types of research designs. The case study approach enables in-depth description of a case or multiple cases under investigation (Creswell, 2007) and provides rich and in-depth data to gain deep understanding (Denzin & Lincoln, 2005) into the phenomena under investigation.

Isaac and Micheal (1995) posit that research involving small sample sizes is justifiable when it involves an in-depth case study that provides a great amount of qualitative data from each informant, as is the case in this study. Purposive sampling was used as it enables choosing research informants who will yield insights and in-depth understanding of the research questions rather than empirical generalisations (Patton, 2002; Miles & Huberman, 1994). Therefore, we purposively selected the total sample of twenty-four informants to include ten TEs, ten teacher trainees (TTs) and four administrators (ADs) from two TTIs in Uganda. Due to a small number of available Art and Design TEs at Sheema, three TEs were included. The rest of the informants (TTs and ADs) were equally selected from both institutions. Although this study focuses on TEs, it was necessary to include opinions from TTs and ADs because they are key stakeholders in the development of TDC. In the Ugandan context, TEs may include lecturers, tutors, instructors, technicians and studio or laboratory attendants at different levels of teacher education. TTs are included because they are studying to become teachers and directly observe TEs´ classroom instruction and digital practices. In addition, ADs are responsible for overseeing the daily teaching or managerial operations in the TTIs and thereby have knowledge on the conditions necessary for developing TDC.

Semi-structured interviews and observations were used as methods to explore the views, experiences, beliefs and motivations of individual informants in relation to the research question, which provided reliable and comparable data (Gill et al., 2008; Hardman, 2005; Barriball & White, 1994). Data were collected between March 2017 and July 2018. During this period, interviews were conducted with the individual informants at their convenience lasting for an average of one hour. In addition, two TEs from each institution were observed engaging in classroom practice to analyse the TEs' behaviour and interaction with digital tools in the classrooms. This was done to identify discrepancies between data sources or events that informants might be reluctant to share as well as to observe situations informants described during interviews. The interviews were audio recorded and then transcribed into text along with the other data obtained from observations (such as field notes and comments made during observation).

Miles and Huberman(1994) posit that valid analysis is immensely aided by data displays that are focused enough to permit viewing a full data set in one location and are systematically arranged around the research question. In this study, the data from the transcripts was organised by specific questions in the interview guide in table charts created in Microsoft Word. This made it easier to identify words and phrases that frequently emerged from the responses to each question and were related to the main research question. These words and phrases were colour-coded, and similar codes were later clustered to create categories.

Marshall and Rossman (1995) observe that identifying salient themes, recurring ideas or language and patterns of belief that link people and settings together is the most intellectually challenging phase of analysis and can integrate the entire endeavour. Indeed, the categories in this study identified were collapsed into two main over-arching themes emerging from van Dijk (2005), namely those of formal and informal approaches to learning.

Although qualitative methods like interviews and observations can yield rich and informative data, they can be criticised for their subjectivity (Wood & Griffiths, 2007). Such subjectivity may compromise the validity and reliability of the data being collected. For this reason, triangulation was employed by assessing and comparing data collected through interviews and observations of the informants. Secondly, during interviews and observations, attention was taken not to influence the informant's opinions by allowing them to freely express their views and perform classroom activities respectively. Thirdly, to ensure quality of data, the data collection instrument (interview questions) was piloted with a group of experts in the area of this research who provided feedback on the clarity of the tool with reference to the research question.

Ethical issues were addressed by protecting the identity of the institutions and informants by use of pseudonyms and codes, respectively. To further increase the validity of the data, immediate feedback was received from each informant after reading through and approving his or her transcribed interview or observation reports.

FINDINGS

The main question in this study was: *How do art and design TEs develop digital competence for teaching in TTIs in Uganda?* The answer to this question is organised by the two over-arching themes of 'formal' and 'informal' approaches to learning derived from van Dijk (2005). Each of the response categories that emerged from the data, were linked to the research question after the coding process. Furthermore, these categories were associated with a relevant theme in the ensuing sub-sections.

Formal Approaches

Continuous professional development (CPD): All TEs reported having been engaged in CPD activities, including workshops and seminars, conferences, presentations, orientation, technical support, online training, mentoring, peer coaching and research development projects. Several TEs recounted that although they had gained some digital competences from CPD activities, such knowledge remains theoretical and is not specific to their teaching subjects; application of such knowledge in real classroom practice is difficult due to inadequate digital infrastructure. On this point, one of the TEs stated:

> *We have been trained through our internal CPDs, informal workshops and seminars. We have learnt how to do filming and video production, and how to construct LMS [Learning Management System] and upload e-content, making multimedia content, podcast and using games in class. The latest was how to make cartoons (animation). Actually, UNESCO has been funding the training. I am limited to use the skills because we do not have enough digital resources… (TE#3)*

The above statements relate to the situation observed in classrooms at both institutions in which some TEs used traditional teaching methods like "chalk and talk" and lecturing to deliver content in digital classrooms. In such situations, lesson delivery was more theoretical and trainees were encouraged to visit computer laboratories to explore and practice on their own after the lesson. At one of the TTIs, an educator was observed grouping 150 trainees into teams of fifteen to work together on the assignment, thus dividing the ten computers in the computer lab between the groups.

All ADs agreed that training in the use of digital technologies is sometimes conducted to ensure TEs develop or upgrade their digital competences. One AD added that such training mainly provided general knowledge on the use of digital tools rather than digital competences required by art and design teachers:

> *…through our online Learning Management System, a platform we have designed for professional development, our teachers have acquired varied knowledge concerning use of ICT in teaching. However, we have no specific courses or training for art and design teachers…. (AD#1)*

Pre-service training: Several of the TEs interviewed acknowledged having taken one or more ICT courses as a component of their professional academic programmes during pre-service training. However, most TEs reported that these courses did not help them develop specific digital competencies required in their subject area and that they could not make practical use of the knowledge provided in the classrooms. Most TEs reported gaining sufficient general skills to use digital tools like a computer, word processors and PowerPoint:

> *I have attained some formal training in office suite basics; I have done online training in commonwealth of learning. UNESCO has also helped us in so many ways. We have had training in integration of ICT. The competencies are generalized…. (TE#2)*

All TTs interviewed confirmed the existence of ICT courses in their pre-service training programmes. More than half of the TTs at both TTIs, indicated that the ICT courses they attended were offered as distinct courses rather than as an integral part of art and design subjects. TTs also reported that TEs often did not provide enough time for TTs to learn the practical uses of digital tools. At Sheema, for instance, all the informants reported that computer studies were not given due attention by TEs because it was examined by neither the institution nor the national examination body. In relation to this, one administrator reported that:

> *…of course some teachers reschedule the time allocated for computer lessons to teach other examinable subjects because computer studies is not examinable either by the institution or the national examination body. It is added on the timetable to benefit our students… (AD#4)*

Informal Approaches

Collaboration: Interestingly, all the TEs reported developing TDC through informal collaborations with fellow educators, students, peers, technical persons and experts to co-teach, work together on specific projects that require the use of technology and exchange digital knowledge and experiences. Two TEs had this to say with regard to collaboration:

> *I collaborate with teachers; for example in teaching multimedia crafts that require knowledge on textile technology; I consult textile teachers to guide my students on how to use specific digital tools that I do not have expertise, through which I learn in the process (TE#5)*

> *I collaborate with other technical people, especially when the tool is new; we share knowledge. Sometimes I either call upon a person who is more specialized with that equipment or software to give an advance briefing… (TE#1)*

Similarly, all the TTs reported collaborating with peers either at school or outside school to learn how to use computers, smart phones and software applications. At Kabwohe, TTs frequently reported developing skills in Adobe Creative Suite applications like Illustrator and Photoshop through informal collaborations with friends. One of the TTs noted:

> *…I believe collaborating with colleagues is crucial if I am to become digitally competent, especially in this dynamic world. Through interacting and sharing with colleagues about my digital challenges, I am helped, and so far in most of my lectures I use a number of digital tools including; computers, camera as well as projectors… (TT#2)*

Furthermore, through classroom observation, it was evident that there were collaborative practices among TEs and TTs. At Kabwohe, two TEs were observed co-teaching in a computer aided design class, and groups of TTs were observed discussing how to model a 3D cartoon in Autodesk Maya, an application that the TEs had briefly explained. Most times, students were observed actively working together in groups, sharing personal laptops and helping each other learn. Due to the limited number of computers and other digital tools, TEs often encouraged students to work in groups on tasks that required the use of digital technology. Both TEs and TTs acknowledged learning from each other through collaboration.

Self-teaching: It was evident from the findings that TEs develop TDC through self-teaching, understood in this study as one's own efforts to acquire knowledge or skills without instruction or collaboration with peers. Informants reported to have done this through trial and error, engaging in self-directed activities related to technology use. In this regard, one TE stated:

> *…sometimes when you are in a school environment and you are assigned a certain subject that necessitates to use a certain digital tool, you have no way out but to take a self-initiative and search for the tool you need in that subject and learn to use it. (TE#7)*

In addition, several TEs reported independently searching for information on particular topics related to teaching with technology in the art and design field, mainly from online sources. Here, TEs cited Google, electronic journals and YouTube, along with relevant textbooks in the library. Some of the TEs reported watching video tutorials, observing their colleagues using digital tools, exploring digital tools (social media) and reading operational manuals. Several TEs reported applying the competences gained through self-teaching later in their practice to prepare and present digital content. For example:

> *…there is a lot of scholarly information about the use of digital tools in the teaching process on the internet. For instance, how to use a computer in graphics design and art education. This information is both available in text and video, say on YouTube. So when I read or watch a video, I learn and later apply the knowledge in my teaching practice… (TE#4)*

Likewise, all ADs interviewed at both TTIs agreed that some TEs developed TDC through self-initiatives like discovery and self-teaching. One of the ADs reported:

> *… the integration of digital technologies like computers and the internet at the institution has made it possible for teachers and trainees to discover how certain technologies operate through internet searches. This has helped to boost teachers' knowledge and competence in using technology for teaching, as teachers utilize the information searched to prepare teaching content… (AD#5)*

Similarly, the classroom observations at both TTIs revealed that TEs encouraged TTs to use Internet websites like *Google* and *YouTube* to learn more on their own about topics discussed in class. In one of the class observations, TTs were often seen browsing the Internet on the topic being discussed, using their smart phones without guidance from the teacher.

Repetition: Roughly, half of TEs reported acquiring TDC through repetition, understood in this study as developing a skill through the regular and routine use of digital technologies. TEs broadly reported doing this through regular practice whenever they had access to digital tools. This way, some TEs reported developing positive attitudes and motivation towards technology use in teaching:

> *….the use of digital tools requires regular practice; thus the moment you stop, the next day it will be outdated. By constantly using the computer in new ways as I teach, my attitude and motivation levels develop. Thus at the end my digital competence is improved. (TE#9)*

Similarly, some ADs when asked how TEs develop digital competence at the institutions confirmed that TEs regularly used digital tools in the classroom. One AD had this to report:

> *…most times teachers whose attitude towards technology use is positive are always using digital tools; they are in the computer lab, whatever information they need, they access it so fast…(AD#2: at Kabwohe TTI)*

Although repetition was identified as a major informal approach through which teachers developed TDC, it was observed in the classrooms that only a few TEs had access to personal digital tools like computers. At Kabwohe, one TE did not possess a laptop computer and had to ask TTs to volunteer their personal computers to use in conducting a lesson. In addition, both TTIs in general did not have enough digital tools either for the TEs to use in teaching or for TTs to practice. Moreover, a large proportion of the informants also reported not owning personal digital tools as a challenge to developing TDC. Furthermore, it was observed at both TTIs that TEs

would give instructions on how to perform certain tasks that required the use of digital tools without having adequate tools to demonstrate, and TTs would be left to practice such tasks in their free time.

In summary, the findings mainly indicate that art and design TEs develop TDC through both formal and informal approaches. The formal approaches include *CPD* and *pre-service training,* whereas informal approaches include *collaboration, self-teaching and repetition*. Apparently, TDC gained through formal approaches did not relate specifically to the teaching of art and design subjects, making it inadequate and difficult to apply in real classroom practice. Second, the findings suggest to a larger degree that TEs develop moderate TDC, necessary for practical use in the classroom, through informal approaches. Through collaboration, TEs share knowledge and experiences and participate together with digitally competent persons to develop skills. Even without professional guidance, TEs develop skills on their own (self-teaching) through trial and error, tutorials, Internet resources and the regular and routine (repetition) use of digital technologies. Finally, the findings confirm that TEs´ inadequate physical access to digital resources limits the development of TDC.

DISCUSSION

The findings of this study indicate that TDC gained through formal approaches was overly generic and not specific to the teaching of art and design subjects, thus being inadequate and difficult to apply in art and design classrooms. The present finding seems to be consistent with van Dijk's (2005, p.90) study where he indicates that "computer courses and books are not the most important sources for learning computer skills". While van Dijk underscores the importance of formal education in setting a solid basis for digital skill development, the present findings clearly show a mismatch between formal education and digital skills access. With formal ICT courses in this study being distinct rather than an integral part of art and design subjects, they provide only moderate competence in using software and hardware. Taking into account the inadquate physical access to digital resources at both TTIs,it is evident that TEs will continue to find it difficult to fully develop the informational and strategic skills that are required to develop TDC.In this sense, future formal training needs to arrange for a better way to meet the informational and strategic skill needs of TEs.

An interesting finding in this study is how TEs develop TDC to a large degree through informal approaches. This finding corroborates the ideas of van Dijk (2005), who maintained that developing digital skills through informal approaches has been common for many years even in formal educational settings. These learning opportunities occur informally or incidentally as students and experts observe, imitate, experiment, model, appropriate and provide and receive feedback (van Dijk, 2005).

First, the findings of this study reveal that informal collaborations with persons who possess digital competence is of utmost importance. TEs seek collaboration with and assistance from more digitally competent persons to develop TDC. This finding resonates with So & Kim (2009) and Koehler et al. (2007), who have observed that collaborative approaches help teachers make intimate connections between technology, pedagogy and content from which they develop the compound competence necessary to use digital technology. This collaboration further serves both operational and informational purposes, as collaborative exploring concerns knowledge about how to use digital tools and integrate them into classroom practice. This study also reveals that collaboration with peers helps develop strategic skills to achieve the specific goals of using digital tools in classroom practice.

Second, the development of TDC through self-teaching as reported in the findings, further supports the idea of van Dijk (2005, pp. 90), who argued that "the do-it-yourself approach is a much more important source of learning digital skills". The present study found that TEs have developed digital skills through trial and error, tutorials and Internet use. Although this training has been conducted without professional guidance, it serves to develop informational skills, providing knowledge about searching, selecting, processing and evaluating information in a networked society. Van Dijk adds that most computer and Internet users learn by trial and error; however, he maintains that, "operational skills will remain incomplete when they are only learned by trial and error" (2005, p.92). This could make it difficult for TEs to recognise the relationships between technology, pedagogy and content that constitutes TDC without a particular focus on the educational purpose of technology use. Hence, according to findings of this study, acquisition of TDC through self-teaching may not be an adequate approach to achieving strategic skills.

Finally, the findings indicate that repetition (regular and routine use of digital technologies) is a significant informal approach through which TEs develop TDC. In accordance with the present finding, van Dijk (2005) observes that people learn operational skills through regular practice with digital technologies. Kaasbøll (2014) concurs and adds that when technology users continue to practice through repetition, such skills become automated and could enhance their digital competences. However, van Dijk adds that learning from regular practice could limit understanding of all the aspects of digital skills (operational, operational, informational and strategic) that do not immediately appear to be relevant. This implies that, while TEs develop TDC through repetition, it is vital for TEs to develop the compound and complex skills needed to use digital technologies in their classrooms.

In summary, this study indicates that formal approaches will have less relevance to the development of TDC as long as they fail to address all aspects of digital skills (operational, informational and strategic). In this study, digital skills gained through formal training remained operational and were not specific to the teaching of art and design subjects, thus being inadequate and difficult to apply in real art and design classroom practice. On the other hand, through informal approaches, TEs to a larger degree have developed elements of TDC. However, due to inadequate or non-existent professional guidance within informal approaches, TEs seem to have mostly gained operational skills and only to a lesser degree, the informational and strategic skills that typically are learned from formal education designed for professional practice. It is also important to note that inadequate physical access to digital resources could have prevented TEs from fully developing the necessary TDC required for the actual use of technology in art and design classrooms.

CONCLUSION

The aim of this study was to establish an in-depth understanding of how art and design TEs develop TDC for teaching in TTIs in Uganda. Notably, the findings indicate that TEs develop moderate TDC through informal approaches that include *collaboration, self-teaching and repetition,* which support both operational and informational skills but restrict the acquisition of strategic skills that address the compound knowledge of TDC. To a lesser degree, TEs develop TDC through formal approaches that include *CPD* and *pre-service training*. The skills gained through formal approaches remain operational and are not specific to the teaching of art and design subjects, which makes them inadequate and difficult to apply in real classroom practice. The findings suggest the need for implementing a curriculum that will not only help realise operational skills but also informational and strategic ones. These skills must be fully integrated into all traditional art and design subjects to create a subject-based digital curriculum to enable the development of the TDC required to use digital technologies in the classroom. Finally, there is also an urgent need to consider integrating the strength of informal approaches to the development of TDC into formal art and design education curricula.

LIMITATIONS AND FURTHER RESEARCH

The current study only examined the development of TDC in terms of the digital skills necessary for teacher educators to appropriate digital technologies in the art and design classrooms. However, van Dijk (2005) argues that, even given sufficient motivation, physical access to digital technologies and the skills to apply them are necessary but not sufficient conditions for the actual use of such technologies in the classroom. It would therefore be interesting to investigate the motivation and physical access of teacher educators as well as establish how teacher educators actually use digital technologies in teaching art and design classes in Uganda.

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