



## The Dilemma of Teaching with Digital Technologies in Developing Countries: Experiences of Art and Design Teacher Educators in Uganda

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### Abstract

This case study explores how teacher educators use digital technologies in teaching Art and Design (A&D) in a developing country. It uses semi-structured interviews and non-participant observations to gather qualitative data from teacher educators at two teacher training institutions in central Uganda. To understand the actual use of technologies by teacher educators in the A&D classroom, analysis of the data employed concepts from van Dijk's resources and appropriation theory (RAT) and Mishra and Koehler's TPACK framework. The findings indicate that low digital competence among teacher educators and insufficient access to appropriate hardware, software and the Internet means that A&D teacher educators in Uganda only occasionally use digital technologies in the classroom. Instead, teacher educators use non-professional software such as Microsoft Office to teach Art and Design subjects. The findings further confirm teacher educators' limited awareness of the relationship between technology, pedagogy and content knowledge in the Art and Design classroom. Insufficient access to adequate digital resources, skills and knowledge explains the low creative use of digital technologies in teaching A&D lessons.

**Keywords:** digital technology; art and design; teacher education

### Introduction

Amid the growing impetus to embrace digital technology, there is evidence of substantial adoption of technology for pedagogical purposes in different fields of teacher education worldwide (Salavat, 2016; Lin, 2011; Kotrlik & Redmann, 2009; UNESCO, 2002). Eady and Lockyer (2013) argue that technological advances in recent years have increased the

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variety and accessibility of digital tools, expanding teachers' opportunities to use these in the classroom. Eady and Lockyer (2013) note that many teachers can now use digital multimedia technologies combining text, image, video and audio to improve lesson design, to present information, and to more effectively engage and motivate students. In Art and Design (A&D) teacher education, Lemon (2015) suggests that digital technologies expand teaching and learning possibilities by supporting shared visions, innovative art practices and high levels of engagement in meaning making. Through exposure to these new technologies, art educators can stimulate student learning, imagination and creativity (Black & Browning, 2011) and students can learn how to apply their digital knowledge and skills for creative purposes (Freire & McCarthy, 2014). For example, A&D educators can use a range of software applications to help learners to develop and edit three-dimensional (3D) images and films (Örtegren, 2012).

In developing countries, as elsewhere, Internet access and digital technologies have changed pedagogy and student participation in Art and Design education (Appiah & Cronjé, 2012; Kampouropoulou, Athanasiadis, & Stefos, 2011). For example, Bolujide (2016) reports the use of multimedia software by visual art educators in Nigeria to provide challenging and authentic content that develops the student's mind through exploration, discovery and creativity. Appiah and Cronjé (2012) note that computer technologies in developing countries are slowly changing A&D pedagogy, as both educators and students spend part of teaching-learning time using computers or other digital devices in the design process. With greater access to digital technologies globally, educators can build students' capacity to present, research, process and communicate their art (Lemon, 2015).

However, while teacher educators' schools and classrooms in affluent industrialized nations have abundant technological resources (Vrasidas & McIsaac, 2011; Delacruz, 2004), educators in many parts of the developing world have limited access to such learning aids (Bolujide, 2016; Onwuagboke, Singh, & Fook, 2015; Appiah & Cronjé, 2012). The gap between those who do and do not have access to digital technologies (the digital divide) has for many years been recognized as a multidimensional phenomenon affecting the integration of digital technologies in work processes around the globe (Fuchs & Horak, 2008). Fuchs and Horak indicate that users in the least developed African countries, with low incomes, education, and skills, have very low access to digital technologies and low usage rates compared to users in developed countries. In Turkey, Acilar's (2011) research indicates that although computer and Internet use has significantly increased over time, there is still a digital divide in computer and Internet use within the country, and between Turkey and developed countries. Acilar (2011) notes a significant and consistent gap in computer and Internet use within Turkey; between rural and urban residents, the young and the elderly, male and female, and higher and lower levels of education. Additionally, a significant number of educators make insufficient use of the available technology (Black & Browning, 2011; Peeraer & van Petegem, 2010; Phelps & Graham, 2008). Similarly, studies since the turn of the millennium (Gilakjani, Leong, & Ismail,

2013; Brinkerhoff, 2006; Wood, 2004; Delacruz, 2004) indicate that the use of technology in the classroom presents a dilemma for a majority of educators because of inadequate digital resources, lack of appropriate training, lack of time, lack of institutional support and negative attitudes. In addition, Mishra and Koehler (2006) note a tendency to introduce technology into the educational process without due regard to how it is used, and this compromises its effective pedagogical use.

With regard to A&D education, Wood (2004) identifies a need for art-specific technological training and digital resources for teacher educators. This is because technology is redefining A&D itself in terms of themes, tools and vocabulary beyond how it is taught or learned and so A&D educators need to embrace technology to accommodate changes in teaching practice. However, Apau (2017) notes that even when teachers in developing countries like Ghana use these technologies, it is often for supplementary purposes such as producing lesson materials and preparing content. Apau (2017) suggests that, in addition to both content and pedagogical knowledge, contemporary teaching practice also requires technological knowledge; this includes the teacher's ability to use new technologies for learning purposes, both inside and outside the classroom.

Clearly, then, despite the increasing adoption of digital technologies in the classroom since the turn of the century, educators have not fully exploited them for pedagogical purposes, especially in teacher education programmes in areas such as A&D. Developing countries face particular challenges in this regard. In Uganda, for instance, although the National ICT Policy for education (Uganda, 2014) sets a framework of curriculum and teacher training that facilitates and guides the development and integration of digital technology in all aspects of education, the extent to which digital technologies are used in teacher education programmes such as A&D is unknown (Luwangula, 2011). Andema, Kendrick, & Norton's (2013) case study findings indicate that, despite the existing ICT policy and teacher educators' enthusiasm for digital technology, digital literacy in Uganda is still hampered by the expense of Internet connectivity, inadequate training, power outages, and culturally irrelevant curricula. As such, the digital competences gained by educators through formal teacher education in Uganda are overly generic and not specific to the teaching of teacher education subjects such as Art and Design (Tusiime, Johannesen, & Gudmundsdottir, 2019).

In order to explore how A&D teacher educators use digital technologies in Uganda's teacher training institutions (TTIs), the present study was guided by the following research question.

*How do Ugandan teacher educators (TEs) use digital technology in teaching art and design (A&D)?*

## Theoretical points of departure

This study drew on van Dijk's (2005) resources and appropriation theory (RAT) and Mishra and Koehler's (2006) TPACK framework to analyse the use of technology among A&D teacher educators. RAT has previously been used to describe the digital divide in terms of the relationships between four elements: categorical inequalities, resource distribution, access to ICTs, and participation in society (van Dijk, 2017). RAT is particularly useful for investigating the use of digital technology in the context of limited resources in a developing country.

According to van Dijk, four successive kinds of interdependent access are needed to appropriate new technology:

motivational access (motivation to use digital technology), physical or material 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). (2005, p. 21)

Usage access helps to clarify how people use digital technologies for a particular purpose. Usage relates to properties of the hardware, software or content that can either support or impede access. As a dependent factor, van Dijk (2005) argues that usage access can be analysed in terms of *actual use*, *usage time or frequency*, *usage diversity*, *broadband use and creative use*. As van Dijk relates actual use to physical access to computers and the Internet, the present study explores TEs' physical access to digital technologies when teaching A&D; this broadly includes hardware, software and the Internet. Secondly, we relate usage time to how often TEs use digital technologies like hardware, software and the Internet when teaching A&D. Thirdly, we relate usage diversity to how TEs use digital technologies in teaching A&D. Fourthly, broadband use refers to Internet strength and access and how it supports the use of new applications and online users (for example, teacher educators) at a given time. For present purposes, the term *Internet* is used to refer to broadband access and encompasses physical access as well as usage diversity. Finally, creative use refers to how users themselves create digital content such as websites, blogs or videos or post contributions to an online bulletin board, news group or community (van Dijk, 2005).

In relation to van Dijk's concept of *creative use*, we argue that it is also important to understand the particular way in which TEs use technology creatively for educational purposes. That means how TEs apply knowledge that emerges from the dynamic interplay of knowledge domains when teaching with digital technologies. This can be understood and explained by reference to Mishra and Koehler's (2006) technological, pedagogical and content knowledge framework (TPACK) (Figure 1).

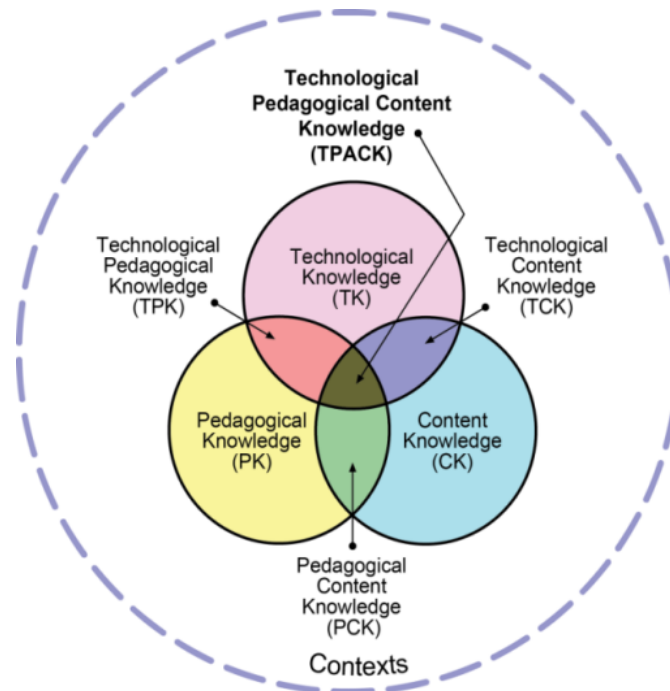


Figure 1: TPACK Framework (Mishra & Koehler, 2006)

Figure 1 shows how compound competences emerge from the three intersections between technology, pedagogy and content. In the present context, technological-pedagogical knowledge might refer, for example, to knowing how to use multimedia to engage students in learning; pedagogical-content knowledge might refer to knowing how to engage students in subject-area knowledge creation; and technological-content knowledge might refer to knowing how to use Adobe Illustrator software to demonstrate illumination effects. The complex compound knowledge required by teachers falls within the intersection of all three areas. Known as technological pedagogical content knowledge (TPACK), this might, for example, address how a teacher educator uses Adobe Illustrator software to engage students in concretizing their knowledge of illumination techniques when evaluating images. Although the TPACK framework has been criticised for a lack of empirical support and scientific usefulness (Archambault & Barnett, 2010; Archambault & Crippen, 2009), Koehler et al. (2011) contend that teachers can make creative use of TPACK to rethink and reimagine what they teach (content knowledge) and how they teach (pedagogical knowledge), and to critique and understand how they can adapt, reuse and repurpose new technology for use in the classroom (technology knowledge) to become thoughtful practitioners (Mishra & Koehler, 2006).

Therefore, to analyse TEs' use of digital technologies to teach A&D in Uganda, we largely relied on van Dijk's theoretical concepts of access to digital technologies (including access to the Internet), usage frequency and usage diversity (including internet-based resources) and creative use. In addition, the TPACK framework was employed as a tool in the analysis to understand TEs creative use of digital technologies in teaching A&D. The TPACK framework has a specific focus on how teachers teach with technologies.

This construct highlights the complex interplay of technology, pedagogy and content, unlike van Dijk's RAT, which focuses on a more general use of digital technologies. Van Dijk (2005) posits that the different kinds of access in RAT are cumulative; i.e. they may depend on each other. It is therefore important to note that the core concepts for analysis in the paper were inspired by van Dijk's RAT, with a particular focus on usage access. Other forms of access that include physical or material and skills access formed an additional backdrop for analysis and discussion.

## Methods

The aim of this study was to understand how TEs from two teacher training institutions (TTIs) in central Uganda use digital technology when teaching A&D. A case study design (Yin, 2014) was selected as optimal for in-depth description of a case or multiple cases (Creswell, 2007). This approach provided rich data for a deeper understanding (Denzin & Lincoln, 2005) of the phenomena under investigation.

Purposive sampling was favoured because it provides for the appropriate selection of participants. This yields insights into the problem under investigation rather than empirical generalizations (Patton, 2002; Miles & Huberman, 1994). Here, the target group was ten A&D teacher educators from two TTIs in Uganda, who were chosen for their acumen and understanding of the phenomenon under investigation. It should be made clear that all participants were qualified individuals who instruct prospective and practising A&D teachers at different levels of professional development.

Data were collected by means of semi-structured interviews and non-participant observations. Kvale (1996) has argued that this combination of interviews and observations is likely to provide more valid information. Interviews offer a useful way of exploring the views, experiences, beliefs and motivations of individual participants (Hardman, 2005; Barriball & White, 1994) regarding the target phenomena and provide reliable and comparable data (Gill et al., 2008). Interviews with the individual participants were conducted at convenient intervals and lasted an average of one hour. This allowed sufficient time to explore the deeper meaning of participants' views before a saturation point (diminishing returns or no new data) was reached (Glenna, 2008).

Kawulich (2005) has suggested that observation-based methods enable researchers to assess nonverbal expressions of feeling, to see how participants interact among themselves and with other objects, and to check how much time is spent on various activities. To this end, from a total of ten TEs who had been previously interviewed, four TEs (two at each institution) were observed in classroom practice – this observation was guided by the TPACK observation checklist. Each observation took an average of one hour in the classroom during which field notes were taken. The observation checklist is a tool for assessing teachers' use of their technology, pedagogy and content knowledge in classroom practice (Trainin & Friedrich, 2014). In this study, the TPACK observation checklist focused on a number of items: firstly, the composition of the classroom (for example,



students, classroom environment); secondly, the TPACK question (for example, how TEs observed the relationship between different components i.e. TK, CK, PK, TCK, TPK, PCK and TPCK); thirdly, teaching learning activities (for example, pedagogical approaches and students' participation); and fourthly, the evidence of TPACK in the lesson plan.

All the interviews were audio-recorded and transcribed, along with field notes from the observations. It is important to note that all the data was collected and transcribed by the first author. Although qualitative methods such as interviews and observation can yield rich and informative data, they are often criticised for their subjectivity (Wood & Griffiths, 2007), and this may compromise validity and reliability. To avoid subjectivity, interview data were cross-referenced with the observations to check for any inconsistencies. In addition, for triangulation purposes and to ensure the quality of the study findings, data from the observations were subsequently used to supplement the interview findings. Furthermore, for ethical reasons, research clearance was sought and granted by Mildmay Uganda Research Ethics Committee (MUREC), the Uganda National Council for Science and Technology (UNCST), the Norwegian Centre for Research Data (NSD), and the participating institutions.

Based on the main research question and transcribed data (interviews and observation notes) from ten TEs, the authors performed a first-level analysis that identified frequently occurring words and phrases in the data (Burnard, Gill, Stewart, Treasure, & Chadwick, 2008). These were colour-coded, and similar codes were later clustered to define empirical categories. A second-level analysis was performed using the theoretical concepts access to digital technologies, usage frequency, usage diversity and creative use described in the previous section to select the data presented in this paper. To protect the identity of institutions and participants, pseudonyms (Kabwohe and Sheema) and codes (TE#1, TE#2...) were used in all transcripts and in the presentation of findings in the next section.

## Findings and Discussion

The main research question asked was “How do Ugandan TEs use digital technology when teaching Art and Design?”. The findings are described and discussed in terms of the theoretical concepts referred to earlier: *physical access to digital technologies*, *usage frequency*, *usage diversity*, and *creative use*.

### Access to digital technologies

To begin, each TE was interviewed about the kinds of digital technologies available to them when teaching A&D, and how those technologies were accessed in TTIs. All of the TEs reported that the available digital technologies (hardware, software and Internet) were insufficient and not easily accessible for teaching use. One TE described the situation as follows:

...we do not have enough digital resources at this institution. Each of our classes has over 60 students. In this room, there are 15 computers, and the other room has 20. Having so many students on one computer limits individual students' access, and some will just be onlookers, doze off or distract others. [...] We want something to be done, but we are limited by the resources. (TE#3)

Remarkably, all of the TEs indicated that there was no open access to the Internet in any of the classes, computer labs, staff rooms or other locations within their institution. Several TEs reported the inadequacy of both hardware and software technologies for teaching A&D classes. For that reason, a few TEs reported having purchased or used personal digital tools, and others mentioned access in public places like Internet cafes or through colleagues who owned such tools. According to one TE,

...I am not in a position to make full use of online platforms because the Internet is not easily accessible at the department where I work. In most cases, I use the Internet on my phone, buying limited data bundles for myself. It is very expensive to commit money to this, especially with social media tax [...] nor do we have enough hardware tools at the institution... (TE#4)

The above accounts confirm what was observed in the classrooms at both institutions. During the observations, it was noted that even among the available digital resources, some were not working (e.g. cameras and computers in the computer labs at both TTIs). At both institutions, it was also observed that professional A&D software applications were not installed. Although a few TEs had personal laptop computers and smartphones, the majority did not own any of the essential digital tools for teaching A&D.

According to van Dijk (2005), physical access to digital technologies is a necessary but not always sufficient condition for technology use. In the present case, usage of digital technologies for teaching A&D at Ugandan TTIs was seen to be impeded by TEs' and students' limited access. In addition, the Sheema findings indicated that the institutional policies (rules and regulations) prohibited students from bringing mobile phones into the institution, although a number of TEs reported using mobile phones during teaching. This invites questions about how effective teaching with digital technologies could be if such rules and regulations prevent students from having personal mobile phones, computers or other devices. Delacruz (2004) notes that teachers' utilization of technology in the classroom is largely a result of institutional policies and support mechanisms that govern students and teachers' personal and professional interest in and access to those technologies. It follows that teachers in Ugandan TTIs may find it difficult to teach with digital technologies because of unsupportive institutional policies. Such policies sometimes contradict the aims of the national ICT policy for education (Uganda, 2014) that guides the development and integration of digital technologies in teacher education programmes. In this regard, Delacruz (2004) suggests the need for supportive institutional policies and procedures to ensure teachers' successful utilization of new digital technologies in such institutions. In the Ugandan context, there is a need for further research to highlight the contradictions between national and institutional ICT policies for education and the actual use of digital technologies in teaching teacher education programmes such as Art and Design.



### Usage frequency

When TEs were interviewed about how often they used digital tools in teaching A&D, several reported occasional use, as indicated in the following statement:

I cannot lie about that. Sometimes I use [digital tools], maybe once a month because of the constraints, mostly for online tools. For hardware tools like computers and projectors, it might be two or three times a week. If we had more computers, usage would be on a daily basis... (TE#3)

On the other hand, some TEs reported using digital technologies regularly when teaching A&D. One had this to say:

For me, almost every time I go to class, I always use some digital tools. [...] I find it necessary to use these [digital tools], whether the class is very big and requires use of a projector, or whether it is small and students can gather around a laptop or desktop computer. [...] I also regularly use digital images for reference in my classes to enable students to understand what I'm teaching in A&D. (TE#7)

In the interviews, only one TE admitted to having rarely used digital technologies in teaching A&D because of limited digital competence and inadequate access to digital resources. Although some TEs reported using digital technologies regularly, the first author observed in classroom observations at both TTIs that the use of digital technologies was treated as an add-on or supplement to the curriculum, rather than as an integral part of the subjects taught. At one TTI, minimal time was allocated to computer studies, and TEs reported that the subject was never assessed, either by the institution or the national examination body, because it was simply an add-on to the teaching curriculum. Additionally, the lack of adequate digital resources reported by TEs at both TTIs, and confirmed during observations, limited the use of digital technologies in the A&D classroom.

Phelps and Maddison (2008) have previously cited time as a major constraint on teachers' integration of digital technologies in the classroom. However, teachers require sufficient time if they are to improve digital competences. The authors noted that teachers who were allowed time to develop their digital skills could be more creative than those who had insufficient time. Van Dijk (2005) posits that precise usage time is a more valid indicator of digital media usage than respondents' reports that they use these media at some time or place. However, van Dijk also acknowledges that the required time diary data are not usually available, and that usage may also be determined by other factors like access, digital skills and user motivation level. Although this study did not collect data on actual daily usage time, the findings from interviews and observations clearly indicate low usage of digital technologies among TEs in Ugandan TTIs.

### Usage diversity

Data from the interviews and observations clearly indicate some diversity in the use of digital technologies in the teaching of A&D. For instance, all TEs interviewed at both

TTIs report using the Internet to search and download information related to their teaching for later use in lesson planning. Despite limited Internet access, all of the TEs indicated that the Internet provides broader scope and more up-to-date information on A&D subjects than the traditional physical art books available from the institutions' libraries or bookstores. In this regard, one TE made the following comment:

In my situation, especially now that I teach art history at undergraduate level, I rely on the Internet as a source of information but also as a vehicle for communicating to my learners what I have decided to deal with at a specific point in the course unit... (TE#5)

Similarly, another TE said:

... as a teacher, I can acquire teaching resources such as videos in the field of A&D with the help of digital tools. For instance, having realized that YouTube is a very good tool for teaching, [...] I download videos related to the project that I want to share with students ... and because such videos cannot be accessed online without the Internet, I save them on a CD for later use in the classroom—even without the Internet, [I can play them] from a DVD player or a computer with a projector... (TE#3)

These examples illustrate that although A&D TEs at both institutions are hindered by limited or non-access to digital resources like the Internet, they try to make use of online services and platforms in the teaching process. Some TEs reported having Internet access on personal devices like smartphones, which they could use to search for information they needed to prepare teaching materials for use in the classroom. Based on the observations at both institutions, TEs lacked Internet access in classrooms or computer labs and could not use Internet resources for actual teaching. However, in one of the observations a TE was seen to browse the Internet on a personal smartphone to show fashion images to students in a textile design class. The phone was passed around the classroom to allow students to see what the educator had just explained. In other cases, TEs referred to important websites or links, enabling students to search on their own after the lesson.

The current findings align with Burton (2001, as cited in Delacruz, 2004) who concludes that most art educators in the United States report using electronic technologies to make handouts and to assess/grade students while others report using computers for online research when preparing lessons. Van Dijk (2005) posits that people with greater Internet access (bandwidth) take fuller advantage of the opportunities afforded by new media. He adds that people not only save waiting time but can also use a large number of online applications. Based on our own empirical findings, we argue that unreliable access to the Internet and other hardware and software limits TEs' appropriation of such technologies in the A&D classroom.

In addition, several TEs reported having used certain hardware and software in preparing digital content for use in teaching A&D. For instance, all of the TEs mentioned having used Microsoft Office applications like Word and PowerPoint to prepare basic teaching materials for A&D, including notes, schemes of work, lesson plans and presentations. These were sometimes printed out and distributed to students as handouts or used as classroom teaching aids. In this regard, some TEs reported having used digital cameras

or smartphones to take photographs or record videos that they would later integrate to provide inspiration in their A&D teaching, using appropriate computer software. Only a few TEs mentioned having created multimedia content using relevant design software, as in the following:

... I have used After Effects in making videos and some tutorials to aid my teaching. So, I use Adobe Creative Suite to create teaching content [...] Of course, I also sometimes use Microsoft Word to prepare short training manuals or notes for students, and PowerPoint to create presentations... (TE#4)

These findings confirm something also noted during the classroom observations—that although TEs strove to integrate digital technologies at different levels of A&D teaching, there was a general lack of specialized software at both institutions for teaching A&D subjects. In the labs, the available computers mainly offered basic Microsoft Office applications that were of little use to teachers or students for A&D purposes. At Kabwohe, for instance, at the time this study was conducted, less than ten of the twenty computers in the lab were running fully functional Adobe Create Suite software, which TEs mentioned as having sometimes used in teaching A&D subjects like graphics, textiles and computer-aided design. However, all of the functioning computers at this institution had Microsoft Office. At Sheema, none of the interviewed TEs reported (or were observed) using any of the professional A&D software applications in the classroom. Although a few were competent users of professional software like Adobe Creative Suite, we realized that a majority tended to use the basic Microsoft Office applications, which were readily accessible. This aligns with findings cited in Delacruz (2004) suggesting that, although many art teachers use ICT resources, most use only basic applications (e.g. word processing) rather than those designed to support creativity.

Van Dijk (2005) advises that usage diversity could be understood in different usage contexts; for this reason, although TEs do use digital tools in diverse ways, the digital media they use need to be relevant and appropriate for teaching A&D. Similarly, Wood (2004) notes the need for art-specific digital resources and technological training for teacher educators.

Some TEs at both TTIs reported having used digital technologies to communicate with students about learning activities, to give feedback on assignments, to consult with students and to follow up their learning outside the classroom. One of the TEs described this in the following way:

Sometimes I use tools like the mobile phone and email to communicate to students in preparation for the next classes. I often use phone calls and SMS to communicate with students. (TE#6)

Similarly, TE#8 reported having used WhatsApp to communicate with students. The students sent the TE pictures of their artwork, enabling him to provide online feedback after they had returned home. Several TEs also reported using computer hardware and software

to record and submit students' results or grades and to store progress reports as part of their evaluation. As one TE said:

...I use my computer and basic Office software applications to record students' results. Now, we can also enter students' results in an online e-system at the institution that converts the data to overall grades. However, the system is not effective because of unreliable Internet and system breakdowns... (TE#7)

Based on the above data, it is interesting to note that TEs used their personal digital devices (such as mobile phones) to communicate with students, highlighting the absence of (or at least limited access to) digital technologies at TTIs in Uganda. Additionally, as mentioned earlier, some students did not possess personal digital tools like computers or smartphones, and the few available computers in the labs were not connected to a reliable or accessible Internet. This means that although TEs reported having used personal technologies to send SMS or email to students, students who had no access to mobile phones or other technologies were unlikely to receive or respond to such information.

Van Dijk (2005) argues that issues of digital inequality impede usage access, especially for those with limited access to digital resources and skills, as confirmed by the present findings. Although van Dijk supports the use of mobile phones for sending messages and chatting, he maintains that there must be sufficient access to such resources and the requisite skills and motivation to use them. In the present case, although TEs were motivated to use the few available technological resources, several educators lacked the relevant digital skills for teaching in the A&D classroom.

### Creative use

To understand the creative use of digital technologies in the classroom, TEs' self-reports on their own practice were supplemented by observations of classroom teaching at both TTIs. Together, the two data sets help to clarify how TEs found limited creative ways (basic use) of integrating technology, pedagogy and content knowledge (TPACK) in their teaching practice.

The interview data confirm several TEs' basic knowledge of technology for teaching purposes; some even practised this in the classroom, though less creativity. The interviewed TEs at both TTIs reported using digital tools either to simplify A&D procedures and concepts when teaching in the classroom. Specifically, some TEs used various hardware and software during the teaching process to create two-dimensional (2D) or three-dimensional (3D) designs or models. For instance, the following is an account of how one TE used digital tools to simplify the work process in a fabric decoration class:

...digital tools have made the design process easier. For example, in the past, my fabric decoration students used to draw motifs on paper by hand. They would then trace the motif to duplicate copies, but nowadays I can use the computer and Adobe Illustrator software to guide students to draw one segment of the motif, and then copy and paste for a sheet full of motifs in no time. This makes the workflow faster and more convenient for both teachers and students... (TE#4)

In a similar vein, one of the few TEs who reported occasionally using various 2D or 3D design applications in teaching said the following:

... Sometimes, I have used video tutorials from YouTube to teach a computer-aided design class. The students are motivated and interactive and become more creative when they discover the new techniques used by expert designers in the videos to handle design challenges. I have also used 3D software to demonstrate basic concepts like character development in game design, 3D modelling and animation... (TE#1)

These examples are a reminder that TEs seem able to realize teaching goals faster and more easily when using technology than would be possible using traditional teaching techniques. Despite the inadequate access to digital resources referred to above, some TEs who possessed both digital skills and personal resources like computers, phones and design software often had a better chance of engaging students in A&D critiques and artistic projects to develop their creativity. In this regard, Eady and Lockyer (2013) note that using appropriate technologies to create artefacts and products allows educators and students to demonstrate creative thinking and knowledge construction. Van Dijk (2005) also feels that users with relevant digital skills could use digital resources to achieve particular goals in different career contexts ranging from education to business. In the same way, teacher educators and students can apply knowledge constructed using technology to generate new ideas and create expressive products.

In the present context, observations indicated that TEs showed no evidence of the unified knowledge needed to appropriately combine subject content, technology and a pedagogical approach. Instead, several TEs exhibited moderate knowledge of how to use the technologies available to them (TK) and the content they taught (CK), with limited knowledge of approaches used (PK). Overall, the classroom observations at both TTIs suggested that TEs lacked any documented lesson plans for the content they taught or the approaches they used or planned to use. For instance, in one of the computer-aided textile classroom observations, the educator had a laptop, projector and Adobe Illustrator software (technologies) and exhibited moderate digital competence in demonstrating how to design layouts and patterns for a shirt. However, the educator was unable to convey to the students the process used to reach the learning goal. The teaching approach (pedagogy) used in this activity was unclear, and no prior written guidelines (content) were given to students. Consequently, none of the students could apply what the educator had demonstrated when given a classroom assignment.

In all of the classroom observations, TEs failed to demonstrate any evidence of applying the combined technology, pedagogy and content knowledge specified by the TPACK framework for achieving learning outcomes through technology-assisted teaching. In this situation, TEs showed insufficient knowledge of how technology might influence their subject matter and their choice of teaching methods.

During the observations, it was also noted that TEs could not easily explain to students how specific technologies could be used to present or alter teaching content. In many cases, TEs used non-professional A&D software applications like PowerPoint and Word

to teach A&D concepts, making it difficult to explain concepts clearly or to achieve learning goals. These findings align with those of Mishra and Koehler (2006), who note a tendency to introduce technology into the educational process without considering how it is to be used. Teaching creatively with the aid of technology requires teacher educators to synthesize their knowledge of technology, pedagogy and content and to apply it to the design of learning experiences (Koehler, Mishra, Akcaoglu, & Rosenberg, 2013).

## Implications and Conclusion

The aim of this study was to develop an in-depth understanding of how Ugandan teacher educators use digital technology when teaching Art and Design. The findings indicate that TEs at TTIs in Uganda only occasionally use digital technologies to teach A&D. This may be partly attributed to a lack of digital competence and insufficient access to digital resources (hardware, software and the Internet). Instead, TEs use non-professional software like Microsoft Office to teach A&D subjects and employ personal digital devices such as mobile phones to access the Internet and communicate with students. The findings suggest that desired learning outcomes mediated by the use of digital technologies may be greatly impeded, and that TEs face an ongoing dilemma in teaching without proper access to digital technologies. In order to increase diverse usage of digital technologies in A&D classrooms, there is a need to address the digital divide that currently exists due to insufficient access to digital technologies and digital skills in Ugandan TTIs. This could be done through a renewed policy focus at both institutional and national levels.

Additionally, the findings highlight TEs' limited awareness of TPACK—the relationship between knowledge of technology (digital tools in use), pedagogy (methods of teaching and learning) and content (taught subject) when teaching in the A&D classroom. The lack of TPACK among TEs explains the limited creative use of digital technologies in teaching A&D in TTIs in Uganda. The implication of this finding is that we need to carry out further research to see whether developing A&D TEs' TPACK competence can improve the creative use of digital technologies in A&D classrooms. Such studies could also address the question of how A&D teacher educators in developing countries can cope when teaching with inadequate access to digital technologies, as identified in this study.

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