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Teachers' Readiness towards the Integration of Information and Communications Technology in Teaching and Learning of Engineering Graphics and Design in KwaZulu-Natal

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ABSTRACT

The integration of information and communications technology (ICT) into the education system has led to changes in the way teaching and learning are conducted. These changes have necessitated the need for teachers to have ICT skills that would help them integrate ICT into teaching and learning (T&L). Hence, this qualitative study was conducted to investigate the state of readiness of Engineering Graphics and Design (EGD) teachers in the integration of ICT in T&L in uMgungundlovu secondary schools. Convenience sampling was employed to select nine EGD teachers to partake in this study. Semi-structured interviews and classroom observations were used to collect data. Data gathered from interviews was subjected to thematic analysis, and data gathered from observations was reported descriptively. The findings of this study revealed that EGD teachers in uMgungundlovu District are ready to integrate ICT into the T&L of EGD, as they indicated that ICT integration in EGD lessons is essential. The study further revealed a shortage of ICT resources and a lack of ICT skills among teachers, which hinder the successful integration of ICT. The study recommends that the Department of Basic Education (DBE) provide teachers with ICT training so that those who are technically disadvantaged can be equipped with relevant ICT skills. The study further recommends that DBE give the schools an AutoCAD license, as it has been proven to be a useful ICT tool.

KEYWORDS

AutoCAD; technology; spatial visualisation; ICT integration; engineering graphics and design; ICT training.

INTRODUCTION

Over the past two decades, ICT usage has been on the rise. Many factors have contributed to this rapid change in the advancement of ICT. The outbreak of COVID-19 and the world's migration to digital learning in the form of adapting to the Fourth Industrial Revolution (4IR) are some of the factors that contributed to ICT advancement. Consequently, the outbreak of COVID-19 has compelled educational institutions to come up with alternative ways to supplement the traditional teaching approach (Wyk et al., 2020). However, Mafenya (2022) argues that this sudden transition has undoubtedly caused an incredible amount of damage and disruption to our educational system. One of the ways that can be used to supplement the traditional teaching approach is the integration of ICT in the T&L of EGD. Hence, this study was conducted to investigate the level of readiness among EGD teachers to integrate ICT into T&L. EGD is a subject offered in the Further Education and Training (FET) phase, which is Grades 10–12 in South African secondary schools (DBE, 2011). The subject EGD is one of the technical-practical subjects that mainly focuses on line work, accuracy, and neatness. The concept of understanding line work rests on understanding the different types of lines that are used in EGD. This notion is echoed by Khoza (2018), who reported that there are 10 different lines that are used in EGD, and all these 10 different lines have different meanings altogether. Therefore, it is imperative for learners who are doing EGD to understand all these 10 different lines and the impact that these lines can have on drawings. Since EGD focuses on teaching principles that have both academic and technical applications (DBE, 2011), it needs a specific skill during its facilitation. These various skills range from spatial skills to the visualisation of abstract concepts to the understanding of different lines used in EGD (Khoza, 2013; Sotsaka, 2015). The integration of ICT requires teachers to remodel their pedagogical methods in T&L (DoE, 2004). This transformation, as expressed by the DoE, compels teachers to tweak their pedagogical methods to accommodate the integration of ICT in their T&L. However, change is hard, especially if you are changing something that you feel is not broken. As a result, many teachers are sceptical of this transformation because they feel that it is too great. In support, Msila (2015) revealed that teachers claimed that they have been teaching for years without using technology and have been producing great results in the process. The concern from teachers is quickly squashed by Maharaj-Sharma and Sharma (2017), who argue that ICT infusion in EGD encourages learners to seek knowledge themselves rather than waiting for teachers to be the sole providers of knowledge. The importance of integrating ICT into EGD lessons became evident when physical education classes were suspended due to the outbreak of COVID-19. Consequently, EGD teachers could not conduct classes virtually, citing that the EGD curriculum was not comfortable for virtual learning. This shows that EGD teachers are far behind when it comes to integrating ICT into their lessons.

Integration of technology into education has been a prominent topic for quite some time. As a result, most developed countries, such as the USA and China, are a step ahead in the integration of ICT into T&L. According to Hismanoglu (2012), Turkey spent about 11.7 percent

of its educational budget on ICT integration. However, in developing countries like South Africa, they are still far behind in the integration of ICT into T&L (Jhurree, 2005). Furthermore, Mashile (2017) posits that only 26 percent of teachers in South Africa are capable of integrating ICT into T&L. Besides that, it looks like EGD teachers are reluctant to use ICT, fearing that it is going to replace them, and this phenomenon might be shared by most of the EGD teachers around uMgungundlovu District as well. The integration of ICT into teaching has brought about changes in the style of T&L (Faloye et al., 2022). This change has compelled the need to investigate the readiness of EGD teachers for the integration of ICT in T&L.

Research Questions

This study used the following main research question:

What is the readiness of EGD teachers for the integration of ICT in teaching and learning in uMgungundlovu secondary schools?

The main research question was supported by the following sub-research questions:

- What are the challenges faced by EGD teachers in the adoption of ICT in EGD classrooms?
- What is the EGD teachers' technological knowledge in teaching and learning?
- What are the different ways that EGD teachers can use ICT to integrate IT into teaching and learning?

LITERATURE REVIEW

ICT as a Tool to Improve Spatial Visualisation

According to Khoza (2013), some concepts in EGD (for example, sectional drawing), require learners to imagine the part of the object that is removed to reveal hidden detail when nothing has been removed. This part of EGD requires learners to have a spatial-visualisation skill, which can be defined as an EGD cornerstone, together with knowledge of the different lines that are used in EGD. As attested by Khoza (2013) and Makgato (2016), most learners have poor spatial skills. Consequently, it has compelled the need to integrate ICT into the T&L of EGD, as abstract concepts can be best studied through technology. This is an indication that ICT integration is imperative in EGD because it can assist with the development of the most important skill in EGD, which is spatial visualisation. Sotsaka (2019) posits that spatial visualisation skills are essential because they develop the ability to transform abstract concepts into concrete ones. Furthermore, spatial visualisation is defined as the mental capability to execute certain graphical tasks (Rodriguez & Rodriguez-Velazquez, 2017). It is evident that to understand some concepts in EGD, one must have a spatial visualisation skill, as has been deemed necessary by the above authors, which can be best taught using technology. This is so because spatial visualisation is a solution to understanding abstract concepts in EGD.

The Importance of ICT Training for Teachers

As much as going virtual is a good idea given the current state we are living in, some teachers are not in a position to conduct lessons virtually as they are not trained to carry out such activities. This is echoed by Msila (2015), who says that teachers are firm believers that training

is very important for them so that they integrate ICT into EGD lessons. During COVID-19 lockdown, teachers around uMgungundlovu could not conduct classes from home as they cited that they did not know how to conduct classes online. They are not confident using technology in front of learners. Another reason was that they also did not have ICT materials to help them carry out lessons from home. The issue of being less confident is alluded to by Howard and Mozejko (2015), who states that teachers are feeling less confident because they lack training. Adams (2020) sees this as an indication that without proper ICT training, teachers are doomed. Furthermore, Barbour (2014) cites that teachers should be subjected to development programmes and workshops where they will be equipped with ICT skills. Training teachers is a crucial component to integrating ICT into T&L. For teachers to be effective in implementing ICT in education, they require training. Many countries across the world have realised the importance of ICT; hence, they have started to provide ICT training to teachers in various forms and degrees (Jung, 2005). However, in South Africa, there are still teachers who claim that they have not been trained to use technology. Furthermore, Alazam et al. (2013) postulate that ICT can prove to be a very crucial component in a classroom if used wisely by a well-trained teacher. This simply means that teachers need to be trained so that they can integrate ICT into T&L effectively. Alazam et al. (2013) found that the level of teachers' ICT skills and usage was moderate in a study that examined the levels of ICT skills and ICT use in classrooms. In addition, teachers who possess ICT skills are found to be more useful than those who do not (Rastogi & Malhotra, 2013). This shows how important it is for teachers to be trained so that they can have relevant skills for integrating ICT. The importance of training teachers is a very important step in ensuring that teachers are in a better position to integrate ICT. This is supported by Tasir et al. (2012), who cite that there is an increase in the number of countries that are undertaking the programme of training teachers for ICT integration. Hence, the explosion of ICT all over the world has compelled individuals to have ICT skills, which are deemed paramount in the present time.

Availability of Resources for Schools to Integrate ICT

For EGD teachers to be able to integrate ICT into the T&L, they need to have access to ICT resources, and classrooms must be in a good state to support the integration of ICT. This notion is voiced by Mathevula and Uwizeyimana (2014), who argue that ICT equipment must first be available in schools before teachers can start integrating ICT into their T&L. In the schools where this study was conducted, teachers had access to basic ICT tools such as the projector, IWB, photocopiers, and computers. Others even had access to AutoCAD, which assists in the teaching of abstract concepts. Being able to teach abstract concepts with ease is a very important step toward improving learners' spatial visualisation, which has been proven to be a big problem. The above assertion is supported (Khoza, 2018; Khoza, 2013; Makgato & Khoza, 2016) that most learners are poor when it comes to spatial visualisation. On the contrary, this is only a dream in developing countries like South Africa, as most schools do not even have a computer or access to the internet (Mathevula & Uwizeyimana, 2014). Consequently, the lack of ICT resources has

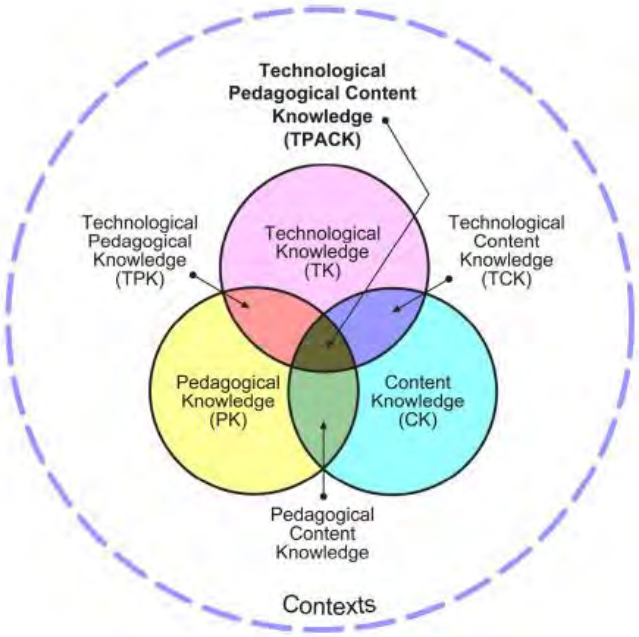
always been a cause for outcry for many teachers around the world, especially in developing countries like South Africa. The contrast is because the study by Mathevula was conducted in Limpopo, which is why the findings contradict the experience in uMgungundlovu District. The same sentiment was echoed by Mathevula and Uwizeyimana (2014), who reported that there is a lack of ICT resources for ICT integration in schools. Photocopiers, TVs, and laptop or desktop computers are the only ICT resources available to teachers in schools (Mathevula & Uwizeyimana, 2014).

THEORETICAL FRAMEWORK

This study adopted the Technological Pedagogical Content Knowledge (TPACK) framework by Koehler and Mishra (2009), as shown in Figure 1 below, to underpin the study. In the context of this study, only three components of TPACK were deemed relevant to the scope of this study, which are: Technological Knowledge (TK), Technological Pedagogical Knowledge (TPK) and Technological Content Knowledge (TCK).

Figure 1.

The TPACK Framework (Koehler & Mishra, 2009)



According to Kurt (2018), TK refers to teachers' knowledge and ability to use a wide range of technologies to enhance T&L. It also has to do with teachers' understanding of using technology in their everyday teaching. In addition, Koehler and Mishra (2009) define TK as the “fluency of information technology,” which translates to having an immense understanding and knowledge about integrating technology into T&L. In the context of this study, this component was used to investigate teachers’ technological knowledge towards the use of technology in their EGD classes. TCK looks at the relationship between technology and content knowledge about the subject matter (Kurt 2018). It's about how technology and content affect each other.

Teachers need to understand which technologies are best suited to address specific topics (Koehler & Mishra 2009). The TCK component is further defined as the knowledge of how technology can create new representations for specific content (Koehler & Mishra 2009). The TCK component is important to understand because, if better understood, an EGD teacher would develop appropriate technological tools to present tools and equipment in both the theoretical and practical constituencies. In this study, this component was used to investigate teachers' level of competency with the use of technology and how well they manage to showcase a newer teaching style when teaching EGD. "TPK refers to the knowledge of how various technologies can be used in the classroom and the understanding that the use of technology can change the way teachers teach" (Koehler & Mishra 2009). TPK was verified through the lesson observations, where teachers were observed on how they use technology to teach EGD. This component was used to investigate teachers' understanding of using a variety of technologies at their disposal in a manner that would enhance T&L.

METHODOLOGY

This study employed a qualitative approach. According to Bhandari (2020), qualitative research involves the collection and analysis of non-numerical data. This study employed a qualitative approach mainly because of its ability to gather in-depth insights into a problem.

Research Design and Paradigm

This study employed a descriptive research design to obtain information to describe the phenomenon. The descriptive research design was used because of its strength in gathering an in-depth view of any phenomenon that is under study (Sumeracki, 2018). This aspect of getting an in-depth view of the matter at hand was evident as the researcher needed to establish the readiness of EGD teachers, and the best way to do that was to get an in-depth view on their readiness.

A study done by Kivunja and Kuyini (2017) articulates three research paradigms that are used in educational research: positivism, interpretivism, and critical theory. Consequently, this study embraced the interpretivism paradigm. The interpretivist paradigm was necessary for this qualitative study because the aim of the study was to understand the phenomenon of EGD teachers' readiness to integrate ICT in their classrooms through face-to-face interviews and classroom observation. Rehman and Alharthi (2016) alluded to interpretivism research relying mostly on verbal data; hence, this study used semi-structured interviews to exploit the advantage of interpretivism.

Population and Sampling

The target population for this study was Grade 10 and 11 teachers from nine selected schools. These teachers were selected because they were all teaching EGD in schools around the uMgungundlovu district. This study focused on schools under the Umsunduzi Circuit situated in Pietermaritzburg under the KwaZulu-Natal province in South Africa, which has 11 secondary schools that offer EGD. Sharma (2017) asserts that researchers usually use sampling because it

is impossible to test every single person in a chosen population, so a subset is required. In addition, Taherdoost (2016) posits that sampling is a technique used to take a subset of people from a larger population. In this study, non-probability sampling was employed. According to McCombes (2019), non-probability sampling is when individuals are selected without following a random criterion, and not every member of the population has a chance of being selected for the study. As a result, this study used convenience sampling methods to select nine Grades 10 and 11 EGD teachers that were available. Table 1 below shows the participants' bibliographies. Taherdoost (2016) posits that convenience sampling involves selecting participants because they are readily and easily available. This method was used because it is very cheap and helps overcome many limitations that a researcher can stumble upon.

Table 1.

Participants Biography

Name of Teachers	Gender	Majors	Experience
Teacher A	Male	EGD and Motor Mechanics	18 years
Teacher B	Female	EGD and Technology	11 years
Teacher C	Female	EGD and Mechanical Technology	9 years
Teacher D	Male	EGD and Technology	14 years
Teacher E	Female	Technical Drawing and Woodworking	25 years
Teacher F	Female	Technical Drawing and Woodworking	20 years
Teacher G	Male	EGD and Mechanical Technology	4 years
Teacher H	Male	EGD	19 years
Teacher I	Female	Technical Drawing and Civil Technology	25 years

The above table shows the bibliography of teachers who participated in the study.

Data Collection and Analysis

Faloye et al. (2022) allude to the fact that there are three commonly used data collection techniques in research: interviews, observations, and questionnaires. A qualitative study normally uses interviews, observations, focus groups, and case studies (Bhandari, 2020; Bhat, 2020). Consequently, this study used semi-structured interviews and classroom observations to gather data. In this study, interviews were used to gain a deeper insight into the matter at hand through one-on-one sessions with the participants. Semi-structured interviews were used because of their ability to get first-hand information from the participants. According to Sotsaka (2015), classroom observation involves being present in the classroom and observing what is

happening. This would give a researcher an opportunity to gather some things that he could not get from the interviews. Classroom observations were used to get a sense of the reality of the teaching methods teachers use to integrate ICT into their T&L. Teachers who participated in the classroom observation are those who were interviewed. Only five teachers gave consent to be observed; consequently, only five teachers were observed. The classroom observation schedule was adapted from the TPACK framework by Koehler and Mishra (2009). The observations were 60 minutes each, as most lessons in uMgungundlovu District are 60 minutes long. The researcher observed five lessons from those teachers who consented from five different schools. The observation schedule was adapted from the TPACK framework. The observations took place during the lesson, but there was no interaction with the teacher or learners as the researcher conducted a non-participant observation. The researcher was assigned a place in the back of the classroom to sit and observe without making any comments.

Data collected through interviews was then subjected to a process called transcription after each interview and typed, showing respondents' quotes as they were responding to the questions asked. The data was then coded, analysed, and discussed thematically. The presentation and analysis of the data took the form of narratives and detailed descriptions with quotes from the respondents to capture their actual views. Verbatim quotations were used in thematic discussions of interview data to support the results. For the classroom observations, field notes were made and reported descriptively. The observation data was then analysed according to the observation schedule.

Ethical Considerations

The principals of all selected schools were asked in writing for permission to use their schools as the study sites. To ensure the integrity of the study, the researcher sent consent forms to respondents, ensuring that participation in the study was voluntary and that if respondents felt uncomfortable during the study, they could stop the study at any time without negative consequences. Confidentiality in the information conveyed by participants was maintained, and the data collected was only used for the purpose of this study. Pseudonyms were used to ensure the anonymity of schools and teachers. Schools were referred to as schools A-I, and teachers were referred to as teachers A-I. The data collected is kept in safe storage.

FINDINGS

Interview findings

The interview questions were intended to answer the main question: What is the state of EGD teachers' readiness for the integration of ICT in T&L in uMgungundlovu secondary schools? And the sub-research questions were as follows: (1) What are the challenges faced by EGD teachers in the adoption of ICT in EGD classrooms? (2) What is the EGD teachers' technological knowledge in T&L? Themes were then created from the teachers' responses for better discussion. Below are the responses of the participants based on the questions asked.

Q1: During your undergrad studies (at the university), did you do any module(s) related to using technology in teaching and learning? If yes, what is it that was mainly taught? Below is how they responded:

From the responses, only one theme emerged. Theme: Teachers were or were not exposed to technology at the university level.

THEME 1: Teacher's Exposure to Technology at University Level

Many researchers have found that teachers' ICT background from university does influence the willingness of integrating ICT when they turn professional. Put simply, it means that if teachers were taught how to use ICT in the classroom while they were trained it has a great effect when they turn professional. This assertion is corroborated by Quaye et al. (2015), who postulate that "there is a positively high impact of ICT on T&L in tertiary institutions in the sense that, broadband is a major factor in increasing collaboration between teachers". Below are how the interviewed teachers responded.

Teacher A said:

"*While I was still in university, we were taught about how to integrate technology when teaching EGD. We were mainly taught in using CAD and PowerPoint to teach EGD."*

Teacher I from School I had this to say:

"*Yes, we did Auto AutoCAD which was taught mainly on our final year of study even during the course of other years we had AutoCAD classes."*

Based on the above statements, it shows that teachers got a background in ICT in university. This means that the chances of integrating ICT into their T&L are great. Quaye et al. (2015) indicated that being exposed to ICT in higher education institutions does influence their use it when they turn professional. In the same vein, Matongo (2022) revealed that teachers are not integrating ICT because they are not trained in colleges where they did their teaching qualifications.

Q2: What technologies are available to use in this school for the purpose of teaching and learning EGD? Below is how they responded:

From the teacher's responses, only one theme emerged. Theme: Schools have resources available to integrate ICT.

THEME 2: Schools have Basic Resources Available

The researcher wanted to identify the availability of resources in schools for the purpose of ICT integration in EGD teaching. It is no secret that teachers who want to successfully integrate ICT into T&L must have the appropriate resources. In response to the question of availability, teachers responded positively.

Teacher I, from School I, said:

"In our school we have a centre for EGD that has 20 computers which are installed with AutoCAD, interactive white board that is used for a projector background as well as a photocopying machine"

In the same vein, Teacher A from School A said:

"There are not much of technologies we have in our school; we only have access to computers with access to the internet and a photocopier."

Based on the above responses, it is clear that teachers in schools have some technologies at their disposal. They have access to the basic technologies that are sufficient to kick-start the integration of ICT into the T&L of EGD. However, this is contrary to the findings of this study. According to Mathevula and Uwizeyimana (2014), a lack of resources in schools has been proven to be a hindrance to the success of ICT integration. This was further asserted by Alharbi (2021), who revealed that ICT resources have been found to be inadequate in schools, which makes it hard to integrate ICT effectively.

Q3: How competent are you in using the technologies that are available in this school for the purpose of teaching EGD? Below is how they responded to the question:

From the teachers' responses, one theme emerged. Theme: Teachers know how to use ICT resources.

THEME 3: Teachers know How to Use ICT Resources

When teachers were asked about their competence in using the technologies available at their school, most showed a high level of competence. Below are some of the responses from the teachers:

Teacher H said:

"In terms of rating, using AutoCAD to draw or prepare worksheets, I'm comfortable. I can do almost everything. So, I can say I'm good with operating these technologies and with AutoCAD I'm home and dry."

Teacher D from School D had the following to say about his level of competency in using technology:

"For the computer I will give myself a 7 out of 10 in terms of creating a question. For a printer that would be 10, A photocopier 10, a projector 10. I am good with the Whiteboard I do have the whiteboard in fact in class we've got the whiteboard and a chalkboard."

The above responses show that EGD teachers are all good or well-equipped at using the technologies that are available to them. If they had all the required technologies, surely they would have used them effectively and efficiently in the process of T&L. But from the above statements, it shows that they know how to use the ICT resources that are at their disposal. A study that examined the level of ICT skills in teachers, conducted by Alazam et al. (2013), revealed that teachers' levels of use of ICT were moderate. which is contrary to the findings from the statements of the teachers above. Furthermore, Alazam et al. (2013) postulate that ICT integration can prove to be a very crucial tool if technologies are used wisely by teachers. This is exactly what was shown by the teachers when asked about their level of competency.

Q4: What is your view of the concept of using technology in your teaching and learning?

From the responses, one theme emerged. Theme: Technology is essential in the T&L of EGD.

THEME 4: Technology is Essential in T&L of EGD

All nine teachers responded positively to the idea of using technology when teaching. They highlighted that teaching and technology can never be divorced; others said technology changes with time, so this should also be the case in T&L. Below is how some teachers responded:

When asked for her view about the integration of technology into T&L, Teacher I from School I had this to say:

"Teaching needs technology, without technology teaching is impaired, because technology moves with time. Technology is very important in T&L of EGD as it makes teaching very easy. And if we are training or raising a generation that must be competitive globally, they need ICT they need technology we just cannot divorce the two (technology and education)."

Teacher H from School H had this to say:

"One thing for sure you cannot run away from is technology because the world is evolving fast in terms of technology. *And we are moving far away from the traditional way of doing things. Things have evolved so we also need to adapt to change. So, I like to believe, and I believe that technology needs to be incorporated in learning and teaching processes because without it you would not survive. Technology is an integral part of T&L."*

This is an indication that EGD teachers understand the importance of incorporating technology into their lessons. These assertions are further confirmed by Erişti et al. (2012), who reported that teachers are willing to integrate technology into their lessons. Erişti et al. (2012) further mentioned that teachers saw the integration of technology into T&L as a good thing, so they reacted willingly. In addition to that, Mustafina (2016) reported that teachers had a positive attitude toward integrating ICT into T&L.

Q5: What are the challenges that you have experienced in using technology? Below is how they responded:

From the teachers' response, only one theme emerged. Theme: Lack of availability of ICT resources in schools.

THEME 5: Lack of Availability of ICT Resources in Schools

Most teachers indicated that the challenge they faced was the lack of ICT resources in schools. They claimed that they understood the importance of integrating technology, but they did not have the resources to use it for the purpose of T&L. This sentiment is shared by Munje and Jita (2020), as the findings of their study revealed that schools do not have adequate resources to integrate ICT. This was further echoed by Ghavifekr et al. (2016), who said that the greatest challenge in schools is the insufficient provision of computer resources, which prevents the integration of technology in the classroom. This is evident in the teachers' responses below.

Teacher F had the following to say:

"The problem is that there is a shortage of resources because our school is very big."

Alharbi (2021) states that there are a host of challenges that teachers come across every day when trying to integrate ICT into T&L. One of those challenges is the lack of provision for

educational software such as AutoCAD, which plays a huge role in improving learners' spatial visualisation.

Teacher G, when asked, said:

"In this school we do not have access to AutoCAD. As a result, learners are failing to understand some chapters better as AutoCAD simplify abstract concept."

On the contrary, some teachers mentioned that the department did provide the school with resources, but there were other challenges that hindered them. This is echoed by one of the participants in the Munje and Jita (2020) study, who said, "*The DBE had provided the school with computers, but due to theft, these were no longer available."* This is an indication that DBE is making provisions so that teachers can integrate ICT into T&L. Teachers and learners encountered many challenges when trying to use video as a tool to integrate ICT. According to Li and Lalani (2020), those challenges included but were not limited to slow internet connections and electricity outages, to mention a few. These statements from the teachers indicate that in schools there is a lack of availability of resources.

Q6: What do you think can be done to assist teachers who are technologically disadvantaged? Below is how they responded:

From the teachers' responses, only one theme emerged. Theme: Department of Education should conduct workshops.

THEME 6: Department of Education should Conduct Workshops

According to the teachers' responses, all nine teachers concur about how they think technologically disadvantaged teachers can be assisted. All the teachers said the DoE should take the initiative in training EGD teachers so that they would be in a better position to integrate ICT into T&L. They all believe that training teachers in ICT through workshops can be very helpful, as illustrated by their responses.

Teacher B:

"I think there must be workshops. The Department of Education and the subject advisors must assist teachers through workshops on how to integrate technology into teaching."

In the same vein, Teacher C said:

"The Department of Education could assist in terms conducting workshops to get the teachers to be taught on how to use these technologies."

The above responses from the teachers share the same sentiment about the importance of workshops to equip teachers. The sentiments expressed by these teachers echo that of Msila (2015) who argued that the district should train teachers so that they would be ICT efficient. This view is further attested to by Barbour (2014), who emphasises that teachers should use teacher development programmes to receive proper training so that they can integrate ICT. Tasir et al. (2012) posit that there has been an increase in the number of countries that are now undertaking a programme of skills development for teachers in ICT integration. Through all the questions that were posed and responses that were given by the teachers, one can conclude

that EGD teachers from uMgungundlovu district are ready to integrate ICT into T&L, although there are a few challenges that pose a threat.

Observation Findings

Observations were conducted to assist in responding to sub-research questions RQ 1 and RQ 2, which are: (1) What are the challenges faced by EGD teachers in the adoption of ICT in EGD classrooms? (2) What is the EGD teachers' technological knowledge in T&L? Below are the observations from different teachers with respect to the components of TPACK, which are TK, TCK, and TPK.

Table 2.

Classroom 0bservation

Item	Teacher A	Teacher B	Teacher C	Teacher D	Teacher E
TCK	The teacher demonstrated knowledge in technology in as far as the content was concerned.	This teacher demonstrated high level of knowledge in using technology to teach the subject matter	Teacher C managed to merge the content he was teaching with technology and was observed to have a strong TCK.	Teacher D was observed to teaching content very well and the technologies used were specific for the content taught.	TCK was observed to be very high in Teacher E and she managed to integrate technology into the content that she was teaching and it blended very well.
TPK	The teacher managed very well to use technology in conjunction with his preferred teaching methods.	This teacher integrated technology very well in his pedagogies.	Teacher C was observed to be using technology very well in his teaching.	The teacher manged to use technology to enhance her teaching methods.	In this aspect teacher E managed to use technology very well to support her pedagogies.
TK	The teacher demonstrated high technological knowledge in all the technologies used.	The teacher had the knowledge for most of the technologies that were at his disposal	The teacher demonstrated a highly TK as he was observed to be able to operate all technologies very well during period.	Teacher D had not much technologies at her disposal but she had knowledge of all technologies that were available to her.	Teacher E was observed to have knowledge in each technology every technology that she was using. So, her TK was excellent.

The table above shows that only five teachers availed themselves of observation.

DISCUSSIONS

Discussion based on interviews

The researcher established that teachers have ICT backgrounds from the university, which assists them in understanding the concept of ICT. Having an ICT background from the university influences the way teachers integrate ICT into their T&L. Quaye et al. (2015) state that being exposed to technology while still in university does influence teachers to use it when turning professional. Consequently, EGD teachers from uMgungundlovu District are integrating ICT into T&L, as most of them were exposed to technology during their training at the university. The findings further established that teachers have access to basic ICT tools like IWB, photocopiers, and computers, which is enough to kick start the integration of ICT into T&L; however, some teachers indicated a lack of educational software like AutoCAD because the license is very expensive and there is a shortage of computers that can support AutoCAD. On the other hand, some teachers indicated that they do not have ICT tools because they were stolen after the DoE provided them. This concurs with findings in a study by Alharbi (2021), which highlights lack of infrastructure as one of the challenges that hinder teachers from integrating ICT. The study further established that EGD teachers are very competent in using technologies that are available to them at school, such as computers, IWB, projectors, and photocopiers. This is discussed by Karsenti (2016), who cites that most teachers use IWB in their EGD classrooms. The only challenge they had was the use of AutoCAD, which most teachers do not have access to. Teachers consistently remarked that the DoE needs to step up and conduct workshops so that they can integrate technology. From the interviews, the study established that teachers understand the importance of using technology in the T&L of EGD. They outlined that since the world is migrating to 4IR, it is impossible to divorce education and technology, as they should go hand in hand. The nature of the subject of EGD warrants the use of ICT tools so that other concepts can be best taught by teachers. The study further established that even though teachers understand the importance of integrating ICT into EGD lessons, there are still problems that hamper the process, such as a lack of internet connection, power outages (load shedding), and a lack of educational software (Mathevula & Uwizeyimana, 2014). The study further established that for all EGD teachers to be ICT-equipped, they need to be trained, and the DoE must conduct workshops that will equip teachers with relevant ICT skills. According to Alazam et al. (2013) and Matongo (2022), for teachers to be able to integrate ICT into EGD lessons, they must be trained. Being trained will ensure that teachers are able to integrate ICT effectively, which will result in learners understanding the abstract concepts taught in EGD as these concepts are better studied using technology.

Discussion Based on Observations

Teachers that were observed displayed good knowledge of using the technologies that were at their disposal. They showed a clear understanding of all the technologies they used. Technologies used by teachers ranged from printers and whiteboards to laptops, computers, and projectors. The availability of these resources in schools was attested to by Mathevula and

Uwizeyimana (2014), who revealed that TVs, photocopiers, laptops, and computers are some of the technologies that teachers have access to for the purpose of integrating ICT. All these technologies used by teachers are the devices mentioned by Huggins and Izushi (2002) when defining ICT. Huggins and Izushi (2002) defined ICT as technologies that ranged from computers to interactive whiteboards, projectors, and access to the internet. However, the researcher observed that there is a shortage of overhead projectors and that accessing AutoCAD is a serious challenge. In contrast to findings in studies done by Bakadam and Asiri (2012) and Karsenti (2016), which found that most EGD teachers have access to the IWB and photocopiers as the basic ICT tools. This is again one of the requirements that an EGD class should have. DBE (2011) states that it is a requirement that an EGD classroom have an overhead projector, a whiteboard, and access to AutoCAD. What the researcher observed is that even though there is a shortage of other ICT tools, teachers were able to use what they had at their disposal to integrate ICT into EGD classrooms. Teachers use computers to print worksheets so that learners can draw. The researcher further observed that EGD teachers used the IWB well, which is something that was alluded to by Karsenti (2016). The researcher observed that most teachers had access to ICT resources, and they used them effectively. The researcher also observed that the second most used technology after IWB was the photocopier, which was the device they used to print or make copies of the worksheets that learners were using. Teachers exhibited high levels of competency in using an IWB and a photocopier, among other technologies at their disposal. From the observations, the researcher observed that EGD teachers were able to use technologies for the purpose they were intended to, which was in line with the content that was taught. This speaks highly to the aspects of TPACK (TK, TPK, and TCK) that the researcher was observing. All these components were observed to be strong in teachers, which indicates that EGD teachers in uMgungundlovu District are ready to integrate technology into the T&L of EGD.

Limitations of the Study

The limitations of the study were that the researcher was only allowed to observe Grades 10 and 11, but not Grade 12. Another limitation of the study was that the researcher was only allowed to interview and observe one teacher per school. The researcher is of the opinion that if access to more than one teacher per school was provided, more data might have been produced and the findings might have been improved.

CONCLUSSION

The main objective of this study was to investigate the level of readiness of EGD teachers for the integration of ICT in T&L in uMgungundlovu secondary schools. From the results of this study, it is evident that EGD teachers in uMgungundlovu district are indeed ready to integrate ICT into their teaching. The findings of this study showed that EGD teachers understand the importance of using technology when teaching because of the nature of the subject. The findings further revealed that if technology is used in EGD lessons, abstract concepts can be manipulated to the advantage of learners. To achieve that, AutoCAD and other technologies

must be implemented as prescribed by the DBE. The findings also indicate that EGD teachers are integrating ICT with the little ICT tools that they have. All schools observed had a basic form of an ICT tool; basic tools range from an IWB to a photocopying machine. From the observations, it was revealed that EGD teachers are using the IWB exceptionally well, and they all have access to a photocopy machine, which is used to produce documents, which indicated that their technological knowledge is exceptional. The findings of the study imply that teachers need ICT training so that they can integrate ICT into lessons. The findings revealed the same thing as teachers' indications that DBE needs to conduct workshops so that technologically disadvantaged teachers can be capacitated. The findings also revealed that people lack the skills to use AutoCAD because schools do not have access to it. As a result, teachers were unable to use AutoCAD, which is a requirement from DBE for any EGD class. The findings also revealed that workshops can also be used to equip teachers with relevant skills to operate AutoCAD. According to the findings, therefore, the objectives of the study have been met, as the findings reveal that EGD teachers from uMgungundlovu District are ready to integrate ICT into T&L.

Recommendations

Based on the findings and discussions of the study, the study recommends that DBE in KwaZulu-Natal should provide ICT resources to schools so that they can integrate ICT into their EGD lessons. The study also recommends that the DBE in KwaZulu-Natal provide adequate security so that resources can never be stolen again. The study further recommends that DBE intervene and assist those teachers who are technologically disadvantaged so that all EGD teachers can be on the same level in terms of using ICT resources. This can be done by conducting workshops and training that will equip EGD teachers with relevant ICT skills. The study recommends that DBE provide all schools that offer EGD with AutoCAD licenses.

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