TECHNOLOGY-ASSISTED DOCTORAL SUPERVISION: PRACTICE AND LESSONS FROM ANGLO-SAXON UNIVERSITIES IN CAMEROON

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ABSTRACT

This study investigates how technology-assisted doctoral supervision in teacher education can improve the quality of the supervision process in Cameroon. It is an exploratory sequential mixed method which involves an initial qualitative phase with PhD students followed by a quantitative phase with PhD supervisors. The study was situated in the Affordances Theory mooted by Gibson (1979) that explains how technological affordances can support the supervisory process. The snowball sampling technique was used to select n=80 PhD students using 9 focus group discussion and n=210 doctoral supervisors who responded to the questionnaire. The qualitative data was analysed using thematic-content method while the quantitative data was analysed using the statistical package for social sciences (SPSS) version 25.0, frequency counts and percentages and Pearson parametric test. Findings showed that there is a significant and positive relationship between the use of ICT tools on doctoral supervision and students' output. Also, the non-use of ICT tools was found to have a slightly negative effect on doctoral supervision. While the use of ICTs by both supervisors and PhD supervisees was evident, it was mostly limited to phone calls and WhatsApp due to inadequate skills in ICT. With issues of globalization, crisis and pandemics, technology is relevant to improve on doctoral supervision. It is, therefore, recommended that the use of technology should be included in postgraduate pedagogy and teacher education to improve on the quality of doctoral supervision. A similar research work can be carried out in other universities in Cameroon and developing economies to corroborate the findings. A comparative analysis is relevant for generalization and improvement in doctoral supervision.

Keywords: Doctoral education, supervision, higher education, technology

INTRODUCTION AND LITERATURE REVIEW

Doctoral education, which is used interchangeably as PhD education, is relevant for the development of every country because of its impact on research, innovation and knowledge production. This explains why measures should be put in place to improve on doctoral education for the sustainability of education output. One of the recommendations to improve on doctoral education is to provide support that enables students use Information and Communication Technology (ICT) in the research process (Stein and Sim 2020, 1). This has become even more relevant following the COVID-19 experience in Cameroon where face-to-face method of teaching left much to be desired. Educators and/or educationists introduced alternative media of teaching and learning other than the traditional face-to-face approach by incorporating technology. Thus, the use of technology in education is not new but how it is used is most relevant.

In the context of this study, supervision is a process where an experienced educator guides someone who needs to develop specific skills (Hussey and Campbell-Meier 2020, 510). Therefore, doctoral supervision is a collaborative process between the supervisor and doctoral student (Jackson, Tamara, and Kim 2021, 1064). The process requires the student to develop knowledge and understanding and make contributions to a body of knowledge in their chosen discipline by sharing experiences and working alongside their supervisor (Polkinghorne et al. 2023, 46). This requires maximum collaboration and positive interpersonal relationship between the supervisor and the supervisee. The use of ICTs in doctoral education provides alternative ways for students to communicate with their supervisors, and this has implications on their interpersonal relationship.

With the expansion of higher education and increase in the demand for PhD studies that have greatly increased the number of students per supervisor, more alternative approaches to supervision are required for supervisors and supervisees to strike a right balance between quality and productivity.

The use of technology in supervision is one way to make supervision hitch-free. This is only possible if supervisors and students have the knowledge and skills for effective practice. Worthy of note is the fact that teachers in higher education (HE) do not undergo teacher education training before recruitment, except for those who studied education as a specialized field. As such, teaching, research and supervision are based on experience and policy recommendations. An enquiry on the practice of technology-assisted supervision will provide

insight regarding policy recommendation on the training of doctoral supervisors for improved productivity of graduates. Motshoane and McKenna (2021, 14) considered doctoral supervision as a form of pedagogy per se. It is a form of professional development that is relatively new or non-existence in many higher education institutions in the world. As such, there is a need to focus more on the pedagogy of doctorate (Huet and Casanova 2021, 774).

Previous research on doctoral education has mostly focused on the market for PhD graduates (Etomes and Molua 2023; Ganning and Figueroa 2019; Germain-Alamartine et al. 2021), issues on the supervisory processes (Khosa et al. 2020; Omona 2020), policy responses related to doctoral education (Cuthbert and Molla, 2016) and the quality of PhD programmes (Nerad and Evans 2022). Few research works on the use of digital technology in doctoral supervision (Yatich 2021; Stein and Sim 2020) were mostly carried out in the global north. In addition, none of such research works known to the researchers has been carried out in Cameroon. As such, this research project will contribute to literature on doctoral education in Cameroon and Africa.

The Use of ICTs in Doctoral Education

Doctoral education is key to scientific and research development and transfer of knowledge in the global economy (Ruano-Borbalan 2022, 367). Institutions such as the academia mostly recruit doctoral graduate because they need their skills and expertise to improve on the quality of the institution while individuals demand for doctoral education to improve on their living standards, both in terms of employment and earnings (Sarrico 2022, 1303). Hramiak (2017, 31) found that doctoral education impacted the professional practice of graduates both as teachers and learners. However, the supervision process plays a key role in the doctoral journey (Yatich 2021, 49), especially the extent to which the supervisors communicate with their students and provide appropriate support for quality outcome (Le et al. 2021,1). With issues of globalization, supervisors need continuous professional development (Huet and Casanova 2022, 775), especially in the use of ICTs which Maor and Currie (2017, 14) recommend to be integrated in postgraduate supervision pedagogy.

The use of ICTs in doctoral supervision reduces the demands from supervisors and supervisees, and provides an array of tools and applications online for supervisors and students (Gumbo 2019, 108). This is in line with Jowi et al. (2018, 23) who show that the use of online platforms for supervision improves on quality. In a related study on the use of web-based tools to develop collaborative supervision by Maor et al. (2015), findings reveal that web 2.0 tools developed greater dialogue and interaction between students and supervisors rather than a

passive viewing of content. In addition, supervisors, together with their students, created virtual spaces that combined technology and pedagogy into the process where research projects could be developed in a core collegial and collaborative way. Some of the ICT tools identified for effective use in the supervisory process include mobile phones, Skype, Drop Box and Twitter (Maor and Currie 2017, 8).

While previous studies acknowledge the support of ICTs in supervision, little is known about the skills for effective and efficient use in doctoral research setting (Sim and Stein 2019, 1). Depending on the perception of the use of ICT by students and supervisors, it can either be seen as a challenge, a change or an opportunity in the doctoral research process (ibid). This study investigates the practice of technology-assisted doctoral supervision and how lessons from this practice can improve on doctoral supervision in Anglo-Saxon universities in Cameroon. This raises the following questions: How does the use of ICT tools in doctoral supervision impact the supervisory process? And what are the factors that hinder effective use of technology in doctoral supervision? We statistically tested the hypothesis that there are no significant effects on the use of technology in doctoral supervision.

Application of the Affordances Theory on Technology-Assistive Education

The study adopted Gibson's (1979) Affordance theory that focuses on the relationship between animals (including human beings) and an object. It explains the relationship between an object and a subject which has a range of functions as well as provide constraints (Davis and Chouinard 2017, 2). A previous study by Hammond (2010, 1) has related the Affordance theory to the use of ICT in education. This is because "objects compel use, and people are conditioned at the level of perception by the form, substance, or texture of the objects. This means objects have intrinsic, pre-cognitive meanings; they speak a language of their own, shaped by what they can do for us" (Matei 2020, 7).

In the present study, the theory provides insights regarding how the use of ICTs in doctoral supervision can be beneficial to the supervisor and supervisee. Access to technology affordances by students and teachers in higher education will improve the success rate (Aluko 2021, 44) of students. Aluko and Ooko (2022, 431) stress the need for digital literacy for the 21st century, drawing experience from the COVID-19 pandemic. An experience from Cameroon during the lockdown showed poor performance of some students in higher education due to inadequate knowledge and skills in online learning, access to online resources and

management of online studies (Etomes 2022, 39). Considering that crisis and pandemics are inevitable, the need for technological affordance cannot be overemphasized.

RESEARCH METHODOLOGY

Research design

The study adopted an exploratory, sequential mixed method where qualitative data was collected and analysed and results from the qualitative data based on themes generated were used to develop the quantitative instrument for data collection and analysis to further explore the problem (Creswell and Plano Clark 2011, 5). This approach was selected because it provides in-depth exploration of the problem before validation, allowing for greater versatility in discovering new ideas (Cooper and Schindler, 2013,1). In addition, a larger population is involved in the quantitative phase which gives room for generalization of findings. As such, this approach comparatively provides more vigorous validity (Heesen et al. 2019, 9).

Qualitative Phase

The qualitative phase involved focused group discussions with PhD students from the two Anglo-Saxon universities in Cameroon: the University of Buea and the University of Bamenda. The snowball sampling technique was used to select n=80 PhD students from a population of n=174 PhD students from the 2020 cohort in 9 successive focused groups. Channels used include WhatsApp fora for students, colleagues and heads of department to disseminate the information to recruit students for the study. The choice of the sample was justified by the fact that students admitted in November 2020 are expected to complete course work by December 2021. They were assigned to supervisors in February 2022. The research process for doctoral students is usually two years. As such, one-year experience is enough to provide valuable response to the questions under investigation. The focus group discussion was done online using a Zoom meet.

Quantitative Phase

Findings from the focus group discussion was used to generate a questionnaire that was administered to doctoral supervisors. The study purposively selected n=210 (142 male and 68 female) doctoral supervisors with a minimum of 5 (five) and a maximum of 20 (twenty) years

of experience. The snowball sampling was used to sample each participant for the study. Heads of departments were the major channel used to recruit supervisors. The questionnaire was made available in hard and soft copies. The soft copy was in a Google form. As such, administration was done using face-to-face and online platforms such as WhatsApp and emails.

Empirical Analysis

The qualitative data was analysed using thematic-content method that involved the development of codes and themes, while the quantitative data was analysed descriptively using the statistical package for social science (SPSS) version 25.0, frequency counts and percentages. Statistics from the test of normality showed that the data does not significantly deviate from the normal distribution pattern (p-values > 0.05). Therefore, the Pearson parametric test was used to test the significant impact of the use of ICTs on doctoral supervision. The findings from both qualitative and quantitative analysis were integrated during data presentation.

ETHICAL CONSIDERATION

Participants' consent was solicited before participation. Each participant clearly read the consent form and agreed to participate in the survey. Participants were given at least a week and at most two weeks to respond to the questionnaire or take part in the focus group discussion. This provided ample time for them to read the information sheet and consent form and decide whether to participate or not. Anonymity of participants was ensured as names and personal characteristics of participants were excluded in the presentation of results. Participants were also given codes during the focused group discussion. Furthermore, a letter of authorization was provided by the University of Buea research unit where one of the researchers is attached to, to carry out this research project. This guaranteed access to the study area.

FINDINGS

The presentation of the findings was based on the sections in the questionnaire. The findings from the questionnaire and focus group discussions were presented concurrently to provide a better understanding of the problem under investigation (Fetters, Curry and Creswell 2013, 3)

Students were involved in 9 focus group discussions on the use of technology in doctoral supervision as shown in Table 1. FG1-FG9 represents focus group 1 to focussed group 9.

FG1_1 represents focussed group 1 participant 1up to focus group 1 participants 11 (FG1_11). This presentation follows for all 9 focus group discussion panels.

Table 1: Number of PhD Students in Focus Group Discussion Panels

Focus Groups (FG)	Participants Categories	Number of Participants
FG1	FG1_1, FG1_2, FG1_3, ……FG1_11	11
FG2	FG2_1, FG2_2, FG2_3, ……FG2_10	10
FG3	FG3_1, FG3_2, FG3_3, ……FG3_10	10
FG4	FG4_1, FG4_2, FG4_3, ……FG4_8	08
FG5	FG5_1, FG5_2, FG5_3, ……FG5_10	10
FG6	FG6_1, FG6_2, FG6_3, ……FG6_10	10
FG7	FG7_1, FG7_2, FG7_3, ……FG7_8	08
FG8	FG8_1, FG8_2, FG8_3, ……FG8_7	7
FG9	FG9_1, FG9_2, FG9_3, ……FG9_6	6
Total		**80**

Also, considering that the questionnaire for supervisors included both closed and open-ended questions, codes were also assigned to supervisors as S1-S210 for sample quotations of the open-ended questions.

Section 1: Practice of technology-assisted doctoral supervision

This section presents findings related to the type of ICT tools used by both supervisors and students and the impact of these tools on doctoral supervision. The impact can either be positive or negative.

Most of the ICT tools used by both students and teachers included mobile phones, laptops, Google handles, emails, voice recordings, Telegram and Zoom meet. However, all students who used technology tools with supervisor reported that the most used tool is the mobile phone as indicated by some of the students.

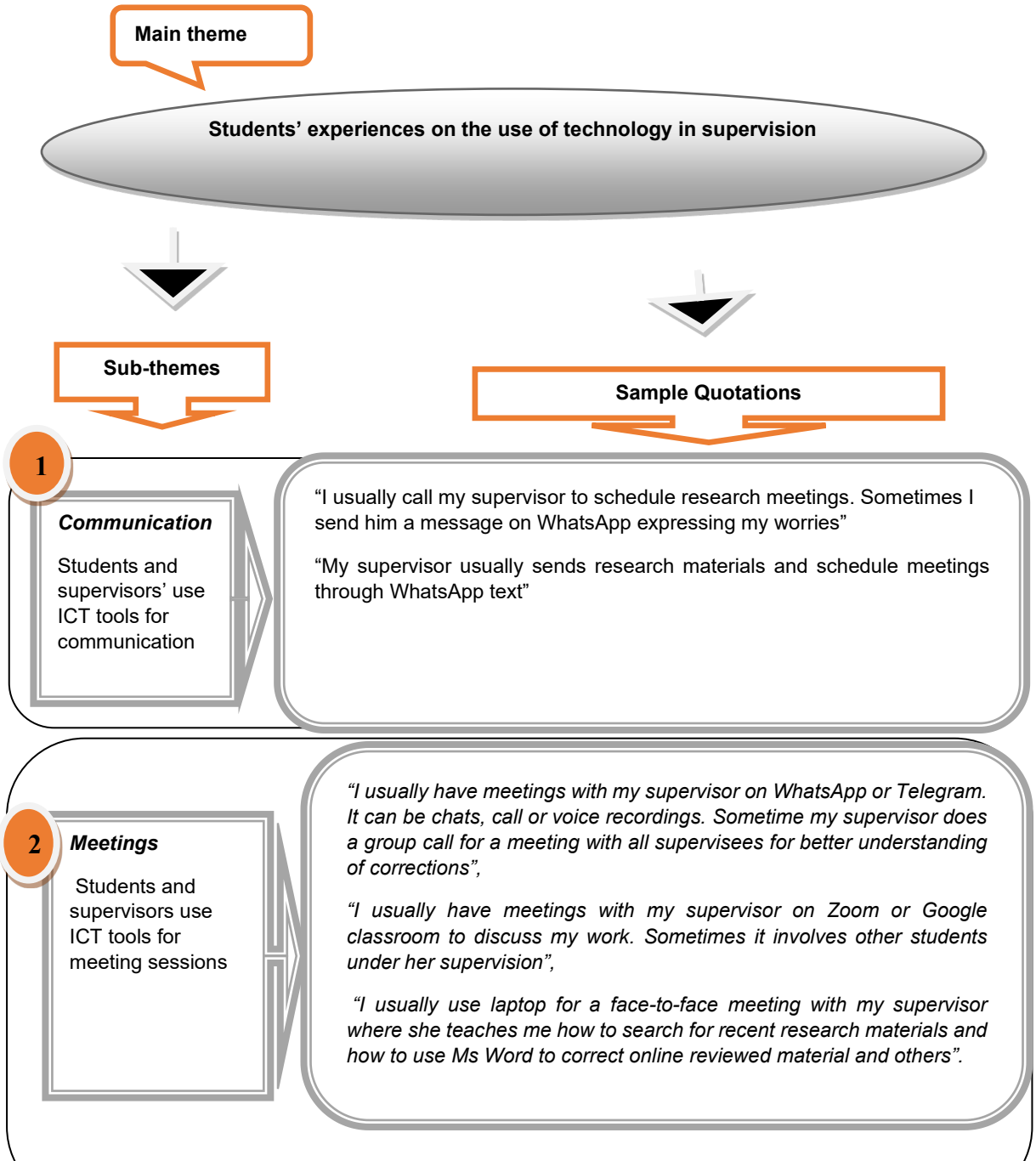
The students also reported that they mostly use mobile phones in the supervisory process because their supervisors are not versed with the use of most technological tools. This is in line with the findings from the supervisors which indicated that most PhD students used WhatsApp 92.9% (195), followed by mobile phones 92.4% (194), emails 79.5% (167) and Google handles 70.5% (148). A lesser number of supervisors use Zoom meet 40.0% (n=84), while only 19.0% (n=40) use Telegram and 15.2% (n=32) use Dropbox. Figure 1 shows students' responses on how these tools were used by supervisors and supervisees in the supervision process.

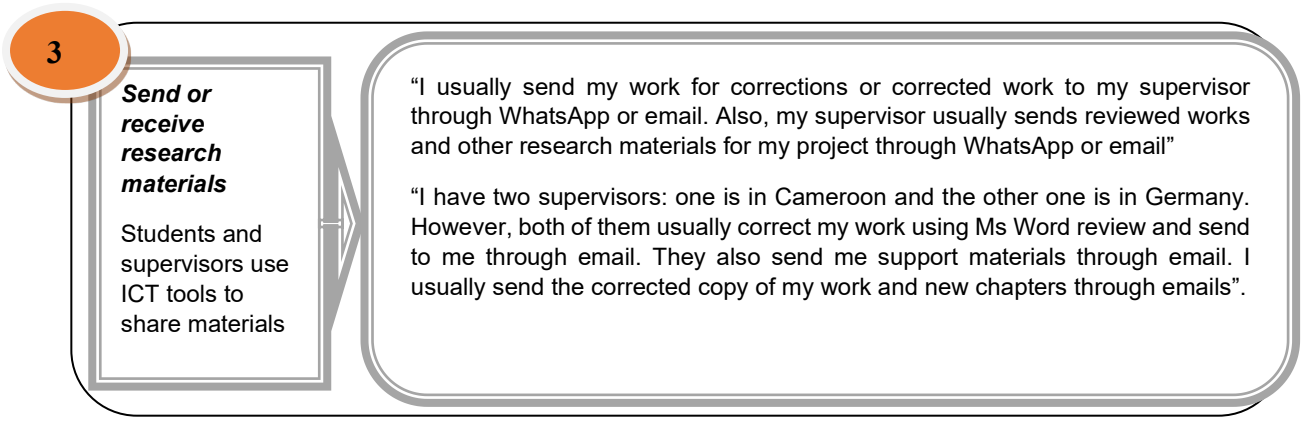
Figure 1 shows that students and supervisors use ICT tools in the supervision process for communication, meetings and to send or receive research materials. Most students used mobile phones to communicate with their supervisor by making calls to schedule an appointment for a meeting or ask questions for clarification. These involved the use of WhatsApp or normal text

messages and voice recordings. Students also attested that they use platforms such as Telegram, WhatsApp and emails to communicate with their supervisor (s).

Supervisors and supervisees usually discuss key issues concerning a research work, do corrections and follow-up. Some meetings are on a one-to-one basis or group that included other supervisees. Some students and supervisors used laptop during the face-to-face meeting to teach students how to use some ICT tools in research. This includes how to google search recent research materials to strengthen their work, edit work using Microsoft Word review tab, and how to format a research work for proper and orderly presentation of materials. Some students attested that during the face-to-face meetings with their supervisor, they use their mobile phones to record the discussion with the knowledge of the supervisor. One of the participants indicated that:

Figure 1: Students' experiences on the use of technology in doctoral supervision





> "My supervisor advised us to record the discussion during the meeting. Listening to the recording over and over enable me to understand corrections and not to repeat the same error"; (FG6_3)

At the beginning of every supervision process, supervisors create a WhatsApp forum or Instagram forum for their supervisees to ease communication. One of the participants indicated that he was elected the course delegate to coordinate the activities of the group which involves both PhD and Masters research students under the same supervisor. Based on this, they have meetings to discuss their challenges and help each other while he sends a report to the supervisor. To follow up and address the problems that students face in the supervisory process, the supervisor sometimes organises meetings to discuss related difficulties with them.

It was observed that students usually send their research work to their supervisor(s) through WhatsApp and emails for correction, and supervisors sent reviewed work and other research materials through the same channels.

Findings also revealed that few of the participants did not have the opportunity to engage with their supervisors using technological tools. Their supervisors do not take calls or reply to text messages or emails. They only communicate with their supervisors during face-to-face meetings if they are fortunate to meet them on seat, and if they are not busy. One of the students reported that:

> "I tried calling my supervisor when I was just assigned to him and he warned me never to do that again, if I want to see him, I should come to his office. But most often I stand by the office for long hours, sometimes for about three days before he could grant me audience. Sometimes, he will ask me to come and see him in two days after waiting for almost the whole day and it is very frustrating". (FG1_9)

This is more challenging, time consuming, sometimes frustrating and creates conflict between the supervisor and supervisee.

Rating supervisors' use of ICT tools

The findings from the supervisors supported that of the doctoral students with respect to the use of ICT tools in the supervisory process. Overall, 38.3 per cent of supervisors used ICT tools always, 51.4 per cent used it sometimes and 10.3 per cent never used it. Specifically, more of supervisors 65.7% (n=138) always call supervisees when necessary (e.g., to pick up their work, schedule meetings, etc). Similarly, 61.0% (n=128) accepted to always communicate with supervisees via ICT tools with respect to issues concerning their research project. 64.8% (136) supervisors sometimes send students' corrections online (e.g., WhatsApp, email, etc.) and have virtual meetings with supervisees (n=131) through WhatsApp, Telegram or Zoom. Supervisors (n=104) sometimes receives research work from supervisees through WhatsApp or emails.

Even though supervisors used ICT tools in supervision, they mostly used WhatsApp (92.9%), mobile phones (92.4%) and emails (79.5%) and mainly for communication (sending and receiving information or materials). While less than half (40%) of the supervisors used Zoom meet in the supervisory process, very few supervisors used Telegram (19%) and Dropbox (15.2%).

Supervisors (n=11) also reported that they used laptops to teach their supervisees, through face-to-face working sessions, on how to search for materials online, check for plagiarism, how to develop an online survey, key-in data using software such as Epidata set, and Excel, and how to analyse qualitative data. They (n=18) also teach their supervisees how to prepare good PowerPoint presentations that communicate information in different ways.

Students' knowledge on the use of ICT

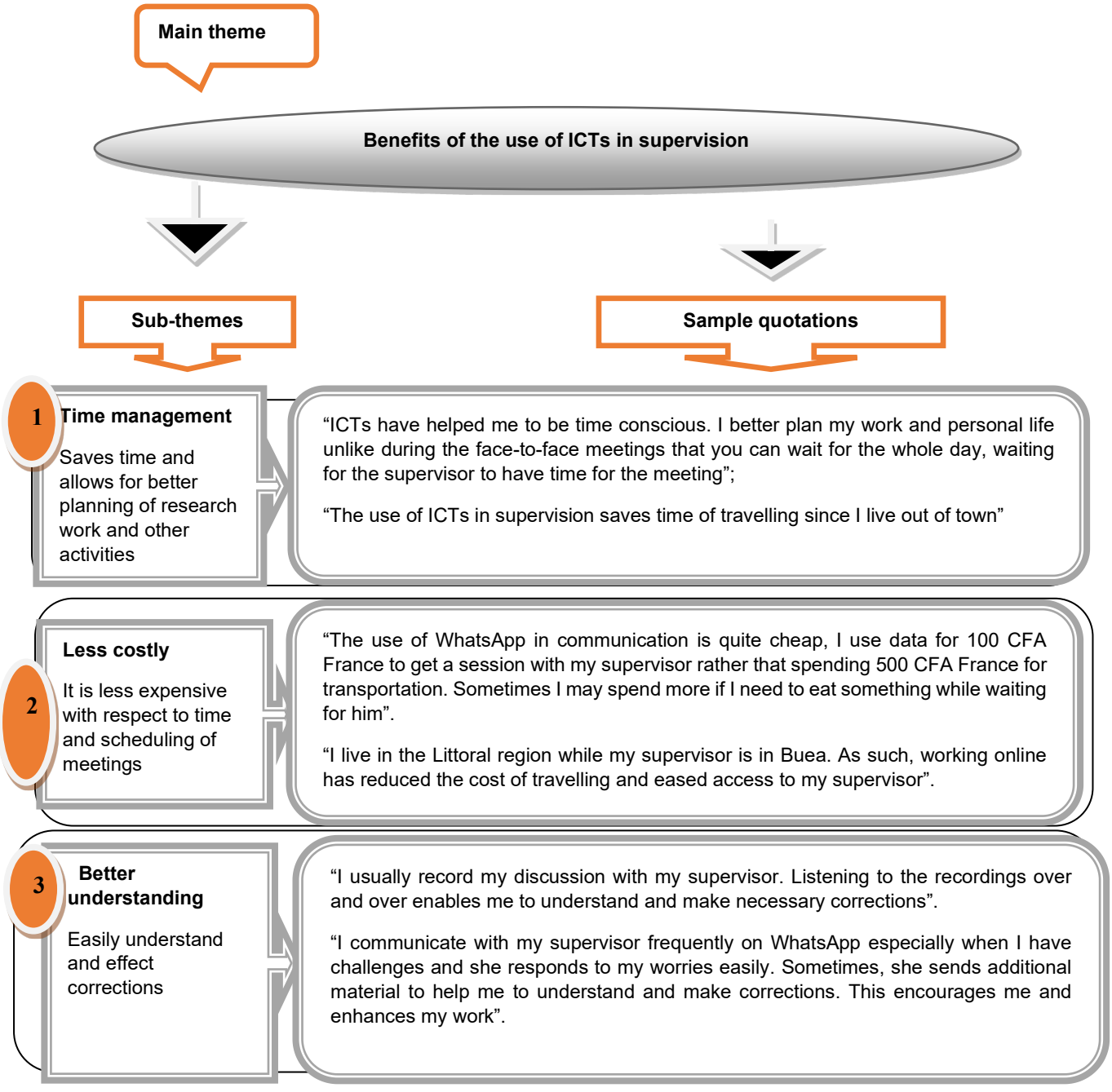
Students' response on their knowledge on the use of ICT revealed that most students have limited knowledge. Most of them could only make use of WhatsApp and Zoom meet. This was justified by the fact that a majority of them have not undergone any training on the use of ICT. They mostly learn from friends and personal discovery, which limits the use of ICT in the supervisory process.

However, another set of students reported that they have undergone training with their supervisors or took short courses which were self-sponsored. This is indicated in some of their direct statements:

> "I had a training on the use of ICTs even though it was very brief. I have also learned a lot from my supervisor; he taught me how to create an online survey when I was about to start field work". (FG2_6)

> "My supervisor provides training to all his supervisee on the use of ICTs in supervision because he is well knowledgeable with the use of ICTs. He taught us how to use Zoom meet, write professional emails, review and make corrections on Microsoft Word and how to search for recent research materials" (FG2_8).

Some students (n=13) reported that this training is ongoing because their supervisor uses every given opportunity to provide training on recent ICT tools. They are encouraged because the supervisor has a mastery of the use of ICT skills. This is mostly common with students from the Faculties of Agriculture and Veterinary Medicine, Engineering and Technology, Health Sciences and Science. Except for the Faculty of Science, these are professional faculties that encourage the use of technology. Figure 2 presents students response on the benefits of the use of ICT in doctoral supervision.



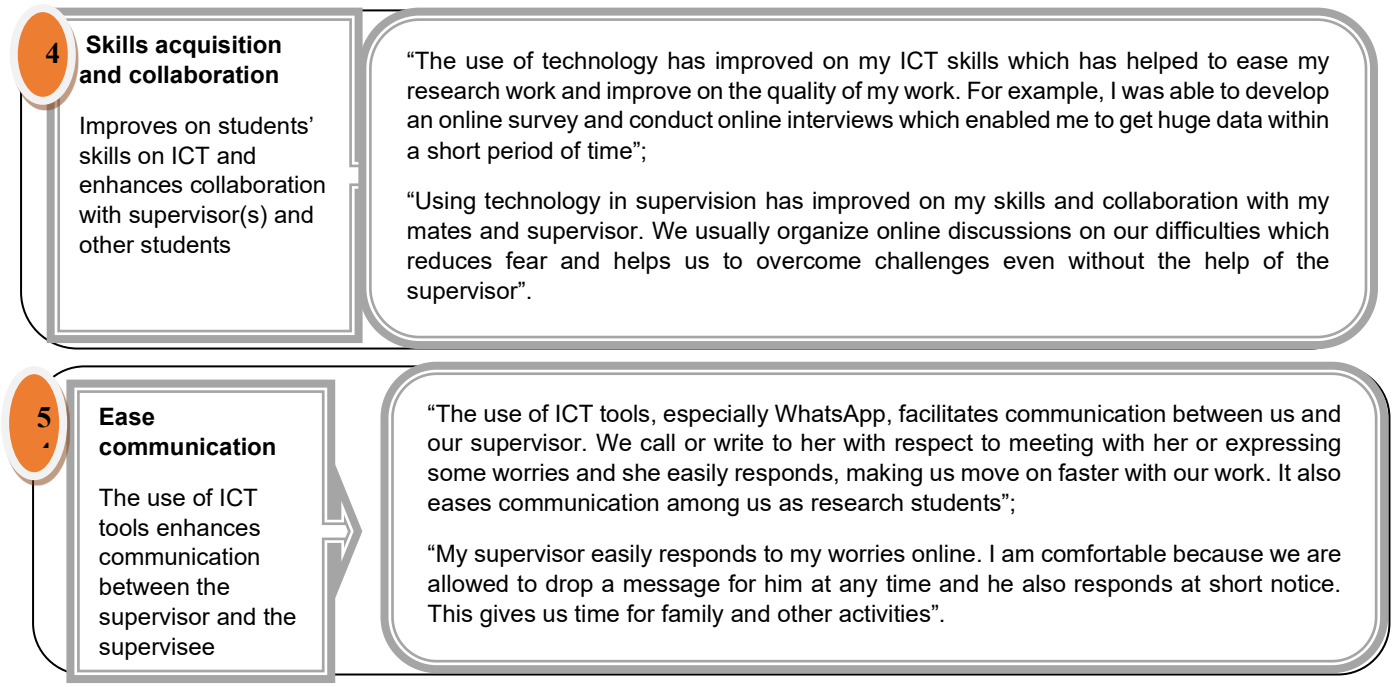


Figure 2: Benefits of the use of ICT in doctoral supervision

While it is evident that students and supervisors used technology in the supervisory process, they attested it has benefits in the supervisory process as seen in Figure 2. The benefits include time management, better understanding of corrections, reduced cost of their research project, easy communication and improved skills acquisition and collaboration with fellow colleagues and the supervisor.

The use of ICTs reduces risk of traveling especially students who stay out of town. Sometimes students travel from one region to another just to submit corrections or receive copies of their corrections. But the use of ICTs where students easily send or receive research work using emails, drop box and WhatsApp, and discuss corrections with their supervisor using online platforms such as Zoom, Google classroom and WhatsApp has made the supervision process easy and encouraging. One of the students attests that:

> "The use of ICT tools has made me more enthusiastic about my work. I easily get corrections from my supervisor and can easily present my worries to him. As such, I am moving faster than I thought in the research process". (FG6_1)

This does not only reduce risk, but the cost of travelling. In addition to cost, students reported that sending and receiving corrections online reduces the cost of printing which is very expensive due to increase in the price of paper on the market. The findings also revealed that

the use of ICTs in supervision has provided opportunity for students to improve on their ICT skills which has enhanced collaboration with their supervisor and their mates. They could organise online meetings without the supervisor to discuss issues related to their research project. As indicated by a participant:

> "The use of ICT tools in supervision helps me to learn how to use new ICT which helps me in other research activities and in performing my job because most of these things are not taught in the classroom". (FG7_2)

The ease of communication is also one of the benefits of the use of ICT tools. It facilitates communication between students and supervisors and amongst students. Students have the opportunity to write to their supervisors on issues related to their work and the supervisor easily respond to their worries which ease the thesis writing process. It also allows students to easily manage their time between research, work and family.

Supervisors' opinion on the Impact of the use of ICTs in doctoral supervision

Based on the importance of ICT tools in doctoral supervision, overall, 92.8 per cent of supervisors accepted that it impacts supervision while 7.2 per cent disagreed. Specifically, all supervisors 100% (n=210) accepted that the use of ICT tools saves time. Similarly, 98.1% (n=206) of respondents agreed that the use of ICT tools helped them to better manage other activities, while 1.9% (4) disagreed. Also, 96.2% (n=202) of supervisors opined that the use of ICTs improves collaboration with students, while 3.8% (8) disagreed. Furthermore, 94.3% (n=198) of supervisors accepted that the use of ICT enhances the acquisition of ICT skills by both students and supervisor, better manage other activities and makes supervision smoother and easier whereas 5.7% (n=12) disagreed. Similarly, 92.4% (n=194) of supervisors accepted that use of ICT tools enhances communication with supervisees. Also, 90.5% (n=190) of supervisors agreed that ICT tools in supervision facilitate students' completion of project meanwhile 9.5% (n=20) disagreed. 84.8% (n=178) of supervisors also agreed that ICT tools enable students to better understand their work while 15.2% (n=32) disagreed. Finally, 84.5% (n=174) of respondents agreed that the use of ICT tools enhances better understanding of students and their work.

Why some supervisors do not use ICT tools in supervision

With reference to the non-use of ICT tools, findings revealed that although the majority of supervisors agreed that the use of ICT tools impacts supervision, most of them 62.9% (n=132)

still sometimes prefer to meet with students face-to-face while 25.7% (n=54) do it always and 11.4% (n=24) never. Furthermore, 55.2% (n=116) of supervisors sometimes prefer to give their students directives by commenting on drafts using their pens only while 21.9% (n=46) do not always use ICTs to effect corrections and 22.9% (n=48) never. This shows that there is need for improvement of ICT usage by the supervisors.

Among the supervisors (n=24) who indicated they never used ICT tools, their main reason is the lack of ICT skills and knowledge by them and students. Electricity problem, cultural factors, lack of ICT tools and the lack of interest are other reasons mentioned by a few (n=10) of them. A majority of them (n=21 out of n=24) said that their face-to-face method with students helps their supervisees to understand corrections better as depicted by some participants:

> "I use face to face communications in the areas where the students face difficulties", "Face-to-face communications and meetings enhance understandings" (S50)
>
> "There is a better understanding of the issues raised when there is a face-to-face communication between supervisors and the supervisee". (S130)

Other reasons include better communication, strong relationship between supervisor and supervisee and students are better follow-up with face-to-face supervision.

SECTION 2: FACTORS THAT HINDER THE EFFECTIVE USE OF TECHNOLOGY IN DOCTORAL SUPERVISION

This section examined the factors that hinder effective practice of technology by students and supervisors as shown in Figure 3.

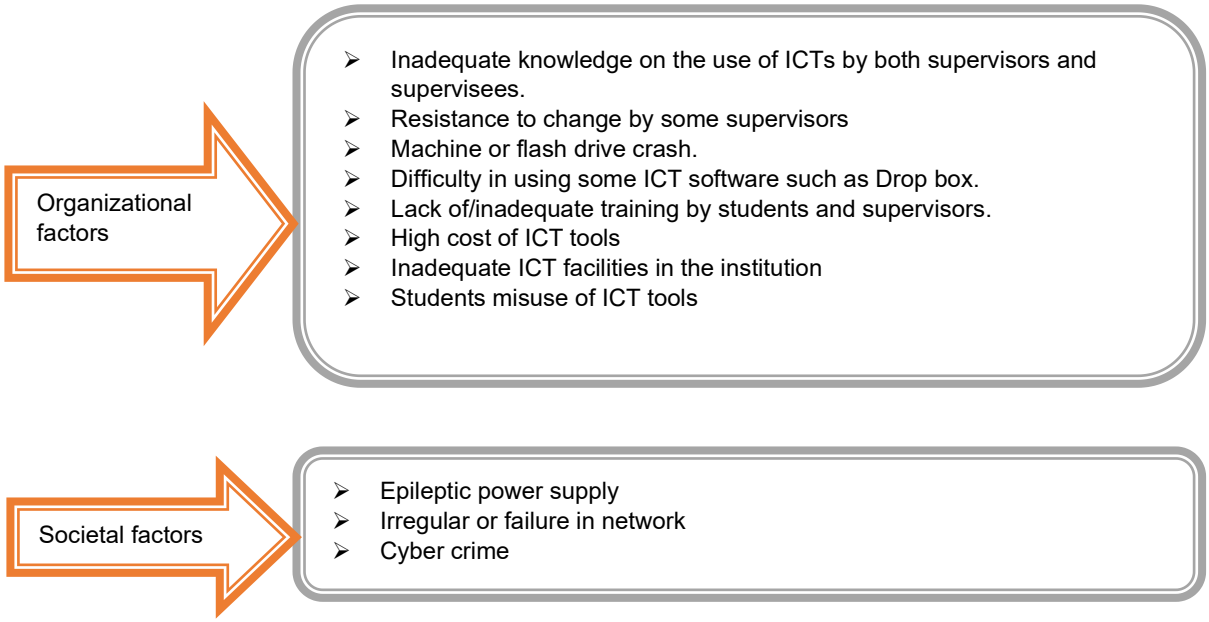


Figure 3: Factors that hinder effective use of technology in doctoral supervision

Students and supervisors identified seven major factors that hindered the effective use of technology in doctoral supervision which are categorized as organizational and societal factors. In examining the organizational challenge, most students and supervisors have inadequate knowledge on the use of ICT tools due to lack of or inadequate training on ICTs. This makes it difficult for them to use some ICT software such as Dropbox.

Some students complained that some supervisors refused to receive soft copy or do track changes with the excuse that they do not know how to do it. This is more frustrating to them because it is not only expensive to print corrections all the time but also time consuming.

A few of the supervisors (n=6) complained of having eye problem that prevents them from reading soft copy. Other supervisors suggested that the inadequate knowledge in the use of technology by both teachers and students makes tracking changes complicated as identified by one direct statement:

> "While editing research project online is a major challenge because it takes too much of my time and (I) sometimes find it difficult to explain certain corrections online, the few attempts have proven problematic because students find it difficult to effect corrections online effectively and could not trace some of the corrections made. Such problem hardly occurs using hard copies of the thesis". (S16)

In addition, some of the supervisors that are versed in the use of ICT tools do not have time and patience to teach supervisees but they expect them to use it in the supervisory process which is quite challenging. Another organizational challenge is the loss of research materials due to flash drive or machine crash. This is coupled with the fact that they have no mastery on how to store their materials in case of such incidence.

Societal factors

The two major societal factors that hinder effective use of ICTs in the supervision process are the epileptic power supply and irregular Internet network. Most of the students who use ICT tools with their supervisor reported that sometimes their meetings are cut short or rescheduled due to either power cut or irregular Internet access. This sometimes delays their work, because it takes about one week to reach their supervisor on phone, especially those staying out of town because of poor network.

Table 2: ***Summary of descriptive statistics***

Variables	N	Minimum value	Maximum value	Mean	Standard deviation
Use of ICT tools	210	1	3	2.28	0.586
Impact of ICT tools on supervision	210	1	4	3.41	0.591
Non-use of ICT tools in supervision	210	1	3	2.06	0.632

The descriptive summary statistics showed that on a mean scale of 1-3 and with a cut-off point of 2, the mean value for the use of ICT tools is 2.28, while that for non-use of ICT tools in supervision is 2.06. This implies that most supervisors do not regularly use ICT tools. Only a few of them use it regularly (always). However, despite the fact that most supervisors do not always use ICT tools, the mean value for impact of ICT tool on supervision is 3.41 on a mean scale of 1-4 which is far above the cut-off point of 2.5. This implies that the majority of supervisors accepted that the use of ICT tools impact supervision.

Correlation Analysis

Table 3: Perceived impact of use of technology on doctoral supervision

		Use of ICT tools	Non-use of ICT tools	Doctoral supervision
Pearson test	R-value	1	-.387**	.418**
	p-value	.	.000	.000
	N	210	210	210
	R-value	-.387**	1	-.027
	p-value	.000	.	.695
	N	210	210	210
	R-value	.418**	-.027	1
	p-value	.000	.695	.
	N	210	210	210

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

Statistically, the findings showed, on the one hand, that there is a significant and positive relationship between the use of ICT tools and doctoral supervision (R-value .418**, *p*-value 0.000< 0.05). On the other hand, the non-use of ICT tools was found to have a slight negative effect on doctoral supervision but not significant (R-value = -.027, *p*-value .695>0.05).

DISCUSSION OF FINDINGS

The use of technology in teacher education supervision is one way to make supervision smoother considering that the supervision process is usually a stressful one for both supervisors and students. It is more challenging within a context where most supervisors are involved in teaching, other research activities and administration. Therefore, engaging in supervisor development activities such as training in the use of ICTs will improve on competence and quality (Pyhältö, Lotta and Henrika 2024, 560). While the use of ICTs is recommended for doctoral education, skills and understanding of effective and efficient use is most relevant (Sim and Stein 2019, 1).

The successful use of technology is only possible if supervisors and students have the knowledge and skills required for effective practice. The findings revealed that most supervisors and supervisees used ICTs in the supervisory process but the ICT tools used was limited to mobile phones, laptops, Google handles, emails, voice recordings, Telegram and Zoom meet. They mostly use ICT tools to schedule meetings, communicate and send or receive research materials. Indeed, very few students had online meetings with their supervisors while very few supervisors could review research work online. Communication is key in the supervisory process because it enhances understanding and collaboration (Le et al. 2021, 2).

The limited use of ICTs in the supervisory process was due to lack of or inadequate knowledge in the use of technology by both students and their supervisors which supports the findings of Gumbo (2019, 104) in investigating the University of South Africa supervisors' knowledge of technological tools and ICTs for postgraduate supervision. Similar research by Zaheer and Munir (2020) on supervising research thesis online revealed that irregular contact, technology and time constraints were the main issues faced by supervisors. Supervisors faced challenges in virtual communities and academic collaboration. According to Zaheer and Munir (2020, 141), students' attitude and supervisor's mindset are key to the success of distance research supervision.

This supports Gibson's Affordance theory which emphasizes the benefits of the interaction between subjects and objects such as ICT tools (Davis and Chouinard 2017). The subjects in this case are the students and supervisors while the objects are the ICT tools. The effective use of the object (ICT tools) in supervision provides varied opportunities for students and supervisors to improve on supervision (Matei 2020, 2). Given that doctoral education creates an opportunity to improve on the skills of both teachers and students (Hramiak 2017, 42), inadequate or lack of ICT skills limits research collaboration and practice and these were some of the benefits of the use of ICTs in supervision identified in this study. This is contrary to the findings of Maor and Currie (2017, 1) who investigated the use of technology in

postgraduate supervision pedagogy in Australian universities and found that supervisors were competent in the use of ICT tools and even initiated the uptake of new technology in the supervisory process.

In exploring the Affordances theory on newly introduced hybrid-model teacher education programme in developing context, Aluko (2021, 52) found that students hardly participated in online studies due to limited access to the Internet, the cost of bandwidth, technophobia and inadequate online and academic support. Aluko's findings reaffirmed the interdependent relationship that exists between both individuals and the affordances that exist in an environment which supports the findings of this study. However, while students in her research were provided technological affordances such as online digital resources, online discussion forums, Wiki summaries and trainings on how to use the provided learning management system, students in the present study do not have such opportunities. They struggle on their own to gain access to some ICT tools which was a major limitation to their use.

Despite the fact that supervisors and supervisees used limited ICT tools in supervision, it was evident that it had a positive impact on the supervisory process as evident in time management, better understanding of concepts, access to research material, ease of communication, skills acquisition and collaboration. This implies the introduction of technological affordances to support the supervisory process will produce more positive results. This supports the assumption of the Affordance theory that the interaction between subjects and objects speak their own language and is shaped by what they can do (Hammond 2010, 1–2). As such, the integration of ICTs in postgraduate supervision pedagogy is identified as one way to improve on the quality of doctoral supervision especially in the collaboration between the supervisor and supervisee (Maor and Currie 2017, 14). While it provides a range of tools for use by both the supervisor and supervisee, it reduces their demands in terms of meetings, time and research materials (Gumbo 2019, 102) which improves on the quality of supervision.

The correlational analysis depicts a slight negative effect on the non-use of ICT on supervision, because students whose supervisors could not use ICTs in supervision felt isolated, making the process frustrating for them while their counterparts felt supported and encouraged by their supervisors. Dropping-of and picking-up research projects without discussion on corrections made by the supervisor can be very frustrating if students do not understand the corrections made. Also, there is the probability for the students to repeat the same mistakes that warrant correction, which delays completion and may lead to dropout. This is in line with the study of Netshitangani and Machaisa (2021, 13) on supervision experiences of postgraduate students at an open distance learning institution in South Africa. This implies that if supervisors and supervisees are engaged in the regular use of ICT tools in the supervisory process, the

quality of supervision will be improved which is seen in the quality of thesis produced, time in completing the project and engagement with the research community. However, this should be supported by regular supply of power and Internet connection which is a major setback in the effective use of ICTs in supervision. Nevertheless, the perception of the supervisor and supervisee on the use of ICTs in the supervisory process is key to its success (Stein and Sim 2020, 3)

CONCLUSION

This study investigated how the use of technology can enhance the quality of doctoral supervision and factors that hinder the effective use of technology in supervision. It explored the extent to which doctoral supervisors and supervisees use technology in supervision and the challenges encountered. The use of technology is evident but limited to basic tools such as WhatsApp, emails and telegram. However, it had a positive and significant impact on the supervisory process. With issues of globalization, crisis and pandemics, technology is relevant to improve on doctoral supervision. It is therefore recommended that the use of technology should be included in postgraduate pedagogy and teacher education to improve on the quality of doctoral supervision. Postgraduate students should also be trained on the use of online resources and learning management system. In addition, institutions should provide the relevant technological affordances such as stable Internet connection, online digital resources and learning management systems to support supervisors and supervisees.

This study was limited to the two Anglo-Saxon universities out of the eleven state universities in Cameroon. This poses a limitation with issues of generalization of findings. As such, a similar research work can be carried out in other universities in Cameroon and developing economies to corroborate the findings. Furthermore, the study was limited to supervisors and doctoral students. Working with other stakeholders such as university administrators and policy makers in higher education may provide in-depth results to improve on the practice of doctoral education. Also, the use of one theory to support the study is a limitation. The use of a more robust theoretical framework and deeper engagement with existing theories on doctoral supervision and technology integration is relevant for further research.

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