THE ASIAN BULLETIN OF BIG DATA MANAGMENT
Vol. 5. Issue 1 (2025)
https://doi.org/10.62019/abbdm.v5i1.324

Challenges and Practices of University Teachers in Embedding Information and Communication Technology while Supervising M.Phil. and Ph.D. Scholars' Research

Nosheen Kanwal, Shehzad Ahmed, M. Tahir Khan Farooqi

Chronicle

Article history
Received: Dec 24, 2024
Received in the revised format: Jan 6, 2024
Accepted: Jan 14, 2025
Available online: Jan 26, 2025

Nosheen Kanwal, Shehzad Ahmed & M. Tahir Khan Farooqi are currently affiliated with the Department of Educational Research and Assessment (DERA), Faculty of Education, University of Okara, Pakistan.
Email: nosheenkanwal38@gmail.com
Email: dr.shehzad@uo.edu.pk
Email: drtahirafarooqi@uo.edu.pk

Corresponding Author*

Abstract

The purpose of the study was to ascertain the perceptions, basic skills, practices, and challenges of supervisors about embedding the latest Information and Communication Technology (ICT) applications in the process of supervising M.Phil. and Ph.D. scholars' research. To investigate the research problem, a quantitative method was used. The population of the study includes all faculty members such as Assistant Professors, Associate Professors, and Professors from public sector universities of Punjab. The sample of the study includes 173 university teachers, who accessed using multistage sampling techniques. Data was collected through a questionnaire named ICTI-IRSPS for supervisors, developed and validated by the researcher. The research tool's overall reliability for supervisors was .897. The reliability range by component was .797 to .828. Data was analyzed using SPSS. Major findings of the study include that faculty members as research supervisors have positive perceptions and low levels of basic skills about ICT applications. They practice the ICT apps to some extent under the supervision of M.Phil. and Ph.D. Researchers. The main obstacles they face during the research supervision process are technical, budgetary, and lack of knowledge and training about the use of particular ICT applications. It is recommended that training workshops may be conducted, equipped computer labs may be established, and specific funds may be specified for the integration of the latest ICT in the research supervision process.

Keywords: ICT, Supervisors, Research Supervision, M.Phil. and Ph.D. students.

INTRODUCTION

ICT is a comprehensive term used in Information Technology (IT). It refers to all areas of communication technology, such as the internet, wireless networks, cell phones, processors, software, middleware, video conferences, social interaction, television, radio, and many other mass media applications (Basri et al., 2018). ICT use has resulted in remarkable advancements in every area of life, especially in developing countries where it has improved the teaching and learning process and caused major changes in the roles of students and educators. The latest ICT applications are significantly impacting the world economy and promoting human progress (Daniels, 2002; Birgin et al., 2020). Its scope, including access to global knowledge, information, communication, enjoyment facts, etc., is unmatched in terms of human advancement. ICT's sophisticated equipment has greatly expanded people's communication options, which has altered several industries, including business, education, engineering, and medicine (Yusuf, 2005). Bulman and Fairlie (2016) claim that the literature analysis led to the development of a brand-new type of supervised learning that embraced the idea of building researcher communities and promoting collaboration. The concepts of group supervision, more intense supervision, and

connection were all part of this more participatory supervision, according to Shahzad et al. (2020). The student, the supervisors' team, and a small number of peers postgraduate students who could or might not be outside subject-matter experts will make up the group. According to Aitchison and Lee (2010), enculturation into a disciplinary community whether it be one discipline or multi/transdisciplinary was essential to many of the new supervisory techniques. By combining this process with liberation, graduate students were able to discover their professional "voice." The ability to become active as independent researchers in their own right, independent of their supervisor's reputation or research agenda, is referred to as "voice" in such circumstances (Essays, 2018).

Numerous technologies, such as Skype, Elluminate, Wimba, Second Life, the phone, MSN Messenger, Wikis, microblogging, email, ePortfolio, Microsoft Office Share-Point for group authoring, and WebCT, are increasingly being used in supervision (Kay et al. 2019). Technological developments in data management tools, software, and predictive analytics (e.g., NVivo, CAQDAS, QDA Miner, and MAXQDA) can potentially have a rapid impact on research methodologies. These new tools facilitate the exchange of research findings and allow students to act as de facto teachers for their supervisors (Basri et al., 2018; Lawal & Olawale, 2020).

ICT Integrated Supervision in Pakistan

Being the sixth most populous country in the world, Pakistan has a massive population. The duty of providing education is scary to the vast majority of people. A shortage of institutional capacity to meet educational demands results from a big population and a small number of trained faculty members (Hadi & Muhammad, 2019). The establishment of online educational institutions was one strategy for addressing this problem, and the Pakistani government took the lead in this area. The Allama Iqbal Open University, established in 1974, and the Virtual University of Pakistan, established in 2002, are the two online and remote learning institutes now functioning in Pakistan. Additionally, ICT-integrated supervision programs have been launched at numerous traditional colleges. Aspiring students use education more effectively when supervision is coupled with ICT. ICT-integrated supervision solves faculty, infrastructural, and capacity issues (Hadi & Muhammad, 2019). It provides all students with equal access to standardized, high-quality content.

Higher education students typically struggle to complete their research projects within the allotted time (Costa, 2018). Supervisors are crucial to research supervision, regardless of the type of education, conventional or ICT-integrated supervision. Supervisors must be motivated to keep an eye on the students (Askew et al., 2016). Research supervisors are impacted by four elements, according to Askew et al. (2016): workload agreements, time demands, student quality, and acknowledgment of the supervisors' contributions. A social relationship between two people who may have different opinions but share the same goals is called supervision. "Intensive, interpersonally focused one-to-one relationship between the supervisor and also the student" is how supervision is defined (Louw & Wood, 2018). During a thesis or research activity, supervision is essential, and the student-supervisor connection influences whether the research thesis is completed successfully (Da Costa, 2016; Lawal & Olawale, 2020). Due to time constraints enforced by the Higher Education Commission, these universities may be concentrating on increasing the throughput of students' theses (Rahman, 2011).

Challenges in the deployment of ICT during the Supervision of Research Process in Pakistan

The majority of university researchers in Pakistan encounter numerous difficulties when conducting their studies (Abbas & Shekarey, 2010). Researchers' interest in technology, supervisor recommendations, lack of time, confidence in utilizing electronic devices, technological knowledge and skills, inadequate training, technical support, and the expensive cost of hardware are typically the most prevalent obstacles. A lack of software in the classroom can seriously limit what students and teachers can accomplish using ICT (Al-Rashed, 2002). Mumtaz (2000) asserts that a major obstacle to undertaking research at universities is the lack of adequate technological resources. He went on to say that as part of an effort, all Pakistani universities gave their lecturers laptops in 2002. The initiative's outcome showed that teachers were now involved in helping students to use ICT.

To fully profit from ICT, universities need the necessary training; this is one of the major challenges that has been identified in the literature (Kay et al. 2019; Hadi & Muhammad, 2019). According to Al-Rashed (2002), ensuring that students, teachers, and other individuals from other professions obtain the benefits of ICT training is a difficult undertaking. For both educators and learners, training is crucial. According to Cox (1999), university instructors who merely know how to turn a computer on and off require professional development training and use technology for instruction. Oyaid (2010) asserts that to enhance students' learning, university instructors must receive training. University instructors expressed interest in receiving training on new technology utilized in classrooms, such as digital cameras, printers, and scanners. Inadequate training that lacks appropriate pedagogy is widespread; teachers do not deploy high levels of ICT applications, claim Unal and Ozturk (2012).

Challenges in understanding issues related to scientific study involve a large number of universities (Hadi & Muhammad, 2019). At the university level, students must note their areas of study because changes in education are increasing day by day with the help of technology (Khan & Khan, 2011; Mertala, 2019). As noted, research with the support of technological tools is becoming very common at present. Instrumentation is necessary in all fields of research, so instrumentation is very important in the growth of new materials. The use of electronic tools enables the researcher to get an idea of what is important or not (Littlejohn, 2002; Chakraborty et al., 2018). For students, however, the dearth of new material creation presents a significant obstacle. One significant problem that researchers face is the absence of apparatus. One major problem for people who wish to work with novel materials is a lack of infrastructure (Rahman, 2011). Universities in Pakistan require digital libraries and must continue to expand their digital library collection (Nor & Pearson, 2008).

THEORETICAL FRAMEWORK

The present study's theoretical framework is supported by the Technology Acceptance Model (TAM). Davis first presented the Technology Acceptance Model (TAM) in 1989. The most popular model for revealing user acceptance performance is this one. In social psychology, this model more especially, the Theory of Reasoned Action (TRA) is frequently used. According to the TRA theory, human ideas influence attitudes, which in turn influence goals and, ultimately, produce performance or behavior (Adams, Nelson & Todd, 1992).

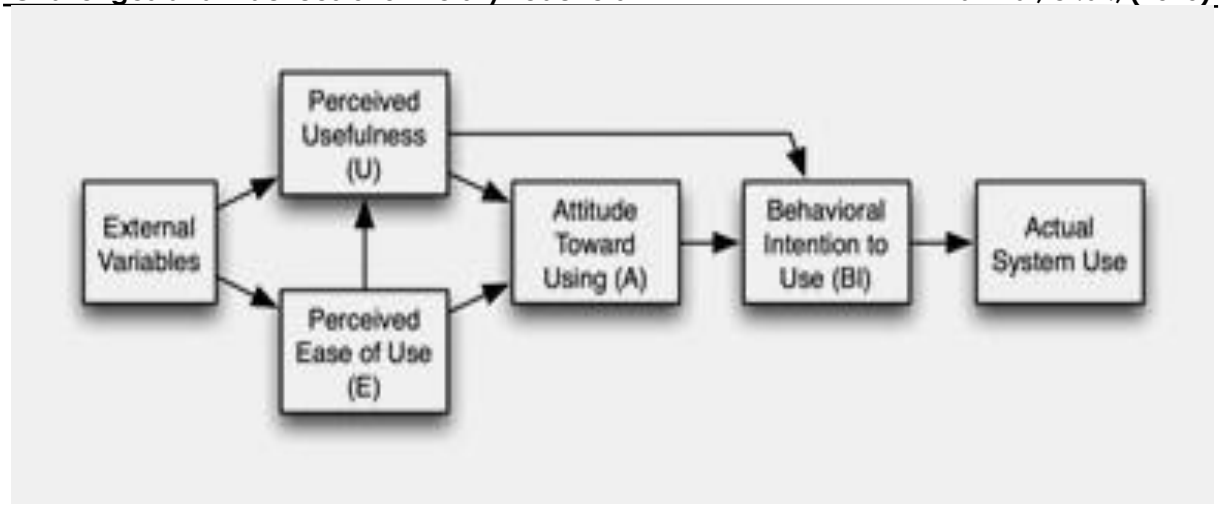

Figure 1.
Technology Acceptance Model (Davis, 1989)

• **Perceived Usefulness (PU),** The degree to which an individual thinks that employing a technique will improve his performance at work is known as perceived usefulness (Venkatesh & Bala, 2008)

• **Perceived Ease of Use (PEOU)** The degree to which an individual thinks that utilizing a method will be effortless is known as Perceived Ease of Use (Venkatesh & Bala, 2008).

ICT has changed the entire world, but in Pakistan, M.Phil. and Ph.D. researchers are still supervised using outdated techniques. It is necessary to look into the ICT-related circumstances surrounding Punjab's postgraduate research supervision procedure. The degree to which supervisors incorporate ICT applications into the research supervision process, as well as the supervisors' basic knowledge of the most recent ICT applications, must be taken into account. Examining the various obstacles that supervisors encounter when utilizing ICT applications for research supervision at Punjab's public universities whether they be technological, financial, pedagogical, or health-related is essential.

- To find out the perceptions of supervisors regarding using ICT in Punjab's public universities during the research supervision procedure.
- To inquire about the level of basic skills of supervisors regarding using ICT in Punjab's public universities during the research supervision procedure.
- To examine the extent of practices of supervisors regarding using ICT in Punjab's public universities during the research supervision procedure.
- To find out the main challenges supervisors face regarding using ICT in Punjab's public universities during the research supervision procedure.

RESEARCH HYPOTHESIS

H_o 1. The practices of supervisors based on designations such as Assistant Professor, Associate Professor, and Professor regarding using ICT in Punjab's public universities during the research supervision procedure, do not differ significantly.

H_o 2. The practices of supervisors based on years of experience regarding using ICT in Punjab's public universities during the research supervision procedure, do not differ significantly.

H_o 3. The challenges of supervisors based on designation such as Assistant Professor, Associate Professor, and Professor regarding using ICT in Punjab's public universities during the research supervision procedure, do not differ significantly.

H_o 4. The challenges of supervisors based on years of experience regarding using ICT in Punjab's public universities during the research supervision procedure, do not differ significantly.

METHODOLOGY

A quantitative method was used to investigate the research problem. The population of the study includes university teachers such as Assistant Professors, Associate Professors, and Professors who are supervising M.Phil. and Ph.D. Scholars during their research process in the public sector universities of Punjab. The sample of the study was selected using multi-stage sampling techniques. Data was collected through a questionnaire named ICTI-IRSPS for supervisors, which stands for Information and Communication Technology Integration in Research Supervision Process Scale developed and validated by the researcher. The reliability of the research tool was .897. The reliability range by component was .797 to .828. Data was analyzed using SPSS, specific tests include Mean, Standard Deviation, T-Test, and ANOVA.

RESULTS

Demographic Descriptions of Participants

Table 1.
Perceptions of Supervisors

University	**Frequency**	**Percentage (%)**
University of the Punjab, Lahore	72	41.6
Bahauddin Zakariya University, Multan	52	30.1
The Islamia University of Bahawalpur	49	28.3
Total	173	100%
Gender	**Frequency**	**Percentage (%)**
Female	76	43.9
Male	97	56.1
Total	173	100%
Designation	**Frequency**	**Percentage (%)**
Assistant Professor	107	61.8
Associate Professor	48	27.7
Professor	18	10.4
Total	173	100%
Supervising Scholars	**Frequency**	**Percentage (%)**
M.Phil.	28	16.2
Ph.D.	56	32.4
Both M.Phil. & Ph.D.	89	51.4
Total	173	100%
Experience	**Frequency**	**Percentage (%)**
1-5	6	3.5
6-10	56	32.4
11-15	77	44.5
16-20	28	16.2
20+	6	3.5
Total	173	100%

Research Objective 1: To find out the perceptions of supervisors regarding using ICT in Punjab's public universities during the research supervision procedure. Supervisors' opinions about the several ICT apps utilized in the research supervisory process are displayed in Table 1. It's useful that most respondents had favorable things to say about using ICT applications.

Items	Mean	St. D	S.D	D.A	N	A	S.A
Using ICT makes communication easier	4.16	1.091	5.8	5.2	2.3	41.0	45.7
ICT use fosters teamwork	4.09	1.122	5.2	6.4	8.1	34.7	45.7
ICT use saves time.	4.18	1.066	3.5	6.9	7.5	32.4	49.7
Using ICT makes information organization simple	4.14	.930	2.9	3.5	9.2	45.7	38.7
ICT use increases productivity	4.06	.998	2.9	7.5	6.9	46.2	36.4
Living and working in the twenty-first century requires the use of ICT	4.27	1.056	3.5	5.8	7.5	27.2	56.1
Using ICT promote autonomy in researcher	3.92	1.025	3.5	8.7	9.8	48.6	29.5
Using ICT promote smart work	3.94	1.185	6.4	7.5	12.1	33.5	40.5
ICT play vital role in research supervision process	4.05	.939	1.7	8.1	6.9	50.3	32.9
Using ICT improve my research supervision skills	4.29	.863	1.2	4.0	7.5	38.7	48.6
Total	4.109	.3318					

S.D (Strongly Disagree), D.A (Disagree), N (Neutral), A (Agree), S.A (Strongly Agree)

According to 86.7% of respondents (M=4.16, SD=1.091), ICT applications make communication easier. According to the same survey, 80.4% of supervisees (M=4.09, SD=1.122) concurred that ICT applications encourage teamwork. The majority of supervisors have favorable opinions on the use of ICT applications throughout the research and supervision process, as evidenced by the overall Mean Score of 4.1092 and SD=.33188. Research Objective 2: To inquire about the level of basic skills of supervisors regarding using ICT in Punjab's public universities during the research supervision procedure.

Table 2 .
Basic Skills of Supervisors

Items	Mean	St. D	S.D	D.A	N	A	S.A
I have access to a variety of search engines, including Ask.com, Wikipedia, Google Scholar, Yahoo, and others	3.90	.992	2.9	9.2	9.2	52.0	26.6
I am able to use digital libraries such as the World Digital Library, Open Library, and Internet Archive	4.13	.944	1.2	7.5	9.2	41.6	40.5
I can access many theses, textbooks, and research journals by using the Pakistan Research Repository	3.99	.985	2.3	7.5	12.1	44.5	33.5
I have access to a variety of online journals, including Taylor & Francis, ScienceDirect, JSTOR, and others	3.98	.918	2.9	4.6	11.6	53.2	27.7
Online data gathering platforms like SurveyMonkey, Typeform, SurveyPlanet, SurveyGizmo, SoGoSurvey, and others are available to me	1.98	.892	27.2	57.8	7.5	4.6	2.9
I am able to analyze quantitative data using a variety of software programs, including MATLAB, SAS, STATA, and SPSS	2.02	.988	26.6	60.7	1.2	6.9	4.6

I am able to analyze qualitative data using a variety of software programs, including Qualtrics, Quirkos, MAXQDA, and NVivo	2.13	.944	22.0	57.8	8.1	9.8	2.3
For reference management, I can use a variety of programs, including Mendeley, EndNote, Zotero, RefWorks, JabRef, and others	1.83	.955	40.5	48.6	1.7	6.4	2.9
I have access to various plagiarism detection programs, including Grammarly, Article Checker, Turnitin, DupliChecker, and others	2.15	1.040	28.3	45.1	12.1	12.1	2.3
I am able to submit research reports for publication using a variety of ICT apps, including those from Elsevier, Wiley, Sage Publications, and others	1.95	1.090	39.9	42.8	4.6	8.1	4.6
Total	**2.806**	**.3038**					

The basic skills of supervisors in ICT applications utilized during the research supervision process are shown in Table 2. The table makes it clear that supervisors disagreed with the statement that they possess fundamental skills for major applications, but they agreed with it for certain ICT applications. According to 78.6% of participants (M=3.90, SD=.992), they can use a variety of search engines, including Ask.com, Wikipedia, Google Scholar, Yahoo, and others. Similarly, 82.1% of respondents (M=4.13, SD=.944) said they could use a variety of digital libraries. 78% of supervisors (M=3.99, SD=.985) concurred that they could access various theses, research journals, and textbooks through the Pakistan Research Repository. Thus, the overall Mean Score of 2.8064 and SD=.30388 shows that the majority of supervisors have a low level of basic skills in ICT applications used in supervising researchers. Research Objective 3: To examine the extent of practices of supervisors regarding using ICT in Punjab's public universities during the research supervision procedure**.**

Table 3.
Practices of Supervisors

Items	Mean	St. D	S.D	D.A	N	A	S.A
I use a variety of ICT applications, including WhatsApp, Skype, and email, to interact with researchers	3.73	1.041	5.2	8.1	15.6	50.9	20.2
I provide scholars with feedback on their research work using Microsoft Word's Track Changes feature	2.69	1.049	8.7	45.1	19.1	23.1	4.0
I provide online feedback and assess supervisees' work	2.82	1.145	6.9	45.1	16.8	21.4	9.8
I set up an internet discussion board so that my supervisees may communicate with one another	2.72	1.103	8.1	46.8	17.9	19.7	7.5
I give academics advice on many search engines, including Ask.com, Wikipedia, Google Scholar, Yahoo, and others	2.72	1.087	7.5	47.4	17.9	20.2	6.9
I instruct students on several digital libraries, such as the World Digital Library, Open Library, and Internet Archive	2.71	1.146	9.8	45.1	19.7	15.6	9.8

I post various assignments, timetables, and deadlines for supervisees using Google Classroom	2.95	1.104	6.9	34.7	22.0	28.9	7.5
I instruct students on document formatting	2.98	1.181	8.7	34.1	18.5	28.3	10.4
I instruct students on various software programs for analyzing both quantitative and qualitative data	2.56	1.183	16.8	43.4	14.5	17.9	7.5
I check student papers for plagiarism using Turnitin	2.46	1.123	20.2	40.5	16.2	19.7	3.5
Total	2.832	.4671					

Table 3 reflects the practices of supervisors regarding different ICT applications during the research supervision process. 71.1% of supervisors (M=3.73, SD=1.041) agreed that they communicate with their supervisees using different ICT applications such as Email, Skype, WhatsApp, etc. 53.8% of supervisors disagreed that They provide researchers with feedback on their study work using Microsoft Word's Track Changes feature, while only 27.1% (M=2.69, SD=1.049) agreed that they can use track change option in MS Word. Similarly, 52% of supervisors disagreed that they evaluate the research work of their supervisees online and give feedback online, while only 31.2% (M=2.82, SD=1.145) agreed that they consider work online. Thus, the overall Mean Score 2.8324 and SD=.46717 shows the low level of ICT practices on the end of supervisors during the process of research supervision. Research Objective 4: To find out the main challenges supervisors face regarding using ICT in Punjab's public universities during the research supervision procedure.

Table 4.
Challenges of Supervisors

Items	Mean	St. D	S.D	D.A	N	A	S.A
I'm not enough trained to use ICT	4.14	.833	06	5.2	9.2	49.1	35.8
I don't have any educational resources to help me use ICT	4.06	.867	1.2	5.8	10.4	51.4	31.2
I deal with technical problems including bad infrastructure, pirated software, and a lack of an internet connection	4.16	.868	.6	5.8	9.8	44.5	39.3
I don't have enough resources to help me use ICT	4.01	1.097	2.9	9.8	12.7	32.9	41.6
I have trouble comprehending the English-language instructional materials	2.40	1.195	24.3	39.9	12.7	17.3	5.8
I'm not confident using ICT	3.95	1.122	2.9	12.7	9.8	35.8	38.7
There is no motivation for me to use ICT	3.61	1.189	8.1	11.6	14.5	43.4	22.5
Using ICT frequently can lead to health issues	4.17	.829	1.2	4.0	8.1	50.3	36.4
I lack the funds necessary to use ICT	2.63	1.172	14.5	41.6	19.1	16.2	8.7
It takes too long to use ICT to find pertinent content	2.90	1.270	15.0	28.9	18.5	26.0	11.6
Total	3.602	.4299					

Table 4 reflects the challenges that supervisors face regarding using different ICT applications during Punjab's public universities' research supervision procedure. 84.9% of supervisors (M=4.14, SD=.833) agreed that they don't have adequate training in

using ICT applications, while only 11.2% agreed about having training in ICT. 82.6% of supervisors agreed that they do not have pedagogical support for utilizing ICT while conducting research supervision, while only 7% of participants (M=4.06, SD=.867) disagreed with the statement. 83.8% of supervisors (M=4.16, SD=.868) agreed that they encounter technical problems such as bad internet connection, inadequate infrastructure, software that has been pirated, etc. while only 6.4% disagreed. Thus, the overall Mean Score of 3.6029 and SD=.42990 shows that the majority of supervisors face a moderate level of challenges regarding using ICT during the research supervision process.

H_o 1 The practices of supervisors based on designations such as Assistant Professor, Associate Professor, and Professor regarding using ICT in Punjab's public universities during the research supervision procedure, do not differ significantly.

Table 5.
Differences among Practices of Supervisors regarding ICT Applications based on Designations

	Sum of Squares	*df*	Mean Square	F	p(sig)
Between Groups	23.319	2	11.660		
Within Groups	96.596	170	.568	20.520	.000
Total	119.915	172			

*p<0.05

It is obvious from Table 5 that the F value (20.520) is significant at p=.000, which is less than 0.05. It shows that supervisors differ in their perceptions regarding using ICT during the research supervision process based on having different designations. Thus, it is concluded that supervisors who have different designations, such as Assistant Professor, Associate Professor, and Professor, have differences in perceptions regarding using ICT during the research supervision process. Thus, the challenges of supervisors based on designation such as Assistant Professor, Associate Professor, and Professor regarding using ICT in Punjab's public universities during the research supervision procedure, do not differ significantly.

H_o 2 The practices of supervisors based on years of experience regarding using ICT in Punjab's public universities during the research supervision procedure, do not differ significantly.

Table 6
Difference among Practices of Supervisors regarding ICT Applications based on Experience Years

	Sum of Squares	*df*	Mean Square	F	p(sig)
Between Groups	2.608	4	.652		
Within Groups	117.307	168	.698	.934	.446
Total	119.915	172			

*p<0.05

It is obvious from Table 6 that the F value (.934) is not significant at p=.446, which is greater than 0.05. It shows that supervisors do not differ in their practices regarding using ICT during the research supervision process based on having different years of experience. Thus, it is concluded that supervisors who have different years of experience have no difference in practices regarding using ICT during the research supervision process.

H_o 3 The challenges of supervisors based on designation such as Assistant Professor, Associate Professor, and Professor regarding using ICT in Punjab's public universities during the research supervision procedure, do not differ significantly.

Table 7 shows that the F value (.012) is not significant at p=.988, which is greater than 0.05. It shows that supervisors do not differ in their challenges regarding using ICT during the research supervision process based on their designations. Thus, it is concluded that supervisors who have different designations, such as Assistant Professor, Associate Professor, and Professor, have no difference in challenges regarding using ICT during the research supervision process.

Table 7.
Difference among Challenges of Supervisors regarding ICT Applications based on Designations

	Sum of Squares	df	Mean Square	F	p(sig)
Between Groups	.004	2	.002		
Within Groups	31.784	170	.187	.012	.988
Total	31.789	172			

*p<0.05

H_o 4 The challenges of supervisors based on years of experience regarding using ICT in Punjab's public universities during the research supervision procedure, do not differ significantly.

Table 8.
Difference among Challenges of Supervisors regarding ICT Applications based on Experience Years

	Sum of Squares	*df*	Mean Square	F	p(sig)
Between Groups	.968	4	.242		
Within Groups	30.820	168	.183	1.320	.265
Total	31.789	172			

*p<0.05

It is obvious from Table 8 that the F value (1.320) is not significant at p=.265, which is greater than 0.05. It shows that supervisors do not differ in their challenges regarding using ICT during the research supervision process based on having different years of experience. Thus, it is concluded that supervisors who have different years of experience have no difference in challenges regarding using ICT during the research supervision process.

DISCUSSIONS

Findings show that supervisors have the opinion that ICT applications promote productivity, collaboration, and smart work during the research supervision process. Supervisors get facilitated and can perform a lot with minimum time and effort. According to the findings, supervisors believe that using ICT apps to oversee research enhances their abilities as researchers and is essential to the research and supervision process. These findings are aligned with the literature (Dange, 2010; George et al., 2006; Akinoso, 2018; Zonneveld et al., 2020; Basri et al., 2018). The study also looked into how supervisors deploy ICT applications throughout the process of supervising researchers. The amount to which supervisors employ ICT applications has been attempted to be determined. Findings from questionnaires show that the majority of participants integrate the ICT applications on which they have skills, and with external help such as by watching videos on YouTube regarding the use of specific tests for specific purposes. The majority of supervisors expressed that they usually perform analysis of quantitative data by using SPSS, but they are only able to perform descriptive analysis, for further analysis they seek help from an expert. The same findings were reported in the literature of (Chakraborty et al., 2018; Hadi &

Muhammad, 2019; Lawal & Olawale, 2020; Shahzad et al., 2020; Siddiquah & Salim, 2017; Ullah et al., 2019). Regarding the analysis of qualitative data, most of the participants expressed that they do it using manual methods, because they do not have skills regarding NVivo, MAXQDA, Quirkos, Qualtrics, etc. Similarly, the majority of participants do not use reference management software, they reported that they manage references manually. Findings are consistent with the research studies (Aderibigbe & Aramide, 2012; Dange, 2010; George et al., 2006; Liew et al., 2000; Rowlands et al., 2007; Tenopir, 2003; Guillén-Gámez et al., 2021; Rodriguez-Segura et al., 2020; Pinkerton, 2021; Hong et al., 2021; Lamond & Cunningham, 2020). Challenges regarding the integration of ICT applications were also investigated through questionnaires. Findings show that participants experience all types of challenges, such as training, technical, financial, and health-related challenges. Findings show that the major challenge that supervisors face is the lack of appropriate training or skills in ICT applications.

The majority of supervisors reported that they do not have training in using specific applications for specific purposes. The main challenge which is reported by the majority of supervisors is related to technical challenges such as inadequate infrastructure, a lack of internet access, pirated software, etc. 3rd challenge according to the majority of participants was the resistance to change, they became habitual to work on manual methods that's why they consider ICT applications as an extra burden. Other challenges that participants face are the lack of material for guidance, health issues, financial issues, etc. These findings are consistent with other studies such as (Adeagbo et al., 2016; Szymkowiak et al., 2021; Liburd & Jen, 2021; Kay et al. 2019; Mertala, 2019). The Government should emphasize in-service training and permanently make it accessible for all university teachers. So, teachers can deal with the fast development. Universities must pay much attention to make students and teachers ready for the technology period. The use of technology must be taught in universities, and standards must be improved (Vannatta & Beyerbach, 2000; Stein et al., 2020; Birgin et al., 2020; Hartman et al., 2019). Students have to manage time to analyze study problems, explore new ideas and concepts, and value research solutions. The researchers create a statistically important association between working with ICT devices and developing critical thinking. The supervisor must encourage new researchers to gain particular technical skills to facilitate learning in ICT conditions (Mumtaz, 2000).

CONCLUSION

The results of the supervisors' questionnaire data led to the study's conclusion. According to the results of the supervisors' questionnaire, most supervisors at Pakistan's public institutions had favorable opinions about ICT applications used in supervising researchers. According to the study's findings, supervisors believe that integrating ICT applications into the research supervision process has increased supervisees' research skills, facilitated communication, encouraged collaboration, and made the process more convenient. According to the study's findings, most supervisors at Punjab's public institutions lack fundamental knowledge of the newest ICT tools utilized in research supervision. According to the study's findings, most supervisors do not incorporate the newest ICT applications into their research supervision process because they are unaware of them or lack sufficient training in them. The study concluded that the majority of supervisors face challenges regarding using ICT applications due to not having adequate training in ICT applications, lack of pedagogical support, poor infrastructure, connectivity issues, virus detection, pirated software, etc. Supervisors

also face health issues while using ICT applications, such as back pain, weak eyesight, joint stiffness, and others. The study concluded that the main obstacle they encounter while utilizing ICT apps is the absence of sufficient instruction on how to use particular ICT applications for particular objectives. The most recent ICT applications utilized in the research supervision process are not well known to most supervisors.

RECOMMENDATIONS

It is recommended that special workshops should be conducted to create awareness about the modern software being used in the world concerning the process of supervising researchers. Well-equipped computer laboratories with the latest software may be established at the department level, where the research scholars could be guided at various stages of their research work regarding the integration of the latest ICT applications. The findings showed that the main hurdle of non-practicing ICT is the lack of resources. Special stipends and grants may be offered to scholars and supervisors regarding getting training on the latest ICT applications that are used in the research supervision process. Guiding material may be made available for supervisors regarding the uses of various ICT applications with translation into the national language. Awareness may be created among supervisors regarding the use of the latest ICT applications, which are being used in developed countries to get maximum output and true benefits of the research supervision process instead of using old manual methods. Supervisors may be encouraged to accept change and implement it practically by integrating various ICT applications into the research process.

DECLARATIONS

Acknowledgement: We appreciate the generous support from all the contributor of research and their different affiliations.

Funding: No funding body in the public, private, or nonprofit sectors provided a particular grant for this research.

Availability of data and material: In the approach, the data sources for the variables are stated.

Authors' contributions: Each author participated equally to the creation of this work.

Conflicts of Interests: The authors declare no conflict of interest.

Consent to Participate: Yes

Consent for publication and Ethical approval: Because this study does not include human or animal data, ethical approval is not required for publication. All authors have given their consent.

REFERENCES

Abbas, Z. E., & Shekarey, A. (2010). NOTE FOR EDITOR: Comparative Study of The Use of Ict in English Teaching-Learning Processes. *Turkish Online Journal of Distance Education*, *11*(2), 13-22.

Adams, D. A., Nelson, R. R., & Todd, P. A. (1992). Perceived usefulness, ease of use, and usage of information technology: A replication. *MIS quarterly*, 227-247.

Adeagbo, O., Van Deventer, M., Asubiojo, B., & Pienaar, H. (2016). Changing information needs of online collaborative researchers: a challenge for reference librarians.

Aderibigbe, N. A., & Aramide, K. A. (2012). Institutional factors and perceived usefulness as predictors of internet use by postgraduate students at the University of Ibadan, Nigeria.

Aitchison, C., & Lee, A. (2010). Writing in, writing out Doctoral writing as peer work. In *The Routledge Doctoral Supervisor's Companion* (pp. 278-287). Routledge.

Akinoso, O. (2018). Effect of the use of multimedia on students' performance in secondary school mathematics. *Global Media Journal*, *16*(30), 1-8.

Al-Rashed, H. A. A. (2002). *Teachers and information communication technology in Saudi Arabia: current use and training needs* (Doctoral dissertation, University of Hull).

Askew, C., Dixon, R., McCormick, R., Callaghan, K., Wang, G. Y., & Shulruf, B. (2016). Facilitators and barriers to doctoral supervision: A case study in health sciences. *Issues in Educational Research*, *26*(1), 1-9.

Basri, W. S., Alandejani, J. A., & Almadani, F. M. (2018). ICT adoption impact on students' academic performance: Evidence from Saudi universities. *Education Research International*, *2018*, 1-9.

Birgin, O., Uzun, K., & Mazman Akar, S. G. (2020). Investigation of Turkish mathematics teachers' proficiency perceptions in using information and communication technologies in teaching. *Education and Information Technologies*, *25*(1), 487-507.

Bulman, G., & Fairlie, R. W. (2016). Technology and Education: Computers, Software, and the Internet. NBER Working Paper No. 22237. *National Bureau of Economic Research*.

Chakraborty, D., Dhara, S. K., & Santra, A. (2018). Effectiveness of ICT in strengthening the process of higher education system in India. *Amity Journal of Management Research*, *3*(1), 40-53.

Costa, K. (2018). A systematic review of challenges in research supervision at South African universities.

Cox, M. (1999). What Factors Support or Prevent Teachers from Using ICT in the Primary Classrooms. British Educational Research Association Annual Conference [Education-line Online] Available at: http://www. leeds. ac. uk/educol/documents/00001304. html

Da Costa, T. P. S. (2016). Supervisor types: which one is your match? *Cell death discovery*, *2*(1), 1-2.

Dange, J. K. (2010). Post Graduate Students' Computing Confidence, Computer and Internet Usage at Kuvempu University--An Indian Study. *Online Submission*, *3*(2), 39-62.

Daniels J.S. (2002). "Foreword" in Information and Communication Technology in Education– *A Curriculum for Schools and Programme for Teacher Development.*

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340.

Essays, UK. (November 2018). Role of ICT in Research Information Technology Essay.

George, C., Bright, A., Hurlbert, T., Linke, E. C., St Clair, G., & Stein, J. (2006). Scholarly use of information: graduate students' information seeking behaviour. *Information Research: An International Electronic Journal*, *11*(4), n4.

Guillén-Gámez, F. D., Mayorga-Fernández, M. J., Bravo-Agapito, J., & Escribano-Ortiz, D. (2021). Analysis of teachers' pedagogical digital competence: Identification of factors predicting their acquisition. *Technology, Knowledge and Learning*, *26*, 481-498.

Hadi, N. U., & Muhammad, B. (2019). Factors Influencing Postgraduate Students' Performance: A high order top-down structural equation modelling approach. *Educational Sciences: Theory & Practice*, *19*(2).

Hartman, R. J., Townsend, M. B., & Jackson, M. (2019). Educators' perceptions of technology integration into the classroom: a descriptive case study. *Journal of Research in Innovative Teaching & Learning*, *12*(3), 236-249.

Hong, X., Zhang, M., & Liu, Q. (2021). Preschool teachers' technology acceptance during the COVID-19: An adapted technology acceptance model. *Frontiers in Psychology*, *12*, 691492.

Kay, R.; Knaack, L.; Petrarca, D. (2019) Exploring teacher's perceptions of web-based learning tools. *Interdiscip. J. E-Learn. Learn. Objects*, *5*, 27–50.

Khan, S. A., Bhatti, R., & Khan, A. A. (2011). Use of ICT by Students: A Survey of Faculty of Education at IUB. *Library Philosophy and Practice*, *1*.

Lamond, B., & Cunningham, T. (2020). Understanding teacher perceptions of assistive technology. *Journal of Special Education Technology*, *35*(2), 97-108.

Lawal, W. O., & Olawale, G. S. (2020). Information and Communication Technology and Research Productivity of Librarians in Bowen University, Iwo, Osun State. *Information Impact: Journal of Information and Knowledge Management*, *11*(3), 22-30.

Liburd, K. K. D., & Jen, H. Y. (2021). Investigating the effectiveness of using a technological approach on students' achievement in Mathematics–case study of a high school in a Caribbean country. *Sustainability*, *13*(10), 5586.

Liew, C. L., Foo, S., & Chennupati, K. R. (2000). A study of graduate student end-users' use and perception of electronic journals. *Online Information Review*.

Littlejohn, A. H. (2002). Improving continuing professional development in the use of ICT. *Journal of computer assisted learning*, *18*(2), 166-174.

Louw, I., & Wood, L. (2018). Reconsidering postgraduate "supervision" from a participatory action learning and action research approach. *South African Journal of Higher Education*, *32*(4), 284-297.

Mertala, P. (2019). Teachers' beliefs about technology integration in early childhood education: A meta-ethnographical synthesis of qualitative research. *Computers in Human Behavior*, *101*, 334-349.

Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: a review of the literature. *Journal of information technology for teacher education*, *9*(3), 319-342.

Nor, K. M., & Pearson, J. M. (2008). An exploratory study into the adoption of internet banking in a developing country: Malaysia. *Journal of Internet Commerce*, *7*(1), 29-73.

Oyaid, A. A. (2010). Secondary Student's Perceptions of Information and Communication Technology and Their Usage of It Inside and Outside of School in Riyadh City, Saudi Arabia. *International journal of applied educational studies*, *7*(1).

Pinkerton, L. (2021). Teachers' Perceptions Of Technology In The Coronavirus Disease 19 Era.

Rahman, G. (2011). Use of computers among students of dental college in Saudi Arabia. *Journal of Education and Ethics in Dentistry*, *1*(1), 12.

Rodriguez-Segura, L., Zamora-Antuñano, M. A., Rodriguez-Resendiz, J., Paredes-García, W. J., Altamirano-Corro, J. A., & Cruz-Pérez, M. Á. (2020). Teaching challenges in COVID-19 scenery: Teams platform-based student satisfaction approach. *Sustainability*, *12*(18), 7514.

Rowlands, I., Nicholas, D., Jamali, H. R., & Huntington, P. (2007, November). What do faculty and students really think about e-books? In *Aslib proceedings* (Vol. 59, No. 6, pp. 489-511). Emerald Group Publishing Limited.

Shahzad, S. K., Hussain, J., Sadaf, N., Sarwat, S., Ghani, U., & Saleem, R. (2020). Impact of Virtual Teaching on ESL Learners' Attitudes under COVID-19 Circumstances at Post Graduate Level in Pakistan. *English Language Teaching*, *13*(9), 1-9.

Siddiquah, A., & Salim, Z. (2017). The ICT facilities, skills, usage, and the problems faced by the students of higher education. *EURASIA Journal of Mathematics, Science and Technology Education*, *13*(8), 4987-4994.

Stein, H., Gurevich, I., & Gorev, D. (2020). Integration of technology by novice mathematics teachers–what facilitates such integration and what makes it difficult? *Education and Information Technologies*, *25*(1), 141-161.

Szymkowiak, A., Melović, B., Dabić, M., Jeganathan, K., & Kundi, G. S. (2021). Information technology and Gen Z: The role of teachers, the internet, and technology in the education of young people. *Technology in Society*, *65*, 101565.

Tenopir, C. (2003). Use and users of electronic library resources: An overview and analysis of recent research studies. *Council on Library and Information Resources*.

Ullah, M. A., Alam, M. M., Shan-A-Alahi, A., Rahman, M. M., Masum, A. K. M., & Akter, N. (2019). Impact of ICT on Students' Academic Performance: Applying Association Rule Mining and Structured Equation Modeling. *International Journal of Advanced Computer Science and Applications*, *10*(8).

Unal, S., & Ozturk, I. H. (2012). Barriers to ITC integration into teachers' classroom practices: Lessons from a case study on social studies teachers in Turkey. *World Applied Sciences Journal*, *18*(7), 939-944.

Vannatta, R. A., & Beyerbach, B. (2000). Facilitating a constructivist vision of technology integration among education faculty and preservice teachers. *Journal of Research on Computing in Education*, *33*(2), 132-148.

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision sciences*, *39*(2), 273-315.

Yusuf, M. O. (2005). Information and communication technology and education: Analyzing the Nigerian national policy for information technology. *International education journal*, *6*(3), 316-321.

Zonneveld, M., Patomella, A. H., Asaba, E., & Guidetti, S. (2020). The use of information and communication technology in healthcare to improve participation in everyday life: a scoping review. *Disability and rehabilitation*, *42*(23), 3416-3423.