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Integration of digital resources in research work by Indian Higher Education teachers: PLS-SEM analysis

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Abstract

The present study attempted to investigate the integration of digital resources in research work by Indian higher education teachers. The success of the digital resources in research can be affected by several factors, such as digital skills, digital flow, anxiety in the use of ICT, digital ethics, quality of digital resources and the behavioral intention to integrate ICT and the relationship between the factors. An online survey originally constructed by Guillén-Gámez et al. (2023) was used to collect data, and the final sample used for this study was 347 teachers of Universities in Punjab, India. Data analysis and hypotheses testing were done using partial least squares structural equations modeling (PLS-SEM). All the hypotheses are supported except hypothesis 10 implying that the quality of technological resources did not influence integration. The total of the factors corresponded to 65.6% of the variance in the integration of ICT in the research process. The results confirm that the model proposed by Guillén-Gámez et al. (2023) in the Spanish context, is effective in the Indian higher Education context in explaining the technological integration of teachers to use ICT in research work. The findings of this study open the possibilities for researchers in India to find out the reasons for the above results by conducting qualitative or mixed-method research in the context of the use of ICT in the Indian higher education landscape.

KEYWORDS: Digital Skills, Technology, Research Process, Higher Education, NEP 2020.

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1. Introduction

Digital competence is one of the main competencies that is much needed in the teachers of higher education institutes. This competency will contribute to a major shift toward the knowledge society that is envisioned by National Education Policy 2020. Digital competence refers to the knowledge, skills, and attitudes that a teacher must possess to maximize the use of technology. Ferrari (2013) defines digital competence as a collection of skills that enables one to use technology to assist us in our daily lives. It may be understood as the confident, critical, and responsible use of technology for work, entertainment, and education (European Commission, 2018; Kaur et al., 2022). To achieve SDGs (SDG-4, SDG-8, and SDG-9) in 2030, digital competence will be a driver in the context of higher education. Quality education along with decent work for economic growth is an aim that every higher education institution aims for. In this century, digital competence is a new kind of resource in the hands of teachers whether at the primary, secondary, or tertiary level.

Many studies have been conducted to map the digital competency of school teachers, but not much work has been done to identify the digital competency of teachers in higher education which is much needed at this level as well. Teachers need digital competency for integrating enhanced teaching methods and it also helps in enhancing the learner's experience. It further helps them to provide an enriched curriculum to the students in the form of academic papers, e- books.

A recent study conducted by Dong et al. (2024) highlighted the importance of digital competence of college lecturers on professional engagement, digital

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resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence to enhance student learning value.

Builes et al. (2024) concluded that for digital competence education, the most frequently identified areas are professional engagement, digital resources and teaching and learning. This study also highlighted the importance of digital training programs in Higher education institutes.

Based on the findings, the researchers advised instructors to receive technology and pedagogy training and institutions to fund infrastructure development.

The enhanced digital competency amongst higher education teachers opens many avenues for them to access online databases, conduct research, and collaborate globally through digital platforms. Canal et al. (2022) reported that the digital skills of professors have an impact on the learning of the students. The enhanced digital competency of the professors could also lead to changes in pedagogy and university management.

The idea of digital competency has drawn more attention within the past ten years. Technology is advancing so quickly that it has unavoidably impacted every industry, including education and research. In the present era, the internet and other digital technology have had a huge impact on us. Not only have technological trends transformed how we live, but they have also affected how we acquire knowledge (Zhao et al, 2021, Chitkara et al., 2020). Any university's primary missions are teaching and research, which is why they invest a lot of financial resources in hiring and developing the finest faculty members. In order to do this, university lecturers use the internet to obtain data for use in their research, teaching, and knowledge-production activities (Kanyengo & Smith, 2022). Academic staff members must be digitally competent in order to carry out their teaching and research duties effectively and efficiently.

Ferrari (2012) defined digital competence as

> *"the set of knowledge, skills, attitudes, abilities, strategies and awareness that are required when using ICT information and communication technologies and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning and socializing".*

The focus on digital competence continues to grow in higher education in the 21st century (Iansiti & Richards, 2020). Furthermore, the incorporation of these applications into the teaching-learning process would be highly advantageous for today's prospective educators, who are digital natives accustomed to using technology in daily life (Guillén-Gámez, Mayorga-Fernández, and Álvarez-García, 2018). To meet the recently enhanced teaching criteria, teachers also need to acquire associated skills and make adjustments to fit the new learning environment.

Guillén-Gámez et al (2021) examined and contrasted the usage of ICT resources to analyze and compare the digital proficiency of teaching staff in higher education when conducting research. Overall, the findings indicated that there were no appreciable variations in the teaching staff members' levels of digital competency between males and females. Significant variations were discovered in the following domains- ICT anxiety, digital skills, digital ethics, quality of ICT resources, and intention to use ICT. The aforementioned results underscore the necessity for academic institutions to put forth training programs aimed at enhancing the digital competencies of their faculty and research personnel in the areas where deficiencies have been identified.

Gámez, Palmero and García (2023) showed that although instructors had appropriate digital research skills, this could vary depending on transversal skills such as creativity and entrepreneurship, with significant disparities when these skills were at the basic level. Furthermore, whether teachers have research expertise in technology, cryptocurrencies, face identification systems, wearables, or robots, among other topics, this has a substantial impact on their level of digital competence in research.

Aliyu, Adamu & Umar (2024) investigated the influence of digital competence in teaching and research of the academic staff of Modibbo Adama University, Yola, Nigeria. The results of the study revealed, among other things, that the academic staff of Modibbo Adama University, Yola, Nigeria had a high level of digital competence, which highly influenced their teaching and research activities.

As a result of the existence of technology in the field of research, there is an urgent need for faculty at the higher education level to possess conceptual, procedural, and attitudinal abilities in order to initiate research (Guzman & Nussbaum, 2009). At the same time, they must have the digital expertise needed to integrate digital resources, search for and understand information more efficiently, and compile and share scientific knowledge (Guillén-Gámez et al., 2020).

The digital skills of professors in universities have been researched a lot over the last several decades (Oguguo et al., 2023; Şimşek & Ateş, 2022), with a skill level ranging from basic to intermediate (Cabero-Almenara et al., 2021; Santos et al., 2021). However, while studies on research skills have been published, yielding average results (Abykenova et al., 2016; Rubio et al., 2018), most studies have focused on Masters students and very less on university teachers.

Furthermore, the scientific literature that focuses on the interconnections between digital capabilities and research activities is less, where ICT is rarely employed to increase research skills, demonstrating basic levels (Robelo et al., 2018; Sánchez & Bucheli, 2020). Therefore, the present study bridges the gap by providing the results of the linkage of digital integration and research in the context of Indian higher education.

2. Theoretical Framework

The present study has used the theoretical framework proposed by Guillén-Gámez et al. (2023). The following section explores the factors that influence teachers' digital competence and how all of these factors interact with one another.

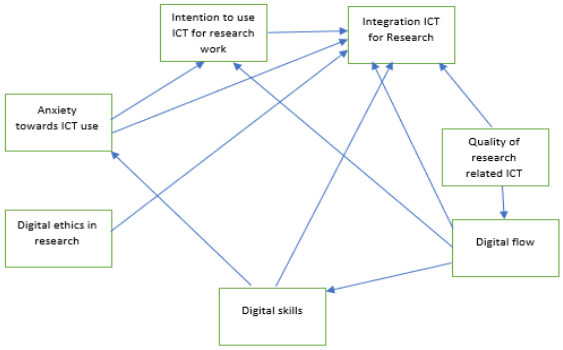

Figure 1 - Theoretical Framework by Guillén-Gámez et al. (2023).

Integration of ICT in Research

Pandey and Pandey (2020) observed that the use of ICT in developing countries like India is on the lesser side as compared to developed countries. According to Mittal (2010), there are disparities in the levels of ICT readiness and use, and this could further cause disparities in the level of productivity which would influence a country's rate of economic growth. Studies have highlighted the role of intentions in predicting ICT integration behaviors (Anderson & Maninger, 2007; Venkatesh et al., 2003; Shiue, 2007). For example, research with 242 Taiwanese science teachers showed that the intention to use ICT strongly predicts its actual use (Shiue, 2007). While intention does not always result in behavior, it is a reliable predictor (Banas & York, 2014). In Czerniak et al. (1999), teachers' intentions explained 18-24% of the variance in actual ICT use. The likelihood of ICT integration increases with stronger intentions (Olugbara & Letseka, 2020). However, teachers are hesitant to use technology if it is subpar (Shiue, 2007), highlighting the need for quality digital resources.

Intention to use ICT for research

Higher education institutions all over the world have increasingly adopted ICT not just for teaching and learning, but also for curriculum development and research. To use technology effectively, teachers must be willing to accept and use it. Sharma and Srivastava (2020) carried out a study in the management institutions in Bengaluru, Pune, Indore, and Delhi to measure the teachers' intention to use technology. The results of the study confirm a significant positive impact of value beliefs, social influence, and perceived ease of use on the behavioral intention to use technology by teachers.

Quality of ICT Resources

Various external factors can significantly affect the integration of ICT in teaching, such as access to the Internet (Lin et al., 2012), available software and hardware (Gil-Flores et al., 2017), and the availability of technical and training support (Lawrence & Tar, 2018). The quality of the resources available in the universities and colleges in India and their easy accessibility to the teachers can help them utilize them for research purposes.

Digital Flow in Research Work

The concept of the flow state was introduced by Csikszentmihalyi in 1975, and it is characterized by a combination of enjoyment and intrinsic interest, with enhanced focus on the task (Davis & Csikszentmihalyi,1977) People experiencing flow are so immersed in a task that they enjoy it completely. If someone gets into the flow state while using ICT, they can start enjoying it and utilizing it effectively. Hoffman and Novak (1996) say that the more individuals experience a flow state, the more likely they are to have higher intentions to use ICT in the future, leading to increased technology use (Ahmad & Abdulkarim, 2019; Kim & Jang, 2015). There has been some research on the concept of flow while using ICT (Sharafi et al, 2006; Rodriguez-Sanchez et al, 2008).

Digital Skills for Research Work

According to DPsouza (2022), India's National Education Policy (NEP) 2020 has proposed many changes in the mainstream education system. Therefore, it is necessary to help the HEI teachers through various initiatives to enhance their technological-pedagogical-content knowledge and help them become more competent in using innovative methods such as inquiry- and problem-based learning effectively, in online, offline, and blended modes. Technological and digital skills include finding, managing, analyzing information, and communicating results. Research skills are defined as the ability to use the scientific method to address and solve problems

(Pérez & López, 1999), utilizing ICT in the process (Hassani, 2015; Murnane & Levy, 1996). Effective use of ICT enables individuals to search for information, manage data, and communicate effectively (García et al., 2018). Proficiency in ICT is crucial for its integration, potentially reducing negative emotions (anxiety) towards its use (Revilla et al., 2017). The European Commission (2006) proposed digital competence as one of the key competencies for lifelong learning and it considers it as one of the key competencies for life (Zvereva, 2023).

Digital ethics in research process

Ethics involves the principles that govern behavior within a community (Dewey, 2008). The rise of digital culture presents ethical challenges for the scientific community (Luke, 2018). Researchers must be knowledgeable about ethical principles (Sanjuanelo et al., 2007) and practice good ICT use (Dominighini & Cataldi, 2017; Stahl et al., 2014). Ethical awareness can promote innovative ICT practices (Stahl et al., 2017). Zvereva (2023) discusses how, in the current scenario, it is important that the relevance of the development of the digital educational environment, the issue of developing ethical regulatory mechanisms in the digital space, revising traditional ethical approaches to assessing the situation and forming new digital educational ethics, be studied.

Anxiety in using ICT for research

Various researchers have categorized attitudes towards ICT into anxiety or stress (Loyd & Gressard, 1984; Yildirim, 2000; Téllez et al., 2022), and it has been defined as a person's reluctance or negative feelings when required to incorporate ICT into their professional activities (Simonson et al., 1987). According to a literature review conducted by Fernández-Batanero et al. (2021), it was found that teachers experience a lot of stress and anxiety related to educational technology, and this stress has only increased over time. A study conducted on 200 university teachers by Mehra and Far (2015) studied their attitudes towards ICT use at different levels of computer anxiety. The study found that teachers with low, moderate, and high computer anxiety exhibited differences in their attitudes toward Information and Communication Technology use. Teachers with low computer anxiety exhibited better attitudes towards Information and Communication Technology use as compared to those with moderate and high levels of computer anxiety.

3. Methodology

3.1 Design and Participants

A non-experimental quantitative survey-type methodology was used. A non-probabilistic purposive sampling was used, collecting a total of 390 responses from Higher Education Teachers of Punjab, India. Out of 390, only 347 responses were selected for further analysis. The sample consisted of 347 Higher education teachers, where 53.6% (n = 186) were female while 46.40% (n = 161) were male teachers. In terms of experience, 19% (n = 66) teachers have 0-5 years of experience, 25.6% (n = 89) teachers have 5-10 years of experience and 55.3% (n = 192) teachers have more than 10 years of experience. In terms of Faculty/Area of Knowledge, 21% (n = 73) teachers belong to Humanities, 36.6% (n = 127) teachers belong to Sciences/Engineering/Medical, 42.4% (n = 147) teachers belong to Social Sciences. Before the teachers filled in the online questionnaire, they have been informed about the purpose of the study. The data collection was carried out anonymously through a form without recording any personal details of Teachers to ensure the confidentiality of teachers.

3.2 Instrument

In this study an instrument developed by Guillén-Gámez et al. (2023) was used to collect data related to use of ICT in research among teachers of Higher Education Institutions. The original instrument composed of 40 questions on 7-point Likert scale. Table 1 shows the items of each dimension together with their corresponding code.

3.3 Data analysis and procedures

This study used PLS-SEM (Partial Least Square – Structural Equation model) for the analysis of the data collected under the purposed model by using Smart PLS software. As this study had two purposes in consideration i.e. testing of theoretical model constructed by Guillén-Gámez et al. (2023) and predicting the model in Indian Higher education context, the use of non-probabilistic purposive sampling with a complex structural model makes a good case for using PLS-SEM for data analysis (Hair et al., 2019).

Following steps were followed during analysis.

For Measurement Model: As per the guidelines given by Hair et al. (2019) for measurement model, Internal consistency (Cronbach alpha value >0.7), Convergent Validity (AVE value greater that 0.50). Discriminant validity (criteria of Fornell-Larcker, Heterotrait-Monotrait correlations (HTMT) and cross-loadings need to be part of reporting.

For Structural Model: Bootstrapping procedure was followed with 10000 samples. Reporting of R square (for explaining the variance in the endogenous variable explained by exogenous variable as per purposed model), t value along p values was done for hypotheses testing. Reporting of effect size (f square) was done with hypotheses testing. Q square values were reported to check the predictive relevance of model (Hair et al., 2019).

Table 1 - Instrument Information Dimension wise and Item Description (adapted from Guillén-Gámez et al. (2023).

Instrument Information Dimension wise and Item Description (adapted from Guillén-Gámez et al. (2023) original paper "Digital competence of teachers in the use of ICT for research work: development of an instrument from a PLS- SEM approach")

DIM.	Code	Scale information	Description
DIM. 1. Digital skills to search for information, manage it, analyze it and communicate results	D1_1	value 1 (I am notable to) to value 7 (I am able to)	I know how to use software for the analysis of qualitative data (Atlas.ti, Nvivo, Ethnograph, Hyperresearch, Maxqda, QDA MINER, NUD*IST)
	D1_2		I know how to use audio and video editors to create and edit collected information through interviews, focal groups, etc. (Adobe Premiere, iMovie, Windows Movie Maker, Audacity)
	D1_3		I have abilities necessary for analysing quantitative data (SPSS, EXCEL, JAMOVI, AMOS, R, Minitab)
	D1_4		I know how to search in scientific data bases (ScienceDirect, ProQuest, PsycINFO, Redalyc.org, Scielo, Academia.edu…)
	D1_5		I know how to use Boolean operators (AND, NOT, OR, XOR) to refine my searches for scientific articles
	D1_6		I have the skills to use bibliographical managers (Mendeley Zotero Endnote, Refworks) those which allow me to store bibliographic references and use such references in my studies following different citation rules
	D1_7		I have abilities in managing my scientific social media, add my published studies and/or consult their reading statistics
	D1_8		I usually use scientific social media to interact with other investigators.
DIM. 2. Digital ethics in digital research	D2_9	value 1 (I never do it) to value 7 (I do it frequently)	I apply the rules of copyright when I share the results of my studies through scientific social media
	D2_10		Before sending a study for its' publication, I digitally check it and apply the publication rules employed in every editorial/journal (APA v.7; Chicago, Harvard…)
	D2_11		I check the original source, and the results of a study referenced by other authors in their original publications.
	D2_12		I check that the bibliography selected for my study comes from journals with a certain grade of scientific prestige (for example, that they use paired revision "double look")
	D2_13		I check that in my studies there is no self-plagiarism or plagiarism of other studies
DIM. 3. Digital flow in research work	D3_26	value 1 (Totally disagree) to value 7 (Totally agree)	I find it gratifying to use ICT resources in my investigation works
	D3_27		I find it enjoyable to use software for the analysis of data both quantitative (SPSS, JAMOVI, R…) and qualitative, Atlas.ti, Nvivo…) to complete my research
	D3_28		I am motivated by the thought that by using digital software for data design and analysis I can more easily publish my scientific achievements in high-impact journals
	D3_29		I like to learn new digital resources that are going to allow me to analyse data and/or communicate the results in some software afterwards
DIM. 4. Anxiety towards the use of ICT resources for research	D4_30	value 1 (Totally disagree) to value 7 (Totally agree)	*It overwhelms me to think that I have to learn to use digital resources to collect data and analyse it with some software afterwards
	D4_31		*It makes me anxious to have to be constantly checking the impact indexes of the journals for if the quartile has increased or decreased
	D4_32		* I get tired of having to constantly use ICTs to position and share my scientific publications and improve my digital reputation through the h-index and/ or the i-index10
	D4_33		* I get nervous when I have to teach a colleague and/or student some ICT resource related to research (Mendeley, SPSS, AMOS, Google form, Atlas. ti…)
	D4_35		*In general, I would prefer not to have to learn or use ICT resources for my research

(continue...)

Instrument Information Dimension wise and Item Description (adapted from Guillén-Gámez et al. (2023) original paper "Digital competence of teachers in the use of ICT for research work: development of an instrument from a PLS- SEM approach")

DIM.	Code	Scale information	Description
DIM. 5. Quality of research-related ICT resources	D5_22	value 1 (It is poor) to value 7 (It is excellent)	My place of work had a good internet connection
	D5_23		My department or my investigation group buys ICT resource licenses that require an additional page
	D5_24		Mi department or my investigation group provides me with all the ICT resources I require for my investigations
	D5_25		My department or investigation group has strong devices (pc/laptops) available so that the technological resources function smoothly and quickly
DIM. 6. Intention to use ICTs for research work	D6_35	value 1 (Totally disagree) to value 7 (Totally agree)	Assuming my educational institution provides me with ICT resources for research work, I intend to use them at some point in time
	D6_36		If the institution to which I belong does not provide me with a certain ICT resource that I require for my research, I am responsible for obtaining it
	D6_37		In the near future, I plan to continue learning how to use ICT resources to expand my research work
	D6_38		I intend to further develop my training in the use of online scientific data- bases for my research
	D6_39		I intend to continue to use and/or use bibliographic managers for my future studies
	D6_40		I want to improve my use of social networks to transfer my research and interact with other researchers
DIM. 7. Inte-gration ICT resources for research	D7_14	value 1 (I never do it) to value 7 (I do it frequently)	I use anti-plagiarism programs (Plagium, Viper, Article checker, Turnitin, Compilatio, etc.)
	D7_15		I use bibliographic managers
	D7_16		I use social media to circulate my scientific publications
	D7_17		I use scientific databases for access to read other studies
	D7_18		I use web search engines to consult bibliographies (Google academic / Google scholar)
	D7_19		I use video conference systems to have meetings with my investigation group
	D7_20		I use Google + collaboratives to host my research data
	D7_21		I use data analysis programs (be it quantitative and/or qualitative)

Note: Items with * in their name have an inverse score

4. Results

4.1 Measurement model

D1-5, D6-36, D7-14, D7-18 items were deleted on the basis of outer loadings with value less than 0.7 (Vinzi et al., 2010). D6-37, D6-38, D2-12, item were deleted based on VIF >5.

Convergent Validity

Table 2 illustrates the Average Variance Extracted (AVE) coefficients for the instrument's factors, demonstrating convergent validity. The AVE values for each factor exceed 0.50, indicating that over 50% of the variance in the teachers' scores can be attributed to their respective indicators. Consequently, the AVE coefficients for the model factors, ranging from 0.60 to 0.79, confirm an adequate level of convergent validity along with respective Cronbach alpha values greater than 0.7 (Wasko and Faraj, 2005).

Discriminant Validity

The discriminant validity was assessed using the Fornell-Larcker (Fornell & Larcker,1981) criteria, which measures the extent to which one construct differs from other constructs in the model along with HTMT ratio. As per the values given in the Table 3, all values are below than 0.90 for HTMT (Henseler et al., 2015), the Table 4 shows that the square root of AVE (diagonal values in italics), for the construct was greater than the inter-construct correlation. Hence, discriminant validity is established.

4.2 Structural model and Hypotheses testing

Following the assessment of the measurement model, the next step was taken for evaluation of structural path for the evaluation of path coefficients (relationships amongst study constructs) and their statistical significance (Table 5).

Table 2 - Loadings, Reliability, Convergent Validity.

DIMENSIONS	ITEMS	Outer loadings	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
D1 - SKILLS	D1-1 <- D1	0.741	0.892	0.896	0.609
	D1-2 <- D1	0.788			
	D1-3 <- D1	0.741			
	D1-4 <- D1	0.705			
	D1-6 <- D1	0.811			
	D1-7 <- D1	0.802			
	D1-8 <- D1	0.865			
D2 – ETHICS	D2-10 <- D2	0.906	0.895	0.905	0.76
	D2-11 <- D2	0.913			
	D2-13 <- D2	0.845			
	D2-9 <- D2	0.819			
D3- FLOW	D3-26 <- D3	0.887	0.879	0.884	0.738
	D3-27 <- D3	0.747			
	D3-28 <- D3	0.923			
	D3-29 <- D3	0.867			
D4- ANXIETY	D4-30 <- D4	0.701	0.837	0.853	0.606
	D4-31 <- D4	0.856			
	D4-32 <- D4	0.749			
	D4-33 <- D4	0.824			
	D4-34 <- D4	0.752			
D5- QUALITY	D5-22 <- D5	0.814	0.913	0.916	0.794
	D5-23 <- D5	0.911			
	D5-24 <- D5	0.899			
	D5-25 <- D5	0.936			
D6- INTENTION	D6-35 <- D6	0.83	0.815	0.819	0.729
	D6-39 <- D6	0.869			
	D6-40 <- D6	0.861			
D7- INTEGRATION	D7-15 <- D7	0.733	0.902	0.904	0.672
	D7-16 <- D7	0.829			
	D7-17 <- D7	0.865			
	D7-19 <- D7	0.862			
	D7-20 <- D7	0.817			
	D7-21 <- D7	0.806			

Table 3 - HTMT (Heterotrait-monotrait Ratio of Correlations) ratio.

	D1	D2	D3	D4	D5	D6	D7
D1 - SKILLS							
D2 – ETHICS	0.551						
D3- FLOW	0.592	0.716					
D4- ANXIETY	0.254	0.499	0.467				
D5- QUALITY	0.512	0.638	0.638	0.401			
D6- INTENTION	0.468	0.724	0.814	0.542	0.429		
D7- INTEGRATION	0.824	0.685	0.685	0.4	0.555	0.538	

Table 4 - Fornell-Larcker Criteria.

	D1	D2	D3	D4	D5	D6	D7
D1 - SKILLS	*0.781*						
D2 - ETHICS	0.503	*0.872*					
D3- FLOW	0.526	0.641	*0.859*				
D4- ANXIETY	0.216	0.43	0.416	*0.778*			
D5- QUALITY	0.464	0.577	0.576	0.35	*0.891*		
D6- INTENTION	0.407	0.622	0.744	0.466	0.382	*0.854*	
D7- INTEGRATION	0.742	0.625	0.61	0.358	0.504	0.464	*0.82*

Table 5 - Hypotheses Results.

Hypotheses		Beta values	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Result	5.00%	95.00%	f-square
H1	**SKILLS -> ANXIETY**	0.216	0.218	0.057	3.805	0	Supported	0.118	0.305	**0.049**
H2	**SKILLS -> INTEGRATION**	0.529	0.531	0.046	11.459	0	Supported	0.446	0.6	**0.542**
H3	**ETHICS -> INTEGRATION**	0.248	0.248	0.05	4.934	0	Supported	0.168	0.335	**0.081**
H4	**FLOW -> SKILLS**	0.526	0.528	0.036	14.592	0	Supported	0.462	0.581	**0.383**
H5	**FLOW -> INTENTION**	0.665	0.664	0.045	14.816	0	Supported	0.589	0.736	**0.877**
H6	**FLOW -> INTEGRATION**	0.212	0.211	0.06	3.528	0	Supported	0.114	0.311	**0.043**
H7	**ANXIETY -> INTENTION**	0.189	0.191	0.055	3.438	0	Supported	0.098	0.28	**0.071**
H8	**ANXIETY -> INTEGRATION**	0.099	0.104	0.038	2.612	0.005	Supported	0.037	0.161	**0.021**
H9	**QUALITY -> FLOW**	0.576	0.578	0.032	18.124	0	Supported	0.521	0.624	**0.495**
H10	**QUALITY -> INTEGRATION**	0	0	0.037	0	0.5	Not Supported	-0.061	0.059	**0**
H11	**INTENTION -> INTEGRATION**	-0.11	-0.114	0.055	1.975	0.024	Supported	-0.199	-0.02	**0.013**

The results of the structural model using PLS-SEM indicate the following.

H1 (SKILLS -> ANXIETY) evaluates whether researcher's digital skills in the use of specific digital resources specific to the research area have a significantly and positively relationship with the level of anxiety that they can feel when using them. The path coefficient (Beta value) is 0.216, with a t-statistic of 3.805 ($p < 0.001$), indicating strong and positive relationship, with a small effect size ($f^2 = 0.049$).

H2 (SKILLS -> INTEGRATION): H2 evaluates whether the researcher's digital skills and their subsequent integration of ICT into research process. The path coefficient is 0.529, with a t-statistic of 11.459 ($p < 0.001$), indicating strong support. This implies that enhanced digital skills significantly contribute to integration of ICT in research process, with a large effect size ($f^2 = 0.542$).

H3 (ETHICS -> INTEGRATION) evaluates whether digital ethical standards had a significant effect on the integration of ICT resources in the research process. The path coefficient is 0.248, with a t-statistic of 4.934 ($p < 0.001$), indicating strong support. Ethics positively affect integration, with a moderate effect size ($f^2 = 0.081$).

H4 (FLOW -> SKILLS): evaluates whether Digital flow in research work significantly affects the digital skills. The path coefficient is 0.526, with a t-statistic of 14.592 ($p < 0.001$), indicating strong support. Flow significantly enhances Digital skills to search for information, manage it, analyze it and communicate results, with a large effect size ($f^2 = 0.383$).

H5 (FLOW -> INTENTION) evaluates whether the researcher's flow state on using digital resources in research tasks has a significant relationship with intention of using these resources in the research process. The path coefficient is 0.665, with a t-statistic of 14.816 ($p < 0.001$), indicating strong support. Flow greatly influences intention, with a very large effect size ($f^2 = 0.877$).

H6 (FLOW -> INTEGRATION) evaluates whether the researcher's flow state on using digital resources in

research tasks has a significant relationship with, integration into this process. The path coefficient is 0.212, with a t-statistic of 3.528 ($p < 0.001$), indicating strong support. Flow positively affects integration, with a small effect size ($f^2 = 0.043$).

H7 (ANXIETY -> INTENTION) evaluates whether the researcher's state of anxiety about the use of specific digital resources used in the research process has an impact on the behavioral intention to use these resources. The path coefficient is 0.189, with a t-statistic of 3.438 ($p < 0.001$), indicating strong support. Anxiety significantly influences intention but with a small effect size ($f^2 = 0.071$).

H8 (ANXIETY -> INTEGRATION) evaluates whether the researcher's state of anxiety about the use of specific digital resources used in the research process has an impact on the integration itself in the research process. The path coefficient is 0.099, with a t-statistic of 2.612 ($p = 0.005$), indicating support. Anxiety has a positive, albeit very small, effect on integration ($f^2 = 0.021$).

H9 (QUALITY -> FLOW) evaluates whether the significant relationships between the quality of the techno- logical resources and the state of flow of the researcher exists. The path coefficient is 0.576, with a t-statistic of 18.124 ($p < 0.001$), indicating strong support. Quality significantly enhances flow, with a large effect size ($f^2 = 0.495$).

H10 (QUALITY -> INTEGRATION): the significant relationships between the quality of the techno- logical resources and the integration. The path coefficient is 0.000, with a t-statistic of 0.000 ($p = 0.500$), indicating no support. Quality does not influence integration ($f^2 = 0.000$).

H11 (INTENTION -> INTEGRATION): This hypothesis determines whether the behavioral intention of the researcher regarding the use of ICT in the research process significantly affects the subsequent integration in the research process. The path coefficient is -0.110, with a t-statistic of 1.975 ($p = 0.024$), indicating support but Intention has a negative effect on integration, though the effect size is small ($f^2 = 0.013$).

These results suggest that the constructs of skills, ethics, flow, and anxiety significantly influence integration and intention, with varying degrees of effect sizes. Quality notably impacts flow, but not integration. Intention has a negative influence on integration.

Figure 2 observes that the underlying factors included in the model explain 65.60% of the integration variable variance; the 58% of the intention factor variance is explained by factors anxiety and flow; the quality factor explains 32.9 % of the flow factor variance; the 27.5% of the digital skills factor variance is explained by the flow factor; and finally, the 4.4% of the anxiety variable variance is explained by the digital skills factor.

As the Q^2 value is >0 for each construct, the given model has a predictive relevance. According to Hair et al. (2014), if Q is 0.02 (weak predictive relevance), .15 (moderate predictive relevance), .35 (strong predictive relevance), hence predictive relevance was established.

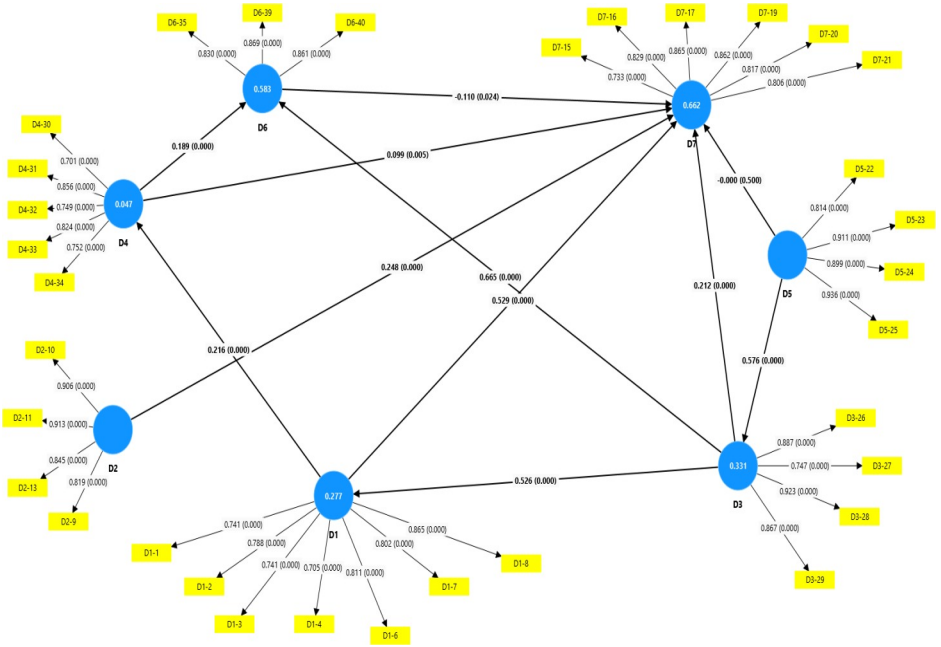

Figure 2 - Structural Model for Hypotheses Results.

Table 6 - Q^2predict values.

Endogenous constructs	Q^2predict	Degree of Predictive relevance
D1 - SKILLS	0.186	Moderate
D3- FLOW	0.325	Strong
D4- ANXIETY	0.04	Weak
D6- INTENTION	0.143	Moderate
D7-INTEGRATION	0.361	Strong

5. Discussion

The main purpose of this study was to investigate the impact of the integration of digital resources by Higher Education teachers in the research process. For this, an instrument prepared by Guillén-Gámez et al. (2023) was used to collect the data. The rapidly changing world today requires the integration of ICT resources in higher education. It is very important that higher education teachers use ICT to enhance their research capabilities. If they have good knowledge of ICT resources, it will be easy for them to use various digital tools to help them in academic inquiry. ICT helps them use data analysis software, to share findings, to connect on projects across the globe, use tools for plagiarism checking, for reference management, etc.

If we discuss H1, the present study supports it. However, the results stand in contrast to those reported by Guillén-Gámez et al. (2023). Also, it also contrasts with research conducted by Revilla et al. (2017) who assert that the continuous application of digital skills by educators is a critical factor in reducing negative attitudes related to using ICT; greater the skill and ease of using ICT, less the stress and anxiety related to ICT usage. These findings suggest that further investigation of the results is required to find the cause behind this. The probable causes for the significant positive relationship between digital skills and anxiety in Indian Higher Education Institutes might include inadequate digital infrastructure, insufficient training, resistance to technological change, constant pressure by academic institutes to publish research papers (Kmetz,2019), and the pressure to adapt quickly to digital tools. These factors can elevate anxiety levels despite possessing digital skills in the Indian context.

The subsequent hypothesis (H2) was validated, establishing a correlation between digital skills and the integration of digital resources in the research process. The digital skills of educators in utilizing technological resources within research processes exhibit the third-largest impact relative to other factors in the causal model. This finding supports earlier research by Alazam et al. (2013) and Teo (2009). This result further emphasizes the significance of teacher training in the practical application of technological resources in scientific processes (Guillén-Gámez et al., 2023; El Hassani, 2015). If the teachers have good digital skills, they would be more likely to integrate digital tools into their research activities.

Regarding hypothesis H3, there is an observable correlation between digital ethical standards and the integration of these resources within the research process (H3). This factor significantly influences the use of digital resources. These findings are open to further investigation. As highlighted by Guillén-Gámez et al. (2023) and Mbunge et al. (2021), there is a necessity for an ethical and digital framework to further optimize the use of technology under optimal conditions. Ethical usage will lead to better and more efficient use of digital tools.

The study also found out a correlation between the teachers' digital flow and their digital competencies in the research process, thereby confirming hypothesis H4. Specifically, a strong state of digital flow in the researcher is associated with better digital skills. When teachers experience complete engagement in using digital tools, and are immersed in the process, it is said that they are experiencing "flow". The results are supported by work by Guillén-Gámez et al. (2023). If teachers are interested in using digital resources in research, it will add to their engagement while using these digital tools for research.

The fifth and sixth hypotheses (H5 and H6) of the proposed model demonstrated results similar to those reported by Guillén-Gámez et al. (2023). They identified a link between digital flow and both the intention to use technology and the integration of digital resources in the research process. The findings revealed that a researchers' digital flow significantly impacts their intention to use technology, subsequently influencing the actual integration of digital resources in the research process. These outcomes go with the findings of Kim and Jang (2015), Calvo-Porral et al. (2017), and Rodriguez-Sanchez et al. (2008). Digital flow can positively impact the teachers' intention to use digital tools as it reduces the levels of frustration and annoyance. This would definitely then lead to a higher likelihood of integrating digital resources into research activities.

The findings also support hypotheses H7 and H8, indicating a positive relationship between technology-related anxiety and the intention to utilize digital resources for research. This result is noteworthy as it contrasts with previous studies (Babie et al., 2016; Guillén-Gámez et al., 2023; Joo et al., 2018; Knezek & Christensen, 2016; Paraskeva et al., 2008; Ünal et al., 2019). Higher technology anxiety can make teachers feel overwhelmed and they may end up avoiding digital tools usage. This can be a barrier to the adoption of new technology in research. This can be countered by ensuring a supportive environment for technology adoption. This could lead to lower anxiety and encourage the integration of digital resources in research.

H9 was supported by findings from Guillén-Gámez et al. (2023), which established a link between the quality of technological resources and digital flow—defined as the enjoyment and motivation of educators in their research activities. The experience of enjoyment in scientific processes is more likely to be enhanced with adequate access to technology (Lin et al., 2012; Gil-Flores et al., 2017). As noted by Guillén-Gámez et al. (2023), referencing Gil-Flores et al. (2017), the access, availability, and quality of digital resources can influence their integration into the educational process. However, it is important that we acknowledge that "teachers are reluctant to use technology as a teaching tool if the tool is not adequate".

The study did not support the hypothesis (H10) regarding the relationship between the quality of technological resources and their integration. A plausible explanation for this finding is that the research was conducted in a developing country where, despite substantial investment and subsidies aimed at advancing technological innovation in universities, progress is slower than anticipated. This outcome hints at the need to further investigate this relationship within the context of Indian higher education. This result can also be analyzed along with the situation that still teachers in higher education use less technology inside the classroom for learning and assessment due to the quality of these resources (Oguguo et al., 2023).

Regarding hypothesis (H11), even though the hypothesis is supported, a negative correlation was found between the teachers' intention to use ICT and the integration of these digital resources into the research process. This finding contrasts with the positive relationships reported by Guillén-Gámez et al. (2023), Kovalik et al. (2013), and Ndlovu et al. (2020). This result supports Banas and York's (2014) assertion that intention does not necessarily predict future behavior. Additionally, Shiue (2007) suggests that the quality of available tools might explain this negative relationship. Talking in terms of the Indian context, the negative correlation between intention and integration may be due to inadequate infrastructure, limited training, or insufficient support. These factors could negatively impact effective utilization.

6. Future Suggestions and Limitations

The findings of this study have important implications for the integration of ICT resources in higher education in India. Higher education institutions need to prioritize the development of digital skills in their faculty members. Ensuring that teachers are comfortable with using technology, such as data analysis software, plagiarism detection tools, and reference management systems, is crucial. Institutions should provide sufficient technical support to make digital learning more accessible and less of a burden for faculty members.

Encouraging the use of technology as a positive and engaging tool, rather than a task, will contribute to a more innovative academic environment. Faculty members should use ICT resources with enthusiasm, fostering a culture of continuous learning and growth. This aligns with the goals of the National Education Policy (NEP) 2020, which emphasizes the need for greater investment in research and innovation in higher education institutions.

As far as the limitations of the present study are concerned, further exploration can be made to build more understanding of ICT integration in higher education. First, the study relied on quantitative data and did not delve into qualitative methods such as interviews, open-ended questions, and focused group discussions, which could have provided deeper insights into faculty members' perceptions, challenges, and experiences with ICT adoption. These methods would have allowed for a more detailed understanding of the barriers and motivations behind the use of technology in academic settings.

Additionally, other variables such as the age of faculty members, their qualifications, the type of institution (public vs. private), and regional differences could have been examined in greater detail. These factors may significantly influence the willingness of faculty members to adopt ICT in their teaching and research practices. For example, older faculty members or those with fewer qualifications in technology may face more difficulties than their younger or more tech-savvy counterparts. Moreover, differences in funding, institutional support, and access to resources between urban and rural institutions or between government and private universities could have an effect on the successful integration of ICT.

The study was limited to the northern region of India. Given India's vast and diverse landscape, expanding the research to include other regions could offer a broader understanding of how ICT adoption varies across different educational and socio-cultural contexts. For instance, regions with better technological

infrastructure and higher educational investments may display different results compared to those with limited resources.

In light of these limitations, future research should aim to replicate this study in various regions across India, incorporating qualitative and quantitative methods to provide a more holistic understanding of ICT integration in higher education. This would further contribute to the development of a comprehensive framework that could guide universities in providing tailored support to their faculty members, helping them to effectively adopt and implement ICT tools in their teaching and research. Such a framework could inform policy recommendations, especially in the context of the National Education Policy (NEP) 2020, by identifying the specific needs and challenges faced by faculty across different regions and institutional types.

Moreover, future studies should investigate the long-term effects of ICT integration on student learning outcomes, as well as the professional development of faculty members. Research could also focus on exploring collaborative efforts between institutions to share resources and best practices, enhancing the overall adoption of technology in higher education.

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