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TEACHERS' DIGITAL COMPETENCE AND ITS RELATIONSHIP WITH TEACHER EFFECTIVENESS AT HIGHER EDUCATION LEVEL IN PUNJAB

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ABSTRACT

Digitalization in higher education involves using digital tools for administration, teaching, evaluation, research, and extension activities. The proficiency of educators in digital skills is imperative for achieving optimal teaching outcomes. This study endeavors to examine the correlation between teachers' digital proficiency and their effectiveness in instructional delivery within public sector universities situated in Punjab. Additionally, it seeks to ascertain whether there exist noteworthy variances in teachers' digital proficiency based on demographic factors. Employing a quantitative survey method, this research adopts a descriptive research approach. The investigation was conducted across public sector universities in the province of Punjab, with three universities selected through convenience sampling. A total of 370 teachers were randomly chosen from these institutions to participate in the study. Standard research instruments were utilized for data collection, while statistical software SPSS facilitated data analysis to derive conclusions. Descriptive statistics were computed, followed by correlation analysis, simple linear regression, and independent sample t-tests to interpret the findings. The results revealed a substantial association between teachers' digital proficiency and their efficacy in higher education. The study also found that teachers' digital competence and effectiveness are moderate in nature. There was no significant difference in digital competence based on gender, experience, age group, academic qualification, and training. The study concluded that educators in higher education have the capacity to acquire the requisite knowledge, skills, and proficiency to augment their digital competence and instructional efficacy in an increasingly technology-driven environment. Nonetheless, the research identified certain constraints and proposed avenues for future investigation.

Keywords: Digitalization in higher education; Teachers' digital competence; Teaching effectiveness; Higher education; Communication technologies.

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INTRODUCTION

Digitalizing higher education through information and communication technology can improve service to stakeholders and bring educational reforms. It requires stakeholders to develop computer and information technology skills to maximize digital resources. Students acquire information, skills, and attitudes through computers, the internet, and social media. Technology has significantly altered educational procedures, including teaching, learning, assessment, and research. Digitalization offers opportunities for cooperation, resource sharing, coaching, and participation in beneficial activities for all (Srivastava & Dangwal, 2021). Digital technology is crucial in teaching and learning, providing modern resources, information access, international collaboration opportunities and alternative professional development approaches. It has made it possible to create and use modern pedagogies in higher education across various countries (Anwar et al., 2021). The global digitalization of higher education presents new challenges for teachers to deliver excellent instruction and adapt to student demands. Technology offers numerous opportunities to meet

global education systems' demands, but teachers must foster students' necessary information, skills, moral compass, and self-assurance (Bhullar, 2019).

Digital technology is revolutionizing education, making it a versatile and interactive form. To stay competitive, it's crucial to incorporate technology into the curriculum. Teachers with a solid foundation, improved understanding of digital technology, and innovative methods are better positioned for success in the global society of the 21st-century (Galindo-Domínguez & Bezanilla, 2021). Digital competence encompasses a wide range of technological knowledge and abilities, including media, computer, technology, literacy, information, and communication, a relatively new concept (Srivastava & Dangwal, 2021). As posited by Ferrari and Punie (2012), digital competence encompasses a comprehensive array of skills, knowledge, attitudes, and capabilities essential for utilizing information and communication technologies (ICT) and digital media across various domains such as task execution, communication, information handling, problem-solving, collaborative endeavors, content generation, and knowledge enrichment. These competencies are deemed pertinent for activities spanning learning, professional engagements, recreational pursuits, and social interactions.

Digital competence is essential for learning and teaching in today's digital environment, requiring safe system and technology use. Students learn digital literacy, social media sharing, online safety, privacy settings and technology-based teaching methods like PowerPoint and Keynote (Gudmundsdottir & Hatlevik, 2018). Scholars suggest that training programs for higher education teachers should focus on digital literacy, skills and professional development. Digital competencies should be a fundamental part of these programs, which might draw from units of competency from the intellectual, social, organizational, and cultural studies domains. In a digital world, they ought to be driven by critical thinking and concentrated on innovation, knowledge creation, and teamwork (Pérez, 2013).

Teacher effectiveness entails concentrating on student achievement, classroom procedures and behavior to increase results. It entails establishing explicit learning objectives, being knowledgeable about the curriculum, communicating effectively, using appropriate teaching techniques, tailoring instruction to the needs of the students, foreseeing misconceptions about the material, teaching metacognitive strategies, addressing cognitive objectives, keeping an eye on students' comprehension and performance, integrating instruction with other subjects and taking accountability for the results of the students (Ko & Sammons, 2013). Teachers use various techniques like lectures, group exercises and hands-on learning to teach, fostering a positive learning environment. Effective teaching requires patience, preparation, clear expectations and regular assessment, while being proficient in digital technology (Subramanian, 2022). Effective teachers are crucial for any education system, enhancing student learning through credentials, experience, communication skills, positive behavioral traits, and efficiency. They must be knowledgeable in subject matter and evaluate students based on performance. Teacher effectiveness is critical in developing curricula and instructional practices, determining student needs and expectations. Employer evaluations, student interviews, teaching scholarships, and alumni ratings are key metrics. Teachers must be effective in overcoming obstacles like tenure, cooperation, leadership, accountability, and reform implementation (Kapur, 2018).

Numerous research studies have been conducted on these constructs in various contexts. Various studies, such as the research conducted by Garzón-Artacho et al. (2021), underscore the importance of cultivating teachers' digital competence, taking into consideration factors like age, teacher training, and school type. Similarly, Kožuh et al. (2021) delineated significant variances in teachers' digital proficiency based on factors such as professional training, teaching experience, gender, and subject specialization. Moreover, Cabero-Almenara et al. (2020) conducted research on the enhancement of teacher digital competence, revealing commendable reliability indices across all dimensions of the instrument employed in their study.

Moreover, investigations into teacher effectiveness have been undertaken by several scholars, including Sehjal (2021), whose findings indicated no substantial disparity in the effectiveness of secondary school

teachers based on gender. Bhat and Arumugam (2020) observed that urban school teachers exhibited notably higher effectiveness compared to their rural counterparts. Similarly, Subramanian (2022) established a significant relationship between teachers' digital competence, techno-pedagogy, and their overall effectiveness as educators.

Rationale of the Study

Teachers' digital competence and effectiveness represent pivotal constructs within higher education, with their interplay significantly influencing one another. As technological advancements reshape pedagogical approaches from traditional to digital realms, educators are compelled to attain digital proficiency and techno-pedagogical skills to facilitate meaningful learning encounters. While prior research has underscored the significance of digital competence in correlation with teachers' effectiveness, the majority of studies have been conducted within Western contexts. This study seeks to bridge this gap by exploring the nexus between digital competence and effectiveness among higher education instructors, given the dearth of literature on these constructs within the Pakistani educational landscape.

Statement of the Problem

Within the swiftly evolving higher education sphere, traditional teaching has evolved into a multidimensional endeavor, requiring educators to adeptly navigate the dynamic interplay of digital competence and techno-pedagogical prowess. Digital competence, encompassing the adept utilization of technology to fulfill pedagogical objectives, stands as a critical asset in equipping students for the digital epoch. Concurrently, the effectiveness of teachers profoundly influences student engagement, learning achievements, and the quality education. This study endeavors to scrutinize the correlation between digital competence and teacher effectiveness within the realm of public sector universities in Punjab, Pakistan.

Objectives of the Study

The objectives of the study were:

1. To investigate the level of teachers' digital competence in public sector universities of Punjab.
2. To find out level of teachers' effectiveness in public sector universities of Punjab.
3. To explore the interrelationship between teachers' digital competence and teacher effectiveness.
4. To investigate whether the teachers' digital competence differ significantly with respect to demographics.

Research questions

The research questions of the study were:

1. What are the perceptions of teachers regarding their own digital competence?
2. How do teachers perceive their effectiveness as educators?
3. What impact does teachers' digital competence have on their effectiveness in teaching?

LITERATURE REVIEW

Digital Competence

Digital competence encompasses various technology-related skills and competencies including computer literacy, media, information and communication, enabling effective use of technology in daily life (Ferrari & Punie, 2013). The European Union has ranked digital competence among its eight core competencies for lifelong learning, highlighting its importance in a knowledge-based society.

Dimensions of Digital Competence

Ramkrishna (2017) identified five dimensions of a teacher's digital competence: digital practice knowledge, proficiency with digital technology for education, assessment and authorization of online

content, management and communication of digital data, and collaboration and sharing of digital for education.

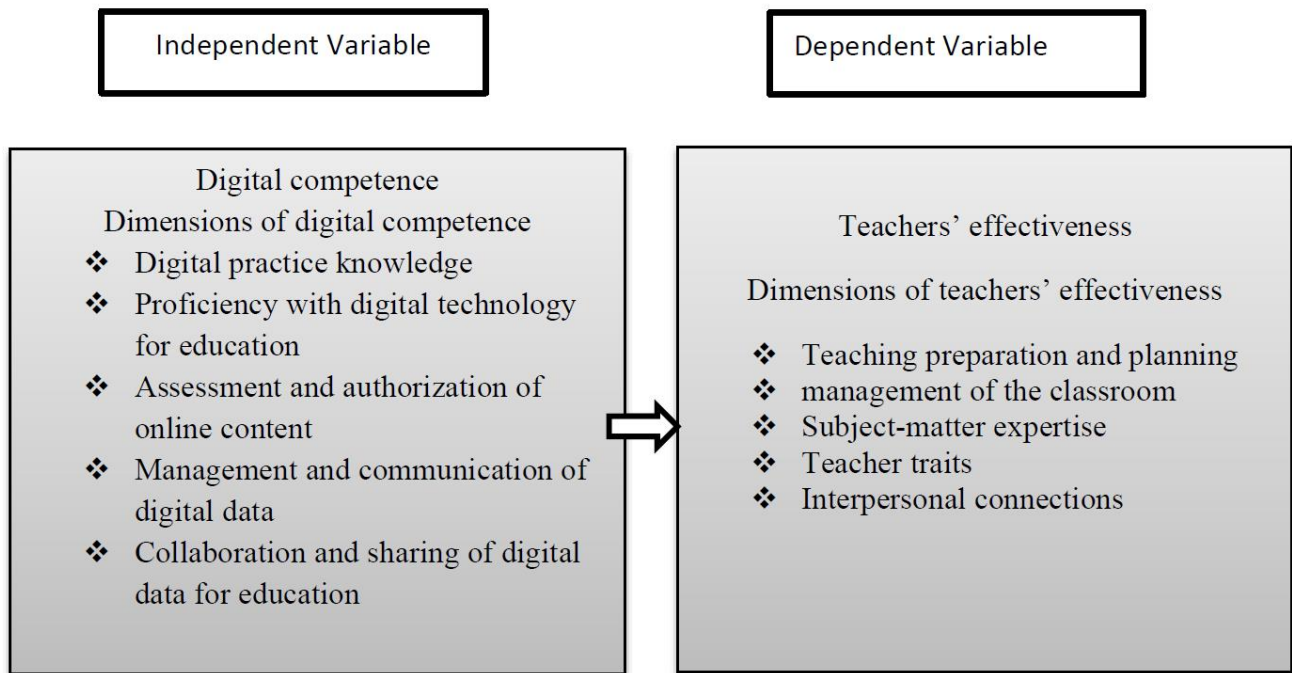


Figure 1. Digital Competence frameworks.

Digital competence is a wide notion with many aspects, ranging from specific descriptions to large organizational frameworks that take into account the required knowledge and abilities. This extensive body of literature has contributed significantly to understanding the multifaceted nature of digital competence. Calvani et al. (2010) propose a paradigm of digital literacy that emphasizes technological, ethical, and cognitive dimensions. Similarly, Agsalud (2017) highlights the Australian Institute for Teaching and School Leadership's delineation of professional standards for educators, which encompasses ICT proficiency for developing instructional materials and fostering conducive learning environments. Furthermore, the Irish Digital Strategy for Schools is informed by the UNESCO ICT Competency Framework for Teachers, as discussed by UNESCO (2011) as well as the Dig Comp Edu and Dig Comp Org frameworks from the EU. Dinham et al. (2013) proposed a model recognizing the integration of knowledge, digital media, and media literacies due to increasing technologies, emphasizing the need for digital competence.

Similarly, Ng (2012) offered a tri-partite model that incorporates technical, cognitive and social-emotional characteristics. Janssen et al. (2013) delineate four key elements comprising digital competence: search and process, create, digital responsibility, and communication awareness. Additionally, Aesaert et al. (2013) uncovered the manifestation of digital competence within the educational technology curriculum across England, Norway, and Flanders. Ferrari and Punie (2013) presents a comprehensive list of competencies derived from the Digicomp project, an EU-funded initiative that identifies key digital competence components and develops a comprehensive framework.

Redecker and Johannessen (2013) proposed an ICT teaching framework that encompasses teaching of ICT, using ICT, and teaching about ICT. Khan (2015) discerned three dimensions constituting general digital competence: didactic digital competence, subject-specific digital competence, and professional-oriented digital competence. Meanwhile, Lund et al. (2014) devised a framework for digital competence among educators, which integrates personal-ethical, curriculum-related, and professional competencies, drawing upon the TPACK framework formulated by Mishra and Koehler (2006).

Erstad et al. (2020) offers eleven components of media literacy, using the terms digital and media literacy interchangeably. Hatlevik et al. (2015) study found four elements of digital competence. Similarly, Vuorikari et al. (2016) introduced a comparable framework, the DigiComp 2.0, as a refinement of the original 2013 model. Almerich et al. (2016) delineated two principal subcategories within ICT competency frameworks for educators: technological and pedagogical competencies, drawing influence from models such as DigiCompEdu and TPACK. Ilomaki et al. (2016) proposed a four-part model for imparting ICT skills, encompassing information and practice, comprehension of limitations, ethical considerations, and engagement with digital ethos. Furthermore, Instefjord and Munthe (2017) suggested a three-tiered organizational structure integrating technical proficiency, pedagogical alignment, and social consciousness.

Hierarchal Models of Teachers' Digital Competence

The Krumsvik (2008) digital competence model suggests that technological competence is crucial for successful teaching, with digital building being the highest level of competence, aligning with Puentedura's (2006) SAMR model, which suggests teachers' technology usage ranges from substitution to redefinition. The Australian Information and Communication Technology Standards for Teachers embrace a developmental perspective, facilitating the gradual augmentation of teachers' competency levels from graduate to proficient and ultimately to highly accomplished.

Gill et al. (2015) review several methodologies used by studies to determine degrees of pre-service teacher competency. Foulger et al. (2017) introduced the Teacher Educator Technology Skills (TETCs) in the United States, aimed at establishing standardized technology competencies for aspiring educators, thereby addressing emerging technological complexities. Furthermore, the UNESCO ICT competency framework for teachers delineates three developmental stages grounded in distinct instructional methodologies, which expand upon the foundational model.

Teacher Effectiveness

The term "teacher effectiveness" is a combination of the terms "teacher" and "effectiveness." It refers to a teacher's capacity to transfer information and skills to students, including instructional tactics, student and classroom management, interpersonal relationships, evaluation, and feedback. It assesses a teacher's maturity and learning, demonstrating their capacity to direct and modify education while maintaining a constructive attitude towards quality improvement (Subramanian, 2022).

According to Anderson (1991) an effective teacher regularly achieves goals based on student learning. According to Wong (2007), effective teachers have three primary characteristics: high expectations for student achievement, great classroom management and mastery-oriented teaching. Teacher effectiveness includes qualities, competences and behaviors that enable students to attain desired results at all educational levels, such as problem-solving, critical thinking, teamwork and citizenship.

Darling-Hammond (2009) identified key characteristics in teacher effectiveness research, including excellent verbal and general intelligence, solid subject matter expertise, understanding of experiential learning strategies, mastery of instruction language, awareness of students' learning and growth, and adaptive knowledge.

Dimensions of Teacher Effectiveness

Kulsum (2010) assessed teacher effectiveness in five dimensions: teaching preparation and planning, classroom management, subject matter expertise, teacher traits, and interpersonal relationships.

METHODOLOGY

Research Procedure

The principal objective of the research was to assess the relationship between teachers' digital competence and their effectiveness. Employing a quantitative survey approach, data were collected from students

across three public institutions in Pakistan, utilizing a descriptive methodology. Furthermore, a questionnaire was administered to investigate the correlation between teachers' digital competence and their effectiveness.

Population and Sampling

The study's population comprised of all teachers of public sector universities of Pakistan. The study employed a convenience sampling method to collect data from three public sector universities situated in Punjab, Pakistan.

Instrumentation

The Teacher's Digital Competence Scale (TDCS) a five-dimensional, five-point Likert type scale developed by Ramkrishna (2017), with a reliability of 0.943 and consists of 50 items was adapted as research instrument. The Teacher Effectiveness Scale (TES), developed by Kulsum (2010), is a second adapted instrument consisting of 60 items rated on a five-point Likert scale, further divided into five dimensions, with a reliability of 0.965.

Data collection and Data Analysis

The researcher secured informed consent from the participants prior to data collection. A questionnaire was distributed to all teachers, accompanied by clear instructions for completion. Participants were requested to express their opinions using a 5-point Likert scale. Ethical protocols were observed to uphold the anonymity of respondents and confidentiality of data. The collected data underwent tabulation and analysis through the utilization of the statistical software package SPSS version 21. To address the research question of the study, both descriptive and inferential statistical methods were employed. Descriptive statistics including frequency, percentage, mean score, and standard deviation were utilized. For inferential statistics, Pearson's Product Moment Correlation Coefficient and Linear Regression analyses were conducted to explore relationships. Additionally, t-tests and ANOVA were employed to ascertain demographic-based differences in opinions.

RESULTS AND DISCUSSION

Demographic Characteristic of the Students

Table 1 shows the demographic information of the participants. The number and percentage of variables have been described.

Gender: With respect to gender, it was found that out of 370 teachers, 216 (58.4%) were male teachers and 154 (41.6%) were female teachers.

Age: With reference to age, it was found that teachers in the age group of 25 to 35 years were 110 (29.7%) while 36 to 45 years were 175 (47.3%) while the teachers' age groups ranging between 46 to 55 years were 64 (17.3%) others were 21 (5.7%) of the total sample.

Academic qualifications: Regarding professional qualifications it was found that out of 370 sampled teachers 203 (54.9%) teachers had M. Phil degree while 148 (40.0%) teachers had Ph. D degree and 19 (5.1%) teachers had had Post.Doc degree.

Experience: With respect to experience, it was found that out of 370 teachers, 115 (31.1%) teachers had 5 to 10 years' experience. While, 158 (42.7%) teachers had 11 to 15 years' experience and 97 (26.2%) teachers had 16 to 20 years' experience.

Smart phones and laptops with internet: With respect to smart phones and laptops with internet, it was found that out of 370 teachers only 7 (1.9%) teachers did not have smart phones and laptops with internet while 363 (98.1%) teachers had smart phones and laptops with internet.

Table 1. Analysis of demographic characteristics of the respondents.

Variables		Frequency	Percentage	Mean	Std. Deviation
Gender	Male	216	58.4	1.41	.493
	female	154	41.6		
	Total	370	100.0		
Age	25 to 35	110	29.7	1.98	.836
	36 to 45	175	47.3		
	46 to 55	64	17.3		
	Others	21	5.7		
	Total	370	100.0		
Academic qualification	M. Phil	203	54.9	1.50	.594
	Ph. d	148	40.0		
	Post.Doc	19	5.1		
	Total	370	100.0		
Experience	5 to 10	115	31.1	1.95	.756
	11 to 15	158	42.7		
	16 to 20	97	26.2		
	Total	370	100.0		
Mobile/laptop with internet	No	7	1.9	1.98	.136
	Yes	363	98.1		
	Total	370	100.0		
Training	No	94	25.4	1.74	.435
	Yes	276	74.6		
	Total	370	100.0		
Usage	1 to 2 hours	84	22.7	2.10	.742
	2 to 4 h	162	43.8		
	Above 4 hours	124	33.5		
	Total	370	100.0		

Digital training

Regarding digital training only 94 (25.4%) teachers did not have any training while 276 (74.6%) teachers had completed their digital training.

Usage regarding internet usage only

Out of 370 teachers 84 (22.7%) teachers use internet from 1 to 2 hours while 162 (43.8%) use 2 to 4 hours and 124 (33.5%) teachers use internet above 4 hours.

Descriptive Statistics

Descriptive statistics were calculated as basics for main analysis. Table 2 presents the descriptive statistics.

Table 2. Perception of teachers regarding level of digital competence.

Sr.	Dimensions of Teacher’s Digital Competence Scale	Mean	SD
1	Digital practice knowledge	4.80	3.15
2	Proficiency with digital technology for education	4.20	3.00
3	Assessment and authorization of online content	4.31	3.05
4	Management and communication of digital data	4.69	3.05
5	Collaboration and sharing of digital data for education	4.54	2.81

Table 2 presents a ranking of all dimensions and an overall mean and standard deviation of teachers' perceptions of their digital competence level. The mean values of all dimensions were above 4.00, indicating a high level of digital competence.

Table 3. Perception of teachers regarding teachers' effectiveness.

Sr.	Dimensions of Teacher Effectiveness Scale	Mean	SD
1	Teaching preparation and planning	4.35	3.75
2	Management of the classroom	4.86	2.95
3	Subject Matter expertise	4.92	3.24
4	Teacher Traits	4.35	3.75
5	Interpersonal Relationships	4.55	2.91

Table 3 indicates that teachers' effectiveness level is high, with mean values exceeding 4.00 across all dimensions.

Inferential Statistics

Inferential statistics, such as the t-test and the ANOVA were used on demographical variables.

Teachers' digital competence based on their gender

This section determines differences between the perceptions of male and female teachers regarding digital competence with the use of independent sample t-test.

Table 4. Teachers' digital competence based on their gender.

Digital competence and its dimensions	Participants	N	Mean	SD.	T	df.	Sig.
Digital practice knowledge	Male	216	21.19	2.91	1.50	368	.35
	Female	154	20.69	3.45			
Proficiency with digital technology for education	Male	215	20.93	3.02	.087	367	.70
	Female	154	20.90	2.99			
Assessment and authorization of online content	Male	213	20.89	3.20	-4.75	364	.26
	Female	153	21.04	2.84			
Management and communication of digital data	Male	216	20.53	3.02	-1.156	368	.51
	Female	154	20.90	3.09			
Collaboration and sharing of digital data for education	Male	216	20.61	2.78	.504	368	.96
	Female	154	20.46	2.86			

Table 4 shows the teachers' perception of digital competence based on gender. It was concluded that there is no significant difference in teachers' perceptions about digital practice knowledge, proficiency with digital technology for education, assessment and authorization of online content, management and communication of digital data and collaboration and sharing of digital data for education based on gender, with p values of .35, .70, .26, .51 and .96 respectively.

Teachers' digital competence based on their Training

Independent sample t-test was utilized to find the differences between the perceptions of teachers regarding digital competence with respect to training.

Table 5 shows the teachers' perception of digital competence based on training. It was concluded that there is no significant difference in teachers' perceptions about digital practice knowledge, proficiency with digital technology for education, assessment and authorization of online content, management and communication of digital data and collaboration and sharing of digital data for education based on training, with p values of .27, .60, .36, .42 and .69 respectively.

Table 5. Teachers ‘digital competence based on of their training.

Dimensions of teachers’ digital	Training	N	Mean	SD.	T	df	Sig.
Digital practice knowledge	No	94	21.26	2.99	1.30	368	.27
	Yes	276	22.89	3.20			
Proficiency with digital technology for education	No	93	20.18	2.60	.082	367	.60
	Yes	276	21.49	3.02			
Assessment and authorization of online content	No	93	20.68	2.90	.365	364	.36
	Yes	273	21.70	3.06			
Management and communication of digital data	No	94	20.82	2.74	0.16	368	.42
	Yes	276	21.64	3.15			
Collaboration and sharing of digital data for education	No	94	20.24	3.11	.530	368	.69
	Yes	276	21.65	2.70			

Analysis of Variance (ANOVA)

This section determines the difference between perceptions of teachers regarding digital competence based on different academic qualification by using ANOVA.

Table 6. Teachers’ perception of digital competence based on academic qualification.

Digital competence and its dimensions		Sum of Squares	df	Mean Square	F	Sig.
Digital practice knowledge	Between Groups	22.38	3	11.19	1.12	.32
	Within Groups	3654.54	367	9.95		
	Total	3676.93	370			
Proficiency with digital technology for education	Between Groups	97.52	4	48.76	5.51	.00
	Within Groups	3236.03	366	8.84		
	Total	3333.56	370			
Assessment and authorization of online content	Between Groups	79.99	7	39.99	4.37	.01
	Within Groups	3321.30	363	9.15		
	Total	3401.301	370			
Management and communication of digital data	Between Groups	4.893	3	2.44	.261	.77
	Within Groups	3433.983	367	9.35		
	Total	3438.876	370			
Collaboration and sharing of digital data for education	Between Groups	34.437	3	17.21	2.18	.11
	Within Groups	2895.187	367	7.88		
	Total	2929.624	370			

Table 6 shows the teachers’ perception of digital competence based on different academic qualification. It was concluded that there is no significant difference in teachers' perceptions about digital practice knowledge, proficiency with digital technology for education, assessment and authorization of online content, management and communication of digital data and collaboration and sharing of digital data for education based on academic qualification, with p values of .32, .00, .01, .77 and .11 respectively.

Table 7 shows the teachers’ perception of digital competence based on different age groups. It was concluded that there is no significant difference in teachers' perceptions about digital practice knowledge, proficiency with digital technology for education, assessment and authorization of online content, management and communication of digital data and collaboration and sharing of digital data for education based on academic qualification, with p values of .02, .00, .20, .37 and .00 respectively

Table 7. Teachers' perception of digital competence based on different age of teachers.

Digital competence and its dimensions		Sum of Squares	df	Mean Square	F	Sig.
Digital practice knowledge	Between Groups	96.71	4	32.23	3.29	.02
	Within Groups	3580.21		3669.78		
	Total	3676.93	370			
Proficiency with digital technology for education	Between Groups	105.42	5	35.14	3.97	.00
	Within Groups	3228.13		3658.84		
	Total	3333.56	370			
Assessment and authorization of online content	Between Groups	42.63	7	14.21	1.53	.20
	Within Groups	3358.67		3639.27		
	Total	3401.30	370			
Management and communication of digital data	Between Groups	28.95	4	9.65	1.03	.37
	Within Groups	3409.92		3669.31		
	Total	3438.87	370			
Collaboration and sharing of digital data for education	Between Groups	98.02	4	32.67	4.22	.00
	Within Groups	2831.59		3667.73		
	Total	2929.62	370			

Table 8. Perception of teachers about digital competence based on experience.

Digital competence and its dimensions		Sum of Squares	df	Mean Square	F	Sig.
Digital practice knowledge	Between Groups	80.89	4	26.966	2.745.04	
	Within Groups	3596.03		3669.825		
	Total	3676.93	370			
Proficiency with digital technology for education	Between Groups	117.15	5	39.052	4.432.00	
	Within Groups	3216.40		3658.812		
	Total	3333.56	370			
Assessment and authorization of online content	Between Groups	80.84	8	26.948	2.938.03	
	Within Groups	3320.45		3629.173		
	Total	3401.30	370			
Management and communication of digital data	Between Groups	20.81	4	6.937	.743	.52
	Within Groups	3418.06		3669.339		
	Total	3438.87	370			
Collaboration and sharing of digital data for education	Between Groups	17.559	4	5.853	.736	.53
	Within Groups	2912.065		3667.956		
	Total	2929.624	370			

Table 8 shows the teachers' perception of digital competence based on experience. It was concluded that there is no significant difference in teachers' perceptions about digital competence and its dimensions including digital practice knowledge, proficiency with digital technology for education, assessment and authorization of online content, management and communication of digital data and collaboration and sharing of digital data for education based on academic qualification, with p values of .04, .00, .03, .52 and .53 respectively

Correlation between teachers' digital competence and teachers' effectiveness

Correlation was conducted to test the relationship between teachers' digital competence and teachers' effectiveness. What is relationship between teachers' digital competence and teachers' effectiveness?

Table 9. Correlation between teachers' digital competence and teacher effectiveness.

Correlation	Teachers' digital	Teachers' effectiveness
Teachers' digital competence	1	.695**
Teachers' effectiveness	.000	1

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

In table 9 it is demonstrated that there is a positive relationship between teachers' digital competence and teacher effectiveness. A positive and high relationship with correlation coefficient $r = r = 0.695^{**}$ ($p < 0.01$) exists between Teachers' digital competence and Teachers' effectiveness.

Regression Analysis

The effect of teachers' digital competence on teachers' effectiveness

Linear regression was applied to find out the effect of teachers' digital competence on teachers' effectiveness. The predictor variable in this study was teachers' digital competence, while teachers' effectiveness served as the dependent variable. Table 10 displays the outcomes of the linear regression analysis.

Table 10. Summary of regression analysis.

Summary	Df	F	sig
Regression	1	1.83	.000b
Residual	369		
Total	370		

* $p < 0.05$

Table 10 illustrates the outcomes of the simple linear regression analysis, predicting teachers' digital competence on teachers' effectiveness. Following regression equation was found $F(39.230) = 1.83$, $aR^2 = 07\%$, $p < .00$. The above results of linear regression revealed that the independent variables teacher's digital competence have significantly related their teacher effectiveness. Table 3 presents the regression coefficient of both variables

Table 11. Regression coefficient.

Model	B	Std. Error	Beta	T	Sig
(Constant)	32.564	3.920		8.308	.000
Digital competence	.689	.037	.695	18.418	.000

Table 11 depicts the regression coefficients for digital competence as the predictor variable. Consistent with the regression summary outlined above, the coefficients in Table 11 also indicate a significant influence of digital competence on teachers' effectiveness.

Limitations

The study explores teachers' digital competence in higher education, but has limitations due to the limited sample size and the potential for generalizability. The inclusion of students and a different methodology

could enhance the study's results, broaden the scope of analysis from quantitative to qualitative, and adding more variables related to teachers' digital competence.

Discussion

The primary aim of the study was to investigate the relationship between teachers' digital competence and their effectiveness in higher education, while also assessing the levels of both digital competence and effectiveness among teachers. The findings revealed a significant correlation between teachers' digital competence and their effectiveness in higher education, which is consistent with the findings of Mannila (2018). The study found moderate levels of teacher digital competences, contradicting previous research by Ramakrishna (2017), Garzón Artacho et al. (2020) supported by Khan & Cheema (2022) and Khan et al. (2022). The study found moderate levels of teacher effectiveness, which contradicts previous research by Agsalud (2017), and Lalnunfeli et al. (2019).

The study found no significant gender-based difference in teacher digital competences, contradicting previous research by Ramakrishna (2017) and supporting Sánchez-Caballé and Esteve-Mon (2022). Furthermore, the study uncovered no significant difference in teacher digital competences across age groups, contrasting with the findings of this study and aligning with previous research by Grande-de-Prado et al. (2020). The study reveals no significant difference in the digital competence of teachers based on experience, as supported by Touron et al. (2023) and contradicted by Ramakrishna (2017). No significant difference exists in the digital competence of teachers with respect to training. The study by Hatlevik (2017) and Ramakrishna (2017) contradicted the notion and supported by Riaz and Hussain (2020). The study found no significant difference in teachers' perceptions of digital competence based on their academic qualifications.

CONCLUSIONS AND RECOMMENDATIONS

The government should regularly provide in-service training to all teachers to ensure they are up-to-date with the latest teaching techniques. The government and policymakers should monitor the allocation of funds for orientation programs, awareness programs, and ICT training to enhance digital competency and effective teaching. Policymakers should mandate administrators to organize seminars, workshops and conferences at the district and state level to increase higher education teachers' awareness of improving their teaching skills, attitudes and beliefs, which will significantly benefit both themselves and their students.

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