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# UNPACKING THE ROLE OF ICT AND FACULTY COMPETENCY IN ENHANCING TEACHER PERFORMANCE: A QUANTITATIVE STUDY

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## ABSTRACT

*This study examines the effect of Information and Communication Technology (ICT) resources and teacher competency on teacher performances in higher education. A quantitative, cross-sectional study was designed of 250 faculty members working in public universities in the province of Sindh, Pakistan. The structured questionnaire inquired the degree of ICT resources used, the self-assessed ICT competencies of the teachers as well as their performance in teaching. Reliability and validity of the measurements were determined using Cronbach's alpha, composite reliability, and exploratory factor analysis. Data were analyzed using the statistical package, The Statistical Package and Program for Social Studies (SPSS), using descriptive statistics, correlations and a regression modeling program. Results demonstrated significant positive relationships among all constructs. ICT resources explained 66.7% of the variance in teacher performance ($\beta \approx 0.817$, $p < 0.001$) and 75.0% of the variance in teacher competency ($\beta \approx 0.866$, $p < 0.001$). Teacher competency alone explained 44.3% of performance variance ($\beta \approx 0.665$, $p < 0.001$). A multiple regression model confirmed that both ICT resources ($\beta \approx 0.345$) and teacher competency ($\beta \approx 0.505$) were significant predictors of performance, accounting jointly for 56.8% of the variance ($R^2 \approx 0.568$). These findings indicated that teacher performance is also directly improved by access to ICT and indirectly improved through competency development. The study concludes that higher education institutions should pursue a dual approach to the use of ICT that expands ICT infrastructure and simultaneously invests directly in ongoing teacher training programs. Policy implications point to the need for capacity-building programs to ensure the effective utilization of technological resources for the eventual improvement of educational quality and outcome.*

***Keywords:*** *Information and Communication Technology (ICT); Teacher Competency; Teacher Performance; Regression Analysis; Higher Education; Pakistan*

## INTRODUCTION

The fast development of Information and Communication Technology (ICT) has revolutionized nearly all sectors of human activity including education. In the global knowledge economy, this has meant that higher education institutions are under increasing pressure to infuse ICT on the teaching and learning processes in order to remain relevant and competitive [1]. ICT offers the possibility to develop innovating pedagogical methods, increase access to learning materials and promote interactive engagement between teachers and students. For educators, technology provides tools that can help to improve productivity, efficiency, and the quality of instruction. Research continues to suggest that ICT use in the classroom can lead to positive outcomes in terms of student learning outcomes, motivation and academic performance [2]. Universities around the globe are thus spending heavily on the provision of digital facilities, online learning systems and faculty development programs to realize the potential of ICT for educational excellence.

Despite these progressions globally, there are still challenges, especially in developing countries. While ICT hardware and software are becoming more widely available, this advantage is not fully realized unless teachers are equipped with requisite competencies to integrate ICT hardware and software into the teaching process effectively [3]. Teachers are not passive users of technology, but active mediators who make the difference between whether digital technology is used to enhance or diminish learning. Teacher competency (which puts together the knowledge, skills and confidence needed to use ICT in pedagogical settings) constitutes a key factor in determining to what extent ICT resources translate into enhanced teaching performance [4]. Several researches highlight that if not trained properly and if not provided with a proper environment to use ICT, the educators might resist it or make less use of it, which limits the impact of ICT [5]. This dual requirement of infrastructure and human capacity drives home the need to study ICT resources and teacher competency in conjunction and not in isolation. In case of Pakistan the adoption of ICT in higher education is evolving yet still unequal. Government initiatives and institutional investments have increased access to internet connectivity, computer labs and digital libraries in numerous universities [6]. However, these resources are not available consistently across institutions and how effectively they are used depends a lot on the faculty. Teachers in public universities especially in developing regions like Sindh are faced with barriers such as poor training opportunities, lack of institutional support and even in some situations a lack of awareness about how ICT can be integrated into pedagogy practices [7]. While many studies have been conducted in Pakistan that examine the attitude of students towards e-learning or challenges faced in the ICT infrastructure, there is comparatively less research studies that focuses on how the access to ICT resources as well the competency of teachers interact to affect their own performance [8]. This gap is particularly interesting because teachers are the main agents of the quality of education. Understanding the combined impact of ICT and teacher competency on performance may give practical insights for higher education policy makers.

The main objective of this research is to study the impact of ICT resources and teacher competency on the education performance of teachers in public universities in Sindh by studying the performance of public teacher. A secondary objective is to examine the role of teacher competency, as a mediator, between ICT resources and teacher performance. By using regression modeling approach, the study seeks to quantify the relative contributions of ICT availability and teacher competency to the overall outcomes in performance. This approach permits the identification of direct effects as well as indirect effects, which provides a more nuanced understanding than simple correlation analysis.

To guide this investigation, following questions are asked: (1) To what extent ICT resources predict the teacher performance? (2) What is the extent of relationship between ICT resources and teacher competency? (3) Does teacher's competency a significant predictor of teacher performance and does it mediate the impact of

ICT resources on the teacher performance? These questions are operationalized into 3 testable hypotheses: H1: Greater availability and use of ICT resources are associated with teacher performance and H2: Greater ICT resources are associated with teacher ICT competency and H3: Teachers ICT competency are associated with teacher performance, possibly mediating the link between ICT and teacher performance.

The importance of the present study is both in the theoretical and practical contributions. Theoretically, the research combines two strands of literature - availability of ICT resources and competency of teachers - into one predictive model of performance. Prior studies have often considered each of these factors separately with no consideration of their possible interaction. By testing a model based on the theoretical assumption that technology and human capital need to develop together to achieve optimal educational outcomes, the study presents empirical evidence in support of this argument. The implications of the results in practice are as follows: The results are a guide for higher education institutions in Pakistan and other developing nations. The evidence that ICT resources and teacher competency are both significant predictors of performance indicates that the key strategy that universities need to follow is a two-pronged approach: expanding the infrastructure while simultaneously engaging in teacher training and professional development programs [9].

The scope of the study is limited to faculty members in the social sciences departments of public universities in Sindh province. This focus was selected with the intent to have manageable boundaries and to get a representative sample of teaching faculty. While the results are expected to yield useful insights, they may not be readily applied to private universities, other disciplines (natural sciences, engineering etc), and to other institutions outside of the province of Sindh. In addition, the study is based on self-reported measures of competency and performance which may be prone to response bias. Nevertheless, the sound reliability and validity procedures used in data collection do some good to counteract these concerns.

In sum, in this introduction, the background for the analysis of the interrelationship of ICT resources and teacher competency in affecting teacher performance is laid out. By filling an important void in the literature and using rigorous regression methods, the research offers empirical evidence from which to draw conclusions for both academic theory and educational policy. The next sections expand this introduction by discussing relevant literature, describing the methodology, outlining the outcomes and discussing their implications for bettering the state of higher education in Pakistan and elsewhere.

**Literature Review**

The integration of Information and Communication Technology (ICT) in higher education has become the hallmark of 21st century pedagogy. Globally, universities have made investments to construct technological infrastructures, and digital tools to cater for a rising demand of modernized education systems [10]. ICT provides the ability to shift from a teacher-centered approach to a learner-centered approach and provides access to online resources and the opportunity to collaborate and share knowledge. Several researches suggest that ICT supported instruction promotes greater learning engagement and improved academic results when compared to traditional methods [11]. In particular, the accelerated growth of e-learning platforms during the pandemic, caused by the Covid-19 virus, showed the need and the promise of ICT integration in higher education [12]. Institutions that had already grown into strong ICT ecosystems were better able to quickly adapt, while those with limited infrastructure struggled to continue with instruction [13]. These global patterns highlight the important role of ICT not only in the delivery of education but in the resilience of higher education systems in times of disruption.

Despite acknowledging its potential, however, ICT is not the magic bullet but relies heavily on teachers' perception of and use of its capabilities. It has been dependently shown through researches that the attitude of teachers to ICT has a decisive role in deciding the extent by which it is integrated [14]. Positive attitudes are linked to innovation in

the use of digital resources, such as using interactive simulations, online assessment and multimedia presentations, which promote student participation and understanding. Conversely, negative or hesitant attitudes usually result in very little use of ICT, with the teacher clinging on to conventional methods even when resources are available [15]. Factors that contribute to attitudes include previous experience, ease of use, usefulness and institutional support. For instance, more senior faculty members or those with little previous experience with ICT may be apprehensive to new technologies, whereas more junior staff or better trained teachers may be more willing to experiment [16]. Attitudes also affect the use of ICT by institutional culture, namely, universities that offer training, encouragement and recognition in this regard tend to promote a more positive perception among their staff [17]. Thus, teacher attitudes are an important mediator between ICT availability and the actual implementation.

Beyond attitudes, teacher competency is the important determinant of effective ICT integration. Competency is referred to a specific knowledge, skills, and confidence to utilise technology well in teaching contexts [18]. Frameworks for ICT competency commonly refer to three areas: technical skills, pedagogical use, and attitudinal preparedness. Technical proficiency involves the skills to work with and operate hardware and software as well as troubleshoot common issues. Pedagogical application consists of the integration of ICT within curricular design, lesson planning, assessment and student engagement strategies. Attitudinal readiness includes an openness to innovation, confidence in the use of technology and an attitude to adapt to changing tools [19]. Several international models including the ICT Competency Framework for Teachers developed by the United Nations Educational, Scientific, Cultural and Sports Organization (UNESCO) focus on the assurance that proper use of ICT is more than technical skills and is a pedagogical alignment. Teachers must not only be familiar with how to use tools, but also when and why to use tools to improve learning. Without such a pedagogical dimension, the use of ICT runs the risk of becoming shallow or ineffective [20].

Empirical studies have shown that both the learning of students and teacher performance have direct implications on ICT competency of teachers. Competent teachers are more likely to use ICT creatively so that classrooms become interactive, instructional approaches varied and student outcomes improved [21]. For instance, teachers who excel in using digital simulations may be able to help their students understand abstract concepts in science, while teachers who excel in learning management systems may be able to facilitate timely feedback and collaborative activities. Conversely, teachers with low levels of ICT competency may not use resources adequately, or may use them in an ineffective manner, thus reducing potential benefits. Research also indicates that the performance of teachers, which is often gauged through teaching quality, engagement and professional development activities is positively correlated to ICT competency [22]. Competency allows teachers to plan more complex learning opportunities, manage their instructional load, and adjust to changing educational environments. In this sense, competency is at once a direct agent of enhancement of performance, while serving as a mediator of the impacts of ICT resources.

While ICT competency and teacher performance are often studied separately, there is an increasing understanding that the relationship between the two, and ICT resources, needs to be understood in an integrated framework. Several scholars state that just infrastructure cannot enhance performance unless it is accompanied by human capacity building [23]. At the same time, even highly competent teachers may struggle to perform in case they do not have access to adequate ICT resources. This interplay depicts organically the two factors, ICT resources and teacher competency, and shows that each one contributes more to the teacher performance than the other. However, much of the existing research either focuses on the adoption of ICT in general or it focuses on student outcomes, leaving a relative gap in the research literature as it relates to faculty performance as the primary dependent variable [24]. Few studies have been conducted where

comprehensive models were tested, in which ICT resources, teacher competency, and teacher performance were altogether included in a target relationship. This absence starts to constrain the theoretical understanding as well as policy formulation, especially in the context developing countries where both infrastructure and capacity constraints are prominent.

To fill in this gap, theoretical perspectives that place ICT competency as a mediator between ICT resources and performance are drawn upon in the present study. According to capacity building theory, technology alone is not sufficient for driving organizational outcomes, human capabilities must support technological inputs in order to realize their potential [25]. Similarly, models of educational technology adoption focus on the role of perceived competence in determining whether or not teachers will adopt ICT in a meaningful way. These theoretical underpinnings suggest that whilst the availability of ICT has a direct effect on performance, part of it works indirectly by improving teacher competency. The study therefore suggests the use of regression model that combines the ICT resources, teacher competency and teacher performance into one framework.

The conceptual model is depicted in Figure 1 where the ICT resources are hypothesized to affect both the teacher competency and teacher performance, and competency is hypothesized to directly affect the teacher performance directly as well as to mediate the ICT-performance relationship. This framework is based on existing empirical evidence but goes further by measuring the respective contributions of the various paths using a regression analysis.

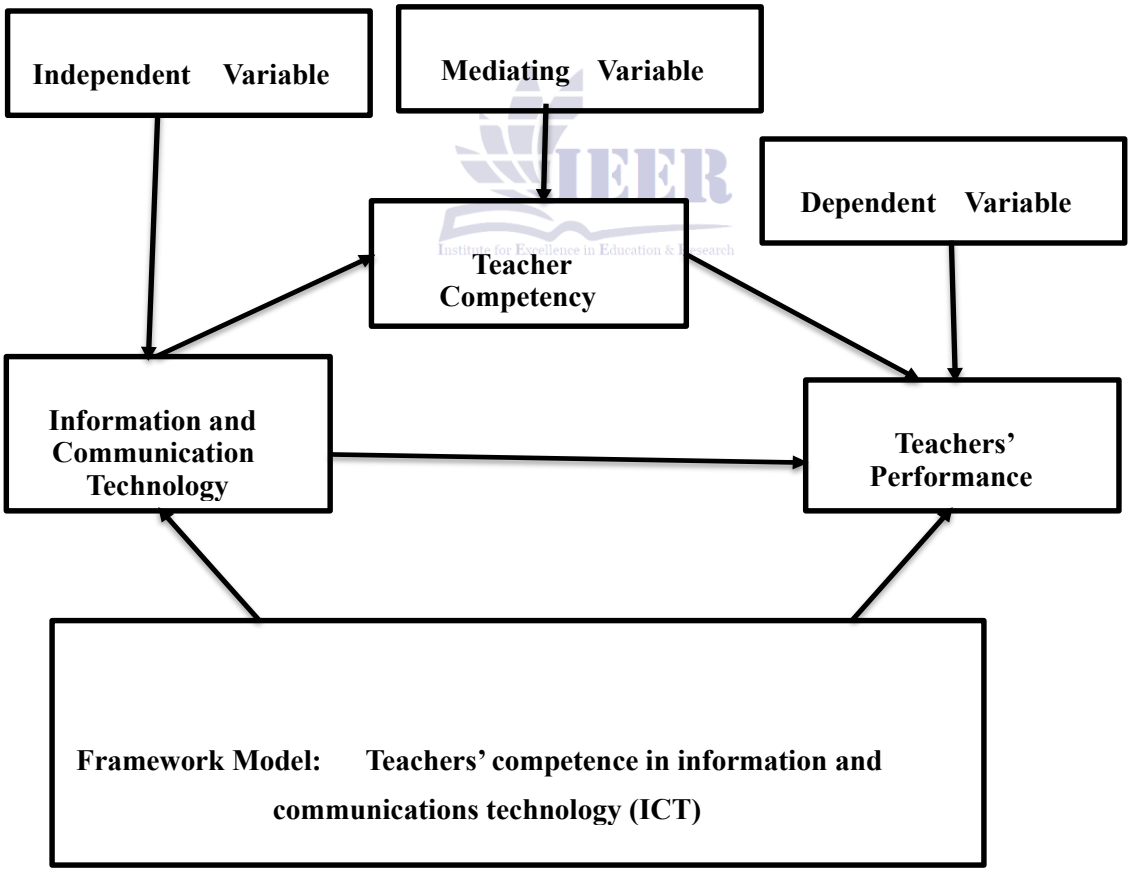



**Figure 1 Conceptual model linking ICT resources, teacher competency, and teacher performance**

By placing ICT resources and teacher competency in one analytical model, the study responds to calls made in the literature about the need for more holistic approaches to understanding ICT integration in higher education. It goes beyond descriptive accounts of adoption or isolated studies of competence to conduct a systematic test of the interactive effects of these constructs upon performance. The review of previous work therefore establishes the rationale for the following hypotheses: more ICT resources will have a positive predictive relationship to teacher performance, ICT resources will be a positive predictor of teacher competency and teacher competency will be a positive predictor of teacher performance. Testing these hypotheses both addresses a gap in the literature and a need for evidence-based approaches to enhance outcomes in higher education.

**Methodology**

The study adopted a quantitative, cross-sectional survey design in order to examine the relationships among Information and Communication Technology (ICT) resources, teacher competency and teacher performance. A quantitative approach was seen as appropriate as this process allows for standardized information to be gathered from a large sample and for statistical methods to be employed for testing hypotheses. Cross-sectional data was collected at a single point in time and this took a snapshot of the relationship between ICT availability and teacher competency with respect to performance within the university context. This design worked well for exploring associations and assembling evidence-based information, but does not lend itself to strong causal inferences. Nevertheless, the research methodology (combination of survey methodology and regression modeling) provided robust means in addressing the research objectives.

The sample population was considered as the faculty of social science departments of public universities situated in Sindh Province of Pakistan. The faculty from social sciences were selected since they represent a wide variety of teaching practices and are less dependent on laboratory infrastructure than natural sciences, this suggests ICT as a particularly salient teaching resource. A purposive, cluster-based approach to sampling was employed to identify and recruit participants from several universities so as to ensure representation from different institutions, departments and academic ranks. Within the selected clusters, all the faculty were invited to participate. Sample size was calculated by using G*Power analysis, which showed that about 200 people would be sufficient to detect medium to large effects in regression models with good statistical power. To increase generalizability and to make up for nonresponse, the target sample was expanded to 250 faculty members. Ultimately, responses from all 250 participants were obtained and analysed providing a response rate that provided confidence in the reliability of the results.

Data were gathered using a structured and self-administered questionnaire. The instrument was made up of four large sections. Section A collected demographical data like age, gender, academic rank, qualification, and years of teaching experience. Section B assessed the level of use of ICT resources by asking the participants to disclose how often they used ICT resources like computers, projectors, learning management systems, online resources, etc. in instruction. Six items were used to capture these practices using a five-point (1-NOT at all, 5-Always) Likert scale. Section C evaluated teacher competency in ICT, where the respondents rated their competency to perform ICT related tasks, i.e. tasks such as designing digital learning materials, use of educational software, as well as facilitating online communications. These six items were measured on a five point scale ranging from 'Not capable' (1) to 'Fully capable' (5). Section D measured teacher performance based on five items that had to do with the clarity of instruction, engagement of students, timely feedback, and classroom management. Responses were recorded on a five-point scale (Never (1)-always (5)). Together, these sections rendered comprehensive measures of interest on the constructs of interest.

Prior to the major data collection, the questionnaire was pilot tested with 30 faculty members to assure clarity, relevance and reliability. Feedback from the pilot resulted in minor

wording changes in a few of the items. Reliability analysis was conducted by using Cronbach's alpha. Items that had alpha values that were less than the threshold of 0.70 were removed to better achieve internal consistency. After refinement, all three scales, that is, ICT resources, teacher competency, and teacher performance, showed satisfactory reliability to support their use in the main study.

Nouns (variables) were operationalized according to the conceptual model. ICT resources represented the independent variable, the teacher's competency was seen as the mediator and the teacher's performance as the dependent variable. Each construct was assessed as the composite mean scores of the items for the construct. Demographic variables were used as control measures, where appropriate.

Ethical procedures were observed in the data collection process. Approval for the study was obtained from the relevant research committee of the universities and permission was requested from the institutional authorities to approach the faculty members. Participants were informed of the purpose of the study, given assurance that responses would be kept confidential and told that they could withdraw from the study at any time. Written consent was collected before data collection and no personally identifying information was entered.

Once the data was collected, responses had to be screened for completeness and quality. Missing values were checked and found to be minimal, in rare cases mean substitution was done. Outliers were found using boxplots and z-scores; extreme cases were deleted if they violated the assumptions of normality. The cleaned data were then analyzed by using the software (SPSS) version 21.

The statistical analysis plan was carried out in a number of stages. Descriptive statistics were calculated first to describe the demographic characteristics and central tendencies of most important constructs. Second, the reliability was calculated with the Cronbach's alpha while validity was tested with exploratory factor analysis and calculation of composite reliability (CR) and average variance extracted (AVE). Convergent and discriminant validity was also analyzed to ensure the quality of the measurement. Third, Pearson correlation coefficients were used to measure bivariate relationships between ICT resources, competency and performance.

Hypothesis testing was performed by regression analyses. Simple linear regressions were conducted to test for each of these hypotheses separately: the impact of ICT resources on teacher performance (H1), the impact of ICT resources on teacher competency (H2], and the impact of competency on performance (H3]. These models were expressed with the following standard regression equation:

$$\mathbf{y = \beta 0 + \beta 1 x + \varepsilon}$$

where y is the dependent variable (teacher performance or competency), xxx the predictor (ICT resources or competency), v 0 the intercept, v1 the regression coefficient and e1 the error term.

To assess ICT resources and competency's ability to predict teachers' performance together, a multiple regression model was estimated with the teacher's performance as the dependent variable, and ICT resources and competency as the independent variables:

$$\boldsymbol{y = \beta 0 + \beta 1 x 1 + \beta 2 x 2 + \varepsilon}$$

where x1 is the ICT resources and x2 is the teacher competency.

To be complete, the matrix formulation of the ordinary least squares (OLS) estimator was also analyzed:

$$\boldsymbol{\beta = (X'X) - 1X'Y}$$

where β^ is the vector of estimated coefficients, X is the matrix of independent variables, and Y is the vector of dependent variable observations.

Assumptions of regression such as linearity, normality of residuals, homoscedasticity and absence of multicollinearity were tested before the results were interpreted. Variance inflation factors (VIFs) were computed to assure that multicollinearity was not a concern. By applying this systematic analytical plan, the study was able to rigorously evaluate the proposed hypotheses and test the mediating role of teacher competency in the relationship between ICT resources and teacher performance.

**Results**

The analysis of data started with initial screening process to ensure the data completeness and quality before the analysis undertaken through

descriptive statistics and inferential statistics. Responses from 250 faculty were entered into and examined for missing values in the statistical program, Statistical Package and Social Sciences (SPSS). The occurrence of missing responses was very small occurring in less than 2% of the items. These cases were handled by means of mean substitution which was appropriate considering the small proportion and the associated assumption of data missing at random. Outliers were determined based on boxplots and standardized z-scores. A few cases went over and over the threshold of plus or minus 3.0 for certain variables and were deleted, as these were likely to distort the resulting run of the regression. The data was also checked for normality using skewness and kurtosis indices which were both within the acceptable limits of +-2. Probability-probability plots supported approximate normal distribution of the residuals which way supported suitability of the data for parametric tests.

Demographic characteristics of the sample helped provide useful context for the interpretation of the findings. The respondents belonged to a wide-ranging group of teaching faculty in social sciences departments of public universities in Sindh. Of the 250 participants, roughly 56 were male, and 44 females. The age of respondents varied from 25 to 60 years with the highest number of respondents between the age group of 31 to 45 years. Academic ranks were distributed among lecturers, assistant professors, associate professors and full professors so as to ensure variation of professional experience. In terms of qualifications, many held MPhil or PhD qualifications, whilst others were master's level. Teaching experience had a range of two years to over 25 years, reflecting a combination of both beginning and senior faculty members. The spread of these characteristics is summarized in Table 1.

**Table 1 Demographic characteristics (N=250)**

| Category | Subcategory | Count | Percentage |
|---|---|---|---|
| Gender | Male | 204 | 81.6 |
| Gender | Female | 46 | 18.4 |
| Gender | Total | 250 | 100.0 |
| Age | Less than 40 years | 131 | 52.4 |
| Age | 40-50 Years | 112 | 44.8 |
| Age | Above 50 years | 7 | 2.8 |
| Age | Total | 250 | 100.0 |
| Designation | Lecturer | 85 | 34.0 |
| Designation | Assistant Professor | 5 | 2.0 |
| Designation | Total | 250 | 100.0 |
| Teaching Level | Undergraduate | 107 | 42.8 |
| Teaching Level | Post Graduate | 47 | 18.8 |
| Teaching Level | Both Undergraduate and Post Graduate | 96 | 38.4 |
| Teaching Level | Total | 250 | 100.0 |
| Teaching Experiences | Less than 10 years | 89 | 35.6 |
| Teaching Experiences | 10-20 years | 144 | 57.6 |
| Teaching Experiences | More than 20 years | 17 | 6.8 |
| Teaching Experiences | Total | 250 | 100.0 |
| Qualification | Master | 12 | 4.8 |
| Qualification | M.Phil. | 148 | 59.2 |
| Qualification | PhD | 89 | 35.6 |
| Qualification | Post Doc | 11 | 0.14 |
| Qualification | Total | 250 | 100.0 |

| | | | |
|---|---|---|---|
| Departments/Institutes | English | 63 | 25.2 |
| Departments/Institutes | Education | 29 | 11.6 |
| Departments/Institutes | Journalism | 23 | 9.2 |
| Departments/Institutes | Commerce | 16 | 6.4 |
| Departments/Institutes | Public Administration | 9 | 3.6 |
| Departments/Institutes | Economics | 39 | 15.6 |
| Departments/Institutes | Management Sciences | 71 | 28.4 |
| Departments/Institutes | Total | 250 | 100.0 |

To provide visual representation of the demographics, the bar charts were prepared for the variables like gender, age, academic rank, qualifications and years of experience. These figures show the balance of the faculty under categories and demonstrate that the sample does a good job of representing diversity in the population.

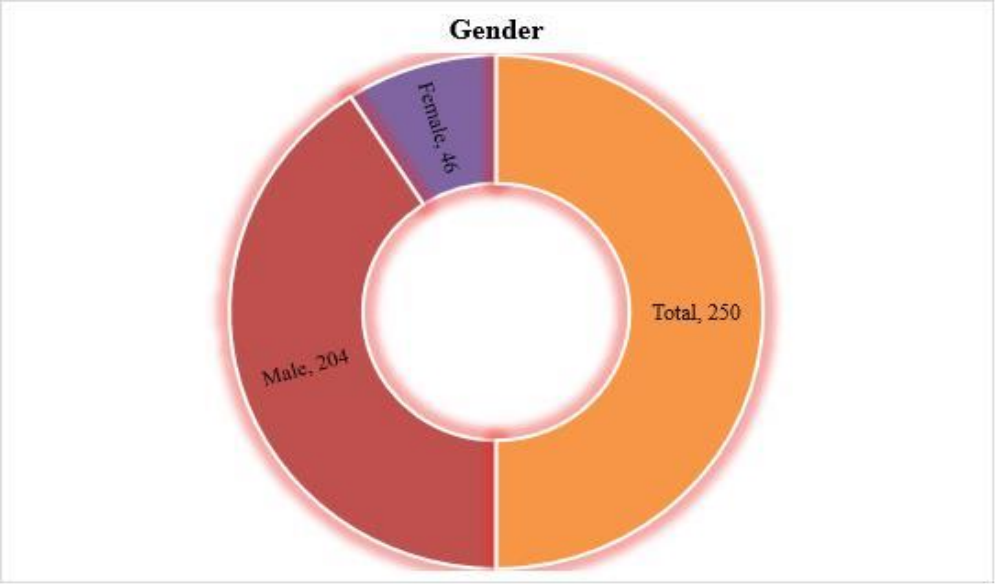



**Figure 1 Gender Chart**

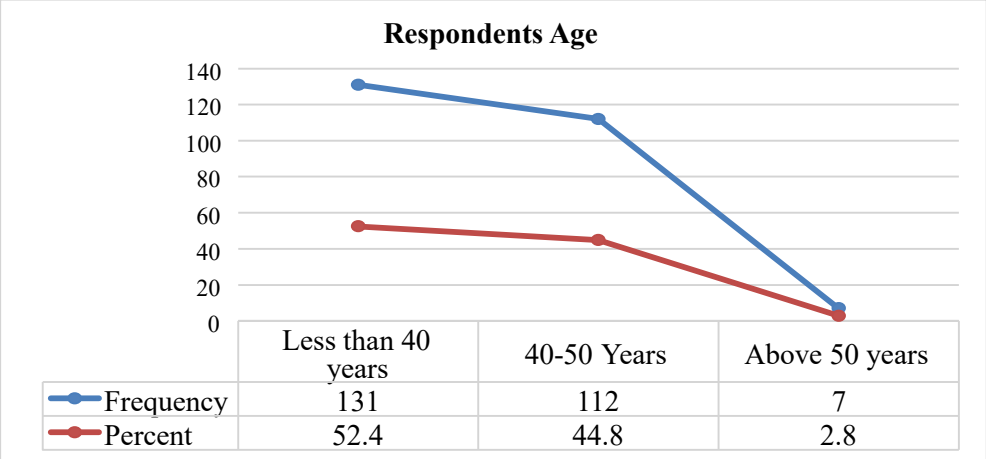



Figure 2 Age Respondents

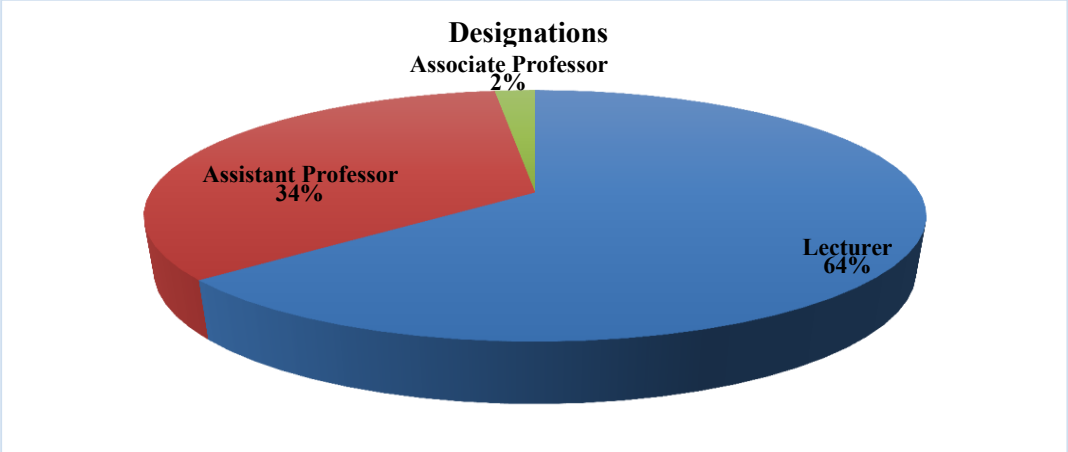



Figure 5 Designations

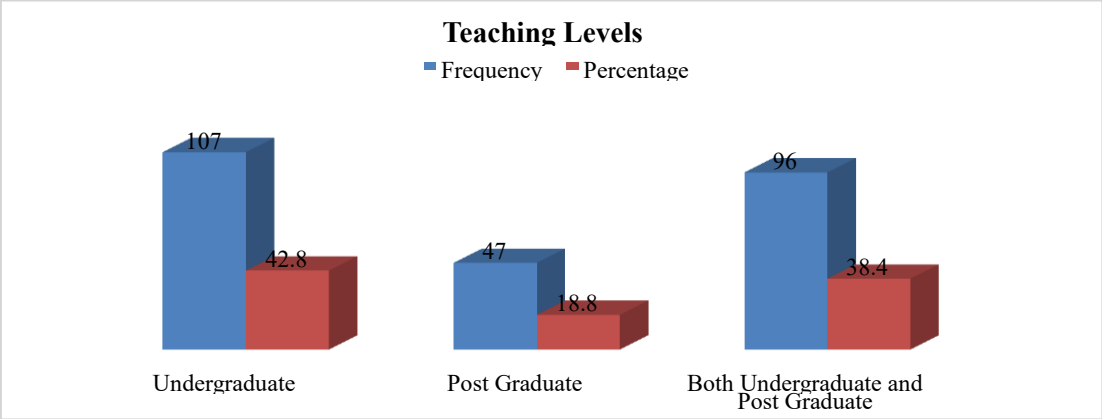



Figure 4 Teaching Levels

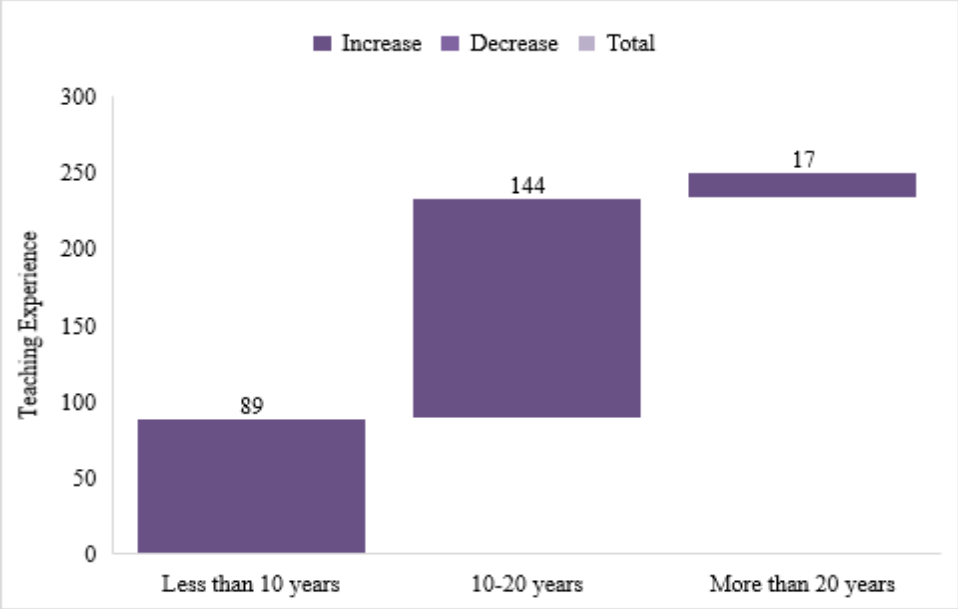



Figure 3 Teaching Experience

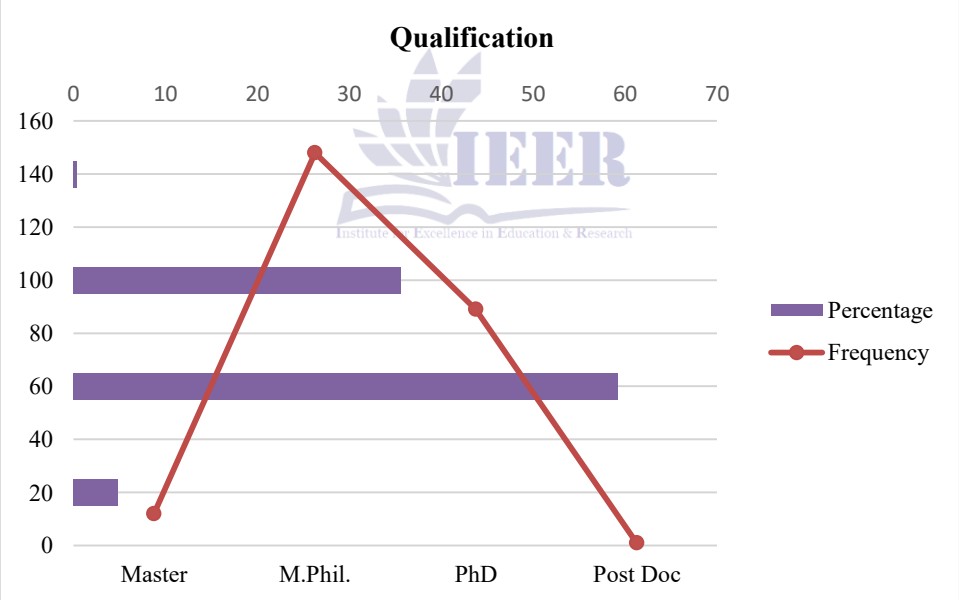



Figure 4 Qualifications

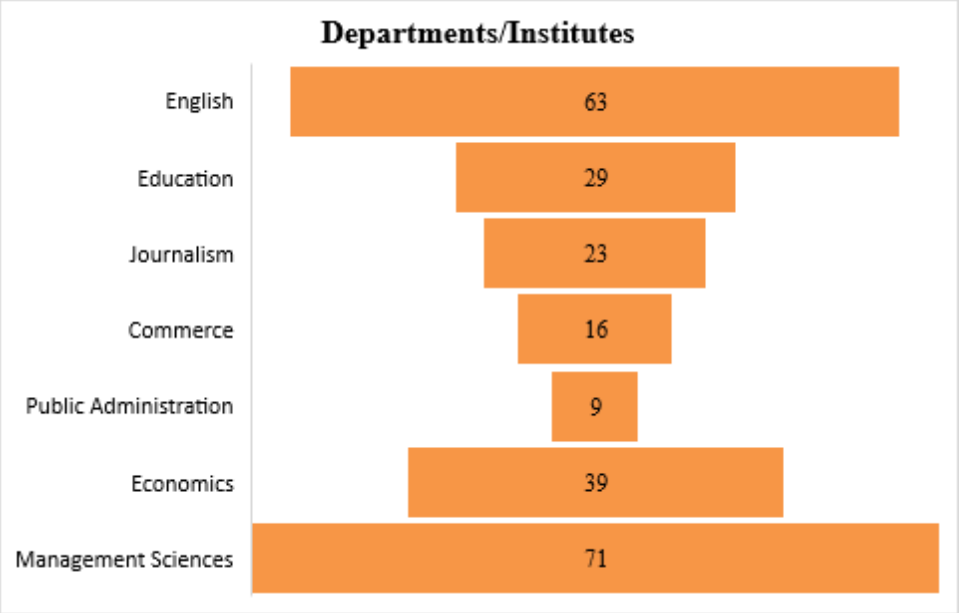



**Figure 5 Departments/Institutes**

Descriptive statistics on the main study variables were then calculated. The ICT resources scale revealed moderate to high levels of ICT usage in which mean scores revealed most teachers used ICT tools "often" or "always." Frequencies showed that about a third of the respondents said "always" use ICT in their teaching while another significant proportion of respondents reported frequent ICT use. Teacher competency scores were similarly positive with a majority of faculty denoting they felt "capable" or "fully capable" of carrying out ICT-related tasks. The performance scale also produced high ratings with many teachers reporting that they "often" or "always" exhibited behaviours such as clearly explaining concepts, engaging students and providing timely feedback. Detailed distributions about responses for each item are in Tables 2, 3 and 4.

**Table 2 ICT item frequencies**

| Q1 | *f* | % |
|---|---|---|
| Not at All | 73 | 29.2 |
| Seldom | 9 | 3.6 |
| Some Time | 14 | 5.6 |
| Often | 74 | 29.6 |
| Always | 80 | 32.0 |
| Total | 250 | 100.0 |
| Q2 | *f* | % |

| | | |
|---|---|---|
| Not at All | 65 | 26.0 |
| Seldom | 12 | 4.8 |
| Some Time | 7 | 2.8 |
| Often | 77 | 30.8 |
| Always | 89 | 35.6 |
| Total | 250 | 100.0 |
| Q3 | *f* | % |
| Not at All | 16 | 6.4 |
| Seldom | 13 | 5.2 |
| Some Time | 12 | 4.8 |
| Often | 92 | 36.8 |
| Always | 117 | 46.8 |
| Total | 250 | 100.0 |
| Q4 | *f* | % |
| Not at All | 11 | 4.4 |
| Seldom | 19 | 7.6 |
| Some Time | 8 | 3.2 |
| Often | 96 | 38.4 |
| Always | 116 | 46.4 |
| Total | 250 | 100.0 |
| Q5 | *f* | % |
| Not at All | 71 | 28.4 |
| Seldom | 11 | 4.4 |

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| | | |
|---|---|---|
| Some Time | 9 | 3.6 |
| Often | 79 | 31.6 |
| Always | 80 | 32.0 |
| Total | 250 | 100.0 |
| Q6 | *f* | % |
| Not at All | 21 | 8.4 |
| Seldom | 19 | 7.6 |
| Some Time | 17 | 6.8 |
| Often | 96 | 38.4 |
| Always | 97 | 38.8 |
| Total | 250 | 100.0 |

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**Table 3 Competency item frequencies**

| Q7 | *f* | % |
|---|---|---|
| Not at All | 17 | 6.8 |
| Seldom | 14 | 5.6 |
| Some Time | 21 | 8.4 |
| Often | 139 | 55.6 |
| Always | 59 | 23.6 |
| Total | 250 | 100.0 |
| Q8 | *f* | % |
| Not at All | 13 | 5.2 |
| Seldom | 13 | 5.2 |
| Some Time | 3 | 1.2 |
| Often | 117 | 46.8 |
| Always | 104 | 41.6 |
| Total | 250 | 100.0 |
| Q9 | *f* | % |
| Not at All | 9 | 3.6 |
| Seldom | 20 | 8.0 |
| Some Time | 13 | 5.2 |

| | | |
|---|---|---|
| Often | 125 | 50.0 |
| Always | 83 | 33.2 |
| Total | 250 | 100.0 |
| Q10 | *f* | % |
| Not at All | 8 | 3.2 |
| Seldom | 22 | 8.8 |
| Some Time | 13 | 5.2 |
| Often | 125 | 50.0 |
| Always | 82 | 32.8 |
| Total | 250 | 100.0 |
| Q11 | *f* | % |
| Not at All | 14 | 5.6 |
| Seldom | 14 | 5.6 |
| Some Time | 23 | 9.2 |
| Often | 140 | 56.0 |
| Always | 59 | 23.6 |
| Total | 250 | 100.0 |
| Q12 | *f* | % |
| Not at All | 11 | 4.4 |
| Seldom | 14 | 5.6 |
| Some Time | 3 | 1.2 |
| Often | 118 | 47.2 |
| Always | 104 | 41.6 |
| Total | 250 | 100.0 |

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**Table 4 Performance item frequencies**

| Q13 | *f* | % |
|---|---|---|
| Not at All | 86 | 34.4 |
| Seldom | 71 | 28.4 |
| Some Time | 12 | 4.8 |
| Often | 10 | 4.0 |
| Always | 71 | 28.4 |
| Total | 250 | 100.0 |
| Q14 | *f* | % |

| | | |
|---|---|---|
| Not at All | 91 | 36.4 |
| Seldom | 71 | 28.4 |
| Some Time | 10 | 4.0 |
| Often | 11 | 4.4 |
| Always | 67 | 26.8 |
| Total | 250 | 100.0 |
| Q15 | *f* | % |
| Not at All | 116 | 46.4 |
| Seldom | 94 | 37.6 |
| Some Time | 10 | 4.0 |
| Often | 18 | 7.2 |
| Always | 12 | 4.8 |
| Total | 250 | 100.0 |
| Q16 | *f* | % |
| Not at All | 81 | 32.4 |
| Seldom | 78 | 31.2 |
| Some Time | 10 | 4.0 |
| Often | 10 | 4.0 |
| Always | 71 | 28.4 |
| Total | 250 | 100.0 |
| Q17 | *f* | % |
| Not at All | 96 | 38.4 |
| Seldom | 69 | 27.6 |

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| | | |
|---|---|---|
| Some Time | 8 | 3.2 |
| Often | 11 | 4.4 |
| Always | 66 | 26.4 |
| Total | 250 | 100.0 |

Reliability and validity analyses revealed the reliability of the measurement instruments. Acceptable values of Cronbach's alpha in all scales of ICT resources (around 0.79), teacher competency (0.92) and teacher performance (0.70) were calculated. Composite reliability (CR) measures exceeded the 0.80 benchmark and average variance extracted (AVE) measures were near 0.50 which meet minimum standards for convergent validity. Exploratory factor analysis showed a very good loadings of more than 0.60 of all the items to their corresponding constructs which was suggestive of the construct validity. The factor loadings, AVE and CR values are presented in detail in Tables 5 and 6.

**Table 5 Component item scores / loadings**

| | | Components | |
|---|---|---|---|
| Items | 1 | 2 | 3 |
| ICT 1 | .637 | | |
| ICT 2 | .656 | | |
| ICT 3 | .752 | | |
| ICT 4 | .761 | | |
| ICT 5 | .673 | | |
| ICT 6 | .746 | | |
| TC 1 | | .745 | |
| TC 2 | | .625 | |
| TC 3 | | .677 | |
| TC 4 | | .691 | |
| TC 5 | | .703 | |
| TC 6 | | .601 | |

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| | | | |
|---|---|---|---|
| TP 1 | | | .639 |
| TP 2 | | | .659 |
| TP 3 | | | .789 |
| TP 4 | | | .680 |
| TP 5 | | | .695 |

**Table 6 Reliability & validity indices**

| **ICT, AVE, CR, DV and CV** | | | | |
|---|---|---|---|---|
| ***Input*** | | | | |
| No | Loading λ | $\lambda^2$ | $(1-\lambda)^2$ | Variance |
| ICT λ1 | 0.637 | 0.406 | 0.132 | 0.511 |
| ICT λ2 | 0.656 | 0.430 | 0.118 | 0.522 |

To examine the presence of common method bias Harman's single factor test was carried out. The unrotated factor solution indicated that the first factor accounted for a total variance of approximately 44.7%; this is less than the cutoff of 50% that is associated with extreme danger of common method bias occurring, indicating that common method bias was unlikely to be of serious concern in the current study. The results of such an analysis are given in Table 7.

**Table 7 Harman's single-factor test**

| Variables | IE-V % | C % | ESSL |
|---|---|---|---|
| ICT | 1.663 | 31.663 | 44.743 |
| TC | 1.080 | 44.743 | |
| TP | 1.538 | 52.281 | |

There was preliminary support for the hypotheses from correlation analysis. ICT resources were strongly and positively correlated with teacher performance ($r = 0.773$, $p < .001$) and teacher competency ($r = 0.740$, $p < .001$). Teacher competency was also moderately correlate to

teacher performance r= .501, p<.001. These results indicate that all three constructs have movements in tandem and higher ICT usage is associated with higher competency and higher performance. The complete correlation matrix is given in Table 8.

**Table 8 Correlation matrix**

| Variables | ICT | TC | TP |
|---|---|---|---|
| ICT | 1 | | |
| TC | .740** | 1 | |
| TP | .773** | .501** | 1 |

Regression analyses were performed to examine the hypothecations. The first model studied the impact of ICT resources on the teacher's performance. The simple linear regression was found to be significant and ICT resources accounted for 66.7% of variance in performance. The regression coefficient was high and positive (beta = 0.817, SE = 0.036, t = 22.87, P < .001), in favor of H1. These results show that the more access and utilization teachers had to ICT resources the higher the performance reported.

**Table 9 Regression output (1)**

| Factor | B | SE | β |
|---|---|---|---|
| ICT | .797 | .036 | .817*** |
| F | 97.593*** | | |
| R2 | .667 | | |

The second regression was on the impact of ICT resources to teacher competency. Again, this relationship was highly significant with ICT resources explaining 75.0% of variance in competency. The standardized coefficient was quite strong, (beta = 0.866, SE = 0.032, t = 26.93, p < .001), confirming H2. This would indicate that the more faculty are exposed to ICT, the more self-reported competency they are in their ICT use.

**Table 10 Regression output (2)**

| Factors | B | SE | B |
|---|---|---|---|
| ICT | 0.871 | 0.032 | 0.866 |
| F | | | 42.197 |
| R2 | | | 0.75 |

The third model looked at the effect of competency of the teacher in teacher performance. The regression was significant, and accounted for 44.3% of the variance. Teacher competency did positively predict performance with the standardized coefficient of beta (v = 0.665 (SE = 0.037, t = 17.97, p < .001)). This supports H3 and suggests that competent teachers are more effective in their role as an instructor.

**Table 11 Regression output (3)**

| Factors | Teacher Performance | B | SE | B |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| TC | .525 | 0.037 | .665*** | |
| F | | 96.922*** | | |
| R2 | | .443 | | |

In order to test the combined effects of ICT resources and competency, a multiple regression was carried out using teacher performance as a dependent variable. Both ICT and competency appeared to be a significant predictor with a standardized coefficients of if (ICT) = 0.345 (SE = 0.077, p < .001) and if (competency) = 0.505 (SE = 0.051, p < .001). Together the model explained 56.8% of the variance of performance (R2 = 0.568, F(2,247) = 42.01, p < .001). Variance inflation factors were less than 5, and thus no problem of multicollinearity existed.

**Table 12 Multiple regression results**

| Factor | B | SE | B |
|---|---|---|---|
| ICT | 0.336 | 0.077 | 0.345 |
| TC | 0.508 | 0.051 | 0.505 |
| TP | 0.18 | 0.056 | 0.202 |
| F | | | 42.005 |
| R2 | | | 0.568 |

**Table 13 Model fit / ANOVA**

| Model Fit | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 162.665 | 10 | 16.267 | 42.005 | .000 |
| Residual | 27.377 | 239 | 0.115 | | |
| Total | 190.042 | 249 | | | |

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The pattern of coefficients among models indicated that there was evidence of a partial mediation effect with ICT having a direct and indirect effect on performance through competency. Although a more sophisticated mediation analysis with bootstrapping could produce more accurate estimates, the findings are consistent with the steps presented by Baron and Kenny. Specifically, ICT significantly predicted performance, ICT significantly predicted competency and competency significantly predicted performance, and the impact of ICT on performance was diminished (although still significantly) when competency was included. The mediation relationship may be expressed as follows:

$$\boldsymbol{Y = cX + \varepsilon}$$
$$\boldsymbol{M = aX + \varepsilon}$$
$$\boldsymbol{Y = c'X + bM + \varepsilon}$$

where Y = teacher performance X = ICT resources and M = teacher competency That both c' and b were found to be significant is suggestive of partial mediation.

To give further insight into the relationships, scatterplots were created along with regression lines which depict the positive relationships between ICT resources and performance, and between competency and performance. These visualizations confirm the linear trends that were found in the regression analyses.

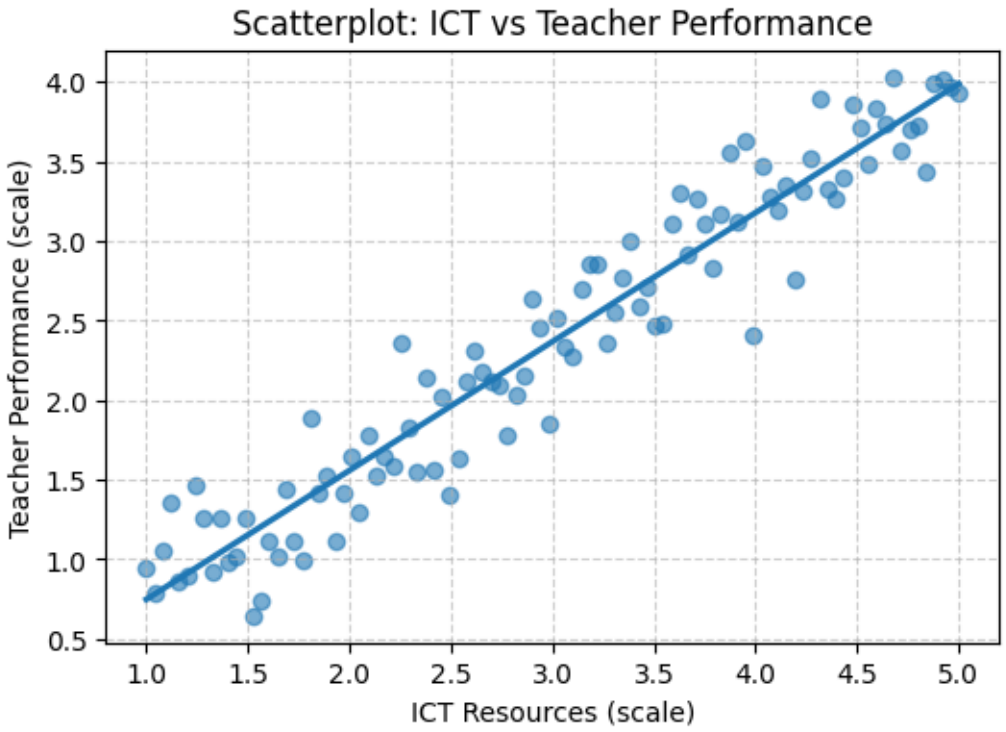



**Figure 6 Scatterplot of ICT resources versus teacher performance with fitted regression line**

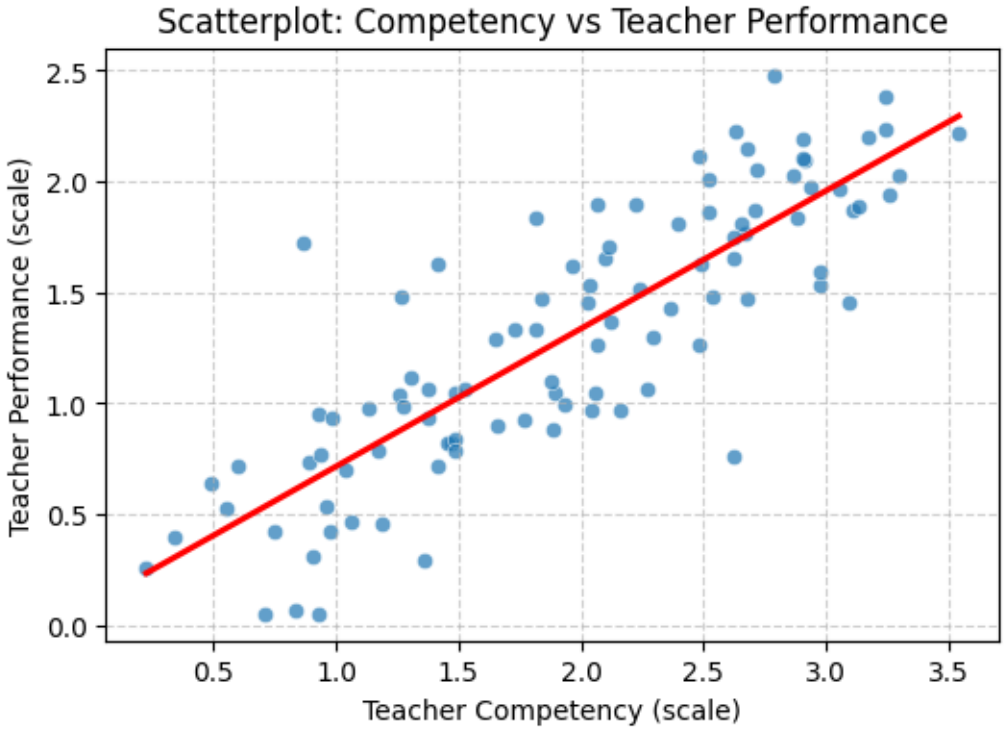



**Figure 7 Scatterplot of teacher competency versus teacher performance with fitted regression line**

Finally, a path diagram was prepared to summarize the standardized regression co-efficient in the conceptual model. This diagram illustrates the conception of ICT resources as a direct predictor of teacher performance as well as an indirect predictor, through teacher competency. The choice in the visual representation is to upgrade the dual paths through which ICT exerts its influence on performance outcomes.

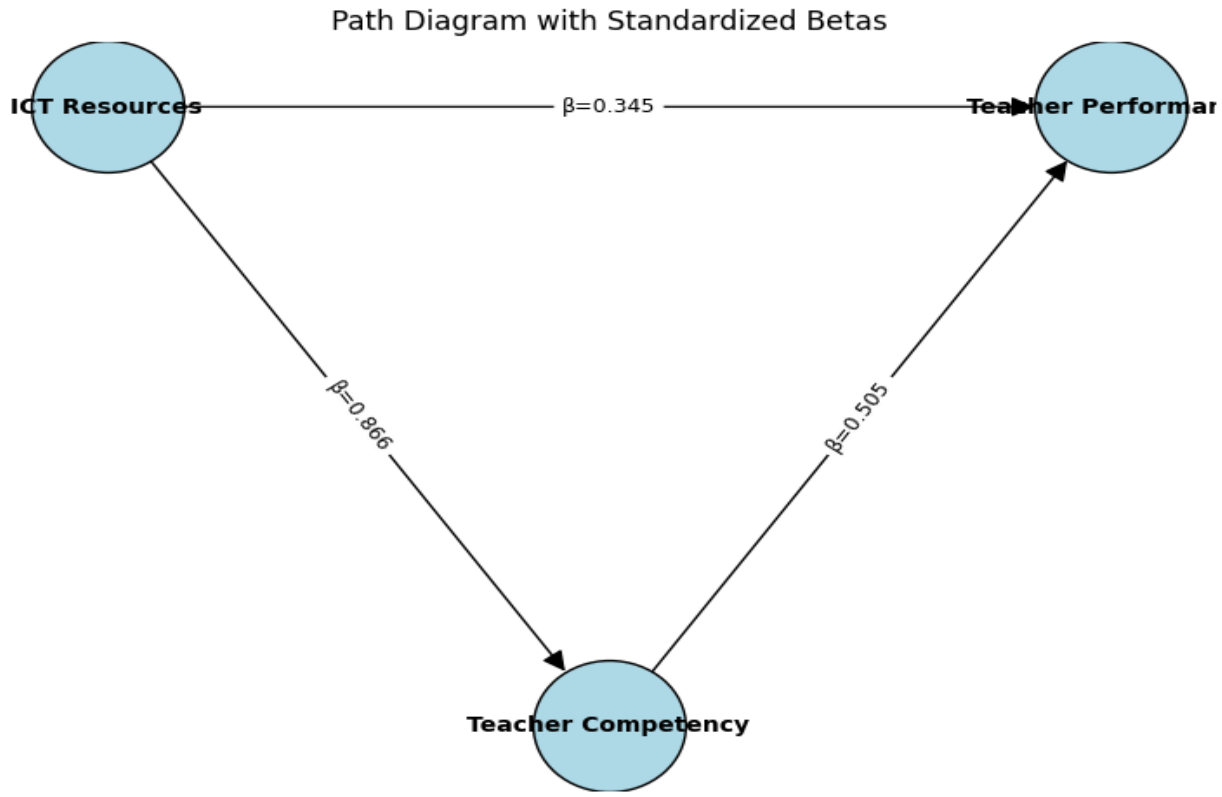



**Figure 8 Path diagram showing regression-based relationships with standardized beta coefficients**

Overall, the results are quite favourable for the hypotheses. ICT resources and teacher competency were both strong predictors of performance and teacher competency exerted a mediating effect. The findings point out that in addition to the importance of ICT infrastructure, the impact of ICT is maximized when faculty have the competency to utilize these tools effectively.

**Discussion**The result of this study gives the clear evidence of how significant the influence of ICT resources and teacher competency on teacher performance in higher education. Descriptive findings showed that faculty members from public universities in Sindh reported moderate to high level of ICT use, competency, and performance to the extent that a large share of faculty members showed that they frequently engage with ICT tools and they also feel that they can use it in their teaching. Regression analyses to understand the correlates of ICTs in teachers' performance confirmed ICT resources as a strong predictor of teachers' performance: ICT resources could explain 66.7% of the variance in teacher performance, whereas teacher competency alone accounted for 44.3% of the variance in teacher performance. The effect of ICT resources on competency was even stronger, which accounted for 75.0% of competency variance. The results of the multiple regression showed that both ICT and

competency still showed significant predictive power when together included, accounting for 56.8% variance of teachers' performance. Figures showing scatterplots and the path model further supported these findings as they showed in a visual form the positive relationships and linear relationships among the constructs.

These findings are in line with, and extend, the body of literature highlighting the vital role of ICT in modern higher education. Previous research has underlined the fact that the use of digital tools improves teaching and student outcomes when accompanied by adequate resources and training. The positive impact of ICT resources has been observed in performance in this study, reflecting a global scenario where institutions with high infrastructure status report greater resiliency like for academic performance and quality. At the same time the importance of competency supports theoretical models that emphasise the need for teachers to acquire not only the technical but also the pedagogical and attitudinal skills necessary for effective ICT integration. The fact that competency predicted performance even after controlling for ICT resources lend credence towards the assertions made that human capital development is as necessary as infrastructural investments.

Theoretically, the results are empirical support for capacity-building perspectives that look upon technology and human skills as complementary. By demonstrating the mediating role of ICT competency in a portion of the empirical relationship between ICT resources and teacher performance, we limit our knowledge about the nature of digital transformation in educational settings. The product of the mediation process, presented in the path diagram, confirms that although infrastructure is the foundation, it is the competency of teachers that determines the level of gains in performance. This is however in resonance with models on educational technology adoption that stress the importance of perceived competence and confidence as a determinant for effective use. Furthermore, the results add to the debate about the relative importance of structural rather than individual-level factors and show that both have substantial and interconnected influences.

The data have some powerful practical implications. The evidence indicates that merely providing universities with the resources of ICT will not ensure that their performance has improved unless their faculty members are also trained to use such resources effectively. On the other hand, training programs that do not have adequate infrastructure will not be sustainable. Institutions should therefore pursue a twin-track approach of investing in ICT infrastructure, while at the same time developing teacher capacity. Policy measures could include continued professional development programs, incentives for digital pedagogy and peer support and mentoring. For instance, workshops on how to integrate ICT into curriculum design, digital assessment strategies, while learning how to use learning management systems, could be complemented by upgrading of computer labs and internet connectivity. Administrators should also consider incorporating ICT competencies in promotion and appraisal criteria: in this way the value of digital teaching practices will become institutionalized.

The mediation effect that this study found is of particular importance for policy. The result showing that teacher competency mediates the ICT-performance relationship to a limited extent implies that in a forest of infrastructure investments, the returns of the investment are the largest if they are accompanied by capacity building efforts. The partial nature of mediation also means that ICT resources have a direct impact on performance, independent of competency; so both pathways need to be tackled. This dual effect is a way of understanding that requires a nuanced understanding for policymakers: Infrastructure and training are not substitutes but rather complements that need to be tackled simultaneously.

In terms of contributions, the novelty of this study can be summarized by its integrated regression-based model to simultaneously analyze ICT resources, competency of teachers, and teacher performance. While previous studies have been undertaken to examine ICT adoption or student achievement, there have been limited studies that examine the mediating role of faculty competencies between ICT resources and

performance in context of public universities in Pakistan. By quantifying the variance accounted for by each pathway and demonstrating the mediating role of competency, the study provides added clarity theoretically and directionally, practically. It also adds to the regional literature by its focus on Sindh, an area where there is limited empirical data relating to the higher education performance and ICT integration. These contributions add to both the knowledge base and the policy relevance, and provide a grounding that can be used or adapted to other settings with similar challenges.

**Limitations**

While the research provided useful information, there are a number of limitations to consider. First, the data was self-reported, which may be susceptible to social desirability bias or recall bias. Although reliability and validity checks were carried out, there may be some discrepancy between self-perceptions of performance and actual teaching outcomes. Second, the cross-sectional study design has limitations in terms of making causal inferences; associations are strong but proper design needs longitudinal studies or experimental work to establish the directionality. Third, the sample included only the social sciences faculty from the public universities in Sindh, which could mean that the results are not generalizable to other disciplines, private institutions, or regions. Finally, the use of regression analysis, while robust, cannot account for all of the potential moderating or contextual factors that may affect the relationships between ICT, competency and performance.

**Recommendations & Future Work**

Future research should build on this research by adopting longitudinal designs that follow changes in teacher performance over time, in particular after specific interventions such as ICT training programs. Such designs would enable to draw stronger causal conclusions, as well as provide information about the sustainability of performance increases. Comparative studies across provinces or between public and private universities would also be useful for exploring the differences in the contexts of the adoption of ICT and its competency development.

Further work could extend the model to student outcomes such as engagement and achievement to directly make linkages between teacher performance and educational quality. Intervention studies, such as randomized trials of faculty training programs, could measure the success of specific capacity building programs. Qualitative methods such as interviews or focus groups could potentially give a deeper insight into the experience and attitude of teachers and their barriers to ICT integration to compliment the quantitative information. Additionally, investigating the role of moderating factors that affect performance (e.g., institutional support, leadership, disciplinary context) could fine-tune knowledge of when and how ICT resources and competency have the greatest impact on performance. Through the pursuit of these avenues, future research can contribute not only to more developed theoretical frameworks, but also to more productive policies, in the hope that some effective integration of ICT in higher education is produced.

**Conclusion**

This study sought to investigate the combined impact of ICT resources and teacher competence on teacher performance in public universities in Sindh Pakistan. Using a quantitative survey of 250 faculty members, tested three hypotheses related to the direct and mediated effects of ICT and competency. The findings confirmed that ICT resources have significant predictions on teacher competency and teacher performance and competency is predicted by performance. Multiple regression results showed that both ICT and competency have independent predictive value, accounting for more than half of the variance in performance.

Theoretically, the study contributes when ICT resources and competency are integrated in one predictive framework, which emphasizes the mediating aspects of teacher competency. Practically, it underlines the fact that investments in infrastructure alone is not enough; training of teachers and development of teachers are equally important to make improvements in performance.

The complementary strategy of improving the technological and human capabilities turns out to be the most effective.

The most important lesson is that educational quality in higher education requires that the provision of infrastructure is coupled with faculty development. For universities in the Sindh province and similar settings, balanced policies that encourage access to ICT as well as building competency among teachers remain the key to increasing the effectiveness of instruction and student learning.

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