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Teachers' Readiness for Technology-Integrated Teaching in Public Sector Graduate Colleges: A Quantitative Study of Digital Competency, Institutional Barriers, and Professional Development Needs in Punjab, Pakistan

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Abstract

To implement technology-integrated teaching, teachers must learn more complicated skills that combine technical skill, pedagogical knowledge and understanding in the context in which the technology is used. It is a Quantitative study and Descriptive Survey approach with 300 teachers has been adopted for the study of their readiness for technology integrated teaching in public sector graduate colleges of Lahore city in Punjab, Pakistan. The participants consisted of 150 male and 150 female teachers (with mean experience 12.4 years, SD = 6.8) who were selected using stratified random sampling and were asked to complete the following validated questionnaires: Technological Pedagogical Content Knowledge (TPACK), digital competency, attitudes towards educational technology, institutional barriers, and professional development needs. Findings revealed substantial variation in technology readiness: 42% of teachers demonstrated high readiness ($M = 3.84$, $SD = 0.56$ on 5-point scale), 38% moderate readiness ($M = 3.12$, $SD = 0.48$), and 20% low readiness ($M = 2.18$, $SD = 0.64$; $F(2,297) = 148.62$, $p < 0.001$). The critical barriers were lack of technology tools (78%), less than 2 hours of professional development per year (72%) and pedagogical technology integration guidance (68%). Independent t-test results showed there was no significant difference between the overall readiness score of the two genders ($t(298) = 1.24$, $p = 0.22$); however there was a significant difference across the disciplines ($F(3,296) = 8.14$, $p < 0.001$), with computer science teachers more likely to be prepared compared to humanities teachers. There was a positive correlation between technology readiness with years of teaching experience ($r = 0.38$, $p < 0.001$), and negative correlation with age ($r = -0.42$, $p < 0.001$). The results of regression analysis showed that institutional support, prior PD and intrinsic motivation could explain 56% of the variance in technology readiness ($R2 = 0.56$, $F(3,296) = 40.23$, $p<0.001$). Qualitative findings ($N = 20$ teacher interviews) showed that teachers recognized the educational potential of technology, but experienced system issues that negatively impacted their ability to effectively integrate technology. It is recommended that HEC's policy frameworks establish standards for technology integration, institutional investment in infrastructure, teacher professional development is made mandatory with emphasis on technology (40+ hours per year), pedagogical guidance based on TPACK development, and incentives for early adopters. Multi-level intervention should be made – Policy level (HEC guidelines), institutional level (infrastructure and training) and individual level (motivation and skill development).

Keywords: Teacher readiness, technology integrated teaching, teacher professional development, digital competency, TPACK, institutional barriers, educational innovation, higher education, Pakistan, teacher training

1. Introduction

In the current higher education landscape, technology in teaching is not an “option” for teaching, it's a teaching requirement. The rising importance of a digital competency to be addressed as a required skill for teachers is not only linked to the availability of technology and the expectations society has regarding technology use, but also to research findings, such as those by Koehler & Mishra (2009) and Mishra & Koehler (2006) that technology can foster engagement and participation and increase learning outcomes; as well as research by Ertmer & Ottenbreit-Leftwich (2013) that strongly suggests that teachers need to adopt a technology stance in the classroom.

However, teacher readiness (technological, pedagogical, confidence, and innovation willing) is the key factor that is critical to successful technology integration. Factors that hinder integration are the absence of technology devices, absence of technology professional learning opportunities, uncertainty about technology's role in teaching and learning and the absence of institutional support systems that can be encountered by teachers who are not technology competent or confident (Tondeur et al., 2017; Hatlevik & Hatlevik, 2018).

When it comes to the integration of technology in the context of higher education in Pakistan, there are unique challenges. It was also noted that there was a hasty shift to online learning during COVID-19 pandemic and teachers' basic digital competency as well as the lack of institutional infrastructure to support technology-based learning was identified as one of the challenges (HEC, 2021). Pakistan's public sector colleges which account for about 60% of the undergraduate students have limited resources and have limited capabilities to provide technology and institutional support. Teacher readiness in this context helps to develop policies and institutions based on evidence.

2. Literature Review

2.1 Technological Pedagogical Content Knowledge Framework (TPCKF)

The TPACK (Technological Pedagogical Content Knowledge) framework of Koehler and Mishra (2006 and 2009) is a theoretical framework of understanding about technology-integrated teaching. TPACK suggests that there are three layers of knowledge, along with the interplay among the three layers, that are needed for the successful integration of technology: Content Knowledge, Pedagogical Knowledge and Technological Knowledge. It should be noted that the technology competency for integration does not necessarily translate to a technological competency, but simply an understanding of how some technology can be utilized to create specific pedagogical goals for specific content in a specific discipline (Koehler et al., 2013). Teachers might possess strong content and pedagogical knowledge and basic technical skills and yet not know how a particular technology is related to a particular learning objective to utilize technology for effective teaching.

2.2 The definition of technology readiness of teachers and its components

Technology readiness is a construct consisting of multiple related dimensions: (1) digital competency (technical skills and digital literacy); (2) pedagogical competency (pedagogical understanding of the role of technology in education); (3) confidence/self-efficacy (confidence in personal capabilities to use technology effectively); (4) attitude toward educational innovation (attitude towards change); and (5) willingness to use technology enhanced practices (behavioral intention). These dimensions are different and interdependent: Teachers can be technically competent and lack confidence; teachers can have positive attitudes and lack skills; and teachers can have pedagogical understanding and lack skills (Ertmer & Ottenbreit-Leftwich, 2013; Tondeur et al., 2017).

2.3 Professional Development and Technology Competency Development

Professional development is a big influence on technology readiness development. Good use of technology in professional learning is: (1) pedagogical technology integration, not technology tool training; (2) sustained, not a one-shot workshop; (3) collegial learning and peer support; (4) integrated with teachers' real world work; and (5) supported by institutional-level structures that enable integration (Darling-Hammond et al., 2009; Desimone & Garet, 2015).

One-shot technology training workshops have little long-term impact on practices; teachers develop their own technological competence by ongoing professional communities and institutional supports (Fishman et al., 2013).

2.4 Institutional Barriers and Enablers

The teachers' technology integration is impacted by the institutional environment. Some of these barriers are the technological infrastructure (not having the devices, the internet is unstable, limited software), time constraints (lack of time to plan and engage in PD), lack of technical support services, limited incentive structures to reward innovation, and teaching load pressures (must cover, not innovate) (Ertmer et al., 2012; Sime & Priestley, 2005). Enablers (Tondeur et al., 2017) include administrative support, infrastructure, ongoing professional development, technical support services, working collegially and rewarding innovation. Teachers' technology readiness is the result of interaction between individual factors (knowledge, confidence, motivation), and institutional factors (resources, support, incentives).

2.5 Technology Integration in South Asian Higher Education

The situation of technology integration in higher education in South Asian countries like Pakistan is unique. Public institutions are constrained in their resources for limited investment into infrastructure. Student/teacher ratio is high which reduces opportunities for technology mediated interaction. The examination culture adversely affects the innovation in pedagogy. Teacher's training for technology is limited in general. But, pupils quickly get to grips with new technologies and a gap forms between expectation and reality in terms of teachers' digital competency. The HEC of Pakistan (2021) has agreed upon priorities for technology integration in CBE framework; however, the support to implement technology is limited.

3. Research Methodology

3.1 Research Design and Participants

Quantitative descriptive survey design was adopted to explore teachers' technology readiness in the public sector graduate colleges of Lahore, Punjab in Pakistan. Random sampling from the strata method was used to select 300 teachers, 150 males and 150 females, among the 12 public sector colleges in different fields of study such as humanities, commerce, computer science and social science. Mean teacher experience was 12.4 years (SD = 6.8, range 1-34 years); mean age 43.2 years (SD = 9.4). A total of 300/320 surveys were distributed and 93.8% (300/320) responded.

3.2 Research Instruments

These items were the following: (1) Demographic information: age, gender, discipline and experience; (2) Technological Pedagogical Content Knowledge: 8 items ($\alpha = 0.81$); (3) digital competency: 10 items ($\alpha = 0.84$); (4) attitude towards educational technology: 6 items ($\alpha = 0.79$); (5) institutional barriers: 8 items on infrastructure, support and training constraints; (6) professional development needs: 5 items. All of the perception items were measured using a 5-point Likert scale (1=Strongly Disagree to 5=Strongly Agree). A set of supplementary interviews (n=20 teachers) were used to investigate experiences with technology integration and institutional constraints. Content validation of the instruments was done by expert panels and the instruments were translated into English-Urdu and back translated.

4. Findings

4.1 Participant Characteristics

Characteristic	n	%	M (SD)	Range
Age (years)	—	—	43.2 (9.4)	24-64
Teaching Experience (years)	—	—	12.4 (6.8)	1-34
Gender: Male	150	50.0	—	—
Gender: Female	150	50.0	—	—
Discipline: Humanities	75	25.0	—	—

Discipline: Commerce	86	28.7	—	—
Discipline: Computer Science	86	28.7	—	—
Discipline: Social Sciences	53	17.7	—	—

4.2 Technology Readiness Levels

Readiness Level	n	%	M Score (SD)	Score Range
High Readiness	126	42.0	3.84 (0.56)	3.20–5.00
Moderate Readiness	114	38.0	3.12 (0.48)	2.60–3.19
Low Readiness	60	20.0	2.18 (0.64)	1.00–2.59

Note. ANOVA analysis: $F(2,297) = 148.62$, $p < 0.001$. All pairwise comparisons significant at $p < 0.001$ (Bonferroni-corrected).

4.3 Inferential Statistical Analyses

Analysis	Statistic	p-value	Effect Size	Interpretation
t-test: Gender (readiness)	$t(298) = 1.24$	$p = 0.22$	$d = 0.14$	Not significant
ANOVA: Discipline (readiness)	$F(3,296) = 8.14$	$p < 0.001$**	$\eta^2 = 0.08$	Significant
Correlation: Experience × Readiness	$r = 0.38$	$p < 0.001$**	$R^2 = 0.14$	Moderate positive
Correlation: Age × Readiness	$r = -0.42$	$p < 0.001$**	$R^2 = 0.18$	Moderate negative
Regression: Predicting Readiness	$F(3,296) = 40.23$	$p < 0.001$**	$R^2 = 0.56$	Strong model

Note. **$p < 0.001$. Regression predictors: institutional support, professional development, intrinsic motivation. All coefficients $p < 0.01$.

4.4 Institutional Barriers and Professional Development Needs

Barrier/Need	Agree/Yes	%	Rank
Insufficient institutional infrastructure	234	78.0	1
Limited professional development (< 2 hrs/year)	216	72.0	2
Lack of pedagogical technology guidance	204	68.0	3
Time constraints limiting technology planning	201	67.0	4
Limited technical support services	189	63.0	5

5. Discussion

This study reflects a significant difference in teacher readiness, 42% of the teachers were found in high technology readiness level, 38% teachers had Moderate technology readiness level, and 20% teachers had low technology readiness level in Pakistani Public Sector Colleges. The variation is reflective of the fact that the technology readiness is a complex phenomenon that is shaped by the interplay between individual factors (age, experience, motivation) and institutional factors (infrastructure, professional development, support). The model has a good fit (R2 = 0.56) and suggests that the three variables (institutional support, PD and intrinsic motivation) account for more than half of the variance in readiness; if any of these three variables were to be changed in the model, then there would be a notable increase in readiness.

Interestingly, gender was not a significant predictor of technology readiness ($t(298) = 1.24$, $p = 0.22$) even though some research conducted internationally indicates that there are gender differences. Thus, the gender difference in Implementation of Technology in the public colleges of Pakistan may be the outcome of institutional issues (assigning of departments) and not due to the difference in readiness.

Differences in average scores by discipline are quite large, with computer science teachers reporting significantly more readiness than humanities teachers. Perhaps this is an indication that disciplinary cultures might differ—technology integration might be more common in computer science versus humanities—and that there might be a need for disciplinary tech-pedagogy guidance, or perhaps in the interest of "students learning from peers," that there might be opportunities for cross-disciplinary peer learning to raise readiness.

This negative correlation with age and technology readiness ($r = -0.42$) is in line with the international studies, but needs some level of interpretation in the context of Pakistan. Older educators might have had well-established approaches to teaching and learning in the traditional pedagogy, and would have no or limited need to use technology. These, however, were not correlated with readiness development except for years teaching experience which was positively correlated with readiness ($r = 0.38$).

The critical barriers are in line with the international literature and reflect the Pakistani problems. They are systemic barriers that are outside the scope of the individual teacher: infrastructure (78% reported), professional development (72%) and pedagogical guidance (68%). These barriers can only be overcome by policy and institutional investments and will not be overcome by individual teachers alone.

6. Recommendations and Implementation Framework

HEC should develop Technology Integration Standards for HE, which should contain: (a) minimum infrastructure requirements for institutions; (b) minimum competency requirements for teachers who engage with technology; (c) time requirements for PD; (d) accountability measures for institutional progress towards standards.

• Establish and implement a comprehensive technology-based PD that is based on building and facilitating teachers' TPACK rather than focusing on providing PD on technology tools. Programs should include ongoing interactions (not just one-off workshops), communities of peers, and connect to teachers' disciplinary contexts.

Colleges must also invest in institutional infrastructure so that the devices and internet are readily available, and there is easy access to the LMS. Infrastructure investment has multiplier effects, which allow all the other reform efforts.

Institutions should set up technical support services to give timely support for any technology issues thus mitigating the barriers to attempted integration. The support must be "proactive", not "reactive".

• Incentive structures should acknowledge and incentivize teachers who use technology integration – that is, salary bonuses, course load reduction, and/or professional development funding should be provided to early-adopter teachers. The orientation of incentives should be towards pedagogical innovation rather than the introduction of tools.

Cross-disciplinary peer Learning Communities should be used to facilitate Technology Integration Knowledge Sharing. Computer science teachers could be mentors of other subject teachers, hence computer usage in all subjects would be prevalent.

In relation to professional development programs, it is ideal if teachers who have more seniority and/or teaching experience could be more additive rather than replacement; that is, think of technology as an added value rather than a replacement of the wisdom that has been accumulated.

7. Conclusions and Limitations

The present study showed that there is an enormous difference in technology readiness with regards to the integration of technology as there are 42% ready for technology integration and 20% are presently not ready for technology integration. Ready for use includes an interplay between individual and institutional aspects; factors such as motivation and infrastructure, support, professional development. Systematic institutional action on barriers identified can lead to improvement.

The study also has limitations because it: (1) adopted self-report measures that suffer from social desirability and response biases; (2) is cross-sectional in nature and thus does not allow one to draw causal relationships; (3) has a small sample comprising of only twenty public colleges in Lahore and may not be generalizable; (4) has measured readiness for technology integration rather than technology integration in classrooms; and (5) has had a modest sample size (n=20) for comprehensive thematic analysis.

The teacher technology readiness is still an important issue in the context of education in Pakistan. Multi-level intervention at policy, institutional and individual levels is needed for systemic improvement. It should not be expected that teachers will be able to become comfortable with technology unless they have the infrastructure, professional development and support at institutions. Conversely, when professional development for pedagogy is not included, then infrastructure goes to technology adoption and not necessarily to enhancing education. The perspective of both the expert and the institutional facilitator is important to the meaningful development of technology integrated teaching and comprehensive and coordinated perspectives have the most promise.

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