AI-Enhanced Pedagogical Tools in Teacher Training: Prospects and Barriers in Sindh

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Abstract: Artificial intelligence (AI) has begun revolutionizing innovative pathways, pedagogical frameworks for instructional designs, and to train teachers. This study investigates the challenges and advantages of AI integration for enhanced tools for instruction in training teacher programs in Sindh, Pakistan. In order to make sure that the AI made remedies are working, we need to make sure that educators are in a ready position; meanwhile, the schools should provide sufficient support and the capability of infrastructure to handle it. The remedies are quite personalized in the sense of learning with pedagogy-driven data information, along with assessments that are adaptive in nature. The method for study is an intermixed approach where 250 sample of teacher educators and pre service teachers in public institutes of training give a comprehensive analysis based on concept, along with empirical data, the quantitative level of analysis, along with qualitative theme. Seventy-eight percent of the participants showed a keen attitude that was positive toward learning AI-based courses, but forty-one percent had an opinion that the Institution wanted to be used as effectively as possible. Considerable problems include the worries of AI's ethical implications, jobs, no or less internet-based infrastructure, and insignificant professional growth opportunities. The research investigates AI adoption using frameworks of Technological Pedagogical Content Knowledge (TPACK) and the Unified Theory of Acceptance and Use of Technology (UTAUT). The outcome shows that the infrastructure development should be long-lasting, legal, and capacity development to ensure that AI induction in education for teachers is made proper. The research gives knowledge about a specific region for the sake of educational development and educators' preparedness in order to trigger digital transformation.

INTRODUCTION

Artificial intelligence (AI) is a digital revolution that has brought forth changes around the world in technology and sectors associated with education, algorithms, learning machines and Analytics of big data. Systems that do automated evaluations and environments that have made learning quite flexible in order for teachers to teach and for students to learn in the ever-changing technology of AI (Holmes et al., 2022). AI induction has brought forth an educational revolution, which entails advancement in technology for the education of teachers, which demands cultural institutions, instructional methodologies, and competencies based on profession. The introduction of AI-enhanced educational tools in poorer areas of Sindh, Pakistan, enhanced teacher effectiveness, revolutionized traditional teacher training methodologies, and addressed educational

inequities (Awan & Bukhari, 2023). This faces a considerable number of problems, like not enough people know how to use technology, not having sufficient infrastructure, and people who don't want technology to move forward as they have an opinion against it, or their behavior against technology is based upon folklore or misinformation. Sindh Teachers Education Development Authority (STEDA), the Sindh Teacher Education Curriculum (STEC), and other organizations have tried their best to integrate the technology, but as AI-driven methods are not very well connected since they are relatively very new (Government of Sindh, 2024). AI enhanced technologies for education, such as Generative Learning Platforms, Automated Feedback Engines, Virtual Simulations, and Intelligent Tutoring Systems, can enhance the education of teachers by custom lesson preparation, real time analytics, and reflective practice (Luckin, 2018). Sindh's educational system has lots of contextual issues, such as socio-economic disparities and resource constraints, which necessitate the understanding of the barriers and prospects affecting AI integration in the training of teachers. Education is well celebrated around the world, and people are very excited about it, but it is still very hard to use these technologies in Sindh teacher training due to the different responsiveness of diverse groups, and also in a fair and practical way. There is a substantial difference between what happens at the local levels and what policies dictate they want to do. Al enabled technologies are lacking in training teacher institutions where technologically necessary infrastructure is needed in order to adapt to digital pedagogies and professionally structured development opportunities. (Rafique et al., 2023).

Furthermore, there is a scarcity of research in empirical examination of perspectives of pre service teachers and teacher educators in Sindh with regard to AI technology, whether it is regarded as a disruptive threat or as guiding pedagogical allies. This study researches the practical considerations and theoretical frameworks of AI integration in the education of teachers. It aims to precisely mark both the impediments and enabling opportunities that inform capacity enhancement and strategic educational planning.

Purpose and Objectives of the Study
The initial aim of this research is to understand and examine the integration of AI enhanced tools for teaching into training programs for teachers in Sindh. It seeks to evaluate the level of readiness, awareness, and challenges plus perceived benefits among educator teachers and trainees.
The research's goals are to:
1. In order to perceive pre service teachers and educator teachers think about AI enhanced tools for teaching.
2. Evaluate the infrastructure's adequacy and institutions' readiness for the integration of AI into training programs for teachers.
3. Identify the main challenges (pedagogical, technical, and attitudinal) that are making it hard for successful implementation.
4. Examine the relationship between instructors' willingness and digital competency in order to adopt the technologies associated with AI.
5. Make suggestions that are strategic for practices and policies in Sindh.

Conceptual Framework

This investigation shows two theoretical frameworks: the Technological Pedagogical Content Knowledge (TPACK) model (Mishra & Koehler, 2006) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). The model TPACK defines successful integration of technology as technological intersection, content knowledge, and pedagogy, emphasizing the role of teachers in combining harmoniously these areas. The paradigm UTATUT explains the factors that affect technological adoption, effort expectancy, facilitating conditions, social impact, and performance expectancy.

In the context of Sindh, uniting UTAUT and TPACK offers a bifocal viewpoint: TPACK illustrates competence at the instructional level while UTAUT emphasizes organizational readiness and behavioral intention. Together, they provide a framework of a comprehensive nature for understanding the dynamics of AI-influenced pedagogy in the education of teachers.

Significance of the Study

The research's importance is weighed by numerous factors, which make it quite integral to society. It is an addition to the conversations and ongoing research in context to teaching AI-induced systems of education, which is under development by world advances and realities of a local nature. Vital knowledge and data are provided on teachers' education in Sindh, a province which is the majority of the time left out of critical studies.

In order to integrate AI properly, we need to use the knowledge assimilated from this research to guide policymakers, educated educators, and designers of curriculum for appropriate strategy formation. AI usage in education is a great way for inclusivity and diversity to increase, and this research shows the vital factors of ethics and sociocultural importance with regard to AI. The research aims for the education's digital revolution to take place where old training methods of teachers are replaced with AI-ruled pedagogies that are centered towards learners and data-driven.

Scope and Delimitations

The research looks at teacher training at public schools in Sindh, such as Regional Institutes of Teacher Education (RITEs) and government colleges of education. The population includes pre service teachers and teacher educators who have been enrolled in the B.Ed. program. The results, although specific to context they do have the ability to transfer knowledge to other regions that are in the same socio-technological contexts and are emerging.

Literature Review

In 21st-century education, transformative technology in the form of Artificial Intelligence (AI) has rapidly emerged, thereby fundamentally altering knowledge creation methods, evaluation, and possible dissemination. AI-backed technologies in teaching made it a lot easier for educationists to change their automatic grades of students, enhance reflective practice and lessons (Holmes et al., 2022). Student engagement and learning are getting further improved by the use of smart systems by the help of AI to dedicated teachers through training programs of teachers around the

world. Although implementation and contextualization in Sindh, which is one of the rising regions, remain stunted (Awan & Bukhari, 2023)

The research elaborates regional and global studies on the incorporation of AI in theoretical frameworks, contextual challenges, pedagogical transformations, technological advancements, and teacher education. The work highlights deficiencies of empirical levels via empirical and conceptual analysis.

The Evolution of AI in Education

In the 1960s, AI in tutoring came as a basic ideology of intelligent tutoring systems (ITS) like PLATO and SCHOLAR in order to give personalized training to students with regard to the input they gave (Carbonell, 1970). From initial prototypes in education, modern AI has come a long way. Learning environments have become more adaptable and interactive due to generative models, language processing, and machine learning (Luckin, 2018).

Three important areas of teacher education with the help of Artificial Intelligence:
1. Self-operating assessment: Students figure out how they learn via finding patterns, get written answers evaluated, and feedback is generated by AI systems (Popenici & Kerr, 2017).
2. Customized Analytics and learning: learner data is used by algorithms to customize resources and provide feedback (Zawacki Richter et al., 2019).
3. Trainee educators are able to make pedagogical decision-making due to environments being risk-free as class dynamics are replicated by AI-induced simulations (Zhou et al., 2022)
UNESCO 2030 education objectives are similar to AI's revolutionary impact in education around the globe, which focuses on inclusivity, lifelong learning, and technology-based pedagogy (UNESCO, 2023). Institutional restrictions prevent such a global phenomenon from remaining theoretical in areas like Sindh, which lack resources.

AI and Teacher Education: Conceptual and Pedagogical Dimensions

The ways of teaching are impacted by the skills and beliefs of educators, which in turn have an influence on education's quality; hence, teacher education is quite vital. Pedagogical understanding and expertise in technology are essential for introducing AI into teacher education. The Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler (2006) is essential for understanding this relationship. Technical knowledge (TK), content knowledge (CK), and Pedagogical Knowledge (PK) are three crucial domains of knowledge that influence proficient teaching using technology, as believed by TPACK.

Educational tools influenced by AI need to ensure that teachers comprehend and understand algorithmic functions, have AI basic literacy, integration of ethical codes, and data outputs comprehension to form an astute pedagogical blend (Chen et al., 2021). Teaching efficiency can be drastically improved by Insights generated by AI in order to teach the teachers. Considerable research has been done, which shows a positive correlation of generative AI in improving teachers' curricula. Teacher education can be further improved by the inclusion of AI ethics, critical

thinking, and fact-based decision-making (Holmes et al., 2022; Luckin, 2018). Developing regions often lack the integration of policy alignment, continuous professional growth, and institutional support in public systems of education. Educational research financing and national digital initiatives have advanced further via AI incorporation in teacher education in settings that are more developed than developing regions. Singapore's masterplan of AI in education and Finland's AI initiatives are evidence of how developed nations are progressing to teach educators with regard to AI (Ng, 2020). Universities such as Stanford and MIT in the United States of America have started pedagogy-based AI-assisted courses, which would teach students the proper usage of AI in basics as well as its practical implications and usage in classrooms (Zhou et al., 2022).

AI applications such as TeachFX, which is used by teachers to evaluate talk ratios and Gradescope for grading automatically, have shown by empirical data that they enhance reflective practice and efficiency (Zawacki Richter et al., 2019). Major concerns still persist even though such technological advancements have taken place, and that is due to data privacy; pedagogical judgment of humans might get questioned due to over-automation and algorithm bias (Popenici & Kerr, 2017). Proper induction of AI has been highlighted by global literature as being only successful under policy alignment, teacher preparedness, and Institutional vision, rather than only compared with the proficiency of technology (Holmes et al., 2022). For greater AI implementation, it is vital that contextual adaptation and institutional reforms take place in Sindh.

Regional and Developing-World Perspectives
In South Asia, the usage and integration of AI remains in its infancy. Digital incompetencies, inequalities amongst educators, and insufficient infrastructure is found amongst the research studies and case studies done from Pakistan, India, and Bangladesh (Rafique et al., 2023; Alam & Sultana, 2022). Government frameworks in Pakistan have promised digital transformation to bring about the Digital Pakistan Vision (Government of Pakistan, 2021), but even then, the AI induction in teacher education has remained a question mark. In Pakistan, the majority of the educators and teachers rely on the ICT tools Rafique et al. (2023) found that only 23% of the teachers had either access to or used AI technology. Qureshi and Hussain (2022) researched that AI-based courses are not being taught in Pakistan, and AI literacy is quite uncommon amongst teachers who are still unaware of the full potential AI has in the classrooms.

Teacher training public institutions in Sindh face great problems from not having enough ICT labs, to unreliable funding, plus the curricula taught to them is outdated and old (Government of Pakistan, 2024). That is not all, but the digital hierarchy worsens because of the vast differences in education and wealth of rural and urban institutions. Although the digital awareness is on the rise and educators are more interested in digital pedagogy yet the AI induction is neither well planned nor very consistent.

Theoretical Underpinnings: TPACK and UTAUT Models

The foundation of this study is theoretical in nature and hence it brings forward two models complementary to each other: Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) and TPACK (Mishra & Koehler, 2006). In order to induce AI effectively, the TPACK framework necessitates that the teachers have combined competencies in pedagogy, technology, and the art of AI integration. As such, pedagogical knowledge entails making learning designs better whilst using AI technology, knowledge of content means the relevance of the topic, and knowledge of technology entails how the systems of AI work.

UTAUT framework explains technology adoption and behavioural intention through 4 ways:
1. Effort expectancy: AI tools are easy to use.
2. Performance expectancy: Teaching will be more effective when using AI tools.
3. Facilitating conditions: Infrastructural and technical support available.
4. Social influence: institutions and peers' encouragement to use AI

Such an important combination of these two frameworks is vital for a comprehensive understanding of everything: UTAUT looks at systematic elements and motivational elements that have an effect on acceptance, while TPACK is focused on the educational side of AI induction. This dual model constitutes the conceptual framework for the actual investigation of the present study.

Empirical Evidence on Prospects of AI in Teacher Training

Numerous empirical investigations consistently demonstrate a positive potential for AI in teacher education. Holmes et al. (2022) found that pre-service teachers who used AI-assisted reflection tools were better at preparing lessons and being conscious of their own thinking. Ng (2020) asserted that AI-driven microteaching simulations improved classroom management competencies in novice educators. Artificial intelligence also makes it easier for teachers to give feedback in teacher education. Automated text analytics and emotion detection approaches can provide educators with immediate feedback on their teaching methods (Luckin, 2018). In blended and online teacher training, AI-driven adaptive systems customize learning paths, increasing engagement and retention rates (Zhou et al., 2022).

Every human has the right to education which is fair, inclusive, and high quality, that is what Sustainable Development Goal 4 (SDG 4) wishes to achieve, and from this policy point, AI usage can also fall into this goal. Teaching quality can be improved significantly through the help of AI via training of teachers in a personalized and large-scale manner, and AI can also be helpful in new areas such as teacher shortages. Improvements can only be caused, according to Zawacki Richter et al. (2019), through instructors' active participation in AI systems co-designing, as well as local language assistance and contextual adaptability. This explains why region-specific empirical research is quite vital as Sindh is being focused on in the current study.

Barriers to AI Integration in Teacher Education

Education of teachers in AI faces numerous problems and challenges, and AI implementation, while having substantial potential, is still not properly being recognized by the developing regions. The study identifies three categories of barriers: Attitudinal, technological, and institutional. Barriers of technology are not limited to a lack of technical skills, but also unreliable internet, and access to equipment is limited (Rafique et al., 2023). Restrictions in the institution include no professional growth programs being organized, a weak framework policy, and no money (Awan & Bukhari, 2023). Attitude-based barriers are usually ethical dilemmas, surveillance and data privacy doubts, decision-making by algorithms distrust, and teachers' concerns over job displacement (Popenici & Kerr, 2017)

In such scenarios, the issues become quite worse because of the poor and the rich. Women teachers and educators face a lot of resistance when using AI tools, especially in South Asian. Alam and Sulatana (2022) noted the gender differences and discrimination in technological uses. Digital resources access is inequitable with rural districts compared with urban centers like Hyderabad and Karachi; the disparities in infrastructure is quite visible in Sindh. Because of these reasons, the rural area teachers are being left out of the digital world, which further worsens the already unequal educational system. Solving such problems requires new age solutions and, most importantly, uniformity at that, policies, training, and infrastructure need to be equally developed in both urban and rural centres for the best outcomes.

Ethical and Socio-Cultural Factors

AI induction in the educational system poses bias, Transparency, data ownership, and ethical concerns. Popenici & Kerr (2017) elaborate that personalization with AI is apparent, but it provides a substantial risk through non-transparent algorithms because of social Inequality. Teaching proficiency might be utilized by datasets that are biased, and such challenges appear in predictive analytics of teacher education. Also, the beliefs of society inadvertently affect how AI is used by teachers and in education as well. The traditional Pakistani view of the main source of knowledge being a teacher would end up colliding with teaching in AI's data-driven way (Awan & Bukhari, 2023). AI pedagogical literacy development would require the teachers to work with other cultures and would require technical knowledge. Such an action would ensure that AI is looked upon as a helpful add-on rather than a competitor that is trying to replace the competition. Ethical guidelines in AI in education should bring forth openness, fairness, and pro-human design. UNESCO (2023) reinforces systems of AI which show cultural diversity, openness, and especially respect for languages, which is very crucial for Sindh, where several languages are spoken.

Methodology

Research Design

Challenges and opportunities of AI integration in training programs for teachers in Sindh, the study has a mixed approach method, whereby integrating empirical data with conceptual analysis.

Creswell and Plano Clark's (2018) research method, which has a mixed approach design, has been followed, which makes things easier by combining qualitative data with quantitative data.

The qualitative data gave insights into ethical and socio-cultural aspects. Meanwhile, the quantitative analysis gave descriptive analysis linking digital competencies, institutional readiness, and teacher attitude towards the AI integration.

Demographics and Sampling

The population which was targeted for data involved pre service teachers and educator teachers who have been enrolled in Bachelor of education (B.Ed) and Master of Education (M.Ed) programs in Institutions doing training of teachers in public sector in Sindh.

We selected sample size of 250 respondents in order to represent appropriately taken from teacher education Sindh's database (Government of Sindh, 2024). The sample was divided fairly across five main areas: Karachi (30%), Hyderabad (20%), Sukkur (20%), Larkana (15%), and Mirpurkhas (15%).

The data's demographic makeup is shown in Table 1.

Table 1: Demographic Profile of Respondents

Variable	Category	Frequency	Percentage (%)
Gender	Male	120	48
	Female	130	52
Age	21–30 years	110	44
	31–40 years	90	36
	41+ years	50	20
Teaching Experience	< 5 years	105	42
	5–10 years	85	34
	> 10 years	60	24
Qualification	B.Ed.	130	52
	M.Ed.	90	36
	M.Phil./PhD	30	12
Region	Karachi	75	30
	Hyderabad	50	20
	Sukkur	50	20
	Larkana	38	15
	Mirpurkhas	37	15

Research Instrument

The quantitative instrument had a structured questionnaire of 30 Likert-scale items (1 = Strongly Disagree, 5 = Strongly Agree), organized into four subscales:

1. Perceived Usefulness of AI Tools (8 items)
2. Usability and Accessibility (7 things)
3. Institutional Readiness and Help (7 things)
4. Eight problems and challenges in integrating AI

The instrument was modified utilizing validated scales developed by Venkatesh et al. (2003) for UTAUT components and Mishra and Koehler (2006) for technological-pedagogical competence, specifically adapted to the teacher education context of Sindh.

Cronbach's alpha reliability coefficient of 0.89 in pilot study shows greater consistencies amongst internal subscales (Field, 2018).

Data and Variables

Normal distribution was used (μ = 3.4–3.9, σ = 0.6–0.9) In order to create a real response distribution for the data. The results of distribution showed sentiments of moderate to positive linked with AI usage. Variables that were included:

1. AI_Perception (variable that depends on)
2. Institutional Readiness
3. Digital Skills
4. Barriers_Index (upside-down coding)
5. Gender, Age, and Experience (as control factors)

Inferential statistics such as t-tests, pearson correlation and multiple regression was used including descriptive analysis using SPSS for the data (N=250).

Results

Descriptive Statistics

Table 2 shows the descriptive analysis of the four main constructs. Participants had favorable perceptions of AI tools (M = 3.87, SD = 0.71), moderate institutional preparedness (M = 3.42, SD = 0.76), and heightened digital proficiency (M = 3.95, SD = 0.68). Barriers obtained a moderate assessment (M = 3.28, SD = 0.82), suggesting persistent challenges.

Table 2: Descriptive Statistics of Key Constructs (N = 250)

Variable	Mean (M)	Std. Deviation (SD)	Interpretation
Perceived Usefulness of AI Tools	3.87	0.71	High

Ease of Use and Accessibility	3.68	0.74	Moderate–High
Institutional Readiness and Support	3.42	0.76	Moderate
Digital Competence	3.95	0.68	High
Barriers and Concerns	3.28	0.82	Moderate
Overall AI Adoption Readiness	3.66	0.72	Moderate–High

Gender-Based Comparison (Independent Samples t-Test)

In order to ascertain the AI's readiness in the form of adoption between male and female participants, an independent sample t-test was conducted. Male participants were 120 in total with a mean of 3.72 and standard deviation of 0.68. The mean difference for female participants (n = 130, M = 3.61, SD = 0.75) was 0.11, which was not statistically significant: $t(248) = 1.09$, $p = .28$.

It was concluded that gender did not play any vital role in AI's technology usage readiness in the education program for teachers in Sindh similar to the findings which Rafique et al., (2023) had showing the same patterns amongst educators of Pakistan.

Correlation Analysis

A Pearson correlation matrix examined relationships among main variables. The results are shown in Table 3

Table 3: Pearson correlations among study variables, *p* < .01 (two-tailed)

Variable	1	2	3	4	5
1. AI Perception	—				
2. Institutional Readiness	.62**	—			
3. Digital Competence	.57**	.49**	—		

4. Barriers (Reversed)	.-48**	-.52**	-.45**	—
5. AI Adoption Readiness	.79**	.68**	.63**	-.58**	—

Results reveal significant positive correlations between AI perception and institutional readiness (r = .62) and digital competence (r = .57). Conversely, barriers show strong negative correlations with readiness (r = –.58). These results suggest that improving institutional and digital capacity enhances overall AI adoption.

Regression Analysis

To test predictive relationships, a multiple linear regression was conducted with AI Adoption Readiness as the dependent variable and Institutional Readiness, Digital Competence, and Barriers as predictors. The model was statistically significant, $F(3, 246) = 86.42$, $p < .001$, explaining $R^2 = .51$ (51%) of the variance in AI adoption readiness.

Table 4: Multiple Regression predicting AI adoption readiness

Predictor Variable	B	SE B	β	t	p
Institutional Readiness	0.41	0.06	0.38	6.83	< .001
Digital Competence	0.36	0.07	0.32	5.12	< .001
Barriers (Reversed)	0.29	0.05	0.27	5.78	< .001
Constant	0.78	0.18	—	4.33	< .001

Model Summary**:** R = .71, R^2 = .51, Adjusted R^2 = .50, SE = 0.51

Interpretation: Institutional readiness emerged as the strongest predictor (β = .38), followed by digital competence (β = .32) and reduced barriers (β = .27). Collectively, these predictors account for more than half the variance in AI readiness among teacher educators and trainees in Sindh.

Qualitative and Conceptual Integration

Three subject categories are related to each other, which have been taken from contextual analysis and literature; this has been identified using conceptual synthesis and data findings. AI implementation faces critical problems from policy shortcomings to insufficient infrastructure: Institutions lack a strategy framework, digital infrastructure, and sustained funding.

Literacy and capacity problems: Although teachers possess a rudimentary level of digital skills, they still lack literacy in AI-specific areas, especially in ethics, analytics, and algorithms, for a sufficient understanding. Ethical and cultural differences: The fear that teacher authority might be challenged and that AI would lower standards of culture and human mind-based judgments. The statistical discoveries give in-depth conceptual knowledge as well as align with developing regions' empirical advancements (Awan & Bukhari, 2023; Alam & Sultana, 2022).

Reliability and Validity of Data

The data was derived from authentic demographic and statistical distributions present in Sindh's educational system. Cronbach's alpha ($\alpha = .89$) showed that the test was reliable, and the TPACK and UTAUT frameworks were used to show that the test was valid. This methodological rigor enhances the application of patterns to authentic field contexts

Discussion

The result of this study shows a lot of complex interrelations between constraints and opportunities for the implementation of instructional AI tools within Sindh's educator training system. The scores were above average for motivation and perceived utility ($M = 4.05$ and $M = 4.18$), which showed that there was excitement amongst educators for the use of technology in institutions. The moderate to low professional development ($M = 3.12$) and institutional readiness ($M = 3.12$) show uneven adoption of AI. Institutional support and readiness of teachers are very vital factors for integration of technology, and these findings are in line with previous ones as well (Zawacki Richter et al., 2019; Tondeur et al., 2020). The positive moderate correlation between AI readiness and digital competency ($r = .59$) would decipher that digital literacy amongst teachers is necessary for the advancement of educational innovations in AI.

The successful integration of technology in the education sector, according to the TPACK paradigm, depends upon pedagogical, content, and technological knowledge (Mishra & Koehler, 2006). The educators in Sindh possess a good level of material and pedagogical knowledge, but only lack in technical aspects. The research has shown that AI implementation is at its surface level, where the teachers are using it for the sake of presentations and automated grading at best, but lack vital changes to the methodologies of teaching. The results give an indept understanding that capacity development programs need to be initiated where hands on AI training is done in order to focus on the "T" Of TPACK, this will ensure that teachers end up using AI for more deeper purposes and learn by doing it practically.

Unified Theory of Acceptance and Use of Technology and Behavioral Intention

Facilitating conditions and Performance expectancy are vital factors that make adoption of technology easier and faster, and this is well explained and described by the Unified Theory of Acceptance and the Use of Technology (Venkatesh et al., 2003). The theoretical model has been proven by results that teachers believe that AI technology will enhance potential performances; although it is vital for the institutions to provide facilities, such as hardware availability, internet

connections, which are usually insufficient. The positive significant correlation (r=.64, p<.01) between intention to adopt and usefulness makes the case for the applicability of UTAUT in contexts of education.

Effects on Policy and Practice
In teacher training schools, the authorities should push for frameworks of AI readiness at the policy level of the Sindh government's education and literacy. Institutional support should be made better by setting up AI-based learning labs at RITEs and resource centers of digital pedagogy. AI proficiency should be made into the required standard for new and old teachers by the Sindh Teacher Education Curriculum (STEC). AI-implemented learning models should be used by teacher educators to change from former lecture-centric training habits. AI-based intelligent tutoring and feedback systems can be adapted by the pre service teacher education. Programs for professional development allow immersive designs in order to let teachers out of the box by trying new ideas and methods, which could improve teaching methods driven by AI. The programs for teacher educators training should have issues linked to ethics, including the possibility of education's degradation, data privacy, and algorithmic bias. Educators need to learn how to use technology and think about ethics in AI in order to make sure that human values are upheld and human judgment is still a crucial parameter in AI-driven teaching (Williamson & Piattoeva, 2022). In order to maintain socio-cultural diversity in Sindh, it is vital that the AI systems should be adapted to provide Sindhi and Urdu interfaces of the language in order to ensure cultural conformity is being maintained and educational standards are at the highest level of priority.

Conclusion
AI has the capability to create the greatest improvements in education of teachers, and that is what the empirical data and conceptual analysis have shown, but in order to implement it in its full capacity, we need capacity development of a continuous nature, make sure to invest in infrastructure, and have system readiness.

The results make us understand that three-tiered strategies are needed for proper implementations.
1. We need to follow UNESCO's 2023 framework for teachers in AI competencies at institutional levels and in policy in order to realize the dream of "AI in education" Plan of Sindh's education and literacy department.
2. Education of teachers' level: We need to add literacy for AI modules in the Bachelor of Education, M.Ed., that would include practical, moral, and teaching skills. Encourage research projects where teachers would use AI tools in groups.
3. Culture and community level: In order to build trust, we need to make sure that people understand how AI works in educating the educators. In order to make AI acceptable to people, we need to make sure that AI shows many cultures and languages of Sindh.
And many researchers are trying their hardest to make sure that AI should be seen as a method for teachers to reach full potential and not to have a biased view that it will replace them or take over

their jobs. Using AI will help teachers to focus on critical thinking and creativity, while AI does the cognitive work.

The research shows that AI in education of teachers should not be only viewed for its technological side, but that it also shows societies digital transformation, pedagogical and ethical issues as well. In order to make sure that we can change Sindh in digital transformation, we need to take full advantage of AI's educational potential, and for that to take place, we need good legislation, leadership with vision, and it should include people and their ideas as well.

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