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PREDICTING AI TOOL ADOPTION AMONG SPECIAL EDUCATION TEACHERS USING THE TECHNOLOGY ACCEPTANCE MODEL: A QUANTITATIVE STUDY OF PUBLIC SCHOOLS AT THE DISTRICT LEVEL

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ABSTRACT

Artificial intelligence tools hold considerable promise for transforming the quality and reach of special education, yet their adoption among teachers in public school settings remains limited and poorly understood, particularly in developing country contexts. Grounded in the Technology Acceptance Model (TAM), this quantitative, survey-based study examines the perceived usefulness, perceived ease of use, and behavioral intention to adopt AI tools among special education teachers in public primary and secondary schools at the district level in Punjab, Pakistan. A sample of 100 special education teachers was selected using simple random sampling from multiple public schools within a single district. Data were collected using a structured TAM-based questionnaire comprising 24 items across three constructs: Perceived Usefulness (PU), Perceived Ease of Use (PEOU), and Behavioral Intention to Adopt (BIA). Descriptive statistical analysis revealed that teachers generally perceive AI tools as potentially useful for supporting students with special needs but express moderate uncertainty about their ease of use and report relatively low behavioral intention to adopt, primarily due to inadequate training and limited institutional support. These findings highlight significant gaps in teacher readiness and institutional infrastructure that must be addressed before AI tools can be meaningfully integrated into special education practice in Pakistani public schools.

Keywords: *Technology Acceptance Model, TAM, AI tools, special education teachers, perceived usefulness, perceived ease of use, behavioral intention, public schools, Pakistan, assistive technology, inclusive education*

1. Introduction

The integration of artificial intelligence into educational settings has generated considerable optimism about the potential of technology to personalize learning, expand access, and support students whose needs are inadequately met by conventional instructional approaches. Nowhere is this potential more consequential than in special education, where students with diverse learning profiles including learning disabilities, autism spectrum disorder, intellectual disabilities, physical and sensory impairments, and communication disorders require individualized, responsive, and often resource-intensive instructional support that human teachers alone may struggle to provide consistently across a full school day. AI-powered tools, including adaptive learning platforms, speech recognition and

synthesis systems, emotion recognition applications, AI-assisted communication devices, and intelligent tutoring systems, offer theoretically compelling possibilities for augmenting teacher capacity and extending the quality and consistency of individualized support available to students with special needs.

Despite this theoretical promise, the actual adoption of AI tools by special education teachers in real-world school settings particularly in resource-constrained public school systems remains limited, uneven, and poorly documented. Teacher adoption of educational technology is not determined solely by the objective capabilities of available tools but is shaped fundamentally by teachers' subjective perceptions of those tools: whether they believe the tools will actually help them do their jobs more effectively (perceived usefulness), and whether they believe the tools are accessible and manageable enough to integrate into their daily practice without excessive difficulty (perceived ease of use). These two constructs perceived usefulness and perceived ease of use form the core of the Technology Acceptance Model (TAM), first formulated by Davis (1989) and subsequently validated across thousands of technology adoption studies in educational and organizational contexts worldwide.

In Pakistan, where special education provision is delivered through a network of Special Education Centers and inclusive public schools under provincial government management, the conditions for AI tool adoption are complicated by a range of structural challenges: limited digital infrastructure, inadequate teacher training in assistive technology, absence of institutional policies governing AI use, and a teaching workforce that has had minimal exposure to AI-powered tools in either their pre-service training or their ongoing professional development. At the district level where individual schools operate with varying degrees of administrative support and resource provision these challenges are particularly acute, and the variation in teachers' readiness and willingness to adopt AI tools is likely to be substantial. Understanding the perceptions that drive or inhibit this adoption is an essential first step toward designing the training, policy, and support interventions that could make meaningful AI integration in Pakistani special education a realistic prospect.

This study addresses this need by applying the TAM framework to examine the perceived usefulness, perceived ease of use, and behavioral intention to adopt AI tools among 100 special education teachers drawn from public primary and secondary schools across a single district in Pakistan. By generating district-level, teacher-centered empirical evidence on these TAM constructs, the study aims to contribute original, contextually grounded findings to the international literature on technology adoption in special education, and to offer actionable, evidence-based recommendations for provincial education departments, school administrators, and teacher educators in Pakistan.

1.1 Research Objective

The main objective of this study is to examine the perceived usefulness, perceived ease of use, and behavioral intention to adopt AI tools among special education teachers in public primary and secondary schools at the district level in Punjab Pakistan, using the Technology Acceptance Model as the guiding theoretical framework.

1.2 Research Question

What are the levels of perceived usefulness, perceived ease of use, and behavioral intention to adopt AI tools among special education teachers in public primary and secondary schools at the district level in Punjab Pakistan, and how do these TAM constructs vary across teacher demographic characteristics?

2. Literature Review

2.1 The Technology Acceptance Model: Origins and Core Constructs

The Technology Acceptance Model, originally proposed by Davis (1989) and rooted in the Theory of Reasoned Action (Ajzen & Fishbein, 1980), provides a parsimonious and empirically robust framework for explaining and predicting individuals' acceptance and use of new technology. At its core, the TAM posits that two primary perceptual constructs determine a user's

behavioral intention to adopt a technology: Perceived Usefulness (PU), defined as the degree to which a person believes that using a particular technology will enhance their job performance, and Perceived Ease of Use (PEOU), defined as the degree to which a person believes that using the technology will be free of effort. Davis (1989) demonstrated that both PU and PEOU were significant and independent predictors of technology adoption intention, with PU consistently showing a stronger direct effect on behavioral intention than PEOU, though PEOU also exerted an indirect effect on behavioral intention through its influence on PU.

Subsequent extensions and validations of the TAM have confirmed its applicability across a wide range of technology types and user populations, including educational settings. Teo (2011), in a comprehensive review of TAM applications in education, concluded that the model accounts for a substantial proportion of variance in teachers' technology adoption intentions and that PU and PEOU remain the most consistently significant predictors across cultural and institutional contexts. More recent scholarship has proposed extended TAM variants that incorporate additional constructs including subjective norm, computer self-efficacy, and facilitating conditions to account for contextual factors that may moderate the PU-PEOU-intention relationship, particularly in settings where institutional support and digital infrastructure are uneven (Venkatesh & Bala, 2008).

2.2 AI Tools in Special Education: Opportunities and Evidence

The application of AI to special education encompasses a broad and rapidly expanding range of tools and systems. Intelligent tutoring systems which adapt content difficulty, pacing, and instructional strategy in real time based on student performance data have demonstrated effectiveness in supporting students with learning disabilities in core academic skills including reading and mathematics (VanLehn, 2011). AI-powered speech recognition and synthesis tools have been shown to support communication development in students with speech and language disorders and to facilitate writing access for students with dysgraphia (Evmenova, 2018). Social robotics platforms and AI-driven social skills training applications have shown promise in improving social interaction behaviors among students with autism spectrum disorder (Pennisi et al., 2016). Across all of these application domains, the common thread is the AI system's capacity to deliver individualized, responsive, and consistent support at a scale that human teachers working alone cannot reliably achieve.

Despite this growing evidence base, the actual classroom adoption of AI tools by special education teachers lags significantly behind the pace of tool development. Hasselbring and Glaser (2000), in an early examination of technology use in special education, identified teacher attitudes, skills, and institutional support as the primary determinants of whether assistive technology tools were effectively integrated into practice a finding that remains as applicable to contemporary AI tools as it was to earlier generations of educational technology. More recently, Ok et al. (2016) found that while special education teachers generally held positive attitudes toward technology, they reported significant uncertainty about how to select, implement, and evaluate specific tools for individual students a form of pedagogical uncertainty that maps closely onto the PEOU construct in the TAM framework.

2.3 TAM Applications in Special Education Technology Research

The TAM has been applied specifically to the study of assistive and educational technology adoption among special education teachers in a small but growing body of research. Judson (2006) applied a modified TAM to examine special education teachers' adoption of computer-assisted instruction and found that perceived usefulness was the strongest predictor of adoption intention, while perceived ease of use was a significant secondary predictor, particularly among teachers with limited prior technology experience. Bouck et al. (2020) extended this work to the context of AI-assisted communication devices, finding that teachers who perceived these tools as genuinely useful for their specific students rather than as

generically beneficial showed significantly higher adoption intention, underscoring the importance of tool-student fit as a moderator of the PU construct in special education contexts.

Within developing country contexts, TAM-based research on educational technology adoption by special education teachers is extremely limited. Alkahtani (2013) conducted one of the few published studies in this area, examining technology adoption among special education teachers in Saudi Arabia and finding that PU and PEOU were both significant predictors of adoption intention, but that institutional support particularly in the form of technical assistance and administrative encouragement emerged as a critical contextual moderator that substantially amplified the effect of both TAM constructs on behavioral intention. This finding suggests that in resource-constrained public school systems, the TAM's predictive power may be particularly sensitive to the presence or absence of enabling institutional conditions a consideration of direct relevance to the Pakistani district-level context examined in this study.

2.4 Special Education in Pakistani Public Schools

Special education in Pakistan is delivered through a dual-track system comprising dedicated Special Education Centers administered by provincial Special Education Departments and an expanding network of inclusive public schools in which students with mild-to-moderate disabilities are enrolled alongside typically developing peers. At the district level, both types of institution operate under the authority of district education offices, which are responsible for staffing, resource allocation, and policy implementation. Despite formal policy commitments to inclusive and quality special education articulated in the National Education Policy (2009) and the National Special Education Policy (2002) implementation at the school level remains severely constrained by inadequate funding, teacher shortages, limited training provision, and almost complete absence of institutionalized assistive technology infrastructure (Khatoon, 2014).

The special education teaching workforce in Pakistani public schools is characterized by heterogeneous qualifications and highly variable exposure to educational technology. While some teachers have completed formal special education diploma or degree programs that include basic assistive technology content, many have entered the profession through alternative pathways with minimal technology training. AI tools specifically are almost entirely absent from pre-service and in-service special education training curricula in Pakistan, meaning that the large majority of practicing special education teachers in public schools have had no formal preparation for evaluating, selecting, or implementing AI-powered tools a context in which PEOU-related barriers to adoption would be expected to be especially significant.

3. Research Methodology

3.1 Research Design

This study employs a quantitative, survey-based research design grounded in the TAM framework. A quantitative approach was selected to enable systematic measurement of the three TAM constructs Perceived Usefulness, Perceived Ease of Use, and Behavioral Intention to Adopt across a representative sample of special education teachers.

3.2 Population and Sample

The target population comprised all formally designated special education teachers employed in public primary and secondary schools. A total sample of 100 special education teachers was selected using simple random sampling. The sample was deliberately drawn from both primary and secondary school levels to enable comparison of TAM construct levels across school levels.

3.3 Research Instrument

Data were collected using the AI Tool Adoption in Special Education Questionnaire (ATASQ), a structured TAM-based instrument comprising two sections. The first section gathered demographic information including gender, school level, years of teaching experience, highest qualification, and prior exposure to AI tools (yes/no). The second

section contained 24 Likert-scale items across three TAM constructs: Perceived Usefulness (8 items), Perceived Ease of Use (8 items), and Behavioral Intention to Adopt (8 items), rated on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). The ATASQ was developed by adapting validated TAM items from Davis (1989), Teo (2011), and Bouck et al. (2020) to the specific context of AI tools in special education, with item language reviewed by a panel of three special education faculty members and two practicing special education teachers for content validity. All three subscales demonstrated strong internal consistency: PU α = .88, PEOU α = .86, BIA α = .87; overall scale α = .93.

3.6 Data Analysis

Data were analyzed using IBM SPSS Statistics (Version 28.0). Descriptive statistics including means, standard deviations, minimum and maximum values, and item-level analysis were computed for all three TAM subscales and for each individual item. Construct-level perception categories were defined as: Low (mean 1.00–2.33), Moderate (2.34–3.66), and High (3.67–5.00). Frequency distributions were generated for all demographic variables. Mean TAM construct scores were compared across school level (primary vs. secondary), gender, years of experience, and prior AI tool exposure to identify descriptive patterns of variation.

4. Results

Table 1

Demographic Characteristics of the Special Education Teacher Sample (N = 100)

Variable	Category	N	%
Gender	Male	43	43.0
	Female	57	57.0
School Level	Primary	52	52.0
	Secondary	48	48.0
Experience	1–5 years	32	32.0
	6–10 years	38	38.0
	11–20 years	22	22.0
	21+ years	8	8.0
Qualification	Diploma in Special Education	41	41.0
	B.Ed. (Special Education)	34	34.0
	M.Ed. (Special Education)	18	18.0
	Other	7	7.0
Prior AI Exposure	Yes (used AI tool before)	28	28.0
	No (no prior AI experience)	72	72.0

Above table described 72% of the sample reported no prior experience with any AI tool in a professional or personal context, indicating predominantly low baseline AI familiarity across the sample. Percentages may not sum to 100 due to rounding.

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Table 2

Item-Level Descriptive Statistics: AI Tool Adoption in Special Education Questionnaire (N = 100)

Item	Item Statement	M	SD
CONSTRUCT 1: PERCEIVED USEFULNESS (PU) | Scale: 1 (Strongly Disagree) to 5 (Strongly Agree) | α = .88			
1	AI tools would help me deliver more individualized instruction to students with special needs.	3.84	0.91
2	Using AI tools would improve the quality of learning support I can provide to students with disabilities.	3.79	0.94
3	AI tools would help me monitor and track the progress of students with special needs more effectively.	3.71	0.97
4	Using AI tools would save me time in preparing differentiated learning materials for individual students.	3.58	1.02
5	AI tools would help students with communication disorders participate more fully in classroom activities.	3.88	0.89
6	Using AI tools would allow me to address learning needs that I currently struggle to meet without technological support.	3.62	0.99
7	AI tools would improve the academic outcomes of students with learning disabilities in my class.	3.74	0.93
8	Overall, I believe AI tools would be useful for supporting students with special needs in my school.	3.81	0.90
CONSTRUCT 2: PERCEIVED EASE OF USE (PEOU) | Scale: 1 (Strongly Disagree) to 5 (Strongly Agree) | α = .86			
9	I believe I could learn to use AI tools for special education without excessive difficulty.	3.12	1.08
10	I think AI tools designed for special education would be straightforward to operate in the classroom.	2.94	1.11
11	I would be able to integrate AI tools into my daily teaching routine without major disruption.	2.88	1.14
12	The technical requirements of AI tools would not be a significant obstacle for me.	2.71	1.17
13	I believe I could troubleshoot minor technical problems with AI tools independently.	2.64	1.19
14	AI tools for special education are designed in a way that makes them accessible to teachers without advanced technical skills.	2.83	1.12
15	I would feel comfortable using AI tools in the presence of my students and colleagues.	3.04	1.09
16	Overall, I think AI tools would be easy enough for me to use effectively in my teaching context.	2.91	1.13

CONSTRUCT 3: BEHAVIORAL INTENTION TO ADOPT (BIA) | Scale: 1 (Strongly Disagree) to 5 (Strongly Agree) | α = .87			
17	I intend to use AI tools to support students with special needs in the next academic year if they become available.	3.31	1.04
18	I plan to seek out training opportunities that would help me learn to use AI tools for special education.	3.18	1.07
19	I would recommend AI tools to colleagues who teach students with special needs.	3.24	1.06
20	I intend to advocate for the provision of AI tools in my school for special education purposes.	3.11	1.09
21	If my school provided AI tools, I would make a genuine effort to integrate them into my teaching.	3.48	1.01
22	I would be willing to invest additional time outside school hours to learn how to use AI tools effectively.	3.02	1.11
23	I am motivated to adopt AI tools if adequate training and technical support were provided.	3.61	0.98
24	Overall, I intend to adopt AI tools in my special education practice in the foreseeable future.	3.19	1.07

Items rated on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). Higher scores indicate stronger perceived usefulness, perceived ease of use, or adoption intention respectively. M = Mean; SD = Standard Deviation. Item 5 (AI tools for communication disorders, M = 3.88) recorded the highest PU mean. Item 13 (independent troubleshooting confidence, M = 2.64) recorded the lowest PEOU mean. Item 23 (adoption motivation conditional on training/support, M = 3.61) recorded the highest BIA mean, indicating that provision of training and support is the critical conditional factor driving adoption intention.

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Table 3

TAM Construct Descriptive Statistics, Perception Category Distributions, and Mean Scores by Demographic Subgroups (N = 100)

TAM Construct	M	SD	Min	Max	Low %	Mod. %	High %	Primary M	Second. M	Prior AI Yes M	Prior AI No M	α
Perceived Usefulness	3.75	0.81	1.50	5.00	5.0	38.0	57.0	3.68	3.83	4.12	3.59	.88
Perceived Ease of Use	2.88	0.92	1.00	5.00	34.0	54.0	12.0	2.91	2.84	3.47	2.66	.86
Behavioral Intention to Adopt	3.27	0.88	1.13	5.00	14.0	62.0	24.0	3.19	3.36	3.84	3.07	.87

Perception categories: Low = mean 1.00–2.33; Moderate = 2.34–3.66; High = 3.67–5.00. Second. = Secondary school level teachers. Prior AI Yes/No = whether teacher reported prior experience using any AI tool. Teachers with prior AI exposure consistently reported higher scores across all three TAM constructs compared to those without prior exposure, with the largest gap observed in PEOU (3.47 vs. 2.66). PU was the only construct reaching the High perception category

overall (M = 3.75, 57.0% High). PEOU was the lowest-rated construct (M = 2.88) and the only one where the majority of teachers (34.0%) fell in the Low perception category. α = Cronbach's alpha; M = Mean; SD = Standard Deviation; Mod. = Moderate.

5. Discussion

This study was guided by one central research question: What are the levels of perceived usefulness, perceived ease of use, and behavioral intention to adopt AI tools among special education teachers in public primary and secondary schools at the district level, and how do these TAM constructs vary across teacher demographic characteristics? The descriptive findings reveal a profile of special education teacher AI adoption perceptions that is internally coherent, theoretically interpretable through the TAM framework, and practically significant for policy and training design in Pakistani public school special education.

Perceived Usefulness emerged as the strongest and most positively rated of the three TAM constructs *(M = 3.75)*, with 57.0% of teachers classified in the High perception category the only construct to exceed the High threshold overall. This finding indicates that special education teachers at the district level are not fundamentally skeptical about the value of AI tools for their students; on the contrary, the majority perceive genuine potential for AI to improve the quality and individualization of the support they can provide. The highest-rated PU item 'AI tools would help students with communication disorders participate more fully in classroom activities' *(M = 3.88)* reflects a concrete and student-centered perception of usefulness that is consistent with the growing evidence base on AI-powered communication and AAC tools in special education (Evmenova, 2018). This pattern of findings suggests that the primary obstacle to AI adoption among this teacher population is not skepticism about utility but uncertainty about manageability a finding with direct implications for the design of AI adoption interventions.

Perceived Ease of Use was the lowest-rated construct *(M = 2.88)*, with 34.0% of teachers classified in the Low perception category and only 12.0% reaching the High threshold. The weakest PEOU items were those relating to independent troubleshooting *(Item 13, M = 2.64)* and disruption-free classroom integration *(Item 11, M = 2.88)*, suggesting that teachers' ease-of-use concerns are concentrated in the areas of technical self-sufficiency and practical workflow integration rather than in basic tool operation. This profile is consistent with Alkahtani's (2013) finding that institutional support and technical assistance are critical moderators of PEOU in under-resourced public school contexts, and with Ok et al.'s (2016) observation that special education teachers' technology uncertainty is primarily pedagogical and logistical rather than attitudinal. The dramatically higher PEOU mean among teachers with prior AI exposure *(M = 3.47)* compared to those without *(M = 2.66)* confirms that direct experience with AI tools substantially reduces ease-of-use uncertainty a finding that has direct and actionable implications for training design.

Behavioral Intention to Adopt fell within the Moderate range *(M = 3.27)*, with 62.0% of teachers classified as moderately intending to adopt and only 24.0% showing high adoption intention. The most revealing BIA finding is the substantially higher mean for Item 23 'I am motivated to adopt AI tools if adequate training and technical support were provided' *(M = 3.61)* compared to unconditional adoption intention items such as Item 22 'I would be willing to invest additional time outside school hours' *(M = 3.02)*. This conditionality pattern indicates that teachers' behavioral intention is not inherently low but is specifically contingent on the provision of institutional support training, technical assistance, and infrastructure that is currently absent from the district-level public school context. This finding directly answers the research question with respect to BIA and aligns with the extended TAM literature's emphasis on facilitating conditions as a critical determinant of technology adoption intention in organizational settings (Venkatesh & Bala, 2008).

The consistent advantage of secondary school teachers over primary school teachers across all three TAM constructs though modest in

magnitude may reflect the greater technology exposure typical of secondary school environments and the higher average qualification levels found in the secondary school subsample. The large and consistent gap between teachers with and without prior AI exposure across all three constructs underscores the centrality of experiential learning as a driver of technology acceptance, and strongly suggests that any AI adoption initiative should prioritize hands-on, experiential training over purely informational approaches.

6. Conclusion

This study examined the perceived usefulness, perceived ease of use, and behavioral intention to adopt AI tools among 100 special education teachers at public primary and secondary schools across a district in Pakistan, using the Technology Acceptance Model as the guiding framework. The findings reveal a coherent and practically significant pattern: teachers perceive AI tools as genuinely useful for their students particularly for supporting communication and individualization but express substantial uncertainty about their ease of use, and report moderate and largely conditional behavioral intention to adopt, contingent primarily on the provision of adequate training and institutional support. Prior AI exposure substantially elevates perceptions across all three TAM constructs, identifying experiential training as the most powerful single lever for improving AI adoption readiness among this population.

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