TEACHER ACCEPTANCE OF AI-DRIVEN ADAPTIVE LEARNING TOOLS IN CENTRAL ASIAN SECONDARY SCHOOLS: A TECHNOLOGY ACCEPTANCE MODEL STUDY IN UZBEKISTAN

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ANNOTATSIYA. Ushbu maqola O'zbekiston o'rta maktab o'qituvchilarining sun'iy intellekt asosidagi moslashuvchan o'quv vositalarini qabul qilishini Texnologiyalarni qabul qilish modeli (TAM) orqali o'rganadi. Urgench shahrida 127 o'qituvchi ishtirokida o'tkazilgan so'rovnoma natijalari tahlil qilingan.

АННОТАЦИЯ. Статья исследует принятие учителями средних школ Узбекистана инструментов адаптивного обучения на основе ИИ через модель принятия технологий (TAM). Проанализированы результаты опроса 127 учителей города Ургенча.

ABSTRACT. This paper examines secondary school teachers' acceptance of AI-driven adaptive learning tools in Uzbekistan using the Technology Acceptance Model (TAM). Survey data from 127 teachers in Urgench reveal key drivers and barriers to adoption, with digital self-efficacy as the strongest predictor.

Kalit so'zlar (UZ): texnologiyalarni qabul qilish modeli, sun'iy intellekt, moslashuvchan o'qitish, o'qituvchi, O'zbekiston, Urgench.

Ключевые слова (RU): модель принятия технологий, искусственный интеллект, адаптивное обучение, учитель, Узбекистан, Ургенч.
Keywords (EN): Technology Acceptance Model, TAM, artificial intelligence, adaptive learning, teacher acceptance, Uzbekistan, digital self-efficacy.

1. INTRODUCTION

Across Central Asia, governments are increasingly investing in educational technology (EdTech) as a lever for improving learning outcomes at scale. In Uzbekistan, the national "Digital Uzbekistan 2030" strategy has prioritized the integration of digital tools in secondary education [Government of Uzbekistan, 2020: 3]. Yet the deployment of advanced AI-driven tools — such as adaptive learning platforms, intelligent tutoring systems, and automated assessment engines — has proceeded unevenly, with adoption rates remaining low in regional schools outside Tashkent [Azimov, A. et al., 2023: 46].

The gap between technology availability and actual classroom use is well-documented in the global EdTech literature. A critical mediating factor is teacher acceptance: even high-quality digital tools produce negligible learning gains if teachers do not use them, use them superficially, or actively resist their integration [Davis, F.D., 1989: 319]. Understanding what drives or inhibits teacher acceptance of AI-driven adaptive learning systems is therefore not merely a theoretical concern but a practical prerequisite for the success of any EdTech initiative in Uzbekistan and the broader Central Asian context.

The Technology Acceptance Model (TAM), originally proposed by Davis [Davis, F.D., 1989: 319] and subsequently extended to educational and AI contexts, provides a validated theoretical framework for analyzing technology adoption behavior. TAM posits that two primary constructs — Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) — jointly determine behavioral intention to use a technology, which in turn predicts actual usage. Extensions of TAM have incorporated additional constructs such

as digital self-efficacy, social influence, facilitating conditions, and anxiety, which are particularly relevant in lower-resource educational contexts [Venkatesh, V. & Bala, H., 2008: 273].

This paper reports a TAM-based survey study of 127 secondary school teachers in Urgench city, Khorezm Oblast, investigating their acceptance of AI-driven adaptive learning tools, with specific reference to the ALSTEM-UZ platform. The study addresses three research questions:

- RQ1: What is the level of Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) of AI adaptive learning tools among Urgench secondary school teachers?
- RQ2: Which individual and contextual factors — including digital self-efficacy, prior technology experience, subject taught, and years of experience — significantly predict teachers' behavioral intention to use AI adaptive learning tools?
- RQ3: What are the primary self-reported barriers to AI adaptive learning tool adoption among teachers in Urgench schools?

The findings contribute both to the Central Asian EdTech literature, which lacks empirical TAM studies in Uzbek-language school contexts, and to the practical design of teacher support programs that can facilitate sustainable adoption of AI tools such as ALSTEM-UZ.

2. THEORETICAL FRAMEWORK

2.1. The Technology Acceptance Model (TAM)

TAM was introduced by Davis [Davis, F.D., 1989: 320] as a theoretical adaptation of the Theory of Reasoned Action (TRA) specifically for information systems contexts. In TAM, Perceived Usefulness (PU) is defined as the degree to which a user believes that using a particular system will enhance job performance; Perceived Ease of Use (PEOU) refers to the degree to which use of the system is believed to be free of effort. Both constructs

influence Attitude toward Use, which together with social norms determines Behavioral Intention (BI), the proximal predictor of actual system use.

TAM3, proposed by Venkatesh and Bala [Venkatesh, V. & Bala, H., 2008: 274], introduced 16 determinants of PU and PEOU organized into four categories: individual differences (computer self-efficacy, computer anxiety, computer playfulness, perception of external control), system characteristics (perceived enjoyment, objective usability), social influence (subjective norm, voluntariness, image), and facilitating conditions (result demonstrability, output quality, job relevance, trialability). For our study, we focus on the subset of TAM3 determinants most relevant to the Urgench school context: digital self-efficacy, computer anxiety, subjective norm (peer and administrator influence), and facilitating conditions (infrastructure availability, technical support).

2.2. TAM in Educational and AI Contexts

TAM has been extensively applied to teacher technology acceptance in K-12 settings. A meta-analysis by Scherer et al. [Scherer, R. et al., 2019: 14] across 114 studies confirmed that PU and PEOU are robust predictors of teacher intention to use educational technology (combined $r = 0.54$ and $r = 0.46$, respectively). More recent studies have extended TAM to AI-specific tools: Nazaretsky et al. [Nazaretsky, T. et al., 2022: 1] found that teachers' trust in AI accuracy and perceived loss of professional autonomy emerged as additional significant predictors beyond standard TAM constructs when the technology involved automated student assessment. Chai et al. [Chai, C.S. et al., 2021: 1] similarly documented that AI literacy moderated the relationship between PEOU and intention to use AI teaching tools. These extensions inform our adapted TAM instrument for the Uzbek teacher context.

2.3. EdTech Adoption in Central Asia

Empirical TAM research in Uzbekistan and Central Asia is sparse. Rakhimov and Nazarov [Rakhimov, O. & Nazarov, S., 2022: 12] surveyed 84

teachers in Khorezm Oblast and documented high willingness to adopt digital tools paired with low digital self-efficacy, with internet connectivity problems and lack of Uzbek-language interfaces cited as the top barriers. Dusmuratov [Dusmuratov, R., 2021: 45] analyzed EdTech adoption in Tashkent schools and found that administrator encouragement (subjective norm) was the strongest predictor of actual usage, outweighing individual attitude — a finding with direct implications for school-level AI deployment policy. Our study extends this emerging evidence base specifically to AI-driven adaptive tools in Urgench, a context that has not previously been examined.

3. METHODOLOGY

3.1. Research Design and Participants

A cross-sectional quantitative survey design was employed. The target population was all secondary school teachers (grades 5–11) in Urgench city public schools, estimated at approximately 840 teachers across 22 schools based on Khorezm Oblast Education Department records. A stratified random sample was drawn, stratifying by school and subject area to ensure representation across STEM (Mathematics, Physics, Chemistry, Biology, Informatics) and non-STEM (Uzbek Language, History, Geography, English) subjects. Of 160 questionnaires distributed, 134 were returned (response rate 83.8%); 7 were excluded for incomplete responses, yielding a final analysis sample of N = 127.

3.2. Instrument

A structured questionnaire was developed in Uzbek (with Russian translation available on request) comprising four sections. Section A: Demographic and background information (gender, age, years of teaching experience, subject taught, prior digital tool usage). Section B: TAM constructs — Perceived Usefulness (5 items), Perceived Ease of Use (5 items), Attitude toward Use (3 items), and Behavioral Intention (3 items), all measured on a 5-

point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree), adapted from validated TAM3 instruments [Venkatesh, V. & Bala, H., 2008: 280]. Section C: Extended TAM predictors — Digital Self-Efficacy (4 items), Computer Anxiety (4 items), Subjective Norm (3 items), and Facilitating Conditions (3 items). Section D: Open-ended barrier identification (top 3 barriers to AI tool adoption, free-text response). The instrument was piloted with 12 teachers not included in the main study; pilot feedback informed minor wording revisions. Cronbach's alpha for all multi-item scales exceeded 0.78, confirming adequate internal consistency.

3.3. Data Analysis

Descriptive statistics were computed for all TAM construct scores. Pearson correlations and hierarchical multiple regression were used to test the TAM structural relationships and identify predictors of Behavioral Intention. Open-ended barrier responses were coded thematically by two independent coders (inter-rater agreement $\kappa = 0.84$); disagreements were resolved by discussion. All quantitative analyses were performed in SPSS 27.0.

4. RESULTS

4.1. Participant Profile

The sample was 61.4% female (n = 78) and 38.6% male (n = 49), consistent with the gender composition of secondary teaching in Uzbekistan. Mean age was 38.2 years (SD = 8.7; range 24–58). Mean teaching experience was 14.6 years (SD = 9.1). STEM subject teachers comprised 54.3% of the sample (n = 69); non-STEM teachers comprised 45.7% (n = 58). Prior use of any digital teaching tool (including presentation software, online gradebooks, or messaging apps) was reported by 82.7% of participants; however, only 19.7% (n = 25) had prior experience with any AI-specific educational tool.

Table 1. Descriptive Statistics for TAM Constructs (N = 127)

Construct	Mean	SD	Min	Max

Perceived Usefulness (PU)	3.74	0.71	1.60	5.00
Perceived Ease of Use (PEOU)	3.21	0.84	1.20	5.00
Attitude toward Use (ATU)	3.56	0.76	1.33	5.00
Behavioral Intention (BI)	3.42	0.89	1.00	5.00
Digital Self-Efficacy (DSE)	2.93	0.92	1.00	5.00
Computer Anxiety (CA)	3.11	0.88	1.00	5.00
Subjective Norm (SN)	3.68	0.79	1.33	5.00
Facilitating Conditions (FC)	2.87	0.97	1.00	5.00

4.2. TAM Structural Relationships

Pearson correlation analysis confirmed the core TAM relationships. PU was significantly correlated with Behavioral Intention ($r = 0.61$, $p < 0.001$), and PEOU was significantly correlated with PU ($r = 0.53$, $p < 0.001$) and with BI ($r = 0.44$, $p < 0.001$). These effect sizes are consistent with Scherer et al.'s meta-analytic benchmarks [Scherer, R. et al., 2019: 17]. Hierarchical regression predicting Behavioral Intention explained 54.3% of variance in BI ($R^2 = 0.543$, $F(6,120) = 23.87$, $p < 0.001$). In the final model, the strongest independent predictors of BI were Perceived Usefulness ($\beta = 0.41$, $p < 0.001$), Digital Self-Efficacy ($\beta = 0.28$, $p < 0.001$), and Subjective Norm ($\beta = 0.22$, $p = 0.003$). PEOU had a significant indirect effect on BI mediated through PU, consistent with TAM theory [Davis, F.D., 1989: 333], but its direct effect was not significant in the full model ($\beta = 0.09$, $p = 0.21$).

Table 2. Hierarchical Regression Predicting Behavioral Intention (N = 127)

Predictor	**B**	**SE B**	**β**	**t**	**p**
Perceived Usefulness	0.52	0.09	0.41	5.78	<.001
Perceived Ease of Use	0.09	0.08	0.09	1.26	.210
Digital Self-Efficacy	0.27	0.07	0.28	3.91	<.001
Computer Anxiety	-0.14	0.07	-0.14	-2.01	.047
Subjective Norm	0.25	0.08	0.22	3.13	.002
Facilitating Conditions	0.11	0.07	0.12	1.57	.119
$R^2 = 0.543$, $F(6,120) = 23.87$, $p < .001$					

4.3. Group Differences

Independent samples t-tests revealed that STEM teachers reported significantly higher PU (M = 3.91, SD = 0.64) than non-STEM teachers (M = 3.54, SD = 0.74; t(125) = 2.89, p = 0.005, d = 0.53), suggesting that subject-domain alignment with AI tool functionality influences perceived value. Teachers with prior digital tool experience reported higher PEOU (M = 3.35, SD = 0.79) than those without (M = 2.71, SD = 0.91; t(125) = 3.12, p = 0.002, d = 0.75). Years of teaching experience showed a significant negative correlation with BI (r = -0.24, p = 0.006), indicating that more experienced teachers expressed lower intention to adopt AI tools, consistent with findings from other developing-country EdTech adoption studies [Teo, T., 2011: 341].

4.4. Barriers to Adoption

Thematic analysis of free-text barrier responses identified six major themes. The most frequently cited barriers were: (1) Insufficient digital skills and confidence (cited by 67.7% of respondents), (2) Lack of Uzbek-language interface and content (58.3%), (3) Unreliable internet connectivity in school (51.2%), (4) Absence of institutional technical support (44.1%), (5) Concerns about AI replacing teacher roles (38.6%), and (6) Lack of training and professional development opportunities (34.6%). Notably, Uzbek-language interface availability was among the top barriers even though ALSTEM-UZ was designed specifically as a Uzbek-native platform, suggesting that awareness of existing Uzbek-language tools remains low among Urgench teachers and that dissemination and demonstration efforts are needed alongside technical development.

Table 3. Most Frequently Cited Adoption Barriers (N = 127)

Barrier Theme	Count	% of respondents
Insufficient digital skills / low confidence	86	67.7%
Lack of Uzbek-language interface and content	74	58.3%

Unreliable internet connectivity in school	65	51.2%
Absence of institutional technical support	56	44.1%
Concerns about AI replacing teacher roles	49	38.6%
Lack of training / professional development	44	34.6%

5. DISCUSSION

5.1. Interpretation of Key Findings

The overall TAM construct scores reveal a nuanced picture of Urgench teachers' readiness for AI adaptive learning tool adoption. The moderate-to-high mean PU score (M = 3.74) suggests that teachers, in principle, recognize the potential value of adaptive AI tools for supporting student learning — a positive foundation for deployment. However, the lower mean PEOU score (M = 3.21) and, critically, the low Facilitating Conditions score (M = 2.87) signal that perceived usability and infrastructure support remain significant obstacles. Digital Self-Efficacy (M = 2.93) was the lowest-scoring construct across the entire instrument, confirming Rakhimov and Nazarov's finding [Rakhimov, O. & Nazarov, S., 2022: 18] that low digital confidence is the predominant human-factor barrier to EdTech adoption in Khorezm Oblast.

The finding that Digital Self-Efficacy (β = 0.28) and Subjective Norm (β = 0.22) are strong independent predictors of Behavioral Intention alongside PU (β = 0.41) has direct practical implications. It suggests that interventions targeting only the tool itself — improving interface design, adding features — will have limited impact if they are not accompanied by structured digital skills training for teachers and clear, visible endorsement of AI tool adoption by school administrators and the Ministry of Public Education. The significant negative relationship between teaching experience and BI mirrors findings from Turkey [Teo, T., 2011: 342] and India and suggests that professional development programs for AI tool adoption should be specifically designed

with career-stage sensitivity, offering more scaffolded entry points for experienced teachers.

5.2. Implications for Policy and Practice

Based on the findings, we propose four evidence-based recommendations for AI adaptive learning tool deployment in Uzbek secondary schools. First, structured digital literacy upskilling programs — specifically targeting AI tool operation, data privacy basics, and interpretation of AI-generated student progress reports — should be integrated into the pre-service and in-service teacher training curriculum of Uzbek pedagogical universities. Second, school-level technical support roles (e.g., a designated "EdTech coordinator" per school) should be established, as the absence of such support was cited by 44.1% of teachers as a top barrier. Third, the adoption of AI tools should be communicated and visibly endorsed by principals and district education administrators, as Subjective Norm emerged as a significant predictor of BI. Fourth, awareness campaigns demonstrating the availability and functionality of Uzbek-language adaptive tools such as ALSTEM-UZ should be conducted, given that 58.3% of teachers cited lack of Uzbek-language content as a barrier despite such tools existing.

5.3. Limitations

This study has four primary limitations. First, the sample is confined to Urgench city; teachers in other Uzbek oblasts, rural districts, or private schools may differ systematically in TAM construct scores and barrier profiles. Second, the cross-sectional design precludes causal inference; a longitudinal study tracking changes in PU, PEOU, and actual usage over a full academic year following professional development intervention would strengthen causal claims. Third, self-reported behavioral intention is an imperfect proxy for actual usage behavior, which can diverge substantially from intention under real-world constraints [Ajzen, I., 1991: 182]. Fourth, common method bias is a potential threat given that all constructs were measured via self-report on the

same questionnaire; future studies should incorporate objective usage logs from deployed platforms.

6. CONCLUSION

This paper presented the first TAM-based empirical study of teacher acceptance of AI-driven adaptive learning tools in Uzbekistan, based on a survey of 127 secondary school teachers in Urgench city. The results confirm the applicability of TAM in the Uzbek teacher context and reveal that Perceived Usefulness, Digital Self-Efficacy, and Subjective Norm are the strongest predictors of behavioral intention to adopt AI adaptive learning tools, while low digital confidence and inadequate infrastructure remain the dominant adoption barriers. These findings carry direct implications for EdTech deployment strategy in Uzbekistan: successful AI integration requires parallel investment in teacher digital upskilling, institutional support structures, and administrator-led adoption culture — not only in platform development. Future research should extend this study to a multi-region longitudinal design and couple survey data with objective platform usage logs for a more complete picture of the adoption process in Central Asian secondary education.

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REFERENCES

1. Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179–211.

2. Azimov, A., Hamidov, J., & Nazarov, B. (2023). Digital education readiness in Uzbekistan: Challenges and opportunities for AI-driven EdTech. Central Asian Journal of Education and Technology, 5(2), 44–61.
3. Chai, C.S., Lin, P.Y., Jong, M.S.Y., Dai, Y., Chiu, T.K.F., & Qin, J. (2021). Factors influencing students' behavioral intention to use AI-based educational chatbot. Education and Information Technologies, 26, 1–18.
4. Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319–340.
5. Dusmuratov, R. (2021). Digital learning tools in Tashkent secondary schools: Adoption patterns and administrator influence. Uzbek Journal of Educational Research, 2(2), 40–55.
6. Government of Uzbekistan. (2020). Resolution on the Strategy "Digital Uzbekistan 2030". Official Gazette No. 247. Tashkent.
7. Nazaretsky, T., Ariely, M., Cukurova, M., & Alexandron, G. (2022). Teachers' trust in AI-powered educational technology and a professional development program to improve it. British Journal of Educational Technology, 53(4), 1–22.
8. Rakhimov, O., & Nazarov, S. (2022). Teacher attitudes toward EdTech adoption in Khorezm Oblast secondary schools. Uzbek Journal of Educational Research, 3(1), 12–29.
9. Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. Computers & Education, 128, 13–35.
10. Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. Computers & Education, 57(4), 2432–2440. [cited as Teo, T., 2011: 341]

11. Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. Decision Sciences, 39(2), 273–315.