MEHNAT IQTISODIYOTI
VA INSON KAPITALI
ISSN: 3030-3117
https://laboreconomics.uz/

ENHANCING INCLUSIVE HIGHER EDUCATION: FACULTY INSIGHTS ON DIGITAL AND ASSISTIVE TECHNOLOGIES IN UZBEKISTAN

Isaev Kobiljon Abdukodirovich
PhD, docent of “Department of World Economy and International Economic Relations”
Tashkent State University of Economics
ORCID - 0000-0002-4128-6354
E-mail: qobiliy.isaev@gmail.com
Qurbanov Azizbek G‘ulom ugli
Doctoral Researcher (PhD Candidate)
Tashkent State University of Economics
Azacious.kurbanov@gmail.com
https://orcid.org/0009-0003-2375-7161
Nazirova Shakhzoda Khayrullo kizi
Tashkent State University of Economics
nazirovash111@gmail.com
https://orcid.org/0009-0006-8546-506X

Abstract: This article examines the role of digital and assistive technologies in promoting inclusive higher education in Uzbekistan and explores faculty perspectives on their implementation. The study is based on survey data collected from 823 university instructors with diverse academic backgrounds and professional experiences. Key factors such as knowledge of inclusive education, training in assistive technologies, experience with technology use, and accessibility of digital learning platforms were analyzed. Logit and probit models were employed to identify determinants influencing the adaptation of learning materials for students with special educational needs. The findings reveal that awareness of inclusive education, participation in assistive technology training, frequency of technology use, and platform accessibility significantly increase the likelihood of adopting inclusive teaching practices. The study highlights the importance of strengthening faculty competencies, expanding access to assistive technologies, and improving digital infrastructure to foster equitable learning environments. The results provide valuable evidence for policymakers, educational institutions, and researchers seeking to advance inclusive higher education and ensure equal educational opportunities for all students in Uzbekistan.

Keywords: Inclusive education, Assistive technologies, Digital technologies, Logit model, Probit model.

O‘ZBEKISTONDA INKLYUZIV OLIY TA’LIMNI RIVOJLANTIRISH: RAQAMLI VA ASSISTIV TEXNOLOGIYALAR BO‘YICHA PROFESSOR-O‘QITUVCHILAR QARASHLARI

Isayev Kobiljon Abdukodirovich
PhD, “Jahon iqtisodiyoti va xalqaro iqtisodiy munosabatlar” kafedrasi dotsenti
Toshkent davlat iqtisodiyot universiteti
Qurbanov Azizbek G‘ulom o‘g‘li
Toshkent davlat iqtisodiyot universiteti tayanch doktoranti
Nazirova Shaxzoda Xayrullo qizi
Toshkent davlat iqtisodiyot universiteti

Annotatsiya: Mazkur maqolada O‘zbekiston oliy ta’lim tizimida inklyuziv ta’limni rivojlantirishda raqamli va assistiv texnologiyalarning o‘rni hamda professor-o‘qituvchilarning ulardan foydalanish bo‘yicha qarashlari tahlil qilingan. Tadqiqot 823 nafar professor-o‘qituvchi ishtirokida o‘tkazilgan so‘rovnoma natijalariga asoslanadi. Unda inklyuziv ta’lim haqidagi bilim darajasi, assistiv texnologiyalar bo‘yicha tayyorgarlik, texnologiyalardan foydalanish tajribasi va raqamli platformalarning qulayligi kabi omillar o‘rganilgan. Ma’lumotlarni tahlil qilishda logit va probit modellaridan foydalanilgan. Natijalar inklyuziv ta’lim bo‘yicha bilim, assistiv texnologiyalar bo‘yicha treninglar, texnologiyalardan foydalanish darajasi va platformalar qulayligi o‘quv materiallarini maxsus ta’lim ehtiyojiga ega talabalar uchun moslashtirish ehtimolini sezilarli darajada oshirishini ko‘rsatdi. Tadqiqot natijalari O‘zbekistonda inklyuziv oliy ta’limni rivojlantirish uchun professor-o‘qituvchilar malakasini oshirish, zamonaviy texnologiyalarni joriy etish va infratuzilmani takomillashtirish zarurligini asoslaydi. Shuningdek, tadqiqot ta’lim siyosatini shakllantirish va barcha talabalar uchun teng imkoniyatlar yaratishga xizmat qiluvchi amaliy tavsiyalarni taklif etadi.

Kalit so‘zlar: Inklyuziv ta’lim, yordamchi texnologiyalar, raqamli texnologiyalar, logit modeli, probit modeli.

РАЗВИТИЕ ИНКЛЮЗИВНОГО ВЫСШЕГО ОБРАЗОВАНИЯ: ВЗГЛЯДЫ ПРЕПОДАВАТЕЛЕЙ НА ЦИФРОВЫЕ И АССИСТИВНЫЕ ТЕХНОЛОГИИ В УЗБЕКИСТАНЕ

Исаев Кобилжон Абдукодирович
PhD, доцент кафедры «Мировая экономика и международные экономические отношения»
Ташкентский государственный экономический университет
Курбанов Азизбек Гулом угли
Базовый докторант (PhD)
Ташкентского государственного экономического университета
Назирова Шахзода Хайрулло кизи
Ташкентский государственный экономический университет

Аннотация. В данной статье исследуется роль цифровых и ассистивных технологий в развитии инклюзивного высшего образования в Узбекистане, а также анализируются взгляды профессорско-преподавательского состава на их использование. Исследование основано на результатах опроса 823 преподавателей высших учебных заведений, представляющих различные академические направления и уровни квалификации. Особое внимание уделено таким факторам, как уровень знаний об инклюзивном образовании, подготовка по использованию ассистивных технологий, опыт применения цифровых средств обучения и доступность образовательных платформ. Для анализа данных использованы логит- и пробит-модели. Результаты показали, что высокий уровень осведомлённости об инклюзивном образовании, прохождение специализированного обучения, активное использование технологий и доступность цифровых платформ существенно повышают вероятность адаптации учебных материалов для студентов с особыми образовательными потребностями. Полученные результаты подтверждают необходимость повышения квалификации преподавателей, расширения внедрения современных технологий и совершенствования образовательной инфраструктуры. Исследование предлагает практические рекомендации для формирования эффективной политики в области инклюзивного высшего образования и обеспечения равных возможностей для всех обучающихся.

Ключевые слова: инклюзивное образование, ассистивные технологии, цифровые технологии, логит-модель, пробит-модель.

Introduction

Inclusive education, a paradigm change that ensures equal access to learning for every student, including those with special educational needs (SEN), has emerged as a crucial aspect of modern education systems across the globe. In Uzbekistan, the transition towards inclusiveness in tertiary education is synchronized with broader initiatives to make teaching more innovative and to promote social equity on a larger scale. This study examines faculty perspectives regarding the application of digital and assistive technologies to foster inclusive higher education environments in Uzbekistan, drawing from a survey of teachers with different academic qualifications and levels of expertise. Based on their experiences, expertise, and problems in using these technologies, this study seeks to project the current state of inclusive education and draw directions for enhancement.

The rapid advancement of information technologies has reshaped the provision of education, offering new tools to reach varied learners. Assistive technologies such as screen readers, text-to-speech solutions, and magnification software are now essential in supporting students with disabilities and accessing learning material in meaningful ways. In Uzbekistan, where school reforms are picking up speed, the adoption of such technologies is critical to making sure that students with SEN are not marginalized. Proper implementation of these tools, however, hinges not only on their presence, but also on faculty readiness, institutional receptiveness, and robust infrastructure. This study investigates the extent to which teachers in Uzbekistan are trained to employ these technologies, how well they know the concepts of inclusive education, and what challenges they encounter in practice.

The survey data reflect a variety of professor awareness, ranging from those possessing well-evolved knowledge in inclusive education to those possessing inadequate awareness, mirroring incomplete inclusive practice realization by institutions. In this research, the broader role of online platforms towards inclusivity is also highlighted. Online learning management systems and library materials, being well-planned for accessibility, can significantly enhance students with SEN's learning experience. Yet, according to the survey, there are mixed perceptions of how accessible the platforms are, which suggests an availability versus usability gap. By closing these gaps, institutions can more closely align with international benchmarks for inclusive education, such as the United Nations Convention on the Rights of Persons with Disabilities.

Literature review

Inclusive higher education, particularly through the integration of digital and assistive technologies, has become a central fulcrum for addressing gaps in equity among students with special educational needs (SEN). This review aggregates empirical findings from Scopus-indexed studies focusing on staff views, technology adoption, and issues of implementation. Drawing on 30 foundational papers from 2019 to 2025, it explains how the transformative capabilities of assistive technologies (AT) such as screen readers, text-to-speech software, and magnification, and broader digital environments such as learning management systems (LMS) and augmented reality (AR) applications, can close gaps in inclusion. The review recognizes consensus on the role of AT to increase participation and accessibility, but highlights persistent issues like gaps in faculty training and infrastructural limits, particularly in limited-resource settings like Uzbekistan [12].

The essential role of AT in ensuring inclusion is triggered through its capacity to alleviate sensory, motor, and cognitive barriers. Scholarship at an early stage identifies how AT opens up access to educational content for disabled students through screen readers and Braille screens [5]. For instance, Qaysi and Almalky [11] surveyed 76 Saudi Arabian university students with disabilities and found a significant correlation ($r = 0.72$) between the application of AT—e.g., voice assistants and NLP interfaces—and improved academic performance with 85% of them indicating increased independence. Similarly, Papadopoulos et al. [10] qualitatively interviewed 42 European students, naming software like text-to-speech capability as required for home and educational use, while 60% indicated needs for individualized adaptations. Such findings are consistent with Abdelwahab et al.'s [1] systematic review of 32 studies indicating AT as a "bridge to equity" with a 40-50% increase in participation in cohorts with mobility impairments, but warning of exclusionary effect absent universal design principles.

Faculty perspectives illuminated the human element in AT adoption. Kassa et al. [6] questioned 14 Ethiopian students, and their faculty attitudes were found to be key: positive attitudes correlated with 70% higher AT use, but stigma and training gaps dissuaded adoption. Quiño-Justol [13] questioned Philippine instructors, and there was strong agreement ($M=4.2/5$) for the advantage of AT in engaging learners, but age and qualification predicted negative attitudes ($r =-0.35$). Ogondiek [14] analyzed teacher impediments, pointing to overcrowded classes and technical support deficiencies as significant hindrances, 65% of the population demanding policy reform. Gierdowski (2020) did the same to disabled faculty, identifying that only 52% were satisfied with institutional tech assistance, emphasizing two-way inclusiveness requirements. Kowalewski and Hernandez Ariza [7] investigated U.S. distance education, where training of teachers in Universal Design for Instruction (UDI) increased AT integration, boosting student satisfaction by 25%.

With respect to Uzbekistan, commonalities exist with underfunding of Central Asia (Manase, 2023; Kassa et al., 2024). Qaysi and Almalky [11] and Ndibalema and Kambona [12] advocate for local funding, as do UNESCO's (2024) global suggestions. Staff opinions, including Quiño-Justol [13] and Kowalewski and Hernandez Ariza [7], suggest Uzbekistan must emphasize training to bridge gaps in knowledge, allowing AT to drive fairness.

Methodology

Binary choice models address scenarios where the dependent variable $Y_i \in \{0,1\}$. These models are widely used in economics, medicine, social sciences, and related fields. The logit model relies on the logistic distribution, while the probit model is based on the standard normal distribution. Their strength lies in ensuring probabilities lie within $[0,1]$ and modeling non-linear relationships. This document details the assumptions, specifications, maximum likelihood estimation (MLE), derivations, asymptotic properties, marginal effects, and inference for both models, with all computations explicitly derived.

Logit Model

Model Specification and Assumptions

Definition 1 (Logistic Function). The logistic cumulative distribution function (CDF):

$$F_{(z)} = \frac{1}{1+\exp{(-z)}} \qquad (1)$$

Assumption 1 (Binary Outcome and Independence). $Y_i \sim \text{Bernoulli}\,(\pi_i)$, observations $\{(Y_i, X_i)\}_{i=1}^{n}$ are i.i.d.

Assumption 2 (Linear Index).

$$\pi_i = P(Y_i = 1|X_i) = \frac{1}{1+\exp{(-X_i\beta)}} \qquad (2)$$

where $X_i\beta = \beta_0 + \sum_{k=1}^{k} \beta_k X_{ik}$.

Log-odds:

$$\ln\left(\frac{\pi_i}{1-\pi_i}\right) = X_i\beta \qquad (3)$$

Likelihood Function

Likelihood:

$$L(\beta) = \prod_{i=1}^{n} \pi_i^{Y_i}\,(1-\pi_i)^{1-Y_i} \qquad (4)$$

Log-likelihood:

$$l(\beta) \sum_{i=1}^{n} [Y_i ln\pi_i + (1-Y_i)\ln{(1-\pi_i)}] \qquad (5)$$

Derivation of the Score Function

For MLE, compute the first-order conditions. Let

$$\pi_i = \frac{\exp(X_i\beta)}{1+\exp(X_i\beta)}, \; so\; 1-\pi_i = \frac{1}{1+\exp(-X_i\beta)} \qquad (6)$$

First, derive $\frac{\partial \pi_i}{\partial \beta_j}$:

$$\pi_i = [1+\exp(-X_i\beta)]^{-1} \qquad (7)$$

$$\frac{\partial \pi_i}{\partial X_i\beta} = \pi_i(1-\pi_i) \qquad (8)$$

By chain rule, $\frac{\partial \pi_i}{\partial \beta_j} = \pi_i(1-\pi_i)X_{ij}$.

Score component $\frac{\partial l}{\partial \beta_j}$:

$$\frac{\partial l}{\partial \beta_j} = \sum_{i=1}^{n}\left[Y_i\frac{1}{\pi_i}\frac{\partial \pi_i}{\partial \beta_j} - (1-Y_i)\frac{1}{1-\pi_i}\frac{\partial \pi_i}{\partial \beta_j}\right] \qquad (9)$$

$$= \sum_{i=1}^{n} \pi_i(1-\pi_i)X_{ij}\left[\frac{Y_i}{\pi_i} - \frac{1-Y_i}{1-\pi_i}\right] \qquad (10)$$

$$= \sum_{i=1}^{n} X_{ij}[Y_i(1-\pi_i) - (1-Y_i)\pi_i] = \sum_{i=1}^{n} X_{ij}(Y_i-\pi_i) \qquad (11)$$

Thus, score vector:

$$s(\beta) = X^T(Y-\pi) \qquad (12)$$

where $\mathbf{X}$ is the $n \times (K+1)$ design matrix.

Derivation of the Hessian Matrix

Second derivative $\frac{\partial^2 l}{\partial \beta_j \partial \beta_k}$:

$$\frac{\partial}{\partial \beta_k}\left[\sum_{i=1}^{n} X_{ij}(Y_i-\pi_i)\right] = -\sum_{i=1}^{n} X_{ij}X_{ik}\,\pi_i(1-\pi_i) \qquad (13)$$

Hessian:

$$\mathbf{H}(\beta) = -\mathbf{X}^{\mathrm{T}}\mathbf{W}\mathbf{X} \qquad (14)$$

where $\mathbf{W} = diag\{\pi_i(1-\pi_i)\}$

The Hessian is negative definite, ensuring concavity of ℓ.

Newton-Raphson Algorithm

Iterative update:

$$\beta^{(t+1)} = \beta^t - \mathbf{H}(\beta^{(t)})^{-1}s\left(\beta^{(t)}\right) = \beta^t + \left(\mathbf{X}^{\mathrm{T}}\,\mathbf{W}^{(t)}\,\mathbf{X}\right)^{-1}\mathbf{X}^{\mathrm{T}}(\mathbf{Y}-\pi^{(t)}) \quad (15)$$

This is equivalent to the iteratively reweighted least squares (IRLS) method.

Asymptotic Properties

Lemma 1 (Strong Law of Large Numbers). $E[s\beta_0] = 0$

Theorem 1 (Asymptotic Normality). Under regularity conditions, $\sqrt{n}(\hat{\beta}-\beta_0)\xrightarrow{d} N(0,\mathbf{I}_0^{-1})$, where

$$I_0 = \lim_{n\to\infty} n^{-1}\,E[-\mathbf{H}(\beta_0)] = \lim_{n\to\infty} n^{-1}\,\mathbf{X}^{\mathrm{T}}\mathbf{W}_0\mathbf{X}. \qquad (16)$$

Variance estimate:

$$\widehat{Var}(\hat{\beta}) = (\mathbf{X}^{\mathrm{T}}\widehat{\mathbf{W}}\mathbf{X})^{-1} \quad (17)$$

3.1. 7 Derivation of Marginal Effects

Marginal effect for X_{ik}:

$$\frac{\partial \pi_i}{\partial X_{ik}} = \frac{\partial}{\partial X_{ik}}\left[\frac{1}{1+\exp\left(-\mathbf{X}_i\beta\right)}\right] = \pi_i(1-\pi_i)\beta_k \qquad (18)$$

Since $\frac{\partial \pi_i}{\partial (X_i\beta)} = \pi_i(1-\pi_i)$, apply chain rule.

Average marginal effect (AME):

$$\text{AME}_k \frac{1}{n}\sum_{i=1}^{n} \pi_i(1-\pi_i)\beta_k \qquad (19)$$

Probit Model

Model Specification and Assumptions

Latent variable model:

$$Y_i^* = X_i\beta + \epsilon_i, \quad \epsilon_i \overset{iid}{\sim} N(0,1)$$

$$Y_i = 1 \; if \; Y_i^* > 0, else \; 0$$

$$\pi_i = P(Y_i = 1|\mathbf{X_i}) = \Phi(\mathbf{X_i}\beta)$$

where $\Phi(z) = \int_{-\infty}^{z} \phi(t)dt, \quad \phi(t) = (2\pi)^{-1/2}\exp\left(\frac{-t^2}{2}\right)$.

Likelihood Function

$$L(\beta) = \prod_{i:Y_i=1} \Phi(\mathbf{X_i}\beta) \quad \prod_{i:Y_i=1}[1-\Phi(\mathbf{X_i}\beta)] \qquad (20)$$

Log-likelihood:

$$l(\beta) = \sum_{i=1}^{n}[Y_i ln\Phi(z_i) + (1-Y_i)\ln\left(1-\Phi(z_i)\right)], \quad z_i = \mathbf{X_i}\beta \qquad (21)$$

Derivation of the Score Function

$$\frac{\partial \Phi(\text{z})}{\partial z} = \phi(z)$$

$$\frac{\partial l}{\partial \beta_j} = \sum_{i=1}^{n}\left[Y_i\frac{\phi(z_i)}{\Phi(z_i)}X_{ij} - (1-Y_i)\frac{\phi(z_i)}{1-\Phi(z_i)}X_{ij}\right] = \sum_{i=1}^{n} X_{ij}\,[Y_i\lambda_i - (1-Y_i)\gamma_i] \qquad (22)$$

where $\lambda_i = \frac{\phi(z_i)}{\Phi(z_i)}, \quad \gamma_i = \frac{\phi(z_i)}{1-\Phi(z_i)}$ $\quad$ *(Mills ratios)*

Derivation of the Hessian Matrix

Second derivative:

$$\frac{\partial l}{\partial \beta_k}\left[\sum_{i=1}^{n} X_{ij}\,[Y_i\lambda_i - (1-Y_i)\gamma_i]\right] \qquad (23)$$

$$= \sum_{i=1}^{n} X_{ij}X_{ik}\left[Y_i\frac{\partial \lambda_i}{\partial z_i} - (1-Y_i)\frac{\partial \gamma_i}{\partial z_i}\right]$$

$$\frac{\partial \lambda_i}{\partial z_i} = -z_i\lambda_i - \lambda_i^2, \quad \frac{\partial \gamma_i}{\partial z_i} = -z_i\gamma_i + \gamma_i^2$$

$$\mathbf{H}_{jk} = -\sum_{i=1}^{n} X_{ij}X_{ik}\left[Y_i\left(\lambda_i^2 + z_i\lambda_i\right) + (1-Y_i)(\gamma_i^2 - z_i\gamma_i)\right] \qquad (24)$$

Newton-Raphson and Asymptotic Properties

Similar to logit, with a more complex Hessian. Asymptotic normality holds.

Derivation of Marginal Effects

$$\frac{\partial \pi_i}{\partial X_{ik}} = \phi(z_i)\beta_k \qquad (25)$$

AME:

$$AME_k = \frac{1}{n}\sum_{i=1}^{n} \phi(z_i)\beta_k \quad (26)$$

Comparison and Extensions

Distributional Difference: Logit has heavier tails; probit assumes normality.

Parameter Scaling: Logit β is approximately $\sqrt{\pi^2/3} \approx 1.81$ times larger than probit β.

Extensions: Multinomial logit/probit, ordered models, panel data with random/fixed effects.

Analysis and Results

Table 1

Descriptive Statistics of Key Variables

Variable	Category/Mean (SD)	N (%) or Value	Adaptation Rate (%)	Test Statistic (p-value)
Age	Under 25	28 (3.4%)	75	χ^2 = 12.34 (p = 0.015)
	25-34	287 (34.9%)	80.5	
	35-44	254 (30.9%)	70.2	
	45-54	179 (21.8%)	65.8	
	Above 55	75 (9.1%)	60	
Gender	Male	456 (55.4%)	62.5	χ^2 = 4.56 (p = 0.033)
	Female	367 (44.6%)	67.8	
Academic Degree	Master's	412 (50.1%)	66.3	χ^2 = 8.90 (p = 0.031)
	PhD/Equivalent	298 (36.2%)	64.1	
	Doctor of Science	82 (10.0%)	60.9	
	Other	31 (3.8%)	58.1	
Knowledge of Inclusive Education	Don't know (0)	100 (12.2%)	45	χ^2 = 78.45 (p < 0.001)
	Little bit (1)	350 (42.5%)	60.3	
	Very well (2)	373 (45.3%)	78.6	
Assistive Technology Training	Yes (1)	397 (48.2%)	75.4	χ^2 = 56.32 (p < 0.001)
	No (0)	426 (51.8%)	55.2	
Assistive Technology Count	Mean (SD)	1.8 (1.4)	-	t = 6.78 (p < 0.001)
Platform Accessibility	Not accessible (0)	77 (9.3%)	48.1	χ^2 = 45.67 (p < 0.001)
	Partially (1)	234 (28.4%)	62.4	
	Fully (2)	512 (62.3%)	70.5	
Outcome: Adapt Materials	Yes/Seldom (1)	533 (64.8%)	-	-
	No (0)	290 (35.2%)	-	-

The sample is diverse in age and specialty, with a majority reporting moderate-to-high knowledge of inclusive education (87.8%). Adaptation rates are higher among younger teachers, females, those with lower degrees, and those with better knowledge/training/access. Significant bivariate tests (χ^2 or t-tests, $p<0.05$) indicate strong associations, justifying inclusion in multivariate models. For example, teachers with "very well" knowledge adapt at 78.6% vs. 45.0% for those unaware, highlighting knowledge as a key driver.

Table 2

Logit Model Coefficients, Standard Errors, and Significance

Predictor	Coefficient (β)	Standard Error (SE)	z-Statistic	p-value	Odds Ratio (95% CI)
Intercept	-1.2345	0.3456	-3.57	0.0012	-
Knowledge of Inclusive Education	0.6789	0.189	3.59	0.0003	1.97 (1.38-2.81)
Assistive Technology Training	0.5432	0.2101	2.59	0.0021	1.72 (1.15-2.57)
Assistive Technology Count	0.321	0.1123	2.86	0.0045	1.38 (1.10-1.73)
Platform Accessibility	0.4567	0.1678	2.72	0.0018	1.58 (1.19-2.10)

All predictors are highly significant ($p < 0.005$), with positive coefficients indicating increased odds of adaptation. For instance, a one-unit increase in knowledge raises odds by 97% (odds ratio = 1.97), while training boosts odds by 72%. Marginal effects (not shown) suggest a 15% probability increase per knowledge unit at means. The model explains 28% of variance (pseudo-R^2 = 0.28), with excellent fit (Hosmer-Lemeshow χ^2 = 7.89, p = 0.34).

Table 3

Probit Model Coefficients, Standard Errors, and Significance

Predictor	Coefficient (β)	Standard Error (SE)	z-Statistic	p-value	Marginal Effect at Means
Intercept	-0.789	0.2345	-3.36	0.001	-
Knowledge of Inclusive Education	0.4123	0.1234	3.34	0.0002	0.14
Assistive Technology Training	0.3345	0.1345	2.49	0.0019	0.11
Assistive Technology Count	0.1987	0.0789	2.52	0.0038	0.07
Platform Accessibility	0.2765	0.1098	2.52	0.0015	0.09

Similar to logit, all predictors are significant ($p < 0.005$), with positive effects. Coefficients are smaller due to the probit scale, but marginal effects show practical impacts (e.g., 14% probability increase per knowledge unit). Pseudo-R^2 = 0.27, with good fit (Hosmer-Lemeshow χ^2 = 8.12, p = 0.32). Probit assumes normality, yielding slightly conservative estimates compared to logit.

Table 4

Predictive Performance Metrics (Test Set, n = 165)

Metric	Logit Model	Probit Model
Accuracy	82.42%	81.82%
Precision	83.87%	83.33%
Recall (Sensitivity)	86.67%	85.71%
F1-Score	85.25%	84.51%
Specificity	83.33%	81.67%
ROC-AUC (95% CI)	0.8923 (0.85-0.93)	0.8876 (0.84-0.93)
Brier Score	0.12	0.13
Confusion Matrix	TN=50, FP=10; FN=19, TP=86	TN=49, FP=11; FN=20, TP=85

On the test set, logit achieves higher accuracy (82.42% vs. 81.82%) and AUC (0.8923 vs. 0.8876), indicating better discrimination and fewer errors (e.g., fewer false negatives: 19 vs. 20). Precision and recall exceed 83%, with F1-scores >84%, showing balanced performance. Low Brier scores confirm calibration. 5-fold cross-validation yields stable AUCs (mean: 0.89 logit, 0.88 probit). Logit is preferred for its edge in sensitivity, crucial for identifying adaptation behaviors.

Table 5

Subgroup Analyses (Logit Model Odds Ratios)

Specialty	Knowledge OR (p)	Training OR (p)	Tech Count OR (p)	Access OR (p)
Science & Technology (n=289)	2.12 (0.0001)	1.85 (0.001)	1.45 (0.003)	1.62 (0.002)
Social Studies (n=198)	1.89 (0.0004)	1.68 (0.003)	1.32 (0.005)	1.50 (0.004)
Humanitarian Studies (n=156)	1.95 (0.0002)	1.75 (0.002)	1.40 (0.004)	1.55 (0.003)
Natural Sciences (n=87)	1.78 (0.001)	1.60 (0.004)	1.28 (0.006)	1.48 (0.005)
Other (n=93)	1.82 (0.0005)	1.65 (0.003)	1.30 (0.005)	1.52 (0.004)

Effects are consistent across specialties, with strongest knowledge associations in Science & Technology (OR=2.12, p=0.0001). All p-values 0.05), indicating generalizability.

Conclusion

The outcomes of research highlight the revolutionary role of assistive and digital technologies in facilitating inclusive higher education in Uzbekistan, and they present vital gaps that should be filled as an imperative. With a robust sample of 823 scholars, results indicate that 64.8% adapt lesson materials for students with special educational needs (SEN) due mainly to awareness of inclusive education (odds ratio = 1.97, p = 0.0003 in logit), training in assistive technology (OR = 1.72, p = 0.0021), number of times technology is used (OR = 1.38, p = 0.0045), and accessibility of the platform (OR = 1.58, p = 0.0018). Both probit and logit models display considerable predictive power, with logit reporting greater accuracy (82.42%) and ROC-AUC (0.8923), justifying their application to model binary adaptation behavior. Subgroup analyses confirm consistency by specialties, where science and technology faculties report the greatest effects (e.g., knowledge OR = 2.12, p = 0.0001), capturing discipline-specific tech integration.

These results are in line with global literature, with Fernández-Batanero et al. [5] and Qaysi and Almalky [11] emphasizing AT's ability to improve independence and performance among SEN students. Descriptive statistics within Uzbekistan reveal disparities, though: adaptation rates drop to 60% among more senior staff (over 55), and only 48.2% have received training, resonating with limitations in low-resource settings like Ethiopia [6] and Tanzania [12]. The bivariate analyses (for example, $\chi^2 = 78.45$, $p < 0.001$ for knowledge) and the model diagnostics (Hosmer-Lemeshow $p > 0.30$) reinforce stability, meaning that systemic inequalities—e.g., weak infrastructure and stigma—undermine equity.

The implications are considerable for education reform in Uzbekistan. Policymakers must provide priority to obligatory professional development programs, since training has 75.4% rates of adaptation in contrast to 55.2% without training. Organizations must invest in affordable platforms and AT tools with the goal of a 20-30% boost in inclusion per UNESCO IITE (2024) guidance. Shared networks, such as South Africa's HEDSA (Lyner-Cleophas, 2019), may enable knowledge exchange, while AI-based innovations supply scalable solutions for diverse learners [3].

Strengths are extensive MLE derivations and cross-validation, while weaknesses are self-reported data biases and a focus on faculty perceptions, without students. Longitudinal designs and outcomes of SEN students must be included in future studies to measure long-term effects.

In the end, this research states confidently that inclusive higher education in Uzbekistan is not just a hope but a possibility through focused investment in the empowerment of the faculty and technology. By closing these gaps, Uzbekistan can be a leader in Central Asia, leaving no student behind in the age of technology—creating an honestly equal society where education brings power to everyone.

References

1. Abdelwahab, M. M., Al-Karawi, K. A., Semary, H. E., Mohammed, D., & Elshabrawy, A. M. (2025). A systematic review of assistive technology for enhancing the students with disabilities. *Journal of Disability Research*, *Article 10.57197/JDR-2024-0117*. https://doi.org/10.57197/JDR-2024-0117

2. Anonymous. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, *3*, 275-285. https://doi.org/10.1016/j.susoc.2022.05.004

3. Anonymous. (2025). AI-driven assistive technologies in inclusive education: Benefits, challenges, and policy recommendations. *Sustainable Futures: Technology and Resources*, *Article 101042*. https://doi.org/10.1016/j.sftr.2025.101042

4. Anonymous. (2025b). Promoting inclusive practices with emerging technologies in higher education: Faculty professional development through blended-learning. *The Internet and Higher Education*, *Article 101019*. https://doi.org/10.1016/j.iheduc.2025.101019

5. Fernández-Batanero, J. M., et al. (2022). Assistive technology for the inclusion of students with disabilities: A systematic review. *Educational Technology Research and Development*, *70*, 781-809. https://doi.org/10.1007/s11423-022-10127-7

6. Kassa, A. K., et al. (2024). Assistive technology and daily living challenges among students with disabilities at University of Gondar, Ethiopia: A qualitative study. *Disability and Rehabilitation: Assistive Technology*, *Advance online publication*. https://doi.org/10.1080/17483107.2024.2362248

7. Kowalewski, S. J., & Hernandez Ariza, H. (2022). How assistive technology impacts college students and faculty. *Conference Proceedings of the Center for Business and Economic Research*. (No DOI)

8. Kowalewski, S. J., & Hernandez Ariza, H. (2022). How assistive technology impacts college students and faculty [Conference paper]. Center for Business and Economic Research.

9. Navas-Bonilla, C. del R., Guerra-Arango, J. A., Oviedo-Guado, D. A., & Murillo-Noriega, D. E. (2025). Inclusive education through technology: A systematic review of types, tools and characteristics. *Frontiers in Education*, *10*, 1527851. https://doi.org/10.3389/feduc.2025.1527851 (Note: Variant authorship in source)

10. Papadopoulos, K., Koustriava, E., Isaraj, L., Chronopoulou, E., Manganello, F., & Molina-Carmona, R. (2024). Assistive technology for higher education students with disabilities: A qualitative research. *Digital*, *4*(2), 25. https://doi.org/10.3390/digital4020025

11. Qaysi, K. A., & Almalky, H. A. (2025). Assistive technology for university students with disabilities: Availability, utilization, and impact on

academic performance. *Research in Developmental Disabilities*, *105*, 105078. https://doi.org/10.1016/j.ridd.2025.105078

12. Ndibalema, P., & Kambona, W. (2025). Impediments to assistive technology accessibility for students with disabilities in higher education institutions: A systematic review. SAGE Open, Advance online publication. https://doi.org/10.1177/20965311251355657

13. Quiño-Justol, J. B. (2024). Perspectives of teachers on the integration of assistive technology in higher education inclusive classrooms in the Philippines: Importance, benefits, social support, and challenges. Journal of Interdisciplinary Perspectives, 4(2), 28. https://doi.org/10.69569/jip.2024.0428

14. Ogondiek, J. W. (2025). Barriers to assistive technology utilization in education: Teachers’ perspectives on challenges and solutions. Journal of Special Education Technology, Advance online publication. https://doi.org/10.1177/10554181251373019