

ORIGINAL CONTRIBUTION

Exploring the AI-powered Adoption in Higher Education: A Comprehensive Study Using UTAUT4 Model to Understand User Acceptance and Usage

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Abstract— AI-powered learning is an innovative, student-centered educational paradigm integrating formal, informal, and social learning modalities. This study examines the acceptance of AI-powered learning in higher education institutions in Pakistan, concentrating on student acceptance and usage. Contextual awareness, self-directed learning, Personal innovativeness, and performance expectancy Factors were examined using the Smart-PLS approach to evaluate structural relationships and test hypotheses based on the expanded Unified Theory of Acceptance and Use of Technology (UTAUT4). The Results indicate substantial positive correlations between the proposed variables and students' acceptance of AI-powered learning methods. The findings offer significant insights into the structures that may influence the utilization and subsequent outcomes of AI-powered learning acceptance & usage in HEI, including Pakistan, and the UTAUT4 model offers a useful guide for decision-makers and educational institutions working on m-learning adoption at universities.

Index Terms— AI-powered learning, UTAUT4, Contextual awareness, Personal innovativeness, Self-direct learning

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I. INTRODUCTION

The fast technological evolution has changed how universities in Pakistan use Information Communication Technology (ICT). Traditional teaching methods are decreasing because AI technology creates personalized learning platforms that serve students flexibly through digital channels. Modern technology has made significant changes in everyday life. Students can get learning materials from any device at any location. Accessibility needs for better education have led to a broad intake of studying in higher education institutions, according to research studies [1, 2]. In recent times, higher educational institutions in developing countries have used information communication technologies as AI-powered learning [3, 4]. Higher educational institutions in developing countries like Pakistan still employ old teaching methods. Over the years, as time has passed, the technology has taken place in the Asian countries for effective learning. The old-fashioned method should improve the current practice of learning in Pakistan. AI-powered learning is not new in other developed countries, but the focus on improving uptake and learning is needed by developing countries like Pakistan. These methods are used in learning as well as teaching [5]. Based on the information presented in [6], people recognize face-to-face methods as the methods linked with specific places, for instance, schools, particular syllabuses in the books only, or particular teachers and particular classes. Despite this, there is no interaction between the teachers and students after the class, mainly because of poor or no access to technology [7]. The conventional method is employed in Third World countries, including Pakistan. Students and teachers work in direct real-time lessons focusing on using only classroom resources while students practice note-taking and learn from the teacher's teaching. These techniques fail to support

students in building reliable scientific knowledge over time. The teacher-student connection happens right now [8]. The traditional classroom education system now shares power with artificial intelligence learning methods.

The internet, especially modern technology, has brought about several changes and sold many things that were once given a limited scope in a conventional school environment. AI-powered learning means changing from outdated methods to using modern tools. Instead, it is a form of continued and spontaneous learning in multiple situations and environments [9]. Unlike ordinary learning, AI-powered learning indicates that learning should be incorporated into many parts of a student's daily life rather than limited to the usual classroom environment. Previous research [10] also shows that access to information and communication anytime and anywhere is favorable for learners regarding AI-powered Learning. An evaluation of technology adoption and use has concentrated chiefly on the information and communications technology sector, and the efficacy of AI-powered learning in Pakistani higher educational institutions is contingent upon student acceptance. In Asian countries like Pakistan, researchers questioned students to assess their perspectives and prejudices about using P-learning. This objective aims to provide a theoretical model for AI-powered learning informed by student feedback in Pakistani universities, utilizing the UTAUT4 paradigm.

A. Problem statement

In Sindh, Pakistan, the use of AI-driven learning in educational institutions is still relatively new, even though pandemics have accelerated the development of educational technology globally. This research fills the

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knowledge gap about the factors affecting students' propensity to adopt AI-powered learning tools.

II. RELATED WORK

3.1 AI-powered in Higher Education Higher education instructors and students use AI learning technologies for various purposes. Certain universities' computer science courses include AI learning technology. Students assert that AI technology facilitates novel learning methods and provides practical experience and motivation [11, 12, 13]. While AI-driven education offers benefits, it fails to foster creativity and problem-solving abilities in students. Individuals may also question why [14, 15, 16] in higher education seldom references AI-driven learning. Artificial intelligence learning technologies may complicate and incur expenses in education. An increasing number of academics are using AI-driven learning in higher education for specific reasons, making it essential to examine the outcomes associated with this technology. Students use AI learning to acquire programming and linguistic skills, promptly recognizing its advantages.

III. RESEARCH METHODOLOGY

A strategy to collect quantitative data will be employed in this research, which will be analyzed using SPSS 22.0. Qualitative research is initially undertaken for exploratory purposes, followed by a quantitative analysis based on the early quantitative results. This exploratory strategy is often used to investigate research problems. This work employs questionnaires from quantitative research findings to gather further information, partic-

ularly about the comparative benefits of various characteristics. The sample selection criteria require that respondents be either current users of AI-powered learning or have used it. A survey was conducted in this investigation. Approximately three hundred one paper copies of the questionnaire were disseminated across Pakistan, namely in Karachi (the most populous city), Islamabad (the capital), Hyderabad (the second biggest city), and Lahore (one of the wealthiest cities). Structural Equation Modeling, Partial Least Square v.22.0 software will be used for Structural Equation Modeling a. A two-step Structural Equation Modeling analysis will be used for this study. The Partial Least Square will be used to evaluate the one-dimensional effectiveness and reliability of the potential construct in the first step. The second stage will assess the structural model to determine if an associated relationship exists among the several structures of the suggested research model.

A. The evolution of research model

This research integrates seven external findings from the literature with the Unified Theory of Acceptance and Use of Technology to create a new research design. Research demonstrates that UTAUT4 explains technology use better than relevant models of information communication.

This research created Figure 1 to discover how external factors affect how students use and accept educational technology within Pakistani universities. The suggested model incorporates external factors such as Awareness, Self-Directed Learning, Personal Innovativeness, and Performance Expectancy, which were pertinent.

Figure 1: The suggested theoretical research model.

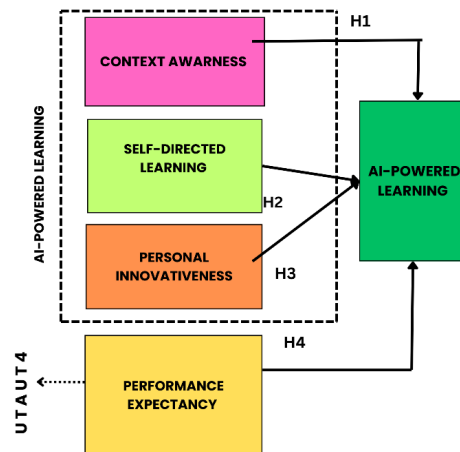


Fig. 1. Proposed conceptual model hypotheses

B. Context awareness

Context awareness serves as the independent variable for this study. The system regards contextual information about the user as an essential element of AI-powered learning, signifying its context awareness [17, 18].

The environment and the system actively adapt and make dynamic, proactive alterations to their functions. AI-powered learning technology functions with the capacity to recognize contextual stimuli universally. Consequently, we put up the following proposal:

Hypothesis 1: CA will positively and significantly influence AI-powered learning technologies.

C. Self-directed learning

Self-directed learning is an autonomous element within the AI-powered learning theoretical framework. Students guide their education in U-learning and seek methods to customize and thoughtfully adapt the learning environment to their needs [19, 20]. Students are active and pivotal players in this process, and their attributes either enhance or impede their drive to engage with the U-learning environment [21, 22]. Individuals must comprehend the significance of self-directed learning about personal variances.

Hypothesis 2: Self-directed learning will positively and significantly

influence AI-powered learning technologies.

D. Personal Innovativeness

PI, a person embraces innovation sooner than another, and this determines their level of personal innovativeness in a social system [23, 24]. That innovation has been embraced to quantify this definition. Another study conceptualizes innovation as an underlying dimension of pertinent personality for analyzing organizational change. [25] provides the idea that one might position oneself on a range of abilities that never ends, which supports doing things by giving the stages of various abilities adaptive labels, focusing on innovative labels. This concept was conceptualized in the information system and information communication technology field when they researched to conceptualize personal innovativeness regarding AI-powered learning in higher education institutions.

Hypothesis 4: PI will positively and significantly affect AI-powered learning technologies.

RESULTS

The study, conducted online, found a positive correlate on between contextual awareness, personal innovativeness, self-directed learning, and per-

formance expectancy, using data from public institutions in Sindh, including the Quaid-e-Awam University of Engineering, Nawabshah Liaquat University of Medical & Health Sciences, and the University of Karachi. The study examines digital assessment intentions during the post-pandemic era, focusing on educational technology users. It analyzes how AI-powered learning participants perform online examinations and assessments using a seven-point Likert scale. The validity of a theory is evaluated through correlation and regression analysis.

TABLE I
DEMOGRAPHIC CHARACTERISTICS(N=301)

Variables	Description	Frequency	Percentage
Gender	Male	158	52.5%
	Female	143	47.5%
Age	21-30	140	46.5%
	31-40	161	53.5%
Education	Master/Bachelor	173	57.5%
	MPhil/PhD	128	42.5%

TABLE II
DESCRIPTIVE ANALYSIS STATISTICS OF ITEMS

Item Code	Statement	Mean	Standard Deviation
CA1	I can receive relevant and timely information during my learning activities.	5.4850	1.7712
CA2	I can access appropriate learning resources and services based on my current physical location.	5.3223	1.7905
CA3	The information provided to me is contextually relevant to my current learning situation.	5.4186	1.8577
SDL2	When encountering challenges with AI-powered learning technologies, I seek support and solutions to address them.	5.6877	1.4267
SDL3	I manage my time effectively while utilizing AI-powered learning tools to ensure productive learning outcomes.	5.7774	1.1663
SDL4	I set specific learning goals that guide my use of AI-powered learning technologies.	5.8605	1.2249
SDL5	I maintain high expectations for my academic performance when using AI-powered learning technologies.	5.9701	1.1206
PI1	When I hear about new information technologies, I am inclined to explore and experiment with them in my learning activities.	5.5349	1.3795
PI2	I am generally enthusiastic about adopting new AI-powered learning technologies to enhance my learning experience.	5.1561	1.7660
PI3	I am eager to try out new AI-powered learning technologies to improve my educational outcomes.	4.9701	1.8300
PE1	I believe that utilizing AI-powered learning methods significantly enhances my learning experience in higher educational institutions.	5.9535	1.3679
PE2	AI-powered learning enables me to complete academic tasks more efficiently and effectively.	6.2060	1.2072
PE3	The use of AI in learning simplifies the processes of both teaching and learning.	6.1130	1.3193
PE4	AI-powered learning offers greater flexibility, allowing me to learn at my own pace and convenience.	6.0664	1.2944
PE5	I consider AI-powered learning methods to be highly useful in achieving academic success.	6.2660	1.3192

E. Hypothesis Testing

The research hypotheses were verified through regression and correlation analysis.

TABLE III
REGRESSION AND CORRELATION ANALYSIS STATISTICS

Hypothesis	Path Relation	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T statistics (O/STDEV)	p Value	Decision
H1	CA → ULT	-0.243	-0.230	0.075	3.256	0.001	Accepted
H2	SDL → ULT	0.363	0.356	0.061	5.984	0.000	Accepted
H3	PI → ULT	-0.244	-0.229	0.075	3.256	0.001	Accepted
H4	PE → ULT	0.246	0.235	0.064	3.823	0.000	Accepted

Significance at level of t -value =2.57 *** $p < 0.001$ and t -value =1.96** $p < 0.05$

The empirical component of this study consisted of 301 individuals who contributed input. In addition, most of the students deemed the use of AI-powered assessment as useful, and this research tries to study the cross section that is suggested for a longitudinal study that will likely reinterpret the users' intentions given the dynamism of human behavior. The present study validated all of the suggested factors and recommended that researchers broaden the limitations and research horizon at the national level in Pakistan to interpret the intention of users to use technology online. Moreover, the research should incorporate parental involvement and public participation in the forthcoming investigation of electronics in the education sector.

IV. CONCLUSION

AI-powered learning technology, integrating digital tools and platforms with education, gained significance in Pakistan after the epidemic. Nonetheless, challenges such as inequities in the educational system and insufficient investment in technology impede its widespread implementation. To enhance computer literacy and equip students for the evolving educational landscape, compulsory IT courses should be integrated across all disciplines. Higher educational institutions must emphasize contextual awareness in the application of AI-powered technology, enabling students to produce and interact with contextually relevant information. Institutions need to foster emotional satisfaction, enhance learners' happiness with technology, and provide tools to assist students in establishing goals. A study involving 301 participants revealed that the majority of students endorsed AI-powered assessment, prompting researchers to broaden the national research scope to comprehend users' goals regarding online evaluations. Moreover, family involvement and community engagement are crucial for forthcoming research on AI-powered within the higher educational institutions in Pakistan.

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