An Extended UTAUT Study of Information and Communication Technology Adoption in Higher Education

Vishal Jain [1], Mohit Kukreti [1], Sujeet Kumar Sharma [2], Sami Ullah [3], Amitabh Mishra [1], Veena Tewari [1], Muhammed Rehan Shaukat [1]

[1] *Department of Economics and Business Administration, University of Technology and Applied Sciences, Ibri, Oman*
[2] *Department of Decision Science & Information Systems, Indian Institute of Management, Nagpur, India*
[3] *Faculty of Management Sciences, University of Central Punjab, Lahore, Pakistan*

Abstract **– This research utilises an extended UTAUT (Unified Theory of Acceptance and Use of Technology) framework that explores the adoption of Information and Communication Technology (ICT) in higher education. With a focus on student engagement in Oman, the research integrates trust as a novel construct and examines the role of gender as a moderator among traditional UTAUT variables. This extension addresses gaps in the literature regarding trust and demographic influences in ICT adoption. Using a quantitative approach and robust statistical techniques, the findings reveal that effort expectancy (EE), performance expectancy (PE), facilitating conditions (FC), social influence (SI), and trust significantly impact behavioral intention (BI) and use behavior (UB). Gender emerged as a key moderator, highlighting nuanced variations in perceptions between male and female students regarding the adoption of ICT tools.**

The study makes both theoretical and practical contributions by refining UTAUT's predictive capability and offering hands-on insights for policymakers and educators to boost ICT adoption. By addressing infrastructure readiness, promoting trust, and tailoring strategies to gender-specific needs, this research lays a foundation for improved digital integration in education. The findings underscore ICT's transformative potential in creating interactive, equitable, and future-ready learning environments, particularly in emerging economies.

Keywords **– ICT, higher education, extended UTAUT, teaching and learning.**

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Corresponding author: Vishal Jain,
Department of Economics and Business Administration, University of Technology and Applied Sciences, Ibri, Oman
Email: vishal.jain@utas.edu.om

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1. Introduction

The global wave of digital transformation has revolutionized information processing and communication, offering unprecedented ease, cost-efficiency, and accessibility [1]. Among its many applications, information and communication technology (ICT) is emerging as a powerful force in academics, facilitating interactive, affordable, and innovative teaching and learning methods [2], [3]. ICT encompasses a broad spectrum of tools, such as computers, mobile devices, cloud platforms, and internet-based applications, which enable seamless interaction among students, educators, and education management systems [4]. By enhancing digital skills, fostering content exchange, and supporting administrative tasks, ICT is shaping the future of education globally [5].

While technology-specific studies highlight the benefits of e-learning, m-learning, and digital platforms, there remains a significant disparity in fair and efficient integration of ICT, particularly for higher studies [6].

Despite its potential to bridge educational gaps and deliver quality teaching, challenges such as inadequate infrastructure, insufficient training, and limited policy support continue to hinder ICT adoption [7], [8]. These barriers underscore the critical need for targeted research that addresses technological readiness and user acceptance across diverse educational contexts.

The original UTAUT (Unified Theory of Acceptance and Use of Technology) provides a comprehensive framework for investigating factors that influence technical adoption [9]. While UTAUT has been widely applied in various domains, its integration in higher education remains underexplored, particularly in contexts involving emerging economies. Additionally, recent extensions of the UTAUT model, such as UTAUT2, have incorporated variables like habit, hedonic motivation, and price value, yet the role of trust—a critical determinant of user confidence in technology—has been insufficiently examined [10]. Trust is increasingly vital in addressing concerns of privacy, security, and technological reliability, which directly impact behavioral intention and usage behavior [11], [12].

The current research makes several important improvements to the current body of knowledge and practice regarding ICT adoption in higher education. Theoretically, it extends the UTAUT by incorporating trust as a critical determinant, addressing a notable gap in the literature. Trust, often overlooked in ICT adoption studies, is essential in mitigating concerns about privacy, security, and technological reliability, making this addition particularly relevant in today's digital education landscape. Contextually, the study provides valuable empirical insights from Oman, an emerging economy with a rapidly evolving ICT infrastructure. By exploring ICT adoption in such a unique setting, the research enhances a deeper, global and inclusive technical know-how in diverse educational environments.

Practically, the research provides actionable suggestions to policymakers, academia, and institutions to facilitate ICT incorporation in the higher education. By identifying the roles of trust, demographic nuances, and gender differences, it equips stakeholders with strategies to address barriers and foster a more inclusive and effective adoption of ICT tools. Further, the current research uses a robust quantitative methodology, integrating moderating effects by examining behavioral intention and usage behavior comprehensively. This approach not only enriches the understanding of ICT adoption but also provides a replicable framework for future research in similar or diverse educational contexts.

2. ICT Adoption in Education and UTAUT

Within the framework of ICT adoption, UTAUT offers a logical and empirically grounded framework to analyze how students and educators perceive and interact with technology. Its constructs provide theoretical clarity in distinguishing between indicators, which stimulate the intentions (e.g., effort expectancy) and those that facilitate actual use (e.g., facilitating conditions). For instance, the interplay between effort expectancy and performance expectancy can shed light on how these factors influence expectations for improved outcomes, which are particularly relevant in educational environments.

Moreover, social influence is uniquely impactful in educational settings, where peer and institutional norms often dictate technology adoption. Subsequently, facilitating conditions further highlight the organizational readiness necessary for ICT integration. By isolating these constructs, UTAUT helps delineate the structural and psychological barriers to ICT adoption, thereby offering actionable insights.

This study adopts the extended UTAUT framework to address two critical theoretical gaps. First, it incorporates trust as a key construct to empirically investigate how it interacts with traditional UTAUT variables Second, it examines the moderating role of gender, offering insights into the relationships among constructs in higher education settings. These extensions emphasize the need to consider both structural and psychological enablers and barriers.

3. Hypothesis Development

By utilizing extended UTAUT for ICT adoption in education, it not only refines UTAUT's predictive capability in academic contexts but also lays the groundwork for future studies to incorporate emerging constructs and moderating variables. The application of UTAUT in this study underscores its enduring relevance as a theoretical lens for investigating the multifaceted nature of technology adoption.

3.1. Performance Expectancy

Performance Expectancy (PE), as conceptualized in the UTAUT, refers to the extent to which a person considers that utilising a technology will improve their task achievement [9]. This construct aligns with expectancy-value theory, which suggests that individuals are motivated to engage in behaviors they perceive as beneficial or performance-enhancing [13], [14].

In the context of ICT adoption in education, PE encapsulates students' perceptions that ICT tools and resources can lead to better academic outcomes, such as improved grades, greater learning efficiency, and enhanced engagement.

Students' behavioral intention to use ICT tools is driven by their belief that these tools will make educational processes more productive and less cumbersome. For instance, ICT enables access to various course materials that fosters personalized understandings, thus reinforcing the perceived utility of these technologies in achieving academic goals [15]. This relationship is confirmed in e-learning systems within developing countries, where students' perceptions of academic benefits strongly influenced their intention to use such systems [16]. Similarly, performance expectancy significantly impacted behavioral intention in their study on lecture capture systems, emphasizing the importance of perceived academic utility [17].

ICT tools often align closely with students' academic objectives, such as accessing lecture materials or improving research productivity, thereby fostering a positive association with behavioral intention [17], [18]. Also, ICT simplifies complex tasks by automating processes and providing real-time solutions, which further enhances students' intention to adopt these tools [19]. These findings are reinforced on ICT adoption among Filipino teachers, where performance expectancy emerged as a critical factor shaping intention [20]. Institutions should prioritize showcasing the tangible academic benefits of ICT tools, such as improved learning efficiency, greater engagement, and better outcomes, through success stories and case studies [16], [21]. Thus, it can be hypothesized:

H1: Performance expectancy significantly influences students' behavioral intention to use ICT in education.

3.2. Effort Expectancy

It refers to the level of simplicity involved in utilising a technology [9]. The construct is rooted in the ICT adoption in education, EE encapsulates students' perceptions of the simplicity and user-friendliness of ICT tools and resources. The easier students perceive the technology, they are more likely to develop a positive intention to adopt and utilize it in their academic endeavors [22].

Theoretical frameworks, such as the UTAUT, suggest that EE influences behavioral intention by reducing the mental and manual exertion needed to use technology. If students perceive ICT as requiring minimal technical knowledge or extensive training, they are more likely to develop confidence and enthusiasm toward adopting the technology.

This aligns with the cognitive load theory, which posits that reducing the perceived complexity of tasks enhances user engagement and motivation.

Empirical studies substantiate this theoretical relationship. For example, it is demonstrated that EE significantly influenced the adoption of learning management systems (LMS) in a management course, emphasizing that students were more inclined to use these systems when they perceived them as easy to operate [17]. Similar results are found in the study of LMS in the Kingdom of Saudi Arabia (KSA), where ease of use positively impacted students' behavioral intentions [21]. This construct is further validated in research on Filipino teachers' ICT adoption, showing that EE played a critical role in shaping intention by addressing perceived technological barriers [20]. In the context of online classes [16], students in less-developed countries exhibited a strong preference for tools with intuitive interfaces and straightforward functionality, underscoring the importance of EE in driving ICT adoption. Institutions should provide ongoing technical support to alleviate any apprehensions related to using ICT tools, thereby reinforcing positive perceptions of ease of use [21]. Therefore, it can be hypothesized that:

H2: Effort expectancy significantly influences students' behavioral intention to use ICT in education.

3.3. Social Influence

As defined in UTAUT, it describes how much people perceive those important others, i.e., peers, friends, teachers, or family members, believe they should employ a particular technique [9]. In educational settings, social influence is particularly significant because students often rely on guidance, encouragement, and the behavior of peers and authority figures to shape their attitudes toward new technologies. This aligns with theories of social norms and conformity, such as the Theory of Planned Behavior (TPB) that posits social pressures influence behavioral intention [13], [14].

In the context of ICT adoption, students' decisions to use technology are often reinforced by the expectations of influential groups or individuals. For instance, when teachers actively integrate ICT tools into their teaching and emphasize their importance, students feel that these applications are essential for academic success. Similarly, peer usage can create a sense of normative pressure, encouraging students to adopt ICT tools to align with group behavior.

Empirical evidence on this theoretical relationship [21] demonstrated that social influence substantially affects students' intention in Saudi tertiary institutions, highlighting the critical role of teacher and peer encouragement.

Similarly, social influence was an essential factor of behavioral intention in their study of lecture capture systems, emphasizing the importance of institutional support and peer recommendations [17]. The survey of tertiary mathematics education in Ghana [15] confirmed that students were more likely to adopt ICT when their teachers and peers actively promoted its use. Additionally, in developing countries, the perceived social endorsement of ICT tools by educators and peers played a vital role in shaping students' behavioral intention to engage with online teaching-learning [16]. For enhancing the impact of social influence on ICT adoption, institutions should foster a supportive environment where teachers and peers actively advocate for the use of ICT tools. Thus, it can be hypothesized:

H3: Social influence significantly influences students' behavioral intention to use ICT in education.

3.4. Facilitating Conditions

This describes how much an individual feels that the required resources, infrastructure, and support are accessible to enable technology use [9]. FC directly influences Behavioral Intention (BI) by shaping perceptions of ease and feasibility regarding the adoption of ICT tools. Furthermore, FC also influences Usage Behavior (UB) by ensuring that external barriers, such as technical issues or lack of institutional support, are minimized or eliminated. Theoretically, the relationship between FC and BI is rooted in the Theory of Planned Behavior (TPB) that posits resources and opportunities significantly impacts the intention to perform a behavior [13]. Similarly, the connection between FC and UB emphasizing the role of organizational and technical competences in enabling behavior. For students, factors such as reliable internet connectivity, availability of ICT devices, and access to technical support directly affect together intention and actual engagement with these tools.

The availability of supportive infrastructure, such as user-friendly e-learning systems and technical assistance, significantly influenced students' intention to adopt ICT tools [16]. Similarly, FC was a strong predictor of behavioral intention among tertiary students using learning management systems, underscoring the importance of institutional readiness in driving ICT adoption [21]. Further, FC impacted intention as well as directly influenced students' real use of lecture capture systems, highlighting the dual role of this construct [17]. Moreover, the role of FC in pre-tertiary mathematics education found that the approach of adequate resources and access to educational software, facilitated both the intention to adopt and the actual use of ICT [15]. These findings collectively affirm that facilitating conditions are a significant enabler of both intention and actual usage in educational settings. Educational institutions can significantly enhance ICT adoption and utilization among students by addressing facilitating conditions comprehensively. Hence, it is hypothesized:

H4a: Facilitating conditions significantly influence students' behavioral intention to use ICT in education.

H4b: Facilitating conditions significantly influence students' ICT usage behavior in education.

3.5. Trust

Trust, in the context of ICT adoption, denotes the assurance people possess in the reliability, security, and adequacy of technology to meet their needs without undue risk [10]. The integration of trust as a variable in the modified UTAUT model is both theoretically and practically significant, particularly in education where concerns about data privacy, security, and system reliability are paramount [11], [23]. Trust has a dual impact: It shapes behavioral intention by influencing perceptions of safety and reliability, and it directly affects usage behavior by fostering confidence in the consistent performance of ICT tools [24], [25]. This dual influence makes trust a critical factor for understanding students' engagement with ICT in education.

Trust reduces uncertainty and enhances user confidence, thereby strengthening behavioral intention to use ICT [26]. When students trust that ICT tools are secure and reliable, they form an optimistic outlook about their adoption and integrate them into their learning routines [27]. Furthermore, trust directly influences usage behavior by alleviating apprehensions about the consistency and functionality of ICT, enabling smoother adoption and sustained engagement [28]. Trust significantly impacted the intention of aged people to adopt healthcare technologies, emphasizing its role across diverse user groups [10]. In an educational context, trust in the reliability of e-learning systems is identified as a strong influencer of intention to use these platforms, particularly in developing countries [16]. Similarly, trust is a key predictor of the acceptance of chatbot-based educational tools, as it is linked to both intention and actual use [25].

The importance of trust in a study on FinTech adoption in banking illustrates its relevance across technologically mediated services, including education [24]. Regular technical support, user-friendly designs, and demonstrable reliability of ICT systems can further enhance trust and encourage usage [10], [11].

These results underline the necessity of trust in fostering both the intention to use ICT and the sustained usage behavior among students. Trust reduces uncertainty and enhances confidence in technology, serving as a pivotal enabler of ICT adoption in education, bridging the gap between intention and action while promoting long-term engagement. Therefore, it can be hypothesized that:

H5a: Trust significantly influences students' behavioral intention to use ICT in education.

H5b: Trust significantly influences students' ICT usage behavior in education.

3.6. Behavioral Intention

Behavioral intention (BI) is a fundamental determinant in the UTAUT, directly linked to actual usage behavior (UB) of technology [9]. BI represents an individual's motivational factors and conscious plan to accomplish a specific task, which is the immediate antecedent of action [13]. In the context of ICT adoption in education, BI reflects the extent to which individuals plan to utilise ICT tools for learning, which ultimately translates into their actual usage behavior.

The theoretical foundation for this relationship lies in the logical progression from intention to behavior [29]. When students form a strong intention to use ICT, influenced by perceived usefulness, ease of use, or social factors, they are more likely to act on that intention and incorporate ICT into their academic routines. For instance, students plan to use learning management systems (LMS) or educational software because they perceive these tools as valuable and engage with these technologies consistently [21].

A substantial positive relationship was found between BI and UB in the context of LMS in Saudi tertiary institutions [21]. Similarly, this relationship in e-learning systems in developing countries, emphasizing that students' intent to use these systems reliably predicted their actual engagement [16]. The study on lecture capture systems also highlighted that students' behavioral intentions significantly influenced their adoption and sustained use of such tools [17]. More recently, this linkage in the context of ICT adoption in pre-tertiary mathematics education, where behavioral intention emerged as a decisive factor in shaping actual usage behavior [15]. Aligning ICT tools with students' academic goals and addressing barriers such as lack of confidence or access to resources can further bolster this intention-behavior link. Therefore, it can be hypothesized that:

H6: Behavioral intention significantly influences students' ICT usage behavior in education.

3.7. Moderating Role of Gender

In UTAUT, gender is identified as a critical demographic factor that moderates the association among main predictors (effort expectancy, performance expectancy, facilitating conditions, social influence, and an extended predictor such as trust) and behavioral intention to use technology [9]. Gender differences stem from variations in socialization, cognitive styles, and attitudes toward technology, which influence how individuals perceive and interact with ICT tools in education. Theoretical underpinnings suggest that females and males vary in their expectations and experiences with technology. For instance, men are generally more influenced by performance expectancy, as they tend to focus on the utility and productivity aspects of technology, while women are more influenced by effort expectancy and social influence, prioritizing ease of use and social acceptance [21], [30]. Additionally, women may rely more on facilitating conditions due to perceived lower self-efficacy in technology usage, making organizational and technical support more critical for their adoption decisions [20].

The moderating role of gender extends to newer constructs like trust, as women are often more sensitive to privacy and security concerns in digital environments. Studies have shown that women tend to place greater emphasis on trust when adopting new technologies, highlighting their preference for secure and reliable ICT systems [24]. This divergence underscores the importance of tailoring ICT adoption strategies to address gender-specific needs and concerns. Studies demonstrated significant gender differences in the adoption of e-learning systems, with men being more driven by performance expectancy and women placing greater importance on effort expectancy [16]. Similarly, the social influence was a better predictor of behavioral intention among females, aligning with their higher sensitivity to peer and instructor encouragement [21]. The facilitating conditions had a more substantial influence on women's intention to adopt ICT, reflecting their reliance on external support mechanisms [20]. Furthermore, gender differences in technology trust, with women displaying higher skepticism toward ICT systems, which directly influences their behavioral intention [30]. Therefore, it can be hypothesized that:

H7: Gender significantly moderates the effect of all extended UTAUT constructs on the intention to adopt ICT in education.

4. Research Methodology

A consistent methodology ensures rigorous testing of extended UTAUT constructs, allowing researchers to capture nuanced relationships and variations among demographic groups. To validate the proposed hypotheses, a structured approach to data collection and analysis is essential. By examining the interactions between behavioral intention and ICT usage behavior and assessing the moderating role of gender, the study seeks to uncover critical insights into the dynamics of ICT adoption in education.

4.1. Research Design

Quantitative research design is utilized to verify the hypotheses under study. It applies the extended UTAUT model [9], [31], which provides a useful framework for comprehending the intricate determinants affecting ICT adoption in higher education. The model predicts the students' performance expectancy, effort expectancy, social influence, facilitating conditions, and trust toward their ICT acceptance and use for teaching-learning.

4.2. Research Instrument and Measure

Current research ascertains that ICT tools are helpful and easy to use. Also, academic organizations should generate a more social, facilitating, and trustworthy infrastructure for their acceptance, leading to a more engaging learning environment. For this purpose, a questionnaire is adapted from the scholarly UTAUT research articles [9], [31], [32], [33], [34], [35], [36]. The questionnaire comprises two parts. The first part covers the personal profile of the respondents. The second part comprises 18 ICT-based items, employing a 5-point Likert scale (1: strongly disagree to 5: strongly agree) across all items.

4.3. Sampling Technique and Participants

The convenience sampling method is used for better accessibility and availability of quality data in a given timeframe [37]. The research sample consisted of undergraduate students registered in the business studies department at one of the leading government universities in Oman. Among the survey respondents (N=248), the females and males were found to be proportioned 145 (58.47%) and 103 (41.53%), respectively. The distribution shows most respondents were at Diploma 158 (63.71%), followed by those at Advanced Diploma level 52 (20.97%), and finally, those at Bachelor level 38 (15.32%) in the undergraduate program (Table 1).

*Table 1. Gender * year crosstabulation*

	Academic Level			Total	Percent
	Diploma	Ad. Diploma	Bachelor		
Female	99	26	20	145	58.47%
Male	59	26	18	103	41.53%
Total	158	52	38	248	
Percent	63.71%	20.97%	15.32%		

4.4. Data Collection and Processing

The survey was created utilising Google Forms and circulated via the university's student group email. The received statistics included some of the missing data. Therefore, after a careful inspection, 248 valid responses were taken for analysis, which is an average sample size to study the UTAUT model [38]. The primary data were examined with IBM SPSS Statistics 26. The factor analysis of the collected data revealed that factor loading scores were more than 0.6, which showed improved reliability and validity indices [39]. Based on these scores, 18 items and seven factors were extracted, with 2-3 items for each factor. Regression analysis used these latent variables (factors) to test the underlying hypothesis.

5. Data Analysis and Results

Running factor analysis on IBM SPSS Statistics (V26) extracted seven factors using principal component analysis (PCA). PCA is a data-reducing tool that transforms a large number of observed variables into a smaller set of latent variables, which represent them [40]. First, the common method bias (CMB) issue was tested using Harman's One-Factor Test. The total variance explained was 30.15%, which is less than the 50% threshold, implying no problem with CMB. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of Sphericity were used to assess the factorability of the data (Table 2). The resulting KMO statistic value was 0.848, and Bartlett's test result was also appropriate at $p < .05$, signifying that the collected data were suitable for further investigation and an acceptable correlation among the items [41].

Table 2. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.848
Bartlett's Test of Sphericity	Approx. Chi-Square	1738.344
	df	153
	Sig.	.000

The first extracted factor was Facilitating Conditions (FC), with an eigenvalue of 2.545, comprising three items and accounting for 14.136% of the total variance. The second factor, with three items labelled Trust (TR), explains a variance of 12.746% with an eigenvalue of 2.294. Behavioural Intention (BI) was the third factor, comprising three items, and explained 10.677% variance and eigenvalue of 1.922. The fourth factor, Social Influence (SI), has three items having a 1.898 eigenvalue along with 10.547% variance. The fifth factor, Performance Expectancy (PE), explains 8.608% variance, includes two items, and has 1.549 eigenvalue. With two items, the sixth factor, Use Behaviour (UB), explains 8.502% of the variance and 1.530 eigenvalue. The last, the Effort Expectancy (EE) factor with 1.456 eigenvalue, 8.091% of the variance, also has two items (Table 3). The theoretical model comprises seven factors with 18 items and 73.306% of the total variance explained.

Table 3. Total variance explained

Component	Item	Rotation Sums of Squared Loadings		
		Total	% of Var	Cum %
Facilitating Conditions	3	2.545	14.136	14.136
Trust	3	2.294	12.746	26.882
Behavioural Intention	3	1.922	10.677	37.559
Social Influence	3	1.898	10.547	48.106
Performance Expectancy	2	1.549	8.608	56.714
Use Behaviour	2	1.530	8.502	65.216
Effort Expectancy	2	1.456	8.091	73.306

**Extraction Method: Principal Component Analysis*

Varimax with Kaiser Normalization factor rotation method was applied to optimize the number of items on each factor with high cross-loadings. The rotated component matrix depicted that, seven components (factors) with 18 items were extracted with loading values of more than 0.6 (Table 4).

Table 4. Rotated component matrix[a]

Factors	Items	1	2	3	4	5	6	7
Facilitating Conditions	FC1	.884						
	FC2	.858						
	FC3	.838						
Trust	TR2		.861					
	TR1		.776					
	TR3		.615					
Behavioural Intention	BI2			.759				
	BI1			.686				
	BI3			.674				
Social Influence	SI2				.764			
	SI1				.750			
	SI3				.612			
Performance Expectancy	PE1					.803		
	PE2					.662		
Use Behaviour	UB2						.792	
	UB1						.784	
Effort Expectancy	EE1							.844
	EE2							.728

**Extraction Method: Principal Component Analysis*
Rotation Method: Varimax with Kaiser Normalization
a. Rotation converged in 7 iterations

The adequate threshold value for Cronbach's alpha (α) ≥ 0.6 was achieved to test the instrument's accuracy. The internal consistency was confirmed by calculating composite reliability (CR) ≥ 0.7. The convergent validity was established with average variance extracted (AVE) ≥ 0.5 [42]. All factors have Cronbach's alpha values ranging from 0.867 to 0.595, confirming survey's reliability. The CR values were from 0.895 to 0.765, which evidence the internal consistency in scale items. The convergent validity was also established, as all the AVE values were more than 0.5. Finally, the discriminant validity was evaluated by the square root of AVE, placed at the diagonal of Table 5. These values were more than the corresponding correlations across the constructs. Hence, it can be seen that the model does not have any severe reliability and validity concerns.

Table 5. Reliability and validity

	α	CR	AVE	FC	TR	BI	SI	PE	UB	EE
FC	.867	.895	.740	**.860**						
TR	.789	.799	.574	.117	**.758**					
BI	.666	.750	.500	.145*	.462**	**.707**				
SI	.754	.753	.507	.020	.618**	.459**	**.712**			
PE	.635	.701	.542	-.010	.409**	.492**	.484**	**.736**		
UB	.786	.766	.621	.517**	.298**	.368**	.227**	.251**	**.788**	
EE	.595	.765	.621	-.078	.337**	.353**	.334**	.324**	.183**	**.788**

PE: Performance Expectancy; EE: Effort Expectancy; SI: Social Influence; FC: Facilitating Conditions;
TR: Trust, BI: Behavioural Intention; UB: Usage Behaviour
**p < 0.05; **p < 0.01; ***p < 0.001; all other correlations are insignificant.*
Diagonal elements are square root of AVEs, and off-diagonal elements are correlations.

The model fit measures were evaluated by means of the Chi-square goodness of fit test (CMIN/DF), root mean square error of approximation (RMSEA), normed fit index (NFI), and comparative fit index (CFI). Table 6 shows that all indices are within the threshold ranges.

Table 6. Model fit measures

Measure	Estimate	Threshold	Interpretation
CMIN/DF	1.508	Between 1 and 3	Excellent
CFI	0.965	>0.95	Excellent
SRMR	0.048	<0.08	Excellent
RMSEA	0.045	<0.06	Excellent
PClose	0.701	>0.05	Excellent

The subsequent stage was to verify the hypothesized relationships using regression analysis. Following the UTAUT research [9], [31], the relationships among five exogenous variables: PE, EE, SI, FC, and TR, the two endogenous variables, BI and UB, and one moderator, Gender (G), were examined.

The results of the theoretical model with the direct effects only model and the full model, including the moderating influences for both BI and UB, respectively, are shown in Table 7. The total variance explained (Adj. R2 x 100) for behavioural intention were 36.0% and 36.6% with direct only and moderated effects, respectively. For ICT usage behaviour, the explained variations were 36.1% and 36.5%, respectively.

Table 7. Results of the theoretical model

	DV: BI		DV: UB	
	D only	D+I	D only	D+I
R^2	.373	.392	.369	.381
Adj. R^2	.360	.366	.361	.365
PE	.297***	-.055		
EE	.157**	.184		
SI	.150*	.440		
FC	.137**	-.051	.467***	.407**
TR	.179**	.306	.133*	.372*
BI			.239***	-.002
PE x G		.697*		
EE x G		-.092		
SI x G		-.527		
FC x G		.295		.082
TR x G		-306		-.483
BI x G				.492

DV: Dependent Variable, D only: Direct effects only; D + I: Direct effects and interaction terms. ***p < 0.001; **p < 0.01; *p < 0.05.

6. Discussion and Implications

The findings suggest an interplay of factors influencing ICT adoption in higher education (Figure 1).

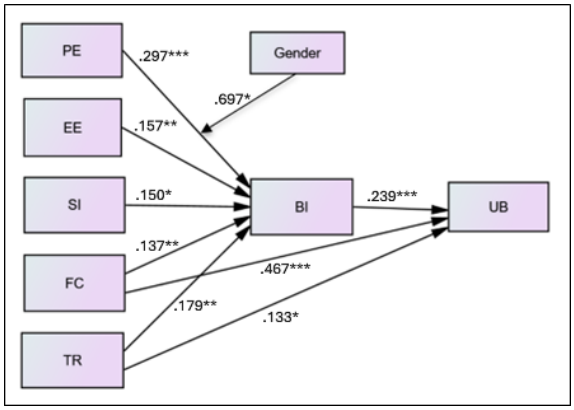

Figure 1. Path diagram

In the direct-only model, the impacts of performance expectancy ($\beta = .297$, $p < 0.001$), effort expectancy ($\beta = .157$, $p < 0.01$), and social influence ($\beta = .150$, $p < 0.05$) on behavioural intention to use ICT in education were found significant, confirming the hypotheses 1, 2, and 3. The facilitating conditions significantly influence both behavioural intention ($\beta = .137$, $p < 0.01$) and usage behaviour ($\beta = .467$, $p < 0.001$), accepting hypotheses 4a and 4b. The extended exogenous variable trust also significantly affects both endogenous variables, behavioural intention ($\beta = .179$, $p < 0.01$) and usage behaviour ($\beta = .133$, $p < 0.05$), supporting hypotheses 5a and 5b. Finally, hypothesis 6, behavioural intention influences users' ICT usage behaviour in education, was also significant ($\beta = .239$, $p < 0.001$). The full model, with direct effects and interaction terms, studies the moderation impact of gender between two variables. The results on gender differences indicate that gender only moderates the relation between performance expectancy and behavioural intention ($\beta = .697$, $p < 0.05$). It indicates that men are generally more focused on tasks compared to women [9].

6.1. Theoretical Implications

The extended UTAUT model is valuable for understanding information and communication technology adoption in education. Researchers can identify the elements affecting students' adoption of these technologies [25]. The results confirm the underlying hypotheses of the extended UTAUT model [9], [31]. When the moderator (gender) is not included in the analysis, the predictors of the extended UTAUT model performance expectancy, effort expectancy, social influence, facilitating conditions, and trust significantly influence the behavioural intention to use ICT in education.

Similarly, facilitating conditions, trust, and behavioural intention significantly influence ICT usage behaviour in education without a moderator [15], [36], [43], [44]. The outcomes also validate the moderating impact by examining the interaction effects of gender with all significant predictors. The results show that performance expectancy is more robust for men when predicting behavioural intention [45], [46]. The effects of gender interaction were insignificant in other relationships, as confirmed by the inconsistent results of multiple studies [31], [32], [34]. These studies also indicate that the higher-order interaction effects (age x gender x experience) were more significant than the lower-order interactions.

6.2. Practical Implications

ICT is becoming increasingly popular among educational institutions, especially after the pandemic [47], [48]. Education institutes worldwide have implemented a blended education system for an effective and efficient teaching-learning experience, further strengthening the need for a technology-based education system [49]. By embracing ICT adoption in education, institutions can cultivate a more engaging and responsive learning atmosphere that equips students for future challenges [50]. ICT-supportive environments, such as resource access, awareness campaigns, reward systems, and community building, can help teachers and students experiment with new technologies and explore their potential benefits. Familiarity with critical predictors such as performance expectancy, effort expectancy, social influence, facilitating conditions, and trust can help educational institutions develop effective strategies and promote the use of ICT in education. Therefore, policymakers and educators should prioritize the incorporation of ICT in education and leverage the insights provided by the UTAUT model to facilitate successful adoption.

7. Conclusion

Information and communication technology (ICT) will remain integral to the present and future because it is linked to constantly evolving parts of human lives. It facilitates the quick communication of information between students and teachers, helps academic institutions promote digital culture professionally, and successfully serves the community to enhance social life. ICT can encourage high interactivity between learners and instructors using educational applications, digital teaching platforms, simulators, and smart classes. ICT can enhance mental skills, including self-learning, self-assessment, initiative, innovativeness, and entrepreneurship, positively impacting students' motivation and performance.

However, ICT has not produced the significant educational revolutions many predicted. There is a need to know the importance of ICT in achieving quality teaching and facilitating stakeholders. The success of accomplishing ICT is contingent on teachers' and students' acceptance and use. Therefore, this study emphasises the relevance of ICT in general and its impact on education in particular. Using the extended UTAUT model, it investigates the effect of contributing variables on behaviour intention and the use of ICT in education. The framework highlights the importance of these variables in enhancing the use of ICT tools, which is essential to promote ICT adoption in education. Increased ICT adoption in education can improve learning outcomes, enhance student engagement, and prepare students for the digital world.

Although the results of this study make a significant contribution to the field, they also have limitations that open avenues for future research. The dependent variable, Use Behaviour, was not directly measured in the survey; instead, it relied on the self-reported intensity of actual use. The sample type only permits gender as a moderator, excluding age and experience. Some of the items from the survey were omitted because of low factor loading. The model is only able to explain less than 40% of variations for both intention and use of ICT. Finally, the study was conducted in one of the government universities in Oman, which has a rapidly changing ICT infrastructure. Therefore, the study's results may not be applicable to other educational institutes and nations.

The future of ICT is promising, with the potential for further technological innovations and developments. As society continues to rely more heavily on technology, the role of ICT in shaping the future will only become more significant. ICT has already demonstrated the ability to transform the education sector, and this trend is expected to continue. While the extended UTAUT model provides a robust framework, future studies could explore the influence of other constructs, such as emotional factors, institutional policies, personality traits, technology self-efficacy, privacy, security, personal innovativeness, information quality, etc. Including certain variables could enhance the prediction of ICT adoption. Future research should also continue investigating the lower to higher-order interacting effects of age, experience, and cultural differences, which were missing in the current research. To further strengthen ICT integration in educational settings, studies are needed for inclusive research with emerging ICT infrastructure, diverse groups, varied timeframes, and different methodologies to confirm the results.

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