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# Integrating Human-Centered AI into the Technology Acceptance Model: Understanding AI-Chatbot Adoption in Higher Education

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**Abstract.** Artificial intelligence (AI) is transforming education by enhancing assessments, personalizing learning, and improving administrative efficiency. However, the adoption of AI-powered chatbots in higher education remains limited, primarily due to concerns about trust, transparency, explainability, perceived control, and alignment with human values. While the Technology Acceptance Model (TAM) is commonly used to explain technology adoption, it does not fully address the challenges posed by AI systems, which require human-centered safeguards. To address this gap, this study extends TAM by incorporating Human-Centered AI (HCAI) principles—explainability, transparency, trust, and perceived control—resulting in the HCAI-TAM framework. An empirical study with 300 respondents was conducted using a structured English questionnaire, and regression analysis was applied to assess the relationships among variables. The model explained 65% ($R^2$ = 0.65) of the variance in behavioral intention and 55% ($R^2$ = 0.55) in usage behavior. The findings highlight that integrating HCAI principles into TAM enhances user adoption of AI chatbots in higher education, contributing both theoretically and practically.

**Keywords**: Human-Centered AI, Technology Acceptance Model, Higher Education, Artificial Intelligence, AI-Chatbots

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## 1. INTRODUCTION

Artificial Intelligence (AI) has the potential to revolutionize education by providing personalized learning experiences, automating administrative tasks, and offering instant support through AI-powered chatbots. However, despite these advancements, many AI tools in education remain underutilized due to concerns about trust, transparency, explainability, and user control. These challenges underscore the need for human-centered frameworks that ensure AI systems are not only ethical and transparent but also aligned with the needs of students and educators. Human-Centered Artificial Intelligence (HCAI) is an emerging field that integrates principles from human-computer interaction (HCI) and AI to develop systems that prioritize human values, ethical considerations, and user-friendly design [1]. Unlike traditional approaches, which focus on technical performance, HCAI represents a paradigm shift by promoting human skills, trust, and ethical engagement between humans and AI technologies [2].

Previous research has often been compartmentalized, with HCI focusing on usability, accessibility, and human factors in interfaces, while AI research has prioritized complex algorithms with less attention to user experience [3]. Although AI applications have been developed in various sectors such as healthcare [4], banking [5], and daily life, concerns about opacity, lack of interpretability, and biases persist [6]. These challenges highlight the need for a holistic approach to AI that integrates ethical and trustworthy AI principles with an emphasis on user experience and transparency. Despite the importance of these concerns, few studies have fully explored the integration of Human-Centered AI into the design of educational technologies, especially in the context of AI chatbots for higher education.

As argued by [7], there is a need to integrate findings from both HCI and AI to create Human-Centered AI. This study bridges that gap by integrating HCI principles into AI design and development, focusing on usability and ethics. The goal is to develop AI systems that are not only effective in their technical capacity but also aligned with human values and needs. To achieve this, we propose a framework that combines Human-Centered AI principles with the Technology Acceptance Model (TAM), a widely used model for understanding technology adoption. By integrating these two frameworks, this study aims to improve our understanding of user adoption of AI-powered chatbots in higher

education. This work is designed to provide actionable insights for researchers, designers, and policymakers looking to enhance the responsible use of AI technologies in educational settings.

The gap in existing knowledge regarding the influence of Human-Centered AI principles on AI adoption in higher education prompts this study. This study formulates the following research objectives and questions to guide the investigation: The Research Objectives as follow.

1) To examine the influence of Human-Cantered AI (HCAI) on user adoption of AI-powered chatbots in higher education.
2) To explore the collective effect of perceived usefulness, perceived ease of use, and trust on the behavioural intention to adopt AI-powered chatbots in higher education.

Research Questions as follow.

1) How do Human-Cantered AI (HCAI) principles influence user adoption of AI chatbots in higher education?
2) How do perceived usefulness, perceived ease of use, and trust collectively influence behavioural intention to adopt AI chatbots in higher education?

By addressing these objectives and questions, this research aims to contribute to the theoretical understanding of AI adoption and provide practical insights for enhancing AI chatbot deployment in educational environments.

## 2. RELATED WORKS

Human-Computer Interaction (HCI) is the study of human-to-technology communication aimed at designing better interfaces that make technology more intuitive, efficient and user-friendly [8]. HCI enables humans to understand and interact with technology and through technology by providing effective means of communication [9]. In recent years, the field of human-computer interaction has matured and researchers have devoted their efforts to comprehending how people engage with technology. Over time, HCI has evolved from focusing on cognitive modeling and usability to prioritizing user-centered design, inclusive accessibility and emotional engagement. This field has emerged and

achieved success in both computer science and the disciplines of psychology and cognitive sciences [10]. HCI is also making contributions to other fields such as ergonomics, sociology, business and graphic design. The application of HCI principles has ensured that products are accessible and usable to all users, including those with disabilities and impairments. [11] highlighted that the core purpose of HCI is to understand human cognitive processes to create interactive systems that are intuitive, efficient and pleasurable. Previous studies in HCI [12] revealed how emerging constructs such as cultural adaptation and emotional connection are currently influencing the design of interfaces that extend beyond basic functionality.

Human-computer interaction (HCI) and artificial intelligence frequently intersect under the umbrella of many technologies in a wide range of application areas, making it crucial to recognize and understand the precise functions of both fields. [1] explored how traditional HCI design principles can be used to create ethical AI systems. Their comprehensive review emphasizes iterative design approaches, interdisciplinary collaboration and a balance between human supervision and automation, particularly in areas such as healthcare, education and entertainment. They emphasize pathways toward human-centered AI designs that foster trust and reduce bias by grounding them in usability and ethical principles. One fundamental idea of HCAI is that by putting people first, AI systems can be developed that are more trustworthy, inclusive and in line with human values and objectives [13]. Researchers from a range of fields have tried to define HCAI from their own points of view, introducing a number of definitions that highlight their differences and similarities. [14] contends that rather than automating human capabilities and experiences, HCAI should concentrate on creating AI systems that augment them. [15] argues that human-centered AI is a collaborative strategy to match AI solutions with moral standards, legal requirements and human values in order to guarantee safety and security and enable reliable AI. Three key elements make up Human-Centered AI, according to [16] : (1) ethically aligned design, which produces AI solutions that do not discriminate, uphold justice and fairness, and do not replace humans; (2) technology that fully reflects human intelligence, which further develops AI technology to reflect the depth characterized by human intelligence (more like human intelligence); and (3) human factors design, which makes sure AI solutions are understandable, explainable, practical and usable.

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Human-Centered AI (HCAI) principles are foundational in the design of AI-powered chatbot technologies in education to ensure that these technologies align with human values and foster user acceptance. Transparency refers to the extent to which the operations and decision-making processes of AI systems are visible and understandable to users, which is critical in educational environments where opaque decisions can undermine user confidence and compromise user security [6]. Transparency fosters accountability by allowing users and stakeholders to scrutinize how AI systems arrive at their outputs, thereby facilitating informed decision-making and ethical oversight in education [12].

Explainability complements transparency by providing users with clear, comprehensible explanations of AI system outputs, enabling them to interpret and evaluate recommendations made by the system [11]. In education, explainability is essential for students to understand AI-generated decisions, promoting shared decision-making and safeguarding student autonomy [15]. A lack of explainability may lead to resistance among students, as they may be hesitant to rely on systems whose reasoning cannot be interrogated or justified [17].

Trust is a critical determinant of user acceptance of AI-powered chatbots, as users are more likely to adopt and rely on technologies they perceive as reliable, ethical and aligned with their interests [18]. Trust in AI systems in education is shaped by factors such as system transparency, explainability, reliability and the perceived competence of the AI in educational settings [19]. Establishing trust requires that users believe the AI system will function as intended without causing harm, while also respecting the users' needs and expectations [18].

Perceived control pertains to the extent to which users feel they can influence, adjust or override the decisions made by AI systems, thereby maintaining human agency in decision-making processes [13]. In education, perceived control is vital to ensure that AI augments rather than replaces human expertise, allowing users to retain ultimate authority over educational decisions while leveraging AI for support [20]. A high sense of perceived control enhances user confidence in using AI systems and mitigates concerns related to automation bias and over-reliance on technology [19]. Collectively, these HCAI

principles are crucial for designing AI-powered chatbots that are ethically responsible, user-centered and likely to be trusted and adopted in educational settings.

AI-Chatbots are an important invention in educational technology system especially within the academic settings. AI-Chatbots use in higher education offer transformative opportunities by enhancing student service, teaching, learning and administrative efficiency as well as streamlining operational workflows within education settings [21]. These Chatbots are so helpful to as they provide real-time tutoring and personalized feedback to students thereby improving their academic performance and learning experience [22]. The potential of AI-Chatbots to provide personalized feedback and support makes them a very important resource for learners, allowing for a more interactive educational environment. The use of AI-enabled tools has the potential to streamline the academic process, providing learners with efficient ways of gathering and analyzing information. This can lead to better academic results through a more effective and engaging learning experience. [23] reported that AI-Chatbots can enhance students' research skills since they can assist with information retrieval and academic writing. Machine learning and deep learning models play very important roles in supporting AI-Chatbots to learn from past data and interactions thereby improving their responsiveness over time [24]. Additionally, AI-driven predictive analytics help in the forecasting of student behavior, learning patterns and academic trends [25]. Despite these opportunities, adoption challenges persist due to issues related to the opacity of AI decision-making, concerns over data privacy, potential algorithmic biases and limited explainability [26]. These concerns contribute to user hesitancy, as trust in AI-Chatbots is undermined when students and educators are unable to interpret or contest decisions impacting their academic support processes and learning outcomes [18]. [27] argued that for the ethical and successful integration of AI-Chatbots in education, there is need for a good and clear understanding of their efficacy and acceptability. Moreover, ethical and regulatory uncertainties further complicate widespread implementation, necessitating the integration of human-centered design principles to address transparency, explainability and fairness [13]. Addressing these adoption challenges is critical to realizing the full potential of AI-powered Chatbot systems while ensuring that such technologies align with human values.

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To cater to the distinctive requirement of our research context, we extend the traditional TAM by incorporating four human-centered AI principles which are explainability, transparency, trust and perceived control. The integration of Human-Centered AI (HCAI) principles into the Technology Acceptance Model (TAM) is essential for understanding user adoption of AI-powered chatbots in educations, as these systems often operate within contexts where decisions significantly affect security of users [26]. Conventional TAM primarily focuses on perceived usefulness and perceived ease of use as predictors of adoption [28], but it does not fully capture the socio-technical complexities inherent in AI-powered systems, particularly regarding explainability, transparency, trust and perceived control. Explainability and transparency address the opacity often associated with AI decision-making processes, enabling users to understand and interpret system outputs in educational settings where comprehension of all processes is critical [6]. By incorporating explainability and transparency as antecedents within TAM, users' cognitive evaluations of system usefulness and ease of use can be more accurately captured, reflecting their need for comprehensible and interpretable AI interactions in high-stakes environments [19].

Furthermore, trust and perceived control are critical to fostering a positive user disposition towards adopting AI-powered chatbot systems. Trust mediates the relationship between system design and user acceptance, as users are unlikely to engage with or rely on systems they perceive as unreliable or misaligned with their interests, regardless of technical efficacy [18]. Perceived control, closely linked to human agency, reflects the degree to which users feel they can influence or override AI decisions, thereby preserving their autonomy in educational decision-making [13]. Integrating these principles into TAM not only enhances its explanatory power in the context of AI adoption but also aligns with ethical imperatives of human-centered design [7]. This enriched framework acknowledges that for AI-powered chatbots in education to be meaningfully adopted, users must perceive the systems as transparent, explainable, trustworthy and controllable, thereby ensuring alignment with human values and the realities of educational practice.

## 3. METHODS

### 3.1. Theoretical Framework

Instead of using other models like TAM2, TAM3, or UTAUT (Unified Theory of Acceptance and Use of Technology), we have decided to use the Technology Acceptance Model (TAM) as the foundational model in our study's theoretical framework. This decision is rooted in TAM's simplicity, adaptability and extensive validation across various contexts, aligning well with our focus on the unique interactive and innovative aspects of user adoption in AI-driven chatbots in education. Although more recent models such as the UTAUT incorporate a broader set of factors, TAM's forward-looking approach allows for a more focused analysis of the core determinants of technology use [27]. This choice is particularly pertinent to our study, which aims to understand the unique aspects of technology acceptance in the context of user adoption of AI-driven chatbots in education.

Study by [28] developed the first Technology Acceptance Model (TAM), which looks at the factors that influence technology use and offers a theoretical framework for comprehending user acceptance of information systems. According to TAM, the main factors influencing technology adoption are perceived usefulness (PU), which is the degree to which an individual believes that performing their job would be improved by using a specific system, and perceived ease of use (PEOU), which is the degree to which an individual believes that using a system would be effortless. The model posits that PEOU directly influences PU because user-friendly systems are more likely to be regarded as beneficial. Behavioral Intention to Use (BI) of the system is influenced by users' Attitude Toward Using (ATU) of the technology, which is influenced by both PU and PEOU. After behavioral intention, the acceptance process is completed by Actual System Use (AU). The significance of creating systems that users find useful is emphasized by TAM. As proposed by [28], the Technology Acceptance Model (TAM) is depicted in Fig. 1 below. It explains technology adoption by demonstrating the connections between perceived usefulness, perceived ease of use, attitude toward use, behavioral intention to use and actual system use.

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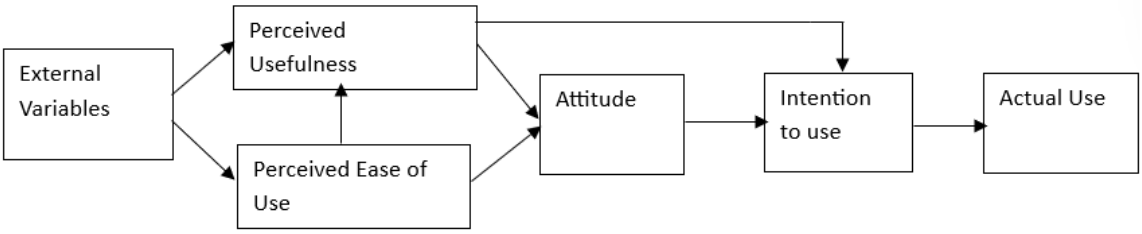


**Figure 1.** Technology Acceptance Model (TAM)[28]

### 3.2. Research Model and Hypotheses

The study was underpinned by a combination of TAM and human-centerd AI principles which include explainability, trust, transparency and perceived control. [29] explained these principles in detail. They highlighted that explainability concerns the ability to help users better understand the inner workings of an AI system by providing clear and understandable explanations for its decisions and actions. Trustworthiness is about instilling trust and confidence in users when interacting with an artificial intelligence system. They further revealed that transparency is about the openness and understanding of the procedures, algorithms, data sources and goals underlying AI systems whereas controllability is the ability of human users to influence, direct, and monitor the behavior and actions of AI systems. According to [28], the TAM model is the most widely used paradigm for analyzing users' attitudes toward technology and their intentions to use it. TAM offers a very thorough and detailed model for technology adoption and utilization, which makes it effective in understanding users' behavior when using computing technology. Consequently, we believed that TAM was the best model for this research, which focused on the adoption of AI-powered chatbots in education by individuals. The Technology Acceptance Model (TAM), which emphasizes perceived usefulness and perceived ease of use, has been widely used to explain user acceptance of new technologies [28]. Traditional TAM does not, however, adequately address the special difficulties that AI-powered chatbots in education bring, especially the opaqueness of AI decision-making processes and problems with explainability, trust, transparency and control [6]. In order to fill this knowledge gap, the study combined the Human-Centered AI principles of explainability, transparency, perceived control and trust with the Technology Acceptance Model to create the HCAI-TAM framework, which helps to understand how users adopt AI-powered chatbots. The research model for this study, which is based on the theoretical underpinnings and literature review, is displayed in Figure 2 below.

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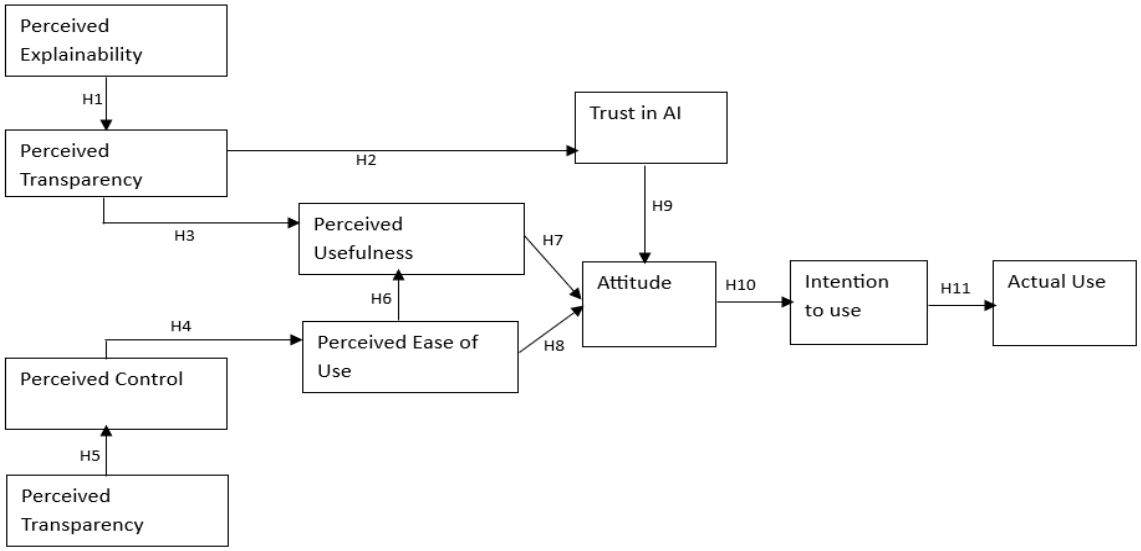


**Figure 2:** The Human-Centered AI- Technology Acceptance Model (HCAI-TAM)

1) Perceived Explainability

Study by [29] defined explainability as the capacity to provide users with intelligible and comprehensible explanations of an AI system's internal operations. Explainable AI aims to close this gap by providing insights into the process and motivations behind decision-making, in contrast to conventional "black-box" AI models that make predictions without providing clear explanations [27]. Understanding the elements that influence an AI model's output helps users build trust and make well-informed decisions.

2) Perceived Transparency

According to [29] transparency is the openness and insight regarding the procedures, algorithms, data sources and goals of AI systems. Transparent AI systems help users trust and validate the results by avoiding the "black box" issue. Transparency should be a top priority for AI systems, and they should give clear justifications for their choices. This encourages accountability by making it possible for users and clients to understand the logic underlying AI-generated transactions and decisions [30].

3) Perceived control

Controllability is the capacity of human users to direct, control and monitor the actions and behavior of AI systems [29]. Human judgment and decisions should take precedence over those of AI systems. Controllability in the educational

environment helps keep AI systems from making bad or inappropriate decisions and guarantees that humans still have final say over important decisions and tasks.

4) Trust in AI

Study by [29] defined trust as the capacity to instill confidence and dependability in human users of AI systems. When it comes to AI-powered chatbots, users are unlikely to accept decisions that they don't understand [31], but understandable explanations could improve trust and the capacity to establish a rapport with AI systems to align human decision-making [32].

5) Perceived usefulness

Perceived usefulness (PU) is the extent to which an individual thinks that utilizing a specific system would improve their performance at work [28].

6) Perceived ease of use

This refers to the degree to which a person thinks that utilizing a specific system would be effortless, which represents the limited resources people can devote to the tasks they are performing [28].

7) Attitude

According to Alsharif (2013), attitude is "the total emotional reaction to utilizing a system." In research that examined how one's attitude toward technology use affected their behavioral intention, [33] discovered that one's attitude toward technology use positively affected their behavioral intention.

8) Intention to use

This is defined as the extent to which an individual has thoughtfully planned whether or not to engage in a particular future behavior. Technology use is significantly influenced by behavioral intention, according to TAM [35]. This perspective is in line with earlier research findings that demonstrate how individual behavior is predictable and influenced by personal intention [32].

9) Actual use

Actual use describes how a person actually uses a system [28].

Based on the above arguments and knowledge, we tested the following hypotheses:

1) H1: Perceived explainability is positively related to perceived transparency
2) H2: Perceived transparency is positively related to trust in AI
3) H3: Perceived transparency is positively related to perceived usefulness
4) H4: Perceived control is positively related to perceived ease of use

5) H5: Perceived transparency is positively related to perceived control
6) H6: Perceived ease of use is positively related to perceived usefulness
7) H7: Perceived usefulness is positively related to attitude
8) H8: Perceived ease of use is positively related to attitude
9) H9: Trust in AI is positively related to attitude
10) H10: Attitude is positively related to intention to use
11) H11: Intention to use is positively related to actual use

### 3.3. Data and Measurement

The data collection was conducted in Zimbabwe, targeting users of AI-powered chatbots in education who have had the exposure to or currently use AI powered chatbots in educational settings. Zimbabwe was chosen for this study due to the fact that the country presents a relevant and timely setting for studying AI adoption in education because universities In Zimbabwe are Increasingly experimenting with AI-powered tools while still facing challenges with Infrastructure and digital literacy and this makes It possible to check variation In exposure and attitudes within a realistic adoption environment. The data was collected both through online distribution and via printed questionnaires in facilities where there was limited digital infrastructure. Participation was voluntary and informed consent was obtained from all the participants. This study used a structured research questionnaire in English to collect data from the targeted sample. The questionnaire was created and reviewed for content validity by a group of information systems academics. The questionnaire was made up of three sections, described as sections A to C. Section A included the demographic variables such as gender, age and educational level for the users. Section B covered the direct determinants within the proposed conceptual framework (HCAI-TAM constructs) and Section C covered the actual usage of AI-powered chatbots in education. The items were measured using a five-point Likert scale that ranged from 1 (strongly disagree) to 5 (strongly agree). Survey research was employed in this study since studies of technology acceptance have traditionally been conducted using survey research. The survey was pilot tested amongst a group of users. The pilot survey had 20 users who use AI-powered chatbots in education. The pilot test was done to refine clarity and reliability before full data collection. The group which participated in the survey was not included in the final data. Preliminary evidence showed that scales were reliable and valid. All the participants completed an initial version of the questionnaire and their assessments and comments

on the questionnaire helped to refine the questionnaire. The final sample size for this study was pegged at n=300 respondents. The collection of data was conducted between July and October 2025 from users of AI-powered chatbots in education from one (1) private university and one (1) public university in Zimbabwe. Two universities were purposively selected to ensure the sample included universities with different resource levels and IT infrastructures relevant to the research questions. Within the selected institutions, participants were then recruited using convenience sampling methods. To explore potential Influences on the responses, demographic characteristics that Include age, gender and university type were recorded.

### 3.4. Research Design and Justification

The study employed a survey research design combined with regression analysis to test the proposed HCAI-TAM framework. Regression analysis was conducted using IBM SPSS Statistics (version 28) to examine and study relationships amongst variables and to test the proposed framework integrating Human-Centered AI principles into the Technology Acceptance Model. Regression analysis was chosen instead of Structural Equation (SEM) or Partial Least Squares (PLS-SEM) due to two main Important reasons. Firstly, the study aimed primarily at exploring predictive relationships among a limited number of constructs rather than testing a highly complex model variable structure. Secondly, regression analysis provides a robust method for assessing predictive power of independent variables on dependent variables facilitating the analysis of how the model constructs influence users' intention to adopt AI-powered chatbots in education.

### 3.5. Reliability and Validity Testing

Cronbach's alpha was used to assess reliability for each construct and the constructs exceeded the acceptable threshold of 0.70. Construct validity was examined through factor loadings In exploratory factor analysis, thereby ensuring that all Items loaded significantly (>0.50) on their Intended outcomes.

### 3.6. Hypothesis Testing and Analysis

The HCAI-TAM framework developed in this study has eleven hypotheses and regression analysis was used to test all the eleven hypotheses derived from the model. This enabled an assessment of how each independent variable Influenced behavioral Intention and actual use of AI-powered chatbots in higher education.

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### 3.7. Research Design Workflow

This study followed a structured process where the first step was the model development. The model was developed by Integrating HCAI principles Into TAM together with the formulation of hypotheses. Questionnaire design and pilot testing was then done where the questionnaire was created, validated. Data collection was then done, where the questionnaires were administered online and In-person across the two universities. Data analysis was then done starting with reliability and validity tests followed by regression analysis to examine the relationships among constructs and test hypotheses. The results were then Interpreted through the assessment of the predictive power by looking at $R^2$ values and discussing the Implications for theory and practice. The research design diagram is displayed in Figure 3 below, where the stages are summarized showing the flow from model development to data collection and finally to Interpretation and Implications.

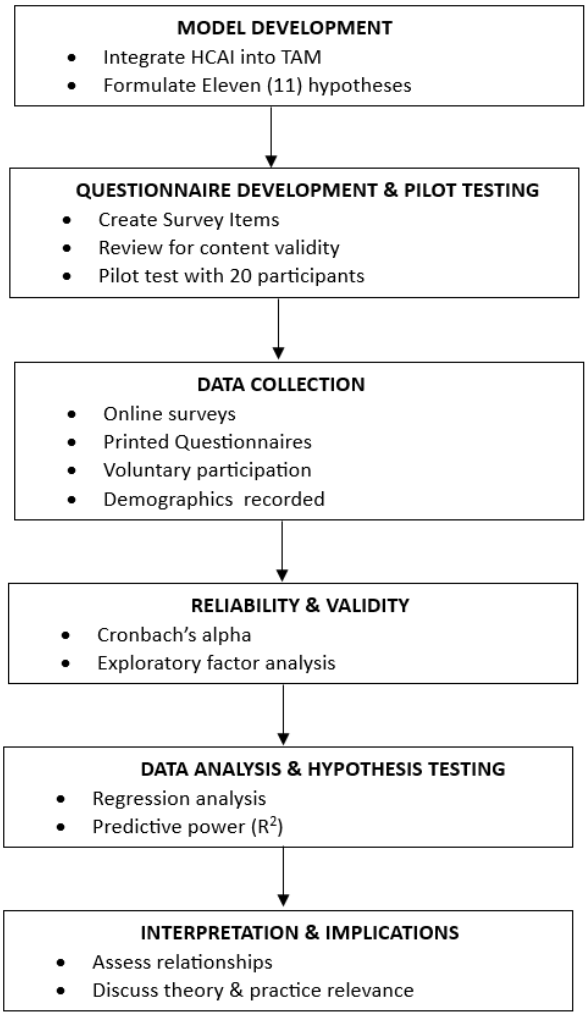


**Figure 3:** Research Design Workflow

## 4. RESULTS AND DISCUSSION

Regression analysis was employed to test the hypotheses, and the results are presented in Figure 3. This analysis provides insights into the relationships between the variables and highlights the strength and direction of these associations. The structural model results in Figure 3 visually summarize the key findings, offering a clear depiction of the model's overall performance and the significant paths that support the research hypotheses.

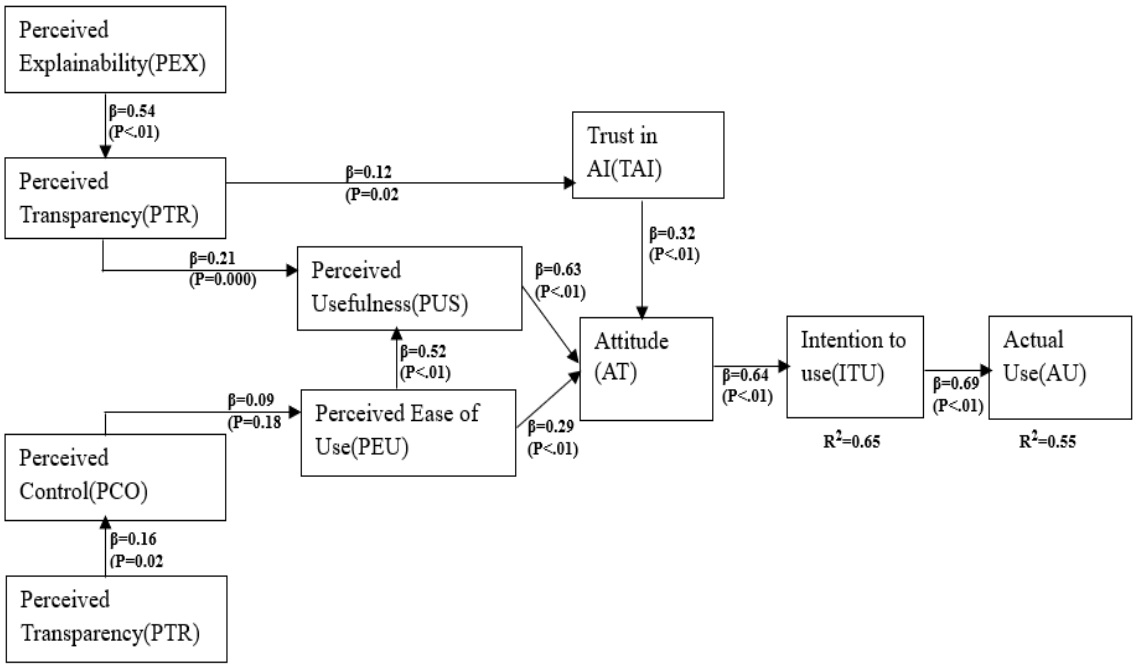


**Figure 3**. Structural model results

### 4.1. Influence of Human-Centered AI on user adoption

This subsection presents an analysis of the results pertaining to Research Question 1, which investigated the influence of Human-Centered AI on user adoption.

The model explains 65%, ($R^2$= 0.65) of variation in behavioral intention to use and 55%, ($R^2$= 0.55) in use behavior. The effect of perceived explainability (PEX) on perceived transparency (PTR) was found to be statistically significant with β =0.54, $p$<0.01, thus supporting **H1.** These findings reveal that students and educators who perceive the AI-chatbot as capable of explaining its decision processes also perceive the system as more

transparent. These results align with principles of human-centered AI, which state that explainable systems build user trust.

Perceived transparency (PTR) was found to have a positive influence on trust in AI (TAI) with β =0.12, $p$=0.02, thus supporting **H2.** The results demonstrate how crucial transparency is for AI-powered chatbots in education since it increases user confidence in those systems. The results support the argument that when students perceive the AI-Chatbot as transparent, that is when the system is providing clear and understandable information about its operations, they are more likely to trust the system. The findings also confirm that transparency reduces perceptions of hidden agendas or black-box behaviour. These findings align with human-centered AI principles which highlight that transparency Is a key driver of trust, and trust Is a key factor that Influences technology adoption.

There is a statistically positive influence of perceived transparency (PTR) on perceived usefulness (PUS) regarding the use of AI-powered chatbots with β =0.21, $p$=0.000, thus supporting **H3**. These findings reveal that when students and educators perceive the chatbot as transparent, providing very clear explanations of its processes and decision making, they are more likely to recognize its utility in accomplishing tasks. Leaners and educators in higher education can understand how the system works if it is transparent, and this increases their perception that the AI is reliable and effective for either learning or administrative purposes. This indicates that users believe more dependable results are produced by transparent systems.

The effect of perceived control (PCO) on perceived ease of use (PEU) was not found to be statistically significant with β =0.09, $p$=0.18 (>0.05), thus not supporting hypothesis **H4.** One reason for this non-significant relationship could be that most AI-powered chatbots use very simple Interfaces that in most cases require minimal user Intervention, therefore having more or less control does not meaningfully change their usability perception because they already perceive them as easy to use. The other reason could be that users do not think that controllability enhances perceived usability by lowering the anxiety that comes with using autonomous systems. With these results, It Is possible that other variables such as system guidance, Interface design or prior experienceenplay a central and key role In shaping perceptions of ease of use.

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The study concludes that there is a positive influence of perceived transparency (PRT) on perceived control (PCO) with β =0.16, $p$=0.02, supporting **H5.** These findings demonstrate that perceived transparency significantly affects perceived control in the adoption of A-powered chatbots. These findings support the idea that perceived transparency has a positive impact on perceived control since users feel more in control and predictable when they comprehend how the AI system operates. Transparency helps students and lecturers to understand the system, it reduces uncertainty and empowers them to make Informed choices, thereby Increasing their sense of agency over the system. These results align with human-centered AI values and principles which underscore transparency as a mechanism to strenthen user autonomy and confidence.

### 4.2. Effect of perceived usefulness, perceived ease of use and trust In AI on Behavioral Intention

This subsection presents and analyzes the results addressing Research Question 2, which examined how perceived usefulness, perceived ease of use and trust in AI influence behavioral intention to use AI-powered chatbots.

Perceived usefulness (PU) was found to be statistically significantly influenced by perceived ease of use (PEOU) with β =0.52, $p$<0.01, thus supporting hypothesis **H6.** The results demonstrate that perceived ease of use has a positive Influence on perceived usefulness in the adoption of AI-powered chatbots in higher education. These results Indicate that when learners find chatbot easy to traverse and Interact with, they are more likely to perceive It as useful in their learning processes. When the system Is easy to use, it reduces the effort and cognitive load thereby allowing users to concentrate more on the benefits of the system, which enhances their perception of Its utility. These results align with the Technology Acceptance Model (TAM), where ease of use Is an Important determinant of perceived usefulness which then affects technology acceptance.

The effect of perceived usefulness (PUS) on attitude (AT) towards using AI-powered chatbot systems was found to be statistically significant with β =0.63, $p$<0.01, supporting **H7.** These findings highlight that perceived usefulness has a strong positive Influence on users' attitude toward using AI-chatbots In higher education. This Indicates that when students perceive the chatbot as Important for their learning purposes, they are more

likely to develop a positive attitude toward using It. These results are consistent with the Technology Acceptance Model which reveals that perceived usefulness Is a critical determinant of attitude which then Influences adoption Intention.

The effect of perceived ease of use (PEU) on attitude (AT) towards using AI-powered chatbots was found to be statistically significant with β =0.29, $p$<0.01, supporting **H8.** The results confirm that perceived ease of use has a positive Influence on users' attitude towards using AI-powered chatbots in higher education. These findings demonstrate that students are more likely to develop a positive attitude towards the use of AI-chatbots If they are easy to use and require minimal effort. The findings align with the TAM model which asserts that ease of use directly affects attitude, as AI-chatbots that are simple and user friendly enhance positive perceptions and willingness to adopt.

The study revealed that there is a positive influence of trust in AI (TAI) on attitude (AT) with β =0.32, $p$<0.01, thus supporting **H9.** The findings reveal that trust In AI has a positive Influence on users' attitude toward the use of AI-chatbots In higher education. This highlights that students are more likely to develop a positive attitude towards the use of AI-chatbots If they trust them, that Is If they believe they are reliable, secure and perform as expected. Trust fosters confidence In the Interaction with the system as It reduces uncertainty and perceived risk. These results align with human-centered AI principles underscoring trust as an Important factor In technology acceptance.

The study revealed a positive influence of attitude (AT) on behavioral intention to use (ITU) AI-powered chatbots in education with β =0.64, $p$<0.01, supporting **H10.** This Implies that when users view AI-chatbots as enjoyable and beneficial, they develop a positive attitude towards them, and hence they are more likely to express a strong Intention to use the AI-chatbots. A favorable attitude creates an Internal motivation as well as reducing psychological resistance, which in turn enhances adoption Intentions. These findings align with the TAM Model which asserts that attitude Is a key determinant of behavioral Intention.

Results from the study indicate that there is a positive effect of behavioral intention to use (ITU) on actual use (AU) with β =0.69, $p$<0.01, thus supporting **H11.** The findings show that behavioral Intention to use has a positive Influence on actual use of AI-chatbots In

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higher education. This outcome demonstrates that users who express a strong Intention to use the AI-chatbots are more likely to translate that Intention Into concrete usage behavior. These results align with the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB) which highlighted that Intention Is the most Immediate determinant of actual system use.

In total, ten out eleven hypotheses that were created were supported by the data gathered in the research. The findings of this research demonstrate how perceived explanability, perceived transparency, perceived control and trust in AI play a critical role in enhancing explanation of user behavior in the TAM framework. The pattern of the outcome reveals that both human-centered AI values and technology acceptance factors jointly shape users' engagements with AI-powered chatbots In higher education. The significant pathways from both the human-centered AI values and the validation of core TAM relationships, highlight the central role of ethical supportive design features In supporting users' confidence In AI systems as well as confirming that usability and functional value remain critical drivers of user acceptance. Table 1 shows the summary of hypothesis testing results.

**Table 1.** Summary Table of Hypothesis Testing

| Hypothesis | Path Relationship | β (Standardized Coefficient) | p-value | Supported / Not Supported |
|---|---|---|---|---|
| H1 | PEX → PTR | 0.54 | p < 0.01 | Supported |
| H2 | PTR → TAI | 0.12 | p = 0.02 | Supported |
| H3 | PTR → PUS | 0.21 | p = 0.000 | Supported |
| H4 | PCO → PEU | 0.09 | P = 0.18 | Not Supported |
| H5 | PTR → PCO | 0.16 | P = 0.02 | Supported |
| H6 | PEU → PUS | 0.52 | p < 0.01 | Supported |
| H7 | PUS → AT | 0.63 | p < 0.01 | Supported |
| H8 | PEU → AT | 0.29 | p < 0.01 | Supported |
| H9 | TAI → AT | 0.32 | p < 0.01 | Supported |
| H10 | AT → ITU | 0.64 | p < 0.01 | Supported |
| H11 | ITU → AU | 0.69 | p < 0.01 | Supported |

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### 4.3. Discussion

The findings of this study underscore the significant role of Human-Centered AI (HCAI) principles in influencing user adoption of AI-powered chatbots within the context of higher education. The integration of HCAI principles such as perceived explainability, transparency, and trust into the design of AI systems has proven to have a considerable impact on users' willingness to adopt such technologies. These principles, grounded in ethics and user-centric values, are crucial for overcoming the barriers of skepticism and reluctance that often accompany the introduction of AI technologies in educational settings.

The study found that perceived explainability (PEX) had a statistically significant positive effect on perceived transparency (PTR), supporting Hypothesis H1. This result suggests that when users believe they can understand the decision-making process of an AI system, they are more likely to perceive the system as transparent. This is particularly important in educational environments where users, such as students and educators, require clear justifications for the actions taken by AI tools. The concept of explainability in AI aligns with human-centered AI principles, which emphasize the importance of creating AI systems that are interpretable and accessible to users. When users can follow the rationale behind AI decisions, they are more likely to trust the system, making them more open to adopting it. This is consistent with literature on transparent AI systems, which highlights that systems that make their inner workings understandable are more likely to be accepted by users in high-stakes environments, such as education.

Building on this, the study also revealed that perceived transparency (PTR) had a significant positive influence on trust in AI (TAI) ($\beta = 0.12$, $p = 0.02$), supporting Hypothesis H2. This finding is vital, as trust has been identified as one of the most significant barriers to the adoption of AI systems. AI systems, particularly those powered by chatbots, often face challenges regarding perceived black-box behaviors, where users cannot understand or predict the system's actions. In this study, transparency in AI-powered chatbots was found to increase trust by making the system's processes clearer, thus reducing the uncertainty associated with using AI technologies. These results are particularly aligned with Human-Centered AI frameworks, which emphasize the role of trust in promoting ethical engagement between humans and AI technologies. Transparency, therefore, is not

just a technical feature but a key determinant in enhancing user confidence and engagement, which directly influences the decision to adopt AI tools in higher education.

Further, the study found a significant relationship between perceived transparency and perceived usefulness (PUS), with $\beta = 0.21$, $p = 0.000$, supporting Hypothesis H3. This suggests that when users perceive an AI system as transparent, they are more likely to view it as useful. In the context of higher education, this is an essential finding, as it implies that transparency in AI systems not only builds trust but also positively affects how students and educators perceive the system's value in achieving their educational goals. Transparent AI systems help users understand how the technology works, increasing their confidence in its ability to deliver useful and reliable results. The finding also suggests that transparency leads to better user engagement and greater willingness to adopt the technology for academic or administrative tasks. This aligns with the Technology Acceptance Model (TAM), where perceived usefulness is a strong predictor of technology adoption.

Another significant finding of this study relates to perceived control (PCO) and its impact on perceived ease of use (PEU). The results did not show a statistically significant relationship ($\beta = 0.09$, $p = 0.18$), meaning that the perceived control that users have over an AI system does not necessarily influence how easy the system is perceived to use. This is an interesting finding and suggests that AI-powered chatbots in this context may be seen as inherently easy to use, regardless of the level of control users have over the system. One explanation for this could be that most AI-powered chatbots used in educational settings are designed with simple, user-friendly interfaces, making them intuitive to use without requiring users to control their operations. Another reason could be that users might perceive control as less important in the context of an AI system that is already perceived as user-friendly. These finding challenges traditional assumptions that greater control enhances usability and points to the need for further research to understand the interplay between control and usability in AI systems.

The results also confirmed that perceived ease of use (PEU) significantly influences perceived usefulness (PU) ($\beta = 0.52$, $p < 0.01$), supporting Hypothesis H6. This aligns with the TAM framework, which suggests that systems that are easy to use are more likely to be perceived as useful. The results demonstrate that when AI-powered chatbots in higher

education are perceived as easy to use, students and educators are more likely to see them as effective tools for accomplishing tasks. This finding reinforces the importance of designing AI systems with a user-centric approach, ensuring that they are simple, intuitive, and capable of minimizing cognitive load. The TAM model supports the idea that ease of use is not only crucial for adoption but also for ensuring that users derive value from the technology. When users can interact with the system effortlessly, they are more likely to recognize its utility in enhancing their learning and administrative tasks.

Lastly, the study confirmed that behavioral intention (ITU) significantly influences actual use (AU) of AI-powered chatbots in education ($\beta = 0.69$, $p < 0.01$), supporting Hypothesis H11. This finding aligns with both the TAM and the Theory of Planned Behavior (TPB), which assert that the intention to use technology is the most immediate predictor of its actual use. This highlights the importance of shaping positive user attitudes and intentions towards AI technologies, which will likely result in greater actual usage. The strong predictive relationship between intention and actual use demonstrates the significance of addressing the factors that influence intention, such as perceived usefulness, ease of use, transparency, and trust, to drive successful AI adoption in educational contexts.

The study highlights the central role of Human-Centered AI principles in shaping users' engagement with AI-powered chatbots in higher education. The results show that transparency, explainability, and trust are key drivers of AI adoption, while perceived ease of use and usefulness further contribute to shaping users' attitudes and intentions. These findings not only extend the Technology Acceptance Model (TAM) but also emphasize the importance of integrating human values into the design of AI systems to enhance their acceptance and effectiveness. The insights gained from this research can help guide future development and deployment of AI technologies in higher education, ensuring that these systems are both ethically responsible and user-friendly, thereby fostering greater trust and engagement.

## 5. CONCLUSION

This study examined perceived explainability, perceived transparency, perceived control and trust in AI and their relationship with perceived usefulness, perceived ease of use

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and attitude towards using AI-powered chatbots in education. The study revealed that there is no positive relationship between perceived control and perceived ease of use of AI-powered chatbots in education. However, the study revealed that perceived explainability has a positive influence on perceived transparency which also has a positive influence on perceived usefulness which the effects attitude towards the adoption of AI-powered chatbots in education. The study also revealed that perceived usefulness, which influences attitude toward the adoption of AI-powered chatbots in education, is positively influenced by perceived explainability, which in turn influences perceived transparency. Results from the study also showed that perceived transparency has a positive influence on perceived control. Additionally, the study discovered that attitude toward user adoption of AI-powered chatbots in education is positively influenced by trust in AI , which in turn is influenced by perceived transparency. Therefore, it can be concluded that, for the successful user adoption and acceptance of AI-powered chatbots in education, there is need to integrate Human-Centered AI principles into the Technology Acceptance Model to better understand and predict user adoption of AI-powered chatbot systems. By integrating HCAI principles into TAM, it was possible to develop a more comprehensive framework that captures the critical factors influencing user adoption of AI-powered chatbots which include perceived explainability, perceived transparency, perceived control and trust thereby facilitating adoption. The recommendation coming from this study is that there is need for AI-powered chatbot system where developers and designers have to prioritize embedding transparency, explanability, trust and user control mechanisms within their AI-powered chatbot educational solutions. These Human-Centered AI principles will enhance user's trust and perceived usefulness, thereby encouraging adoption among users.

More specifically, AI developers, instructional designers and educators should priorities the integration of clear and intuitive explanation features, transparent algorithmic processes and meaningful user control options within chatbot systems. Educational institutions should also incorporate AI literacy initiatives that help users understand how AI-powered chatbots function, thereby strengthening trust and reducing uncertainty. Together, these recommendations will ensure that AI-powered educational systems are user-centered, trustworthy and aligned with the needs and expectations of learners, ultimately promoting wider acceptance and sustained use. Future research should extend this work by examining additional Human-Centered AI constructs such as fairness, safety,

and emotional intelligence, which are increasingly relevant in AI-mediated learning environments. Longitudinal studies would provide deeper insights into how users' attitudes and behaviors evolve over time as they continue interacting with AI-powered chatbots. Further, cross-cultural and multi-country comparative studies could explore whether the influence of HCAI principles varies across different educational and socio-cultural contexts. Future studies may also employ advanced modelling techniques such as SEM or machine learning-based predictive models to assess complex interactions among constructs. Finally, research could evaluate AI-powered chatbots in diverse educational levels and subject domains to determine whether the proposed framework generalizes beyond higher education contexts.

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