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STUDENTS' PERCEPTIONS OF DEEPSEEK IN PAKISTANI HIGHER EDUCATION INSTITUTIONS: THE ROLE OF DEMOGRAPHIC CHARACTERISTICS IN ACCESS, ATTITUDES, AND ACADEMIC CONCERNS

Mir Bahader[*1], Rahim Jan[2], Haseeb Ahmed Piracha[3], Muhammad Hussain[4], Haleema Bibi[5]

*[*1'3]Department of Information Management, The University of Lahore, Lahore Punjab Pakistan*
[2,4]Department of Library and Information Science, Khushal Khan Khattak University Karak, Khyber Pakhtunkhwa
[5]Local Government Rural Development Department, Abbottabad, Khyber Pakhtunkhwa

mir.bahader@doim.uol.edu.pk

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DeepSeek, artificial intelligence, higher education, student perceptions, demographic differences, Pakistan.

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Corresponding Author: *
Mir Bahader

Abstract

Purpose– *This study investigates students' perceptions of DeepSeek in Pakistani higher education institutions, focusing on accessibility, attitudes, and academic concerns, as well as the role of demographic characteristics in shaping these perceptions.*

Design/methodology/approach– *A quantitative cross-sectional survey research design was employed. Data were collected from 1,072 university students in Pakistan through a structured questionnaire. The data were analyzed using descriptive statistics, independent samples t-tests, and one-way analysis of variance (ANOVA) using SPSS to examine differences across demographic groups.*

Findings– *The results indicate that students generally demonstrate moderate to positive perceptions of DeepSeek in terms of accessibility, attitude, and academic concerns. The findings further reveal that gender, age, and university category do not significantly influence students' perceptions. However, significant differences were observed across faculties and semesters, indicating that academic discipline and level of study play a more influential role in shaping students' engagement with AI-based tools. Students from science and health-related disciplines reported more positive perceptions compared to those from arts and management fields, while middle and higher-semester students showed relatively stronger engagement than early-semester students.*

Originality/value–*This study highlights that while demographic characteristics have limited influence, academic context significantly shapes students' perceptions of AI tools such as DeepSeek. The findings contribute to the growing body of literature on artificial intelligence in higher education and provide practical implications for policymakers, educators, and*

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institutional leaders regarding the effective, ethical, and discipline-specific integration of AI technologies in academic environments.

INTRODUCTION

In an age of rapid technological advancement, significant technologies and discoveries enhance all aspects of human life around the world. According to Minh Tri et al. (2021), rapid technological breakthroughs affect every area of human existence, including government, employment, and education. Artificial intelligence (AI) stands out as a major technological achievement. Artificial intelligence represents the creation of computer systems capable of performing tasks that once required human intelligence (Russell & Norvig, 2021). These tasks include problem-solving, observation, learning, and language comprehension. Therefore, the rise of artificial intelligence has profoundly impacted society across various fields, particularly in education. Integrating artificial intelligence (AI) in education has transformed traditional learning methods into technology-based learning, opening up new opportunities to expand the learning experience. One of the most severely impacted areas is language learning (Hartono, 2024). Language learning, particularly English, plays a crucial role in today's global society. Proficiency in English is widely acknowledged as a desired ability that enables individuals to communicate effectively across countries, cultures, and professional domains (Arifatin & Setyaningrum, 2024).

DeepSeek is an AI-driven system designed for natural language processing (NLP), information retrieval, and data analysis. DeepSeek is one of the AI powered chatbots developed by DeepSeek Technologies. According to Dandage (2025), this AI-powered platform boasts distinctive features that enhance user experience, particularly its capability to consolidate various data types, such as text, images, and audio, to deliver more thorough and precise outcomes. Therefore, in the context of learning, DeepSeek plays a crucial role as a learning tool such as text analysis, providing real-time information, and fostering reading comprehension of context.

DeepSeek has an advantage over other AIs such as ChatGPT and Gemini in that it focuses more on domain-specific optimization, transparency, and cost efficiency (Neha & Bhati, 2025). DeepSeek is designed to enhance precise reasoning and decision-making capabilities, making it more practical and reliable. DeepSeek has several variants, namely DeepSeek 7B, DeepSeek MoE-16B, DeepSeek V2, DeepSeek V3, DeepSeek R1-Zero, to the latest variant DeepSeek R1. DeepSeek R1 combines text, databases, and knowledge graphs, and uses Chain of Thought (CoT) techniques to perform step-by-step reasoning and Pro Search to provide context-appropriate responses (Neha & Bhati, 2025). DeepSeek improves accuracy in specific fields such as math, programming and decision-making while maintaining clarity and transparency in the process.

DeepSeek is an advanced platform designed to improve information retrieval and assist learners with prompt-based inquiries. Utilizing state-of-the-art AI and deep learning techniques, it offers an efficient and user-friendly search experience that prioritizes accuracy and relevance. This platform is a valuable resource for individuals, researchers, professionals, and businesses. With its intuitive interface, DeepSeek provides seamless access to information across a wide range of fields. The system ensures the delivery of high-quality content, focusing on precision and effectiveness, and its algorithms are finely tuned to deliver quick and accurate responses (Albuhairy & Algaraady, 2025; Alasmari, 2024).

Research Gap

There has been some recent work that has emphasized the potential of DeepSeek as an emerging generative AI platform, but there are several key aspects in the literature that are lacking. Second, while there are several studies that focus

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on the technical architecture, reasoning capabilities, computational efficiency, and performance comparisons of DeepSeek to other large language models, the literature has not yet explored its educational implications from the student's perspective (Mercer et al., 2025; Krause, 2025). Existing studies have generally examined the educational impact of artificial intelligence tools collectively, emphasizing issues such as academic integrity, academic performance, and AI-assisted language learning, while treating DeepSeek as only one of several AI applications rather than the primary focus (Sabir & Malik, 2026; Khan et al., 2026). Specifically, Sabir and Malik (2026) investigated the relationship between AI tools and students' academic integrity and academic performance among postgraduate students, whereas Khan et al. (2026) explored the role of AI tools in English as a Second Language (ESL) learning using a qualitative approach within a single disciplinary context. In addition, findings of the Bahader et al. (2026) study show that the majority of respondents were relatively familiar with AI technologies. The majority of university teachers believe that the use of AI technologies improves education and benefits both teachers and students. ChatGPT is the most extensively used AI tool, with Chatbots, Pi, Gemini, DeepSeek, and other AI tools receiving little adoption. Furthermore, AI-enabled applications improve resource access, tailored learning, and grading efficiency. Similarly, the study by Shahab et al. (2024) found that although artificial intelligence (AI) has great potential to transform library decision-making, its application in Pakistani university libraries is still in its infancy. To fully realize AI's prospect, obstacles like insufficient financing, inadequate infrastructure, and skill shortages must be addressed. Neither study comprehensively examined students' perceptions of DeepSeek as an independent generative AI platform, nor did they investigate how demographic characteristics influence students' access to DeepSeek, attitudes toward its use, perceived academic benefits, and academic concerns. Therefore, no empirical study has comprehensively investigated Pakistani university students' perceptions of DeepSeek across demographic characteristics such as gender, age, faculty, university category, and semester level. Addressing this gap, the present study investigates students' perceptions of DeepSeek in Pakistani higher education institutions and examines whether these perceptions differ across key demographic characteristics.

Significance of the Study

These gaps are crucial as students' perceptions and experiences of the use of AI technology have the potential to impact technology adoption, engagement, academic performance, and responsible use of AI in educational contexts (Ash'ari & Mohamad, 2025; Zhu et al., 2025). Thus, the current study aims to address these gaps by offering empirical findings regarding the perceptions of students regarding DeepSeek in higher education institutions in Pakistan, mainly focusing on its accessibility, attitudes, academic issues, and variations in demographic factors. The results will be incorporated into expanding research on generative AI in education, and offer practical guidance for educators, policymakers, and higher education institutions on how to effectively use DeepSeek in the classroom and in educational practices. Addressing these research gaps is important because generative AI technologies are increasingly transforming teaching, learning, and academic support in higher education. Understanding students' awareness and perceptions of DeepSeek is essential for determining whether this emerging AI platform can be effectively integrated into educational practice while promoting responsible, ethical, and meaningful use. Despite the growing adoption of AI-assisted learning tools, empirical evidence on students' experiences with DeepSeek remains limited, particularly in developing countries such as Pakistan, where technological infrastructure, digital literacy, and educational contexts differ substantially from those in developed nations. Furthermore, examining demographic and academic differences in

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students' perceptions can provide valuable insights for designing inclusive AI integration strategies, developing discipline-specific interventions, and formulating institutional policies that enhance learning outcomes while addressing ethical and academic concerns. Therefore, this study seeks to address these gaps by investigating university students' perceptions of DeepSeek with respect to accessibility, attitudes, academic concerns, and demographic variations, thereby contributing new empirical evidence to the growing literature on generative AI in higher education and offering practical guidance for educators, institutional leaders, and policymakers.

Hypothesis

H1a: There is a statistically significant association between students' access to and attitudes toward use of DeepSeek and their gender.

H1b: There is a statistically significant association between students' academic concerns regarding DeepSeek and their gender.

H2a: Students' perceptions of access to and attitudes toward use of DeepSeek vary significantly across different age groups.

H2b: Students' perceptions of the academic concerns regarding DeepSeek vary significantly across different age groups.

H3a: There is a statistically significant association between students' perceptions of access to and attitudes toward use of DeepSeek and the category of university in which they are enrolled.

H3b: There is a statistically significant association between students' perceptions of academic concerns related to DeepSeek and the category of university in which they are enrolled.

H4a: There is a statistically significant association between students' perceptions of access to and attitudes toward use of DeepSeek and the faculty in which they are enrolled.

H4b: There is a statistically significant association between students' perceptions of academic concerns related to DeepSeek and the faculty in which they are enrolled.

H5a: There is a statistically significant association between students' perceptions of access to and attitudes toward use of DeepSeek and their semester of study.

H5b: There is a statistically significant association between students' perceptions of academic concerns related to DeepSeek and their semester of study.

2. Literature Review

Generative AI is a transformative force across various industries, offering innovative solutions. AI involvement in numerous sectors has some pros and cons. According to Sedkaoui and Benaichouba (2024) the goal of AI is to enable machines to operate effectively and possess an understanding of their surroundings, making them intelligent. AI involves the use of computer systems to carry out tasks similar to those performed by humans, such as collecting, modifying, generating, acting autonomously, and applying knowledge to complex tasks (Boussioux et al., 2024). In generative AI context ChatGPT ChatGPT is a pioneer in AI conversational models. As a large language model designed to deliver accuracy, variety, and generate responses based on user prompts, it has transformed the way humans interact with computers (Cano-Marin, 2024). It offers exceptional customization and compatibility, enhancing the overall user experience.

What is DeepSeek?

DeepSeek has garnered significant attention both within the AI community and beyond. Since its introduction in January 2025, it is a new addition to the Generative AI landscape. It is a conversational large learning model that delivers accurate responses to user prompts. DeepSeek stands out in the market due to its unique features, including affordability and personalization, as it observes and analyses user behaviour, expertise level, and emotional tone. It also provides responses sourced from authoritative references, such as journals, ensuring precise information. In addition, DeepSeek enhances user interaction by offering vibrant exploration through dynamic filtering, predictive questioning, and visual

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support. (Neha & Bhati, 2025). DeepSeek has some unique features, even comparing it with ChatGPT. Firstly, the training cost associated with DeepSeek's output and accuracy is significantly lower compared to ChatGPT. Then, DeepSeek focuses on advancing toward Artificial General Intelligence (AGI) and is specifically designed to process specialized domains and datasets more effectively. Further, it excels in providing precise information in areas such as legal, healthcare, and industry-specific data. Finally, DeepSeek is an open-source model, making it freely accessible to all users. This openness contributes to its widespread adoption and broad appeal (Ali et al., 2025).

AI-Powered Tool

In the era of advanced digital development, technology has evolved into an important part of everyday human life, including in the field of education. Artificial intelligence (AI)-powered tools have emerged as transformative technologies in higher education by enhancing teaching, learning, research, and academic productivity. Advanced AI systems, such as DeepSeek and other generative AI platforms, enable students to access personalized learning support, generate academic content, solve complex problems, and receive immediate feedback, thereby improving learning efficiency and engagement (Baidoo-Anu et al., 2024; Boussioux et al., 2024). Furthermore, AI-powered educational tools facilitate critical thinking, creativity, collaborative learning, and digital competence while supporting educators in developing adaptive and learner-centered instructional practices (Cano-Marin et al., 2024; Zuo et al., 2025). Despite these educational advantages, scholars emphasize the importance of responsible AI adoption, highlighting concerns related to academic integrity, misinformation, privacy, and ethical use. Consequently, effective institutional policies and AI literacy initiatives are essential to ensure that AI technologies are integrated responsibly and sustainably within higher education environments (Pasupuleti et al., 2025; Zhai, 2025). The integration of AI into language learning has created new opportunities for personalized, efficient, and engaging education. One of the AI-powered tools, specifically DeepSeek, has gained considerable attention due to its advanced capabilities to deliver immediate feedback, such as grammar correction, sentence restructuring, and pronunciation, develop personalized learning pathways, and foster interactive engagement. DeepSeek enables learners to attain their learning goals more effectively. Despite the advantages of DeepSeek, there limitations. DeepSeek still some frequently reiterates concepts even when prompted to elaborate on them. For instance, when users ask for written content, they must present a distinct idea. Nonetheless, DeepSeek often repeats similar ideas. Furthermore, its database is limited to information available up to 2023 since DeepSeek is a new AI application that is launched in 2024.

DeepSeek's Promotional Activities

In the context of the ongoing digital transformation of education, DeepSeek is pioneering a paradigm shift in the learning experience for university students. The platform's distinctive open-source characteristics are not only aimed at optimizing learning outcomes, but also at substantially enhancing learners' psychological and emotional well-being. In contradistinction to the closed nature of AI systems, DeepSeek employs an open-source strategy that engenders a more inclusive intelligent learning environment (Jincheng & Rui, 2025). The system's local deployment capabilities empower students to personalize learning plans according to their distinct cognitive characteristics and emotional requirements. This heightened sense of autonomy has been demonstrated to significantly enhance learning self-efficacy (Bandura et al., 1997). Research has confirmed that DeepSeek's exceptional Chinese language comprehension and logical reasoning capabilities effectively alleviate cognitive anxiety among non-native learners when using AI (Liu & Qu, 2026). Additionally, the transparent reasoning mechanism of the AI eliminates the 'algorithmic black box' and

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cultivates learners' metacognitive abilities (Wang & Cui, 2025). When students can clearly track the AI's reasoning path, their learning confidence and knowledge internalization are both enhanced. The 'visualized intelligent assistance' model has been demonstrated to engender a positive emotional feedback loop. This is achieved through immediate, precise responses which meet cognitive needs and generate a sense of enjoyment in use. Furthermore, transparent interaction processes build technical trust, and personalized knowledge push notifications reinforce a sense of learning control. The synergistic effects of these three factors ultimately lead to sustained learning engagement. It is evident that DeepSeek embodies the trajectory of forthcoming advancements in educational AI, seamlessly integrating technological efficacy with emotional support. This integration is pivotal in enhancing academic performance, while concomitantly cultivating the psychological resilience and positive learning attitudes that are imperative for contemporary learners in the digital age.

Current Scenario of Research on DeepSeek

Since DeepSeek was released in January 2025, there is limited research available on the topic. However, some scholars have explored its structure, engineering, and capabilities. Mercer et al. (2025) noted that DeepSeek is a model designed for efficient reasoning with minimal cost compared to other AI models, yet it remains a strong competitor. This generative AI model combines expert blending with reinforcement learning and advanced engineering as its key components. Its coverage is extensive, and it is structured to provide more precise results. Arabiat (2025) conducted a study to explore the opportunities and challenges of automation in accounting. The research highlighted promising prospects, such as the enhancement of analytical skills, practical applications through simulations, and the development of technicians, all observed through the use of DeepSeek. It was concluded that DeepSeek could have a significant impact on the field of accounting through AI-driven innovations. Aydin & Altınay (2026) compared the DeepSeek, Qwen large language models (LLM), and ChatGPT. They noted that these tools are freely available, open to everyone, and without limitations on inquiries. Their universal appeal lies in the boundless nature of prompt queries and the absence of costs. Furthermore, they emphasized their strong potential in research, academic content development, and writing. By analyzing forty research articles on healthcare and Digital Twin, they integrated AI generative tools to produce content based on posed questions. Their findings revealed that all AI generative tools performed well and generated accurate content when compared to ChatGPT. This outcome reinforces the effectiveness of DeepSeek, a novel AI application in the market. Given the rapid appreciation of DeepSeek, an unexplored research area was considered. The goal was to investigate the perspectives of teacher who have used DeepSeek in their English language classrooms. This study aims to be a pioneering effort to determine whether DeepSeek is widely accepted among teachers. Additionally, it will provide insights into local opinions on utilizing and exploring DeepSeek.

Perceived Accessibility and Attitude toward DeepSeek

Recent studies suggest that university students generally perceive generative artificial intelligence (AI) tools as accessible, user-friendly, and engaging, contributing to favorable attitudes toward their adoption in educational settings. For example, Baidoo-Anu et al. (2024) reported that students viewed ChatGPT as highly usable and expressed positive emotional responses, including enjoyment, curiosity, and enthusiasm. These findings indicate that ease of use and accessibility play a significant role in promoting students' acceptance of AI-supported learning technologies. However, emerging evidence suggests that students' attitudes toward AI are evolving as these technologies become increasingly integrated into higher education. Earlier studies primarily

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attributed positive attitudes to curiosity, novelty, and the innovative nature of AI applications. More recent research indicates that students increasingly value AI tools for their practical educational benefits, including academic support, learning efficiency, convenience, and workload management, rather than their novelty alone (Zhu et al., 2025; Zuo et al., 2025). This transition reflects the growing maturity of AI adoption within educational environments, where students perceive AI as an integral component of their learning experience rather than merely an emerging technology. Furthermore, previous studies have demonstrated that continued exposure to AI applications enhances students' perceptions of ease of use, confidence, and willingness to adopt these technologies for academic purposes (Zhai, 2025). These findings are also supported by the extended Unified Theory of Acceptance and Use of Technology (UTAUT), which emphasizes the influence of effort expectancy and facilitating conditions on technology acceptance (Pasupuleti et al., 2026). Nevertheless, despite the growing body of research on generative AI, most studies have focused on ChatGPT and similar platforms, while empirical evidence regarding students' perceptions of DeepSeek remains limited. In particular, comparative evidence from developing countries such as Pakistan and Indonesia is scarce. This gap highlights the need to investigate students' perceived accessibility and attitudes toward DeepSeek AI across diverse higher education contexts to better understand its educational potential and broader applicability.

Perceived Academic Concerns about DeepSeek

Despite the growing acceptance of generative artificial intelligence (AI) in higher education, the literature consistently highlights several academic and ethical concerns associated with its use. Previous studies have reported that students are concerned about overdependence on AI, plagiarism, diminished originality, reduced critical thinking, and potential risks to privacy and academic integrity. For instance, Baidoo-Anu et al. (2024) found that while ChatGPT was widely recognized for its educational benefits, students also expressed significant concerns regarding ethical misuse, plagiarism, and the implications of AI-generated content for academic honesty. Recent research further suggests that students' concerns extend beyond academic integrity to broader issues related to institutional governance and the responsible use of AI in education. As universities continue to integrate generative AI technologies into teaching and assessment, uncertainty regarding institutional policies, transparency, accountability, and ethical guidelines has become increasingly prominent (Zuo et al., 2025; Zhu et al., 2025). These concerns indicate that although AI offers substantial educational opportunities, its widespread adoption also presents challenges that require effective regulatory frameworks, clear institutional policies, and the promotion of responsible AI literacy among students. Furthermore, previous studies have emphasized that excessive reliance on AI-assisted learning may reduce students' independent problem-solving abilities, critical thinking skills, and academic creativity, thereby raising concerns about the long-term quality of learning outcomes (Zuo et al., 2025; Zhu et al., 2025). Although these concerns have been widely examined in relation to ChatGPT and other established generative AI platforms, empirical evidence specifically focusing on students' academic concerns regarding DeepSeek remains limited. Moreover, little is known about how such concerns are perceived within the higher education systems of developing countries, particularly in Pakistan and Indonesia. Addressing this gap is important for understanding the ethical and academic implications of DeepSeek and for informing the development of institutional policies that support its responsible and effective use in higher education.

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3. Material and Methods

Research Design and Method

A quantitative cross-sectional survey design was used in this study to explore students' perceptions of DeepSeek in HEIs in Pakistan specifically on its accessibility, attitude and academic concerns. A cross-sectional design was deemed suitable because it makes it possible to gather data from a large number of people at one time, and compare them against each other based on various socio-demographic factors. In addition, it explored the influence of demographic factors like gender, age, university category, faculties and semesters on students' perception of DeepSeek. Servey research method was applied in this study, which is suitable for this research. Same method was used in the studies by Bahader, (2022, 2023), Khan et al. (2024).

Proposed Research Model and Framework

A systematic analysis of applicable literature was conducted to comprehend the conceptual framework of the study. For developing literature about access to and attitude toward DeepSeek and academic concern different aspects of DeepSeek, adoption of DeepSeek in education, its accessibility to students, students' attitudes towards DeepSeek, its benefits in education, it's in issues, and academic concern were studied. This study conceptualized a framework to study students' perspectives relating DeepSeek accessibility, attitude, and academic concerns. This study has five independent variables related to students' sex, age, university category, faculty, and semester linked to accessibility, attitude, and academic concerns (the dependent variables) to apply in higher educational institutional in Pakistan (Figure 1).

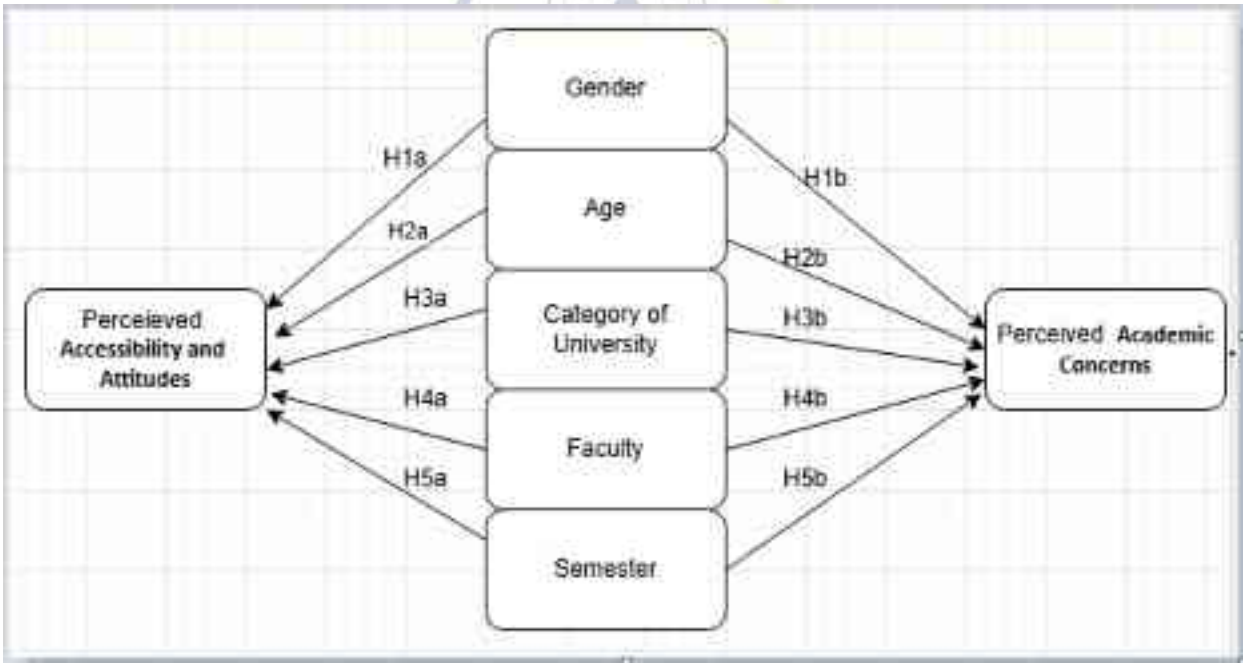


Figure 1: Proposed Research Model and Framework

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Population and Sampling Procedure

The study population was composed of undergraduate students, enrolled in top 20 universities ranked and recognized by Higher Education Commission (HEC) of Pakistan. It was decided to conduct census of all undergraduate students through convenient sample techniques. The date was collected from 1,072 respondents which was adequate for statistical analysis and testing of hypothesis. The respondents represent 50.2% males and 49.8% females. In terms of nationality, 83.7% were from Pakistan and 16.3% from Indonesia. Regarding age distribution, 1.6% were aged 16–18 years, 35.4% were 19–22 years, and 63.1% were above 22 years. The majority of participants (86.8%) attended public sector universities, and 13.2% attended private sector universities. The highest representation came from the faculties of Arts, Humanities, and Social Sciences (52%), followed by Natural and Environmental Sciences (31.4%). The second semester had the highest enrollment (32.6%), reflecting a concentration of early-stage university students in the sample.

Research Instrument

After a comprehensive review of the literature on the application of generative artificial intelligence (AI) in higher education, a structured questionnaire was developed by adapting and modifying validated items from previous studies. The same techniques of instrumentation was applied in the studies of library and information sciences conducted by Habib et al., (2026), The instrument was primarily adapted by the Students' ChatGPT Experience Scale (SCES) developed by Baidoo-Anu et al. (2024) and further refined using studies by Ismail and Maharani (2026), Zhao et al. (2025), Albuhairy and Garaady, and (2025). The wording of all items was modified to suit the context of DeepSeek while preserving the conceptual meaning of the original constructs.

The questionnaire consisted of two sections. The first section collected respondents' demographic information, including gender, age, country, university category, faculty, and semester level. The second section measured two constructs, namely (i) Accessibility and Attitude toward DeepSeek (8 items) and (ii) Academic Concerns related to the utilization of DeepSeek (8 items). The Accessibility and Attitude toward DeepSeek construct comprised eight (8) items adapted from previous studies (Baidoo-Anu et al., 2024; Siregar et al., 2025; Ismail et al., 2024; Zhao et al., 2025; Guo et al., 2025). The items included:

- AA1: I am always keen to learn about new AI technologies such as DeepSeek.
- AA2: I believe artificial intelligence (AI) such as DeepSeek is an important tool for academic success.
- AA3: I am enthusiastic about using technology such as DeepSeek for learning and research.
- AA4: I think that artificial intelligence (AI) like DeepSeek is attractive and enjoyable to use.
- AA5: It does not take a long time to learn how to use DeepSeek.
- AA6: DeepSeek does not require extensive technical knowledge.
- AA7: I do not face many difficulties when using DeepSeek.
- AA8: I fear relying too much on DeepSeek while developing my critical thinking skills.

The Academic Concerns related to the utilization of DeepSeek construct also comprised eight (8) items adapted from previous studies (Baidoo-Anu et al. 2024; Ismail et al., 2024; Guo et al., 2025; Albuhairy & Garaady, 2025; Chen et al., 2024). The items included:

- AC1: I think that relying on technology like DeepSeek can disrupt my critical thinking skills.
- AC2: I am concerned about the potential security risks of using DeepSeek.
- AC3: I am afraid that using DeepSeek would result in a lack of originality in my assignments and academic work.
- AC4: I fear relying too much on DeepSeek while developing my critical thinking skills.
- AC5: I am afraid of becoming too dependent on technology like DeepSeek.
- AC6: I am afraid that using DeepSeek may violate academic integrity policies.

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- AC7: I am concerned that using DeepSeek could lead to accusations of plagiarism.
- AC8: I am concerned about the potential privacy risks associated with using DeepSeek.

Responses to all items were measured using a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Data Collection and Procedure

The data were gathered using an online survey, which was sent to the University students in Pakistan & Indonesia. The purpose of the study and confidentiality and voluntary participation were explained to the participants. The survey was open until the necessary sample size was reached: 1,072 responses. Responses that were incomplete or had no valid answers were omitted from the analysis.

Data Analysis

Data collected were analyzed through the use of the Statistical Package for Social Sciences (SPSS). Demographic characteristics and responses were summarized using descriptive statistics: frequency, percentages, mean and standard deviation. To test for differences between the genders and between the universities, Independent Samples t-test was applied, and to test for differences within the age groups, within faculties and within the semesters, One-Way ANOVA was applied. A significance level of $p < 0.05$ was used to determine statistical significance.

4. Results and Discussions

Associations between students' perspectives on DeepSeek access, attitudes, and academic concerns and their demographic characteristics.

Gender Based Associations

Table 2: Associations of gender with students' DeepSeek access, attitudes, and academic concerns (N=1072)

Variables	Gender				t- value	Sig.
	Male		Female			
	Mean	SD	Mean	SD		
Accessibility and Attitude	3.54	.689	3.52	.716	.467	.640
Academic Concerns	3.50	.665	3.45	.611	.251	.802

An independent samples t-test was performed to compare the students' perceptions of DeepSeek on accessibility, attitude and academic concerns between males and females. The results show that there were not any statistically significant differences between male and female students in both dimensions. For accessibility and attitude, male students (M = 3.54, SD = 0.69) and female students (M = 3.52, SD = 0.72) showed almost similar perceptions (t = 0.467, p = 0.640). Similarly, for academic concerns, male students (M = 3.50, SD = 0.66) and female students (M = 3.49, SD = 0.61) also demonstrated comparable responses (t = 0.251, p = 0.802). The results indicate that there is not significant difference in terms of accessibility, attitude and academic concerns between students of both sexes in Pakistani higher education institutions regarding DeepSeek.

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Age Based Associations

Table 3: Associations between age and students' DeepSeek access, attitudes, and academic concerns (N= 1072)

Variables	Age in Years						F-value	Sig.
	16-18		19-22		Above 22			
	Mean	SD	Mean	SD	Mean	SD		
Accessibility and Attitude	3.61	.597	3.50	.746	3.54	680	.395	.673
Academic Concerns	3.61	.654	3.45	.652	3.52	.629	1.456	.234

A one-way analysis of variance (ANOVA) was conducted to examine age-wise variation students' perceptions of DeepSeek across three age groups (16–18, 19–22, and above 22 years). The results revealed that there were no statistically significant differences among the age groups in terms of Accessibility and Attitude and Academic Concerns. For Accessibility and Attitude, students aged 16–18 years (M = 3.61, SD = 0.59), 19–22 years (M = 3.50, SD = 0.74), and above 22 years (M = 3.54, SD = 0.68) showed similar perceptions (F = 0.395, p = 0.673). Likewise, for Academic Concerns, the mean scores for students aged 16–18 years (M = 3.61, SD = 0.65), 19–22 years (M = 3.45, SD = 0.65), and above 22 years (M = 3.52, SD = 0.62) were also not significantly different (F = 1.456, p = 0.234). These findings indicate that age does not play a significant role in shaping students' perceptions of DeepSeek in Pakistani higher education institutions.

University Category Based Associations

Table 4: Associations between university category and students' DeepSeek access, attitudes, and academic concerns (N= 1072)

Variables	University Category				t- value	Sig.
	Public		Private			
	Mean	SD	Mean	SD		
Accessibility and Attitude	3.53	.708	3.49	.663	.641	.521
Academic Concerns	3.50	.636	3.44	.648	1.094	.274

To investigate students' perception of DeepSeek based on the category of the university (public sector institutions and private sector institutions), an independent samples t-test was used. The result showed that no statistical differences exist between the students of Public University and Private University in both dimensions of the study. There was no difference between the perceptions of students from public universities (M = 3.53, SD = 0.70) and private universities (M = 3.49, SD = 0.66) (t = 0.641, p = 0.521) for Accessibility and Attitude. Similarly, for Academic Concerns, the responses of students from public universities (M = 3.50, SD = 0.63) did not differ significantly from that of students from private universities (M = 3.44, SD = 0.64; t = 1.094, p = 0.274). The results suggest that there is no significant difference between the perceptions of DeepSeek in terms of accessibility, attitude, and academic issues among university categories.

Faculties Based Associations

Table 5: Associations between faculty and students' DeepSeek access, attitudes, and academic concerns (N= 1072)

Variables	Faculties

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	Arts, Humanities, and Social Sciences		Management, Information, and Computational Sciences		Natural and Environmental Sciences		Health and Applied Sciences		F-value	Sig.
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Accessibility and Attitude	3.49	.690	3.48	.739	3.77	.691	3.65	.525	6.172	**.000**
Academic Concerns	3.50	.641	3.43	.640	3.63	.645	3.60	.542	3.558	**.014**

A one-way analysis of variance (ANOVA) was conducted to examine differences in students' perceptions of DeepSeek across different faculties, including Arts, Humanities, and Social Sciences; Management, Information, and Computational Sciences; Natural and Environmental Sciences; and Health and Applied Sciences. The results revealed statistically significant differences among faculties in both Accessibility and Attitude and Academic Concerns. For Accessibility and Attitude, significant differences were found among the four faculties ($F = 6.172$, $p = 0.000$). Students from Natural and Environmental Sciences ($M = 3.77$, $SD = 0.69$) and Health and Applied Sciences ($M = 3.65$, $SD = 0.52$) reported comparatively higher mean scores, while students from Arts, Humanities, and Social Sciences ($M = 3.49$, $SD = 0.69$) and Management, Information, and Computational Sciences ($M = 3.48$, $SD = 0.73$) reported relatively lower scores. Similarly, significant differences were observed in Academic Concerns across faculties ($F = 3.558$, $p = 0.014$). Students from Natural and Environmental Sciences ($M = 3.63$, $SD = 0.64$) and Health and Applied Sciences ($M = 3.60$, $SD = 0.54$) showed higher levels of academic concerns compared to Arts, Humanities, and Social Sciences ($M = 3.50$, $SD = 0.64$) and Management, Information, and Computational Sciences ($M = 3.43$, $SD = 0.64$). These findings indicate that faculty affiliation significantly influences students' perceptions of DeepSeek in higher education institutions.

Semester Based Associations

Table 5: Associations between semester and students' DeepSeek access, attitudes, and academic concerns (N=1072)

Variables	Semesters based association																F-value	Sig.
	1st		2nd		3rd		4th		5th		6th		7th		8th			
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD		
Accessibility and Attitude	3.41	.67	3.6	.6	3.44	.640	3.4	.741	3.52	.823	3.45	.629	3.5	.825	3.49	.7	6.17	**.000**
Academic Concerns	3.40	.63	3.5	.6	3.41	.611	3.5	.636	3.62	.620	3.26	.633	3.5	.710	3.51	.6	3.55	**.010**

A one-way analysis of variance (ANOVA) was conducted to examine differences in students' perceptions of DeepSeek across different semesters. The results revealed statistically significant differences among semester levels in both Accessibility and Attitude and Academic

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Concerns. For Accessibility and Attitude, significant differences were observed across semesters (F = 6.17, p = 0.000). Students in the 2nd semester reported the highest mean score (M = 3.68, SD = 0.66), while comparatively lower scores were observed among 1st semester (M = 3.41, SD = 0.67), 3rd semester (M = 3.44, SD = 0.64), 4th semester (M = 3.41, SD = 0.74), 6th semester (M = 3.45, SD = 0.62), and 8th semester students (M = 3.49, SD = 0.72). Students in the 5th semester (M = 3.52, SD = 0.82) and 7th semester (M = 3.57, SD = 0.82) also showed moderately higher perceptions. Similarly, significant differences were found in Academic Concerns across semesters (F = 3.55, p = 0.010). The highest mean score was observed among 5th semester students (M = 3.62, SD = 0.62), followed by 8th semester (M = 3.55, SD = 0.65) and 7th semester students (M = 3.53, SD = 0.71). In contrast, lower mean scores were reported by 6th semester students (M = 3.26, SD = 0.63) and earlier semesters such as 1st (M = 3.40, SD = 0.63) and 3rd semester (M = 3.41, SD = 0.61). These findings indicate that semester level significantly influences students' perceptions of DeepSeek in higher education institutions.

Summary of the Hypothesis Tests Results

Table 6: Summary of Hypothesis Testing Results for H1a–H5b

Hypothesis	Associations Between Students' DeepSeek Perspectives and Demographic Characteristics	Statistical Test	Conclusion
H1a	There is a statistically significant association between students' access to and attitudes toward use of DeepSeek and their gender	Independent Samples *t*-test	Rejected (No statistically significant association).
H1b	There is a statistically significant association between students' academic concerns regarding DeepSeek and their gender	Independent Samples *t*-test	Rejected (No statistically significant association).
H2a	Students' perceptions of access to and attitudes toward use of DeepSeek vary significantly across different age groups	One-Way ANOVA	Rejected (No statistically significant association).
H2b	Students' perceptions of the academic concerns regarding DeepSeek vary significantly across different age groups	One-Way ANOVA	Rejected (No statistically significant association).
H3a	There is a statistically significant association between students' perceptions of access to and attitudes toward use of DeepSeek and the category of university in which they are enrolled	Independent Samples *t*-test	Rejected (No statistically significant association).
H3b	There is a statistically significant association between students' perceptions of academic concerns related to DeepSeek and the category of university in which they are enrolled	Independent Samples *t*-test	Rejected (No statistically significant association).

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H4a	There is a statistically significant association between students' perceptions of access to and attitudes toward use of DeepSeek and the faculty in which they are enrolled	One-Way ANOVA	Accepted (Statistically significant difference exists).
H4b	There is a statistically significant association between students' perceptions of academic concerns related to DeepSeek and the faculty in which they are enrolled	One-Way ANOVA	Accepted (Statistically significant difference exists).
H5a	There is a statistically significant association between students' perceptions of access to and attitudes toward use of DeepSeek and their semester of study	One-Way ANOVA	Accepted (Statistically significant difference exists).
H5b	There is a statistically significant association between students' perceptions of academic concerns related to DeepSeek and their semester of study	One-Way ANOVA	Accepted (Statistically significant difference exists).

5. Conclusion, Implications, Limitations, and Future Research Directions

The findings of this study provide important implications for theory, practice, and policy in relation to the adoption of AI tools such as DeepSeek in Pakistani higher education. Overall, the results indicate that students demonstrate low to moderate awareness of DeepSeek but hold generally positive perceptions regarding its academic benefits. However, awareness is significantly influenced by gender and age, while perceptions of accessibility, attitude, and academic concerns remain largely uniform across groups. This study provides a comprehensive understanding of students' perceptions of DeepSeek in Pakistani higher education institutions, with a focus on accessibility, attitudes, and academic concerns, as well as the influence of demographic characteristics. The findings reveal that students generally hold moderate to positive perceptions of DeepSeek, indicating a growing acceptance of AI-based tools in academic settings. However, demographic variables such as gender, age, and university category do not significantly influence these perceptions, suggesting that exposure to AI technologies is becoming increasingly uniform across student populations. In contrast, significant differences across faculties and semesters highlight that academic discipline and stage of study are more influential in shaping students' engagement with DeepSeek. Students from science and health-related fields, as well as those in higher semesters, demonstrate comparatively more positive perceptions, reflecting the role of disciplinary exposure and academic experience in enhancing familiarity with AI tools. In conclusion, the growing presence of AI tools such as DeepSeek is not merely transforming academic practices but is fundamentally reshaping how students engage with knowledge itself. Higher education institutions that proactively embrace this transformation, while ensuring ethical, equitable, and guided use, will be best positioned to prepare students for the future of AI-driven learning and global academic competitiveness.

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Theoretical and Practical Implications

This study contributes to the growing body of literature on generative AI in higher education by extending existing research beyond widely studied platforms such as ChatGPT to the emerging DeepSeek AI system. It provides empirical evidence from Pakistan, a context that remains underrepresented in AI-in-education research, thereby enriching the global understanding of students' perceptions of generative AI. The findings also support technology acceptance perspectives by demonstrating that academic context, rather than personal demographic characteristics, is a stronger determinant of students' perceptions and engagement with AI tools. From a practical perspective, the findings suggest that higher education institutions should develop structured strategies for integrating AI technologies into teaching and learning. Universities should provide AI literacy programs, discipline-specific training, and faculty development initiatives to ensure that students acquire the knowledge and skills required for the effective and responsible use of AI. Furthermore, institutions should establish clear policies addressing academic integrity, plagiarism, privacy, transparency, and ethical AI use to maximize educational benefits while minimizing potential risks.

Limitations

Several limitations should be considered when interpreting the findings. First, the study employed a cross-sectional survey design, limiting the ability to establish causal relationships between students' awareness and perceptions of DeepSeek AI. Second, data were collected from universities in Pakistan, which may limit the generalizability of the findings to other educational and cultural contexts. Third, the study relied on self-reported responses that may be influenced by social desirability bias or participants' subjective perceptions. Finally, the investigation focused on students' perceptions rather than their actual usage behavior or measurable learning outcomes associated with DeepSeek AI.

Future Research Directions

Future studies should employ longitudinal and mixed-methods approaches to examine how students' awareness, perceptions, and actual use of generative AI evolve over time. Comparative cross-national research involving both developed and developing countries would further enhance understanding of cultural and institutional influences on AI adoption. Researchers should also investigate the effects of DeepSeek AI on students' academic performance, critical thinking, creativity, self-regulated learning, and digital literacy. Moreover, future research may compare DeepSeek with other leading generative AI platforms, such as ChatGPT, Gemini, Claude, and Microsoft Copilot, to identify differences in educational effectiveness, user acceptance, and ethical implications across diverse higher education contexts. Overall, this study demonstrates that the integration of generative AI into higher education extends beyond technological innovation to represent a fundamental transformation in teaching and learning. Universities that promote equitable access, AI literacy, ethical governance, and pedagogically informed implementation will be better positioned to prepare students for an increasingly AI-driven academic and professional environment.

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