Global Knowledge, Memory and Communication

Integration of AI-based applications in education: how students feel about the ChatGPT era?

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Received 20 April 2024
Revised 29 December 2024
Accepted 24 February 2025

Abstract

Purpose – This study aims to investigate the awareness, utilisation, perception and impact of artificial intelligence (AI) tools among graduate students across various universities in Northeast India. In addition, it delves into the challenges they encounter while integrating AI into their education and learning.

Design/methodology/approach – This study used a survey method to investigate how students at Northeast Indian Universities perceived the incorporation of AI and assessed its impact on their educational activities. Both qualitative and quantitative data were gathered for the study using a questionnaire. After administering the constructed questionnaire, 175 responses were received out of the calculated sample size of 384 respondents. The data was statistically analysed using Jeffreys's Amazing Statistics Programme (JASP) (Version 0.16.3.0; JASP Team, 2022) and MAXQDA 24 (VERBI Software, 2024).

Findings – The findings reveal that male students are relatively more aware of using AI tools in academic writing, with mean scores ranging from 2.394 to 3.385, compared to female respondents. ChatGPT, QuillBot and Grammarly were the most prominent tools they were accessing via their smartphones. The qualitative analysis of two open-ended questions revealed mixed perceptions towards the use of AI indicating that its usage is beneficial only for a shorter period. Several issues were highlighted like inadequate technical assistance, skills constraints, poor connectivity and infrastructure. These have been categorised into positive and negative opinions in recognising AI's educational potential.

Originality/value – This study revolves around the adoption of AI in Northeast India, a unique region with distinct geographical and demographic characteristics. It aims to understand how students of the select region use AI and its impact on educational settings – a first of its kind to the best of the authors' knowledge. Moreover, this study sheds light on the potential difficulties, and perspectives influencing the landscape of AI integration in education, providing insightful information about the dynamics of AI usage in educational contexts.

Keywords Artificial intelligence (AI), Education, Learning, Students' perceptions, Impact, Northeast India

Paper type Research paper

The authors would like to express their sincere gratitude to the anonymous reviewers for their constructive comments to sharpen the quality of the study. Also, the authors are highly thankful to the MAXQDA Qualitative and data-analysis proprietary software developers and extend heartfelt appreciation to the study's respondents for their valuable participation.

Funding: The authors received no financial support for the research, authorship or publication of this article.

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2514-9342
DOI 10.1108/GKMC-04-2024-0227

1. Introduction

Artificial intelligence (AI) has recently entered a new phase of technological advancement that is progressing in unprecedented ways. When we reflect on the past, we can observe the remarkable journey from the Gutenberg era to the current age of AI and an array of new technologies that have transformed virtually every aspect of our world today. Thanks to advances in computational power and other technological breakthroughs, we can now use technology to support nearly all aspects of human life, often achieving greater efficiency (Mannuru *et al.*, 2023).

AI has existed in some form since the mid-20th century. However, it has gained significant attention in recent years due to its widespread practical applications across various facets of human life (Anderson *et al.*, 2018). AI and its associated technologies, such as machine learning, have opened up new frontiers for integrating technology into our lives. They have found applications in numerous fields and have gained broad acceptance and prominence. AI is now efficiently used in tasks ranging from autonomous automobile driving to everyday problem-solving. Given its substantial resurgence and popularity, there is growing concern about AI's ethical and responsible use. Research in policy development is essential to promote its ethical usage and address the potential threats it poses when used unethically (Bollier, 2017).

Currently, experts speculate that with the ongoing advancement of computing power, it will eventually surpass human intelligence and enhance human activities. This technology has applications in various fields for critical analysis, decision-making and natural language processing. Notably, AI-enabled robots are being explicitly used in health care for tasks like diagnosing and treating patients and performing robotic surgeries (Perez *et al.*, 2018). However, there are also concerns raised by many regarding potential adverse effects, including the absence of cognitive abilities, decreased problem-solving skills, data misuse, breaches of privacy and the displacement of jobs (Rege and Yarmoluk, 2020).

A significant paradigm shift has occurred since the emergence of OpenAI in November 2022, particularly regarding the use and application of its tool called ChatGPT. It has revolutionised and redefined stakeholders' thought processes and work styles across various domains. In academia, its usage has expanded from creating educational content to completing assignments and generating reports, making it a disruptive technology, especially for students in their formative years (Wang *et al.*, 2023). However, despite the generally positive outlook, concerns persist about its ethical and academic integrity (Bozkurt *et al.*, 2023). For any technology or innovation to succeed and gain widespread adoption, it must meet specific requirements. According to Devis's Technology Acceptance Model, usefulness and ease of use are crucial in effectively adopting any technology. Similarly, most AI applications today rely on these factors to achieve broad acceptance (Kizilcec, 2023).

Developed nations such as the USA, Canada, China and others are investing significantly in the research and development of AI and its related platforms. In contrast, India, a developing nation, is progressively embracing AI across various sectors, even though there is a need for improved infrastructure, increased information technology (IT) literacy and greater awareness in marginalised communities. This is evident from the projected growth of the Indian AI market, which is expected to reach $7.8bn by 2025 (Majid and Lakshmi, 2022).

In this study, the primary focus of the researchers is the northeastern region of India, which is home to more than 200 tribes and is considered one of the most culturally diverse regions globally (Sivakumar *et al.*, 2013). Another significant reason for this choice is the

extensive integration of artificial systems and related technologies in all service sectors, contributing to over 50% of the country's gross domestic product (GDP) (India Brand Equity Foundation, 2023). For instance, AI is being applied across various service sectors, such as the introduction of AI courses in academic institutions (Chauhan, 2022), the implementation of AI by the North East Frontier Railways (DH Web Desk, 2023), the use of AI-based solutions by Oil India to prevent oil pilferage (NE NOW News, 2019) and the assessment of tea quality in Assam (Mazumdar, 2019). Furthermore, the northeastern region comprises seven states collectively known as the "sister states", each with unique people, history, culture and a wide range of physiographic and ecoclimatic conditions. Therefore, it is essential to investigate the adoption of AI-based technology and the perceptions and potential impact among undergraduate (UG) and postgraduate (PG) students in academic institutions in the northeastern region.

2. Literature review

Many recent studies have explored the application of AI tools in specific educational and geographic contexts. In Germany, a study surveyed 6,300 students to gain insights into the characteristics and usage of AI tools. The results indicated that approximately two-thirds of the respondents use AI-based tools, with ChatGPT and GPT-4 being preferred by nearly half. Notably, engineering and natural science students exhibited the highest frequency of AI tool usage, leveraging these tools to enhance their understanding of subject matter within their respective fields (Garrel and Mayer, 2023). The application of AI has extended to libraries, as seen in a Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis of AI use in Pakistani university libraries. Interviews with five chief librarians revealed that AI is gradually making its way into Pakistani university libraries, although concerns persist regarding funding and implementation costs (Ali *et al.*, 2022). The application of ChatGPT in the education sector, involving 50 English department teachers and students, revealed that Bangladeshi universities are considering ChatGPT for automated administrative support, chatbots and virtual teaching assistants, among other uses. Nonetheless, there is still debate regarding these technologies' efficacy. The findings also imply that ChatGPT and other AI technologies have advantages and disadvantages, and the study advocates their responsible integration into higher education (Ashikullah, 2024). A study that examined students' use of AI in entrepreneurship education used a mixed-methods approach that included surveys and interviews. In total, 16 students' opinions and usage of AI tools were gathered through a survey, and 12 students were interviewed to learn more about their viewpoints. The study revealed that although AI tools are helpful for writing, market research and creating advertisements, their use in specific fields is restricted. The adoption of AI is hampered by possible abuse, stifling of creativity, inaccurate information and lazy behaviour (Zhou *et al.*, 2024). Similarly, the potential applications of AI in Indian libraries have been proposed, highlighting the positive impact it could have (Shubha and Vaidya, 2023). Other studies have also explored the technology's applications in various academic library settings (Lund *et al.*, 2020; Wheatley and Hervieux, 2019).

Among pharmacy college students at King Saud University, a study on AI awareness indicated that 74% possessed AI knowledge. More than half of these students believed that AI adoption would benefit healthcare professionals. In summary, Saudi Arabian pharmacy students displayed positive perceptions regarding their familiarity with AI, its advantages and its potential applications (Syed and Basil A. Al-Rawi, 2023). In addition, health care has seen significant advancements driven by AI. A study explored the foundations of AI in health care and provided recommendations for its more effective application (Chen and Decary, 2020). AI's prospective impacts and advancements were examined in agriculture, with the study indicating

that AI in the farming sector is still in its early stages (Spanaki *et al.*, 2022). Another German study used the expectancy-value theory framework to investigate students' adoption of generative AI. This research aimed to assess students' comprehension of generative AI and their perceptions regarding its value and cost. The findings revealed a significant positive relationship between the perceived value of generative AI and the intention to use it, along with a weak negative correlation between perceived costs and usage intentions (Chan and Zhou, 2023). An online survey also assessed employee willingness to embrace AI in their work culture, revealing that privacy concerns hindered people's readiness to use AI technology. In contrast, trust in AI-based technology increased willingness (Choi, 2020).

Studies involving Romanian UG students and Swedish university students showed generally positive perceptions of AI in an educational context, coupled with concerns about its potential drawbacks (Idroes *et al.*, 2023; Malmström *et al.*, 2023). Moreover, students in Indonesia and Malaysia displayed a positive outlook towards using AI assistance in writing, including the introduction of Automated Writing Evaluation in writing classes, as it can detect grammatical errors and enhance writing skills (Abdul Rahman *et al.*, 2023; Sumakul *et al.*, 2022). Qualitative analysis using MAXQDA software highlighted that teachers and students held optimistic views about AI while expressing reservations about its impact on education and human cognition. In addition, teachers demonstrated a higher proficiency in adopting new technologies (Sangapu, 2019). With the advent of ChatGPT and generative AI in higher education among international students, several studies have assessed the current landscape and educational significance of ChatGPT. This tool is perceived as student-driven and has the potential to reshape education. However, these studies also underscore various potential threats associated with AI implementation, such as privacy concerns, ethical considerations and language barriers (Dai *et al.*, 2023; Wang *et al.*, 2023). The eight-factor "Student Conceptions of AI in Education Scale (SCAIES)" was adopted to analyse students' perceptions about the application of AI in educational settings. Students' perceptions were positively and significantly influenced by all eight out of the shortcomings of traditional education, such as sentiment analysis and personalised learning. Concerns about control and privacy, such as visual analysis and classroom monitoring, were the least prevalent (Djokic *et al.*, 2024). Exploring multiple perspectives on AI in education revealed that numerous applications are covered in the literature currently in publication, such as intelligent assessment and management, personalised tutoring, adaptive learning, profiling and prediction and emerging products. The study emphasises understudied research areas, the multidisciplinary nature of publication venues and the wide variety of theories used in artificial intelligence (AI) in education (AIED) literature (Wang *et al.*, 2024).

Almasri (2024) reviewed the literature on the impact of AI in teaching and learning, revealing that in many nations and scientific fields, AI has been incorporated into science education. AI-powered tools have been used to improve the learning environment, make quizzes, evaluate student work and forecast academic achievement. Jensen *et al.* (2024) identified ten major claims about ChatGPT's effects on higher education, focusing on its characteristics, changes in teacher and institutional practices and its potential to help students adopt autonomous practices. The study suggests that ChatGPT could spur initiatives like inclusion, personalisation and assessment reform. However, students' active participation in generative AI is often overlooked, and they are often presented as plagiarists or victims of inadequate education systems. A survey of 200 university students at Bengkulu University found that while most students view AI as a valuable tool for enriching learning experiences and increasing access to educational resources, they also have concerns about potential AI replacement, loss of human elements in learning interactions and data privacy issues (Herawati *et al.*, 2024). A study involving 1,113 participants examined how AI affects teaching and learning in Saudi Arabian higher education. The results emphasised how AI could enhance

instruction, expedite management and stimulate creativity. The study also envisioned a future of personalised learning experiences, ethical AI integration, collaboration and support for lifelong learning, along with the necessity of ethical considerations like privacy, security and bias (Al-Zahrani and Alasmari, 2024). A separate study reviewed the ethical implications of generative AI, ChatBots and ChatGPT, suggesting their potential use in academic and research writing (Lund *et al.*, 2023). Another study emphasised the need for guidance and strategies in using tech-based tools, as some students use AI without proper evaluation, potentially leading to plagiarism (Burkhard, 2022).

AI and its associated technologies have permeated various service domains, becoming a complex and intriguing area of research. This study addresses a significant research gap in AI in education, particularly concerning its usage, awareness, perceptions and impact on northeastern region university students. In addition, this research explores a culturally diverse region and examines a sample of change-making university students, contributing to a deeper understanding of effective AI implementation in alignment with NEP-2020.

3. Study objectives

Based on our review of the existing literature on AI in educational contexts, the following research objectives have been developed:

- to ascertain the level of usage and awareness regarding AI-enabled tools among the university students of Northeastern India;
- to know the students' purpose, attitude and level of engagement regarding the AI integration into education in northeastern universities of India;
- to identify the gender-wise variation regarding the awareness and usage of AI tools in education among the university students of Northeastern India;
- to identify the gender-wise variation regarding the impact and perception of AI tools among the university students of Northeastern India;
- to assess the challenges encountered by the university students of Northeastern India while using AI; and
- to shed light on their overall perception regarding using AI in learning and imbibing new concepts.

4. Hypotheses of the study

The investigators framed two supporting hypotheses to check the significant difference between the selected user group, i.e. males and females, across different posed indicators, i.e. Usage, Awareness, Impact and Perceptions. Thus, the hypotheses are as follows:

H1. There is no significant difference in the usage and awareness of AI tools among northeastern students with respect to their gender.

H2. There is no significant difference in the impact of AI tools and students' perceptions among northeastern students with respect to their gender.

5. Research methodology

The present study focuses on the sample population from Northeast India, which comprises the contiguous seven sister states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. This region shares its boundary with neighbouring

countries, including China, Nepal, Bhutan, Myanmar and Bangladesh. The Northeast Indian tribes originated from the ethnic groups of Tibeto-Burmese, Proto-Austrioloids and some Indo-Mongoloids. The level of education in Northeast India is unlike India's rest due to several reasons, such as geographical distinction, cultural diversity, religious pluralism, socio-cultural heterogeneity and linguistic varieties. However, North East India (NEI) is a mini world within the world, and the region has become the most neglected area in the country. This trait has alienated the region's population from India and created a socio-cultural gap. Thus, after considering the nature of the study region, the researchers adopted a mixed-method research design combining a survey questionnaire with two open-ended questions. It was designed by reviewing previously published studies (Almaraz-López *et al.*, 2023; McLennan *et al.*, 2022; Syed and Basil A. Al-Rawi, 2023) that intended to observe the needs and perceptions of the sample population.

The questionnaire was developed to fulfil the study's objectives and thus segregated into three sections. The first demographic section (section A) contains six questions, and sections B and C contain eight questions, each focusing on the usage, awareness, perception and impact of AI-based tools/software on students learning and education. Thus, all 16 questions were mixed in nature, i.e. a few were multiple-response questions, most were based on the Likert scale and two open-ended questions were also included to know their present-day challenges and perceptions regarding AI usage. After the initial draft of the questionnaire, it was subjected to check its content validity by the experts and senior professors of concerned specialisation. Moreover, the questionnaire's reliability test was also done by calculating Cronbach's alpha coefficient, which is found to be 0.816, indicating a high internal consistency level for questionnaire items with this specific sample.

The census sampling technique was used, and a Google Forms generated link to an online questionnaire was administered among the UG and PG university students of Northeastern India from January to March 2024, via different online mediums. The researchers had closed the survey after sending three to four times gentle reminders and continuous follow-ups. The sample size for an infinite population has been estimated by using the Cochran formula (1963) i.e. $n_0 = \frac{z^2 \times p \times q}{e^2}$, where n_0 is the sample size, z is the selected critical value of the desired confidence level, p is the estimated proportion of an attribute present in the population, $q = 1 - p$ and e is the preferred level of precision (Nanjundeswaraswamy and Divakar, 2021). Because the researchers wanted to calculate a sample size of a large population whose degree of variability is not known, and assuming the maximum variability, which is equal to 50% ($p = 0.5$) and taking 95% confidence level (i.e. $z = 1.96$) with ±5% precision (i.e. $e = 0.05$), the calculation for required sample size will be as follows:

$$n_0 = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.5)^2} = 384.16 \approx 384$$

After administering the questionnaire to 384 students, the researchers received 175 responses, receiving a response rate of 45.6% (a margin of error of 5.46% at a 95% confidence interval). The researchers have taken multiple follow-ups to gather at least the recommended response rate, as indicated in other published studies (Ajmal *et al.*, 2010; Karlsen and Gottschalk, 2004; Phang and Foong, 2010; Zhou *et al.*, 2024; Memon *et al.*, 2000). However, while preparing this manuscript, the researchers were cautious and concerned about the non-response bias due to the low response rate. Still, no significant non-response bias was found after examining the normality data through the skewness and Kurtosis values. This exploratory small-scale research aimed to uncover which AI tools

graduate students use and how the usage and perception of these tools influence their educational experiences. The data was exported to MS Excel 365, and analysis was done by using Jeffreys's Amazing Statistics Program (JASP) (Version 0.16.3.0; JASP Team, 2022) and a mixed-method data analysis software called MAXQDA 24 (VERBI Software, 2021). The data was analysed by using an independent sample *t*-test to explore gender-based differences with respect to awareness and usage of AI-based tools and, consequently, its impact on students' perceptions from select northeastern universities.

6. Data analysis and interpretation

6.1 Demographic analysis

The section explores the findings from the survey study. Figure 1 presents demographic data for the survey participants. The multi-item graph contains four types of information: educational qualification, age group, gender and subject disciplines of the survey respondents. The demographic data shows that most respondents were graduates (71%) aged 18–23 (72%). The male respondents show more significant interest, with 59% of the total representation and 41% of female representation, which aligns with the findings of Balabdaoui *et al.*, 2024). Considering the subject representation of the respondents, it was revealed that pure science (24%) was a dominant subject. However, the subject representation of the respondents shows discrete data, which shows that the data gathered covered heterogeneous subject areas.

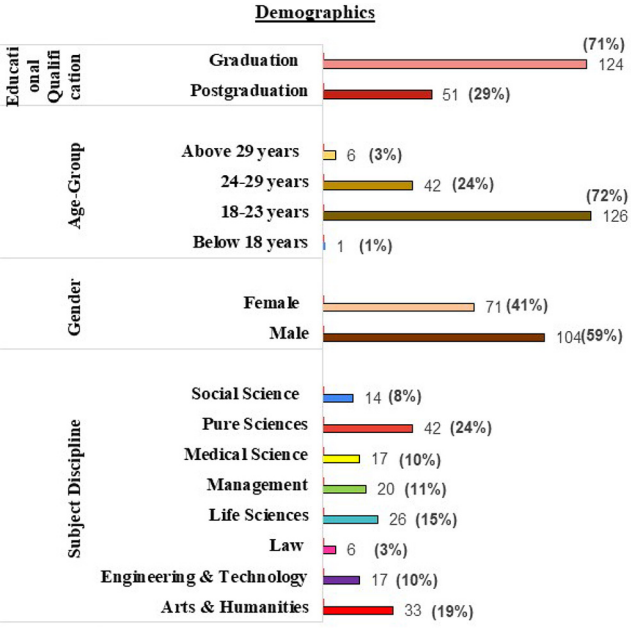

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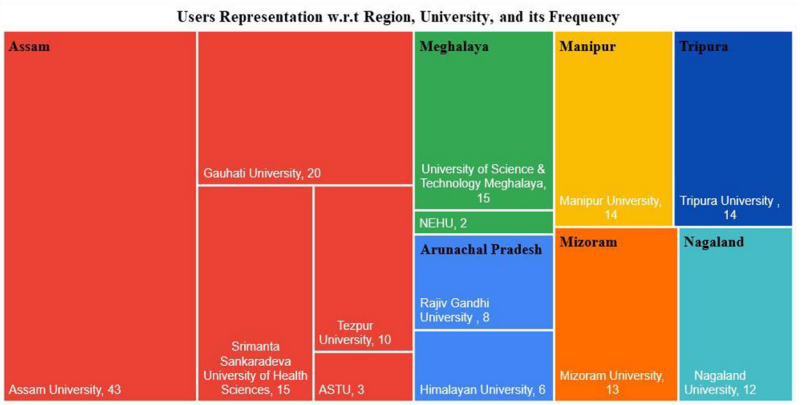
Figure 1. Demographics of survey respondents

Figure 2 shows the user representation of geographical distribution through a tree map. The tree map reveals that Assam contributed 52% of the total respondents, with participation from Assam University, Gauhati University, Srimanta Sankaradeva University of Health Sciences, Tezpur University and Assam Science and Technology University. Meghalaya represented 9.71% of the total respondents by comprising two institutions, i.e. the University of Science and Technology and North-Eastern Himalayan University. In contrast, the states of Manipur, Tripura and Arunachal Pradesh comprise 8% of the respondents. Mizoram and Nagaland show minimal representation compared to these other regions, with 7.42% and 6.85% of the total respondents, respectively.

6.2 Analysis of the multiple-response questions

Following the demographic analysis, the investigators analysed three multiple-response questions to analyse the most used AI tools, their mode of access to AI tools and the purpose of their usage of AI-based tools. Tables 1–3 portray the analyses of three multiple-response questions (MRQs), respectively. In each table from 1 to 3, *N* denotes the number of selected responses, and percentage indicates the proportion of the total number of selected responses, i.e. *N*/total responses. In the other column, the percentage of responses is expressed as the total number of respondents. As each respondent was entitled to select multiple options, the total percent of total respondents selected exceeds 100% because it represents the percentage of each response concerning the total respondents (Jann, 2005; Vaidya, 2021).

Table 1 reveals that 129 (73.7%) respondents use ChatGPT as the most preferred AI tool for generating their daily assignments, similar to the study conducted by Garrel and Mayer (2023) and Costa *et al.* (2024). The subsequent preferred tools are Grammarly and QuillBot, which are found to be equal to 22% and 15.2% of the responses, respectively. It is also observed that other AI tools, such as BingAI, BardAI and CoPilot, are also being used rarely by the student community for their daily assignment purposes.



Note(s): *NEHU: North-Eastern Himalayan University; SSUHS: Srimanta Sankaradeva University of Health Sciences; ASTU: Assam Science and Technology University
Source(s): Authors' own work

Figure 2. User distribution w.r.to states and universities

Table 1. Most preferred AI tool

Statement	Options	Responses *N*	Responses %	% of total respondents selecting
Q8. "Which AI-powered tool do you use the most in your daily assignments?[a]	ChatGPT	129	48.9	73.7
	BingAI	15	5.7	8.6
	CoPilot	6	2.3	3.4
	BardAI	13	4.9	7.4
	QuillBot	40	15.2	22.9
	Grammarly	58	22.0	33.1
	No answer	3	1.1	1.7
Total		264	100.0	150.9

Note(s): [a]Dichotomy group tabulated at value 1
Source(s): Authors' own work

Table 2. Preferred medium to access the AI tools

Statements	Options	Responses *N*	Responses %	% of total respondents selecting
Q11. Predominantly, which of the following gadgets do you use to access AI-based applications?[a]	Smartphones	145	63.6	82.9
	Desktops	42	18.4	24.0
	iPad	14	6.1	8.0
	Equally, both mobile devices and desktop	27	11.8	15.4
Total		228	100.0	130.3

Note(s): [a]Dichotomy group tabulated at value 1
Source(s): Authors' own work

Table 3. Purpose of use

Statements	Options	Responses *N*	Responses %	% of total respondents selecting
Q13. For which academic purpose(s) do you use AI-based applications the most?[a]	For preparing assignments	99	49.5	77.3
	For preparing class presentations	44	22.0	34.4
	For research writings	30	15.0	23.4
	For writing emails	26	13.0	20.3
	No answer	1	0.5	0.8
Total		200	100.0	156.2

Note(s): [a]Dichotomy group tabulated at value 1
Source(s): Authors' own work

Likewise, Table 2 analysed the responses about their mode of access to AI-based applications, it was found that smartphones turned out to be the most preferred medium (i.e. 82.9%), followed by desktops and iPads with 24% and 8% of the respondents, respectively. These findings are similar to the findings of Juma (2021), indicating relatively stable preferences among higher education students in recent years.

Subsequently, the findings of Table 3 reveal that the majority of the respondents (77.3%) use the AI tools for "preparing assignments", followed by "preparing class presentations" and "research writing". These study findings are similar to the study conducted by Adiguzel *et al.* (2023). Hence, it is clear that students are using AI-based tools for various academic tasks and primarily for writing purposes.

6.3 Usage and awareness of artificial intelligence tools among students

After analysing the MRQs, this section explores the extent of awareness and usage of AI-based tools by graduate students at northeastern universities of India in their academics. In Figure 3, the respondents were asked about how long they have been using AI-based tools in their academics, and it is revealed that a maximum of them (46.85%) have integrated the usage of AI from "less than a month", followed by *one to three months* (25.71%).

This demonstrates that in the past six months, more than 80% of respondents have integrated AI-based tools into their educational pursuits; hence, northeastern university students' awareness and usage of AI-based tools have surged during the past six months. For the same purpose, the hypothesis was also framed to determine the significant differences between the male and female students at the selected universities regarding usage and awareness of AI tools, where an independent sample *t*-test was used.

H1: There is no significant difference in the usage and awareness of AI tools among northeastern students with respect to their gender.

6.3.1 Gender-based variation regarding awareness and usage of artificial intelligence tools in education. As illustrated in Table 4, participants had a relatively low usage awareness of AI tools in academic writing, with mean scores ranging from 2.394 to 3.385 among all the respondents. Specifically, male respondents had the highest mean score regarding their usage and awareness level of AI-based tools (M = 3.385, SD = 1.225), and female respondents scored the lowest mean score for frequent usage of any AI-based tool (M = 2.394, SD = 0.978), indicating that male respondents are comparatively more aware of AI-based tools but are less frequently using these tools, than that of the female respondents. These findings align with Arowosegbe *et al.* (2024) and Grassini and Ree (2023a), revealing that while men are more aware of AI, women are more likely to integrate these tools into their daily activities.

Moreover, by applying an independent sample *t*-test, the awareness and usage of AI-based tools were analysed between male and female respondents of select northeastern universities. It portrays that the *p*-value for these items is less than 0.05 (i.e. 0.001), which is

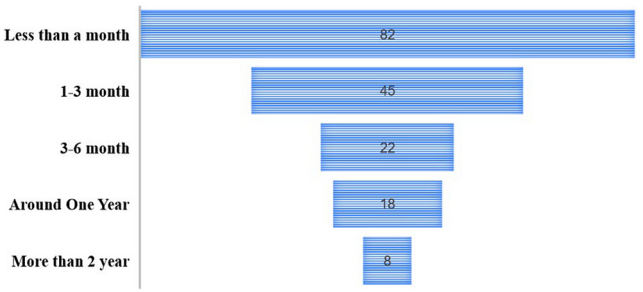


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Figure 3. Frequency of using AI-powered tools for academic purposes

Table 4. Awareness and usage of AI tools w.r.t gender

Statements	Gender	Mean	SD	*p*-value
How much are you aware of AI-based tools like Grammarly, Chat-GPT, Google's Bard, QuillBot, Bing-Chat, etc.?	Male	3.385	1.225	<0.001[a]
	Female	2.746	1.038	
How frequently have you used any AI-enabled tool for academic/scholarly writing (text translation, spelling, summarising, plagiarism check)?	Male	2.942	1.069	<0.001
	Female	2.394	0.978	

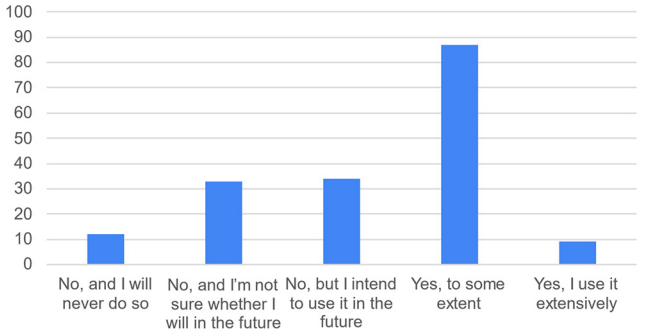
Note(s): Student's *t*-test; [a]Levene's test is significant ($p < 0.05$), suggesting a violation of the equal variance assumption; Male = 104; Female = 71
Source(s): Authors' own work

less than its recommended value. It means there is strong evidence against the null hypothesis, and thus, it is rejected. It suggests a significant difference exists between the awareness and usage of AI-based tools in their university education.

6.4 Impact of using artificial intelligence tools and its perceptions among students

After determining their awareness and usage level of the AI-based tools, it was assessed to explore its impact on the students at the northeastern universities and, subsequently, their perceptions after using AI in education.

In Figure 4, the respondents were asked about their degree of usage of AI-based educational tools, which reveals that about 88 (46.7%) of the respondents affirmed that they are using AI-based tools to some extent, followed by 20% of them had not but intended to use them in the future. Surprisingly, only a small fraction of respondents favour using these extensively, and another small fraction refuse to use it at all; each group represents approximately 5% of the respondents. Thus, it can be assessed that the degree of usage of AI applications among the student community in the northeastern region of India is decent, which is in line with the study findings by Chan and Hu (2023). For the same purpose, the hypothesis was also framed to determine the significant differences between the male and female students at the selected universities regarding the impact of AI tools and students' perceptions, where an independent sample *t*-test was used.



Source(s): Authors' own work

Figure 4. Degree of usage among students

H2: There is no significant difference in the impact of AI tools and students' perceptions among northeastern students with respect to their gender.

6.4.1 Gender-based variation regarding the impact of artificial intelligence tools and students' perceptions. In the cutting-edge, tech-driven knowledge society, AI has become pervasive and ubiquitous, and it is positively and negatively impacting the lives of every individual in all sectors. Table 5 explores a gender-wise assessment of how graduate students perceive AI and how it impacts students' lives. Table 5 summarises those overall students who positively impacted their perceptions, with mean scores ranging from 3.099 to 3.529. Specifically, male respondents reported the highest mean score compared to their counterparts regarding the impact of AI on their perceptions (M = 3.529, SD = 1.061). In contrast, female respondents scored (M = 3.099, SD = 1.185), indicating their extent to integrating AI in education that can help them further enhance their overall learning experience. These findings are in connection with the study findings of (Avery *et al.*, 2023; Franken *et al.*, 2020; Grassini and Ree, 2023b), which again signifies the enhancement of the students' learning experience after integrating AI into their academics.

Furthermore, the findings show that male respondents' level of satisfaction with the overall experience of using AI technologies was higher (i.e. M = 3.462; SD = 0.812), which again signifies the burgeoning use of AI and the higher scope of satisfaction. Likewise, when applying an independent sample *t*-test, the *p*-values for Q1 and Q5 suggest that these are less than the recommended *p*-value of 0.05 (i.e. 0.013 and 0.006, respectively), hence suggesting that a significant difference existed between the impact of using AI and students' perceptions of integrating AI in their academics. On the contrary, the remaining three questions, i.e. Q2, Q3 and Q4, show no significant difference between the impact and the students' perceptions because the *p*-values are greater than the recommended value of 0.05 (i.e. 0.212, 0.135 and 0.064). This suggests that the impact of AI on the perceptions of the graduate students from the northeastern universities showed gradual variations when they were asked about the extent of integrating AI and their level of satisfaction.

6.5 Analysis of open-ended responses

This section describes the findings of the qualitative data analysis gathered by posing two open-ended questions in the survey-based questionnaire. The first question primarily covers

Table 5. Sub-group analysis of impact of AI on students' perceptions w.r.t gender

Questions	Gender	Mean	SD	*p*-value
To what extent do you think AI integration in education can enhance students' overall learning experience?	Male	3.529	1.061	0.013
	Female	3.099	1.185	
In your opinion, how user-friendly are current AI-based educational applications for students and educators?	Male	3.231	0.978	0.212
	Female	3.042	0.977	
To what extent do you think your friends or classmates' opinions about AI integration in education influence your perceptions and decisions about using such technology?	Male	2.981	1.005	0.135[a]
	Female	2.732	1.171	
What are your general feelings and attitudes towards using AI in educational settings?	Male	3.413	1.011	0.064
	Female	3.113	1.103	
What is your level of satisfaction with the overall experience of using AI technologies?	Male	3.462	0.812	0.006
	Female	3.099	0.897	

Note(s): Student's *t*-test; [a]Levene's test is significant ($p < 0.05$), suggesting a violation of the equal variance assumption; Male = 104; Female = 71
Source(s): Authors' own work

the *challenges faced while using AI-based tools and platforms in their academics*. Another question was asked about their *overall perception regarding using AI in learning and imbibing new concepts*. The open-ended responses were analysed quantitatively and visualised with the help of word clouds by using MAXQDA 24 (VERBI Software, 2021) and interpreted subsequently.

6.5.1 Analysis of first open-ended question. In alignment with the quantitative survey questions, the investigator(s) analysed 167 open-ended responses, in which a total of 552 unique words were analysed by applying a threshold of five as a minimum frequency for the occurred words. With these sets of words, 12 different words were retrieved with the type-token ratio of 0.0217, and subsequently, the ranks were generated to their frequencies in decreasing order.

Table 6 represents different challenges that grad students face while using AI tools in their academics. It is well portrayed by the calculated ranks that possible challenges were lack of infrastructure/lack of internet connectivity/lack of sufficient technical skills, information resources and related support, and similar findings can be interpreted from the word cloud, as given in Figure 5.

Furthermore, when the collected responses were refined manually, a few of the responses stated that "the human mind is far better than AI"; "AI is a very helpful and advanced platform, especially for students, but in rural areas, internet connectivity is a major issue". One of the respondents contradicted the response, as quoted:

> Utilizing artificial intelligence (AI) platforms proves to be a convenient endeavour, as accessibility to such resources is not arduous whatsoever. Engaging with AI not only eliminates any impediment to knowledge acquisition but also enhances our ability to implement ideas more effectively. Given the widespread availability of affordable internet access in current times, the task of accessing AI is no longer a formidable challenge.

Moreover, a few of the respondents testified that the "Contents on AI-based tools are sometimes contradictory. We don't get facts or data that we deeply require so a more filter-based approach should be provided to get precise data"; "Some AI tools could answer only theory-based questions, they cannot deal with mathematics. Moreover, they are not up to date. The information they provide is backdated"; "Most of the AI-based tools ask ample

Table 6. Calculated ranks as per the frequently used words in the context of challenges

Words	Frequency	%	Rank
Lack	122	22.10	1
Internet	51	9.24	2
Skill	43	7.79	3
Connectivity	40	7.25	4
Technical	40	7.25	4
Sufficient	28	5.07	6
Infrastructure	18	3.26	7
Challenge	11	1.99	8
Information	8	1.45	9
Tool	8	1.45	9
Issue	7	1.27	11
Problem	5	0.91	12

Source(s): Authors' own work

Source(s): Authors' own work

Figure 5. Word cloud depicts the possible reasons behind their challenges

amount of money to get their subscription for a better experience", while some quoted that "Lack of desired output especially solution, sometimes it gives wrong answers to complex problems of engineering and mathematics".

6.5.2 Analysis of second open-ended question. Investigator(s) analysed 130 open-ended responses, in which a total of 618 words were analysed by applying a threshold of five as a minimum frequency for the occurred words. With these sets of words, 21 different words were retrieved with the type-token ratio of 0.0340, and subsequently, the ranks were generated to their frequencies in decreasing order.

Table 7 represents the overall perceptions of graduate students when they were asked about their AI usage in learning and imbibing new concepts. Subsequently, the calculated ranks show the most frequently occurring words and the same has been visualised in Figure 6 through word cloud. Moreover, when these responses were evaluated manually, then all responses were aligned with these retrieved words, as shown in Table 7. Interestingly, when their emotions are characterised in terms of their positive and negative sentiments, they come out as mixed perceptions regarding the use of AI in learning and imbibing new concepts, which is presented in Table 8.

Thus, Table 8 interprets that AI is a lifesaving tool in today's world. It helps us to become aware of what is necessary for being able to act adaptively in an environment and what is necessary for being able to solve problems intelligently. Furthermore, these sentiments are categorised and presented in Table 9, which shows that their overall challenges and perceptions are in neutral territory.

However, it is important to remember that the human brain is not a computer. Al can save time, eliminate biases and automate repetitive tasks. Furthermore, the responses connote that using AI in learning is beneficial for a short period, but it will have a negative impact in the long term. That entirely depends on it, creating a human mind lacking self-analysis and problem-solving skills. AI should be used to get information, not to solve or analyse problems.

Table 7. Ranking as per the frequently used words in the context of overall perception

Words	Frequency	%	Rank
Help	17	2.75	1
Learn	17	2.75	1
Student	13	2.10	3
Education	11	1.78	4
Time	11	1.78	4
Impact	10	1.62	6
Information	10	1.62	6
Tool	8	1.29	8
Problem	7	1.13	9
Technology	7	1.13	9
Work	7	1.13	9
Future	6	0.97	12
Concept	5	0.81	13
Easily	5	0.81	13
Great	5	0.81	13
Helpful	5	0.81	13
Human	5	0.81	13
Potential	5	0.81	13
Quickly	5	0.81	13
System	5	0.81	13
Useful	5	0.81	13

Source(s): Authors' own work

Source(s): Authors' own work

Figure 6. Word cloud depicts their overall perception regarding the AI usage

7. Conclusion

The presented study investigated how students at Northeastern Indian universities use, perceive and are aware of AI tools in an educational setting. Both male and female participants enthusiastically used AI tools, demonstrating a balanced awareness and usage. This suggests that students widely accept and use AI technologies in educational environments. AI tools such as ChatGPT, QuillBot and Grammarly were the most popular choices for assignments, with these tools being predominantly accessed via smartphones. This underscores how AI systems can seamlessly assist students in their academic pursuits. Over the past several months, introducing AI technologies to several students revealed a growing exposure and familiarity with these tools. This study found that male students

Table 8. Mixed opinions regarding AI usage in learning

S. no.	Positive opinions on AI usage	Negative opinions on AI usage
1.	Al has enormous potential if we start using it wisely for our country's development	More than its positive points it may impact the intellectual abilities of students
2.	Traditional ways of learning are good, but using AI is better	Do hard work and use your brain cells rather than wasting time on AI. Read books. We cannot agree with AI 100%. After all, it is we humans who are developing such wonderful things. Believe in yourself, not in AI
3.	AI makes education more accessible and engaging for learners, and its integration into the education system can enhance students' overall learning	The creative industry is getting pushed back due to the emergence of AI. It can be used but to a limit where we use brains to use it
4.	It's going to revolutionise the whole education system	It has diminished human beings' capacity for creativity. We are losing touch with our fundamental nature as new technology becomes a part of our daily lives. I primarily use AI tools for grammar checks, though I also use them occasionally to quickly make notes. However, instead of using AI technologies to find solutions, I often prefer reading books and academic publications
5.	AI is indeed a great opportunity for enthusiastic learners to learn, and to make themselves educated	I'm not in favour of this as it can impact our skills
6.	It may have a revolutionary impact on education if it's used in a guided manner	It's all good, hopefully, it won't eat the human jobs in the future
7.	It is beneficial but if not used or implemented in a good way may create many problems	It has potential but at the same time has chances of unfair use
8.	I think that using AI tools can help us to choose the most suitable course, materials and methods for our goals, preferences and availabilities. It can also help us to improve our critical skills	My overall view is that the extensive use of AI-based tools will lower the thinking capacity of a student and they will not be able to generate innovative ideas of their doubt because of AI-based tools students can get the answers to any question within a short time
9.	It gives more information in less time which helps to do the work before the deadline	Provides access to enormous amounts of information to everyone but leaning towards artificial technology for every simple problem might hinder the creative intelligence of human beings
10.	It's very fun and very useful in my opinion as we can easily get our subjective information and clear-cut concepts about my doubts	It doesn't provide in-depth knowledge but just gives summary-type ideas. So books remain the ultimate guide for broad knowledge
11.	I believe that it can provide personalised and adaptive learning experiences offer instant feedback and help identify areas where a learner might need more practice	In my opinion, it makes people less efficient as they rather depend on AI instead own talent/ knowledge
12.	The internet is a sea of information and AI helps to provide it in a systematic and factual manner	No doubt, AI helps us to do our assignments, presentations, etc. simultaneously it can harm us. Hence, students will not make efforts to learn new things which may finite their knowledge and due to this, there are some countries where AI was banned to safeguard their youth

Source(s): Authors' own work

Table 9. Categorisation of sentiments for open-ended questions

Categorisation in sentiments	What challenges do you face while using AI-based tools and platforms in your academics, like lack of infrastructure/lack of internet connectivity/lack of sufficient technical skills? Please mention	What is your overall perception regarding using artificial intelligence in learning and imbibing new concepts? Please give your opinion
Positive	10	28
Slightly positive	37	6
Neutral	91	38
Slightly negative	9	18
Negative	8	8
No sentiment	12	32

Source(s): Authors' own work

exhibited heightened awareness of AI usage, hinting at potential gender-based differences in technology adoption rates. Furthermore, the impact of AI on the perceptions of the graduate students from the northeastern universities showed gradual variations when they were asked about the extent of integrating AI and their level of satisfaction.

Despite positive perceptions of AI integration in education, students face challenges, including inadequate skills, poor connectivity, insufficient infrastructure and a lack of technical support. These obstacles emphasise the need for comprehensive approaches to enhance students' access to and competence with AI tools. Furthermore, this survey unveiled a nuanced range of opinions about AI use in education, encompassing different emotions categorised from positive to no sentiment, including slightly positive, neutral slightly negative and negative sentiments. This indicates that students thoroughly understand the benefits and drawbacks of AI in educational contexts, although opined predominantly in the neutral mode. The study's findings underscore the groundbreaking potential of AI tools to enhance students' educational experiences and outcomes. While there is a growing trend towards integrating AI, addressing the raised issues is essential to ensure equitable access and maximise the benefits of these tools in education. The integration of AI in education, especially in Northeastern India, has the potential to enhance learning efficiency and accessibility for students greatly. This technological advancement can shape public policy by encouraging investments in digital infrastructure, reducing regional educational gaps and promoting skill development in line with the National Education Policy 2020 and government initiatives. However, balancing these economic benefits with policies that address potential inequalities is crucial, ensuring that all communities are included. Future research may focus on developing specialised interventions and support systems to fully harness AI's capacity to empower students and enrich their educational journey.

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Further reading

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