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PAPER

An Investigation of University Students' Attitudes towards Artificial Intelligence Ethics

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ABSTRACT

The increasing complexity and widespread use of artificial intelligence (AI) underscore the importance of its ethical dimensions. Understanding diverse perspectives on AI ethics is crucial, especially among university students who will shape future technological advancements. This study aims to deeply examine university students' attitudes toward AI ethics, focusing on fairness, transparency, privacy, responsibility, and non-maleficence. A mixed-methods approach was used. In the quantitative phase, 355 students from engineering (E) and education science (ES) programs were evaluated using the AI Ethics Attitudes Scale. In the qualitative phase, semi-structured interviews with 23 students were thematically analyzed to gain detailed perspectives based on gender and discipline. The findings revealed significant gender-based differences in fairness and privacy, with female students scoring higher than male students. Interdisciplinary differences were evident in the transparency dimension, where ES students showed greater sensitivity. Interviews highlighted that female student emphasized legal compliance and data security more, whereas male students focused on financial information privacy. ES students prioritized user-friendly language and feedback and complaints in transparency discussions.

KEYWORDS

artificial intelligence (AI), attitude, ethics, university students

1 INTRODUCTION

Artificial intelligence (AI) technologies are regarded as one of the most significant revolutions of the 21st century, with advancements in this field progressing at a breathtaking pace [1], [2]. Continuous developments in big data analytics, machine learning, deep learning, and natural language processing have evolved AI technologies and become increasingly sophisticated [3].

Recent advancements in AI algorithms and models, increased computational power, and expanded data collection capabilities have revolutionized multiple sectors [4]. In healthcare, AI-assisted diagnostic systems help doctors detect diseases earlier and more accurately [5]. In the financial sector, AI applications such as

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risk assessment and fraud detection achieve high accuracy rates [6]. In education, AI-based personalized learning systems enhance learning by tailoring programs to individual student needs [7]. These technologies can transform daily life, offering personalized services to individuals and communities [8].

However, rapid AI advancements also raise significant ethical, legal, and social concerns [9]. Ensuring the fairness of AI systems, the transparent and ethical use of data, and preventing privacy violations are central issues in AI discussions [10].

AI ethics aims to establish consistent, applicable, and sustainable moral principles and regulations for developing, deploying, and utilizing these technologies [11]. Grounded in ethical values and widely accepted principles [12], a comprehensive approach is essential within AI ethics, focusing on fairness, transparency, privacy, and accountability [13].

This ensures AI technologies are used fairly and responsibly without harming people and society [13], [14].

Boddington [15] highlights the importance of fairness in decision-making, protecting privacy, and avoiding potential harm. Ethical principles like the balance of benefits and harms, justice, equity, moral agency, motivation, and transparency are critical for integrating AI into society and enhancing trustworthiness. However, challenges and uncertainties in implementing these principles hinder reliable and ethical AI use. Ensuring fairness is complex and requires unbiased, representative datasets to avoid discriminatory outcomes [16].

Transparency in AI decision-making is another significant challenge. It requires processes to be understandable and traceable, and a lack of transparency can lead to accountability issues [17], [18]. AI's need for large amounts of personal data poses privacy risks, and while regulations like GDPR aim to protect data, rapid AI advancements complicate these standards' implementation and updating [19], [20].

Given these challenges, understanding the ethical dimensions of AI and their impact on younger generations is crucial. This study examines university students' perspectives on AI ethics, focusing on how these perceptions influence their attitudes and concerns. The aim is to emphasize the practical implementation of ethical principles in AI, such as fairness, transparency, privacy, and accountability, and to raise awareness. Understanding students' attitudes and concerns is vital for developing policies and practices that promote ethical AI use, ensuring technologies are used more fairly, transparently, and responsibly, thereby building societal trust. This research aims to be a reference for future studies and contribute to the widespread adoption of ethical AI practices.

The aim of this study is to examine university students' attitudes towards AI ethics based on gender and academic discipline, enrolled in engineering and education sciences programs. The research questions of the study are defined as follows:

1. Are students' perceptions of AI ethics differ based on gender?
2. Are students' perceptions of AI ethics differ across different academic disciplines?

2 LITERATURE REVIEW

2.1 User attitudes towards AI ethics

Several studies have explored user attitudes and preferences towards AI ethics. For instance, Nadarzynski et al. [21] conducted a mixed-methods study to evaluate the acceptability of AI-led chatbot services in healthcare. The study revealed varying preferences for different recommendation algorithms based on the sensitivity

of the product category. Participants preferred content-based filtering approaches that do not store personal data for more sensitive products, such as contraceptives. In contrast, trust-based and social recommendation approaches, which rely on data from social media, were generally rejected. The findings underscore the importance of privacy and data security concerns in adopting AI technologies in healthcare settings.

Shen et al. [22] conducted a web-based study to assess Chinese dermatologists' attitudes towards artificial intelligence. The study involved 1,228 dermatologists from various regions in China who completed an online questionnaire. The results indicated that most participants obtained AI-related information through the Internet and meetings or forums, with 70.51% acquiring information through multiple sources. Almost all dermatologists (99.51%) paid attention to AI-related information to varying degrees. Significant differences in attention levels were observed based on gender, hospital level, education degree, and professional title. Most dermatologists (95.36%) viewed AI as an assistant in daily diagnostic and treatment activities.

Van Berkel et al. [23] investigated the effect of information presentation on fairness perceptions of machine learning predictors. In their study, 80 participants evaluated the fairness of predictors using two standard visualization techniques (text-based and scatterplot) and the display of outcome information. The results indicated that the chosen visualization technique significantly influenced fairness perceptions. Additionally, the perceived fairness was affected by the scenario, the participant's gender, and past education. Yoo and Jang [24] used text mining techniques to explore AI ethics perceptions among university students. The study involved 83 students who discussed various AI ethics topics on an online bulletin board. The analysis revealed that 62.5% of students viewed the future of AI society positively. Issues such as invasion of privacy, technology abuse, and unbalanced information acquisition were identified as concerns. The study highlighted the importance of ethical literacy in AI and provided insights for designing AI ethics education in liberal arts. Kieslich et al. [25] found that female students have stricter attitudes towards fairness in AI. However, our study extends this finding by exploring not only gender differences but also disciplinary differences between engineering and education students. Lin et al. [26] reported generally positive attitudes among dental students regarding the ethical challenges of AI in clinical practice.

Pinto dos Santos et al. [27] conducted a multicentre survey to evaluate undergraduate medical students' attitudes towards AI in radiology and medicine. The findings revealed that while most students recognized AI's potential to enhance radiological practice, they were not concerned about AI replacing human radiologists. Additionally, 71% of respondents agreed on integrating AI into medical education, highlighting the growing recognition of AI's relevance. The study also noted that male and tech-savvy students exhibited greater confidence in the benefits of AI.

Du and Xie [28] explored the ethical challenges and opportunities AI presents in consumer markets. They identified critical ethical concerns, such as AI biases, ethical design, consumer privacy, cybersecurity, individual autonomy, and unemployment. The authors emphasized the importance of corporate social responsibility (CSR) in shaping the ethical future of AI. They proposed a conceptual framework considering product-specific, company-specific, and institutional factors. Their study calls for a multi-layered ethical analysis of AI products. It suggests that firms must engage in socially responsible actions to address the ethical implications of AI at multiple levels.

Marienko et al. [29] analyzed the state of artificial intelligence (AI) literacy within Ukrainian secondary education. They found a significant gap in understanding and utilizing AI, with many respondents needing to familiarize themselves with the concept. The study highlighted the need for integrating AI literacy into digital competence frameworks and suggested adapting digital storytelling techniques

and incorporating AI services for educational purposes. The authors emphasized that while teachers generally have a positive attitude towards AI, there is a critical need for professional development and the creation of methods to integrate AI into secondary education effectively.

Despite these significant findings, more research is needed on young people's awareness of AI ethics principles and its impact on AI technologies. This study aims to fill this gap by examining university students' attitudes and concerns about AI ethics, focusing on fairness, transparency, privacy, responsibility, and non-maleficence. The goal is to enhance students' awareness and contribute to policies and practices that promote the ethical use of AI.

3 METHODOLOGY

This study is designed as an exploratory two-phase mixed-methods research to examine university students' attitudes towards Artificial Intelligence Ethics comprehensively. The mixed-methods approach aims to provide a more holistic perspective on the research question by combining the strengths of both quantitative and qualitative research methods [30]. The rationale for employing this methodological approach lies in its ability to integrate numerical data with contextual insights, thereby offering a nuanced understanding of the complex attitudes towards AI ethics. The research design of the study is presented in Figure 1.

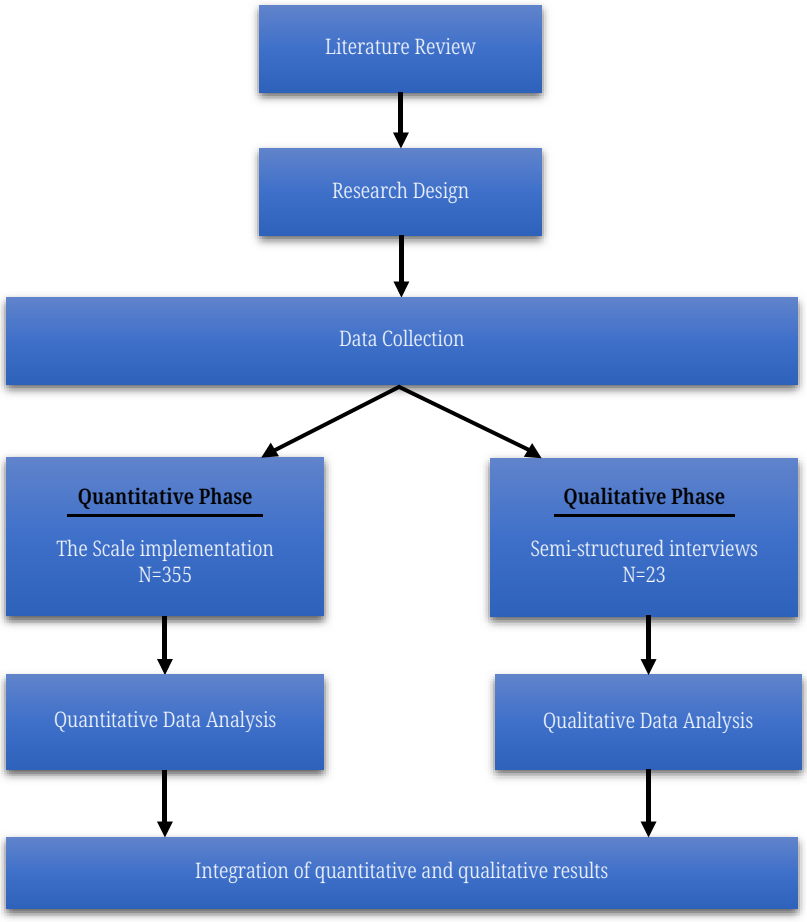

Fig. 1. The research design process

3.1 Participants

The study included a total of 355 participants, with 195 male students (54.93%), 158 female students (44.51%), and 2 students (0.56%) who preferred not to disclose their gender. The academic disciplines represented in the study were E and ES, with 185 students (52%) from E and 170 students (48%) from Education Sciences.

The qualitative phase of the study comprised 23 students enrolled in the ES and E departments at Near East University.

3.2 Data collection procedure

In the quantitative phase, the attitude towards AI Ethics Scale was distributed to 375 students via Google Forms, with 355 completing the survey anonymously. Following the quantitative data analysis, qualitative data were collected to explore attitudinal differences in more depth [31]. The researcher conducted face-to-face, semi-structured interviews with 23 volunteer students, using open-ended questions to examine their thoughts and experiences regarding AI ethics. With consent, the interviews were audio-recorded, each lasting about 15–20 minutes, and subsequently transcribed.

3.3 Data collection instruments

Attitude Scale towards AI Ethics: This study used the Attitude Scale towards AI Ethics developed by Jang et al. [13] to analyze students' attitudes towards AI ethics. The scale includes 17 items across five dimensions: fairness, transparency, privacy, responsibility, and non-maleficence, rated on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). It comprises two sections: demographic data and attitudes towards AI ethics. The scale demonstrated good reliability, with Cronbach's alpha values ranging from 0.753 to 0.865 and an overall reliability of 0.843.

Semi-structured interviews: Interview questions were developed based on the quantitative findings and items from the Attitude Scale towards AI Ethics. Reviewed by three educational scientists and two AI experts, the questions were evaluated for alignment with research objectives, openness, and the ability to prompt in-depth responses. After necessary adjustments, the interview questions were pilot-tested with five volunteer students to identify and address any language or logical issues, resulting in the final form of the questions. The qualifications of the three consulted experts in this study were critical for ensuring the quality and reliability of the semi-structured interview question development and implementation process. The educational scientists, with three, five, and eight years of experience in the field, brought valuable pedagogical knowledge and ethical sensitivity. Meanwhile, the AI experts, with four and eight years of experience in AI, contributed essential technical expertise and data analysis skills. Together, their combined expertise was instrumental in maintaining high standards throughout all phases of the research.

3.4 Data analysis

Quantitative data were analyzed using SPSS 25 software. The Kolmogorov-Smirnov test was used to assess data normality. The independent samples t-test compared means between two groups when normal distribution and equal variance assumptions were met; otherwise, the Mann-Whitney U test was applied.

Audio recordings of interviews were transcribed for qualitative analysis using thematic coding [32]. Transcripts were coded based on participants' responses, focusing on keywords, phrases, and meanings. The coding was reviewed for consistency by the researcher and two experts. Codes were then grouped into main and sub-themes with expert input. Each theme was linked to examples from transcripts and quantitative findings, and their significance to the study was assessed with expert feedback.

3.5 Threats to validity

Several measures were taken to address potential threats to validity. For internal validity, triangulation was employed by using both quantitative surveys and qualitative semi-structured interviews. This approach helps cross-verify data through multiple sources, thus enhancing the credibility of the findings. Regarding external validity, while the sample size may not allow for broad generalizations, the rich, detailed insights obtained can offer valuable preliminary understanding that could be tested in larger, more diverse populations in future research.

4 RESULTS

The findings of this study are presented in the order of the research questions, with quantitative phase findings first, followed by qualitative phase findings.

4.1 Quantitative phase

RQ1. Do students' perceptions of AI ethics differ based on gender?

Significant gender-based differences were found across each AI Ethics Scale dimension. Two participants who did not specify their gender were excluded from the analysis, leaving data from 353 students. The "Non-malicious Intent" dimension did not meet the normal distribution assumption (Kolmogorov-Smirnov test, $p > 0.05$). Consequently, independent samples t-tests were used for all dimensions except "Non-malicious Intent," for which the Mann-Whitney U test was applied (refer to Tables 1 and 2).

Table 1. Independent samples t-test results

Dimension	Gender	N	M	SD	t	p
Fairness	Male	195	3.69	1.015	4.02	0.000*
	Female	158	4.05	0.889		
Transparency	Male	195	3.98	0.982	1.281	0.199
	Female	158	4.09	0.839		
Privacy	Male	195	4.21	0.961	3.091	0.002*
	Female	158	4.62	0.813		
Responsibility	Male	195	3.17	0.892	1.251	0.209
	Female	158	3.22	0.836		

Note: *$p < 0.05$.

The t-test analysis examining the impact of gender on the dimensions of fairness, transparency, privacy, and responsibility is detailed in Table 1. The study found a significant gender difference in perceptions of fairness, with female students (M = 4.05, SD = 0.889) scoring higher than male students (M = 3.69, SD = 1.015); t = 4.02, p < 0.05. This finding demonstrates that female students value the fairness dimension of AI more than male students.

When it comes to transparency, the study found no significant difference in scores between male students (M = 3.98, SD = 0.982) and female students (M = 4.09, SD = 0.839); t = 1.281, p = 0.199. In other words, gender does not seem to strongly influence how individuals perceive transparency.

Statistically significant differences were found in privacy scores, with males (M = 4.21, SD = 0.961) scoring lower than females (M = 4.62, SD = 0.813); t = 3.091, p < 0.05. They indicate that female students perceive the AI privacy dimension more positively than male students.

There was no statistically significant difference in responsibility scores between male students (M = 3.17, SD = 0.892) and female students (M = 3.22, SD = 0.836); t = 1.251, p = 0.209, suggesting that gender does not significantly affect perceptions of responsibility.

Table 2. Mann-Whitney U test results for non-maleficence dimension by gender

Dimension	Gender	N	Rank Average	Rank Total	U	p
Non-Maleficence	Male	195	156.32	30481.5	190438.5	0.004*
	Female	158	202.52	31999.5		

The Mann-Whitney U test was employed because the normality assumption was not met in the "Non-Maleficence" dimension. Table 2 shows a statistically significant difference between the groups, favoring female students (U = 19438.5, p < 0.05).

RQ2. Do students' perceptions of AI ethics differ across different academic disciplines?

Based on data obtained from 395 students, independent sample t-tests were conducted to determine whether there were significant differences across academic disciplines encompassing "Education Sciences" and "Engineering" about the dimensions under study (refer to Table 3). These analyses aimed to ascertain if the academic discipline variable showed meaningful differences in these dimensions.

Table 3. Independent samples t-test results

Dimension	Academic Disciplines	N	M	SD	t	p
Fairness	E	185	3.91	0.979	–0.851	0.401
	ES	170	4.01	0.977		
Transparency	E	185	3.89	0.946	–2.011	0.043*
	ES	170	4.06	0.914		
Privacy	E	185	4.19	0.955	–1.331	0.192
	ES	170	4.28	0.886		
Responsibility	E	185	4.42	0.941	–0.942	0.352
	ES	170	4.52	0.876		

Note: *p < 0.05, ES-Education Sciences, E-Engineering.

As shown in Table 3, a significant difference was identified between ES students and E students on the "Transparency" dimension of the scale ($t = -2.011$, $p < 0.05$). This finding indicates that ES students are more sensitive to AI transparency principles.

No significant differences were found in terms of other dimensions (fairness $t = -0.851$, $p > 0.05$; non-maleficence $t = -1.331$, $p > 0.05$; privacy $t = -0.942$, $p > 0.05$; responsibility $t = 0.151$, $p > 0.05$). These findings indicate that students from different academic disciplines have similar perceptions of AI ethics.

4.2 Qualitative phase

In the quantitative phase of this study, gender-based differences in attitudes were found in the fairness, non-maleficence, and privacy dimensions of the AI Ethics Scale. The qualitative phase used phenomenological methods to explore students' perspectives and feelings about AI ethics principles—fairness, transparency, non-maleficence, privacy, and responsibility—categorized by gender and academic discipline. This approach provided a comprehensive understanding of these attitudes and the underlying reasons among different groups.

RQ3. Do students' perceptions of AI ethics differ based on gender?

Fairness: Following thematic coding analysis of qualitative data, the main themes of "Perception of fairness" and "Impact on fairness" have been identified under the "Fairness" dimension. Subthemes defined within these main themes and their distributions by gender are presented in Figure 2.

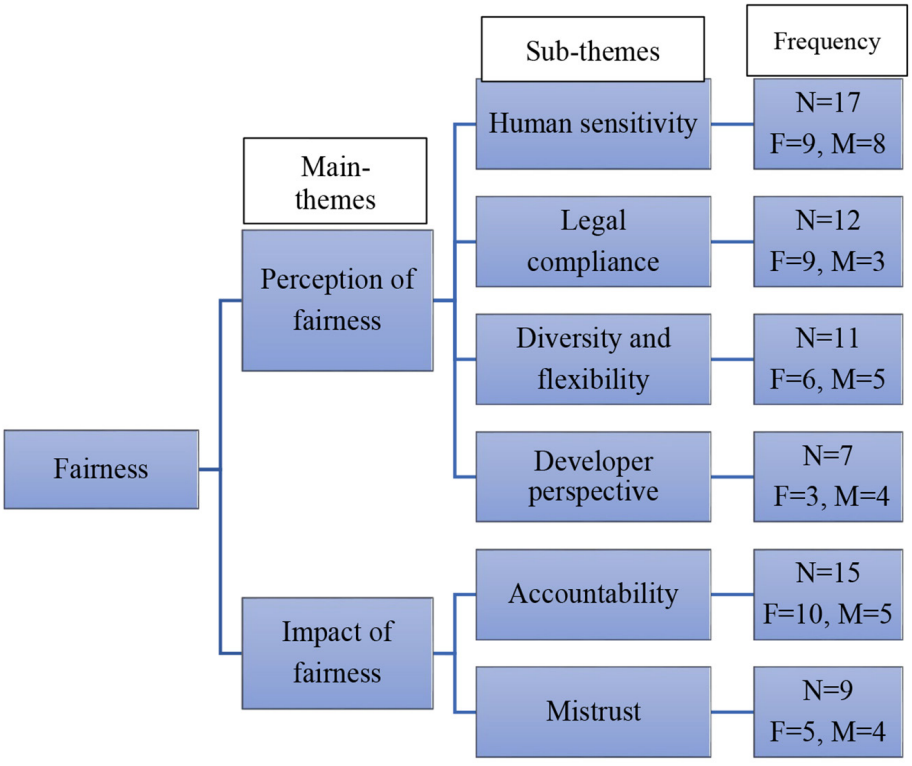

Fig. 2. The main and sub-themes under the "Fairness" dimension and their frequencies by gender (F-female, M-male)

When examining the main theme, "Perception of fairness," it was found that female students emphasize the sub-theme "Legal compliance" more than male students (F = 9, M = 3). This emphasis also highlights its strong association with the sub-theme "Accountability" in fairness (F = 10, M = 5).

Some student statements regarding the sub-themes of the fairness dimension are presented below:

> *"Humans are emotional beings, and we act based on our emotions. However, at this stage, AI lacks emotions; it operates in a purely semantic and logical manner, as it should, following an objective path. It connects concepts to create a roadmap and concludes." (F8)*
>
> *"Since AI is ultimately created by humans, I don't believe that AI directly makes decisions. In this case, it is the human who ensures fairness." (M3)*
>
> *"It is crucial for AI systems to operate in legal compliance. For example, as a student, I have concerns about the protection of my personal data. AI must adhere to data privacy laws." (F2)*

Non-Maleficence: Under the dimension of non-maleficence, two main themes have been identified: the "perception of malice" and the "outcomes of malice." Figure 3 presents the sub-themes defined under these main themes and the distribution of their occurrence frequencies by gender.

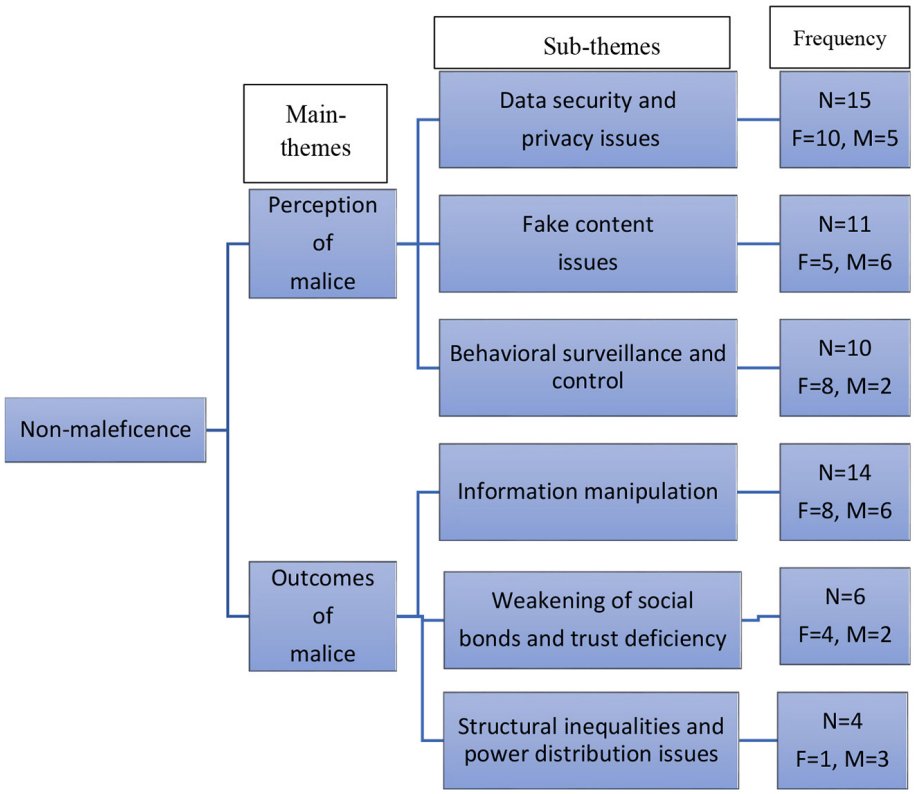

Fig. 3. The main and sub-themes under the "Non-Maleficence" dimension and their frequencies by gender (F-female, M-male)

Many students (N = 15) indicated that AI applications pose serious threats concerning "Data Security and Privacy." This concern was much more among female students (F = 10, M = 5). Additionally, the potential of AI systems to monitor and

control individuals' behaviors, referred to as "behavioral surveillance and control," emerged as another primary concern among the students, with female students highlighting this issue more frequently (F = 8, M = 2). Below are some student quotes related to the sub-themes within the dimension of non-maleficence:

> *"Considering how quickly fake content spreads, I am concerned about the risks AI might pose if used to produce malicious content. Could it be used to manipulate or deceive people? I am genuinely worried about this." (F4)*
>
> *"The idea of human behavior being controlled by AI is frightening, especially the potential for manipulation through ads or recommendations." (M10)*
>
> *"With the spread of fake news, AI could be used to increase ad revenue or influence consumer preferences." (M7)*

Privacy: Under the privacy dimension, the primary theme "privacy perception" was identified. The sub-themes within this primary theme were analyzed, including the frequency of expressions according to gender (see Figure 4).

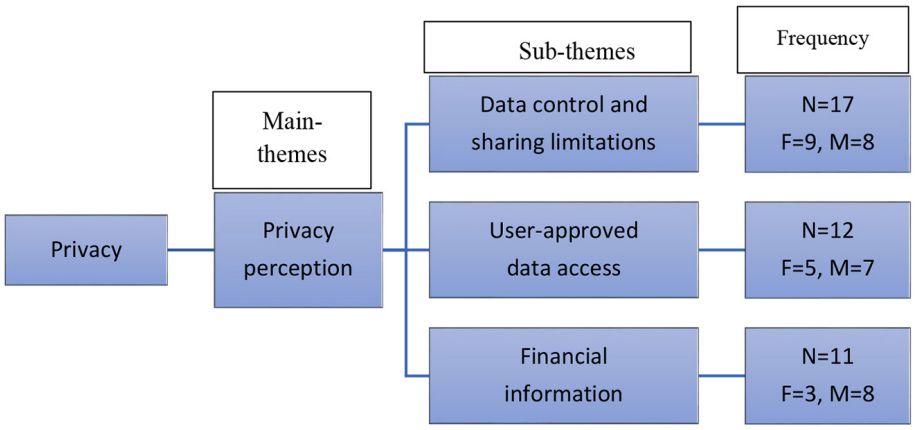

Fig. 4. The main and sub-themes under the "Privacy" dimension and their frequencies by gender (F-female, M-male)

"Data control and sharing limitations" was the most frequently expressed theme (N = 17), with a balanced distribution between female (F = 9) and male students (M = 8). Students emphasized the importance of controlling personal data and limiting its sharing, highlighting the need for data owners to be informed about data usage and to prevent unauthorized sharing.

Regarding "Financial information," male students (M = 8) expressed concerns more frequently than female students (F = 3). They emphasized the privacy and security of financial information, highlighting the risks of data breaches and the need to protect credit card details against cyber-attacks to avoid serious financial consequences. Here are some student statements concerning the dimension of privacy:

> *"If I am providing my personal information, which includes photos, family ties, and location data, the confidentiality of this information must be ensured. Permission must be obtained from the individual for the use of such information. There should be a notification stating, 'Your information will be used in this manner'." (F11)*
>
> *"I should be the one to decide who can access my data. I should be consulted on this matter." (F5)*

Transparency: Through thematic coding analysis of qualitative data, three main themes emerged under the "Transparency" dimension: "Information and understandability," "Transparency of decision processes," and "Responsibility and accountability." Subthemes identified within these main themes and their frequencies distributed by academic discipline are presented in Figure 5.

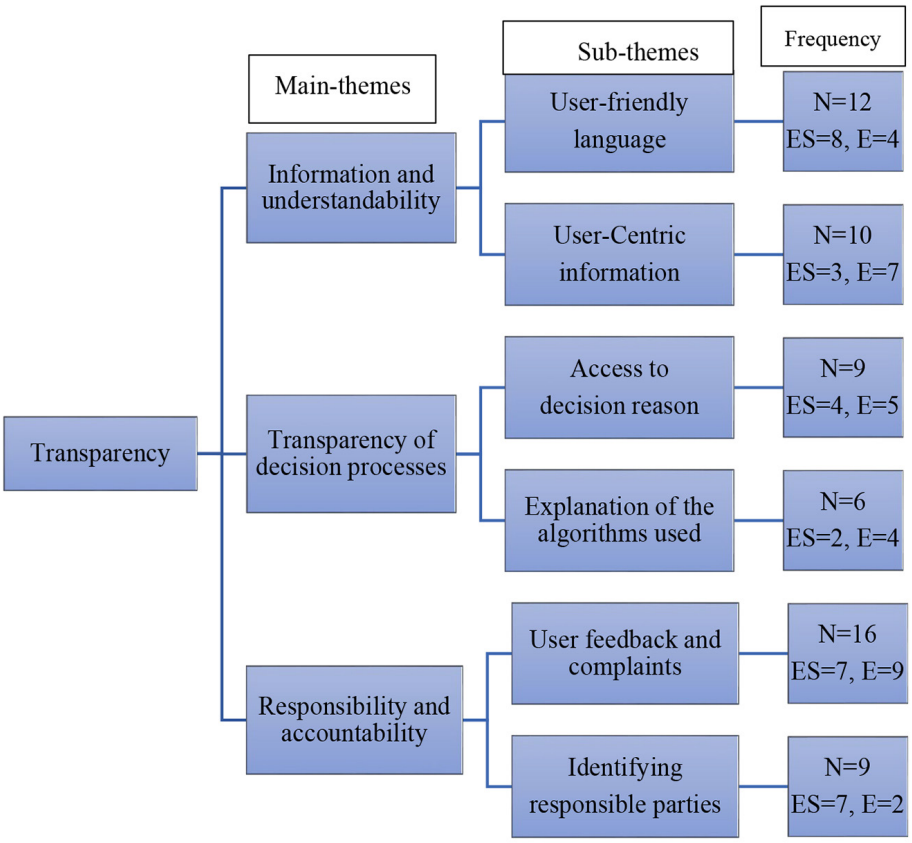

Fig. 5. The main and sub-themes under the "Transparency" dimension and their frequencies by gender (ES-Education Sciences, E-Engineering)

The subtheme of "user-friendly language," emphasizing the importance of comprehensible language use, was identified 12 times. It notably emerged as a critical factor among ES students (ES = 8) compared to E students (E = 4).

The subtheme of "User feedback and complaints," emphasizing the role of user feedback and complaint mechanisms in ensuring transparency, was identified 16 times, emerging as the most frequently mentioned theme among ES (ES = 7) and E (E = 9) students. Students highlighted the importance of users being able to provide feedback and lodge complaints about the operation of AI systems.

The subtheme of "User-Centric information," which emphasizes the importance of tailoring information to user needs, was frequently mentioned among E students (ES = 3, E = 7).

Below are some student statements that highlight themes under the transparency dimension:

> *"Using user-friendly language helps us understand how AI systems work more clearly. For instance, using 'mathematical method' instead of 'algorithm' could be more understandable." (ES1)*

"At times, AI systems can be confusing, making us wonder, 'Why did it make this decision?' But understanding the reasons behind AI decisions gives us more confidence. For example, when AI recommends a product, it can also explain the rationale behind the recommendation, allowing us to make more informed decisions about whether to purchase it." (ES4)

"Imagine using a translation AI app and noticing errors in translations. By providing feedback on these errors to the app developers, they can correct them and improve the quality of translations." (E4)

Responsibility: Quantitative data analysis found no significant difference among groups regarding the "Responsibility" dimension. However, to further elucidate potential linear relationships between this dimension and others, students were interviewed with fundamental and in-depth questions within this dimension. In this context, the responsibilities of various actors within the AI ecosystem, such as AI developers, legislators, technology providers, individual and corporate users, and the system itself, along with critical usage scenarios where determining these responsibilities is crucial [33], were subjected to content analysis based on student responses.

Students were asked which actor in the AI ecosystem bears the most responsibility when an undesirable outcome occurs due to implementing an AI system. The majority of students (n = 14) indicated that legislators are primarily responsible. A balanced distribution of responsibility was observed between developers (n = 8) and data providers (n = 7). Additionally, only two students considered users as responsible actors. Examples of student responses are provided below.

"Regulating the ethical use of AI is actually the job of legislators. There should be clear laws so that it is evident who is responsible when an issue arises." (M1)

"Most importantly, developers should consider potential risks and take necessary precautions to minimize these risks." (F9)

"Data providers must ensure that the data they provide comes from ethical sources and is free from biases." (F2)

5 DISCUSSION

This study investigates university students' perspectives on the ethical dimensions of AI. Quantitative data from online surveys assessed students' attitudes towards justice, transparency, non-malevolence, privacy, and responsibility, considering gender and academic discipline. Qualitative data from semi-structured interviews were analyzed to understand the reasons behind these attitudes and their interrelationships. The findings highlight how sociocultural and educational factors influence attitudes towards AI ethics.

The study reveals that female students are more sensitive to AI's potential for unfair outcomes, particularly in the "justice" dimension. Previous research supports this, showing that women have a heightened perception of fairness in machine learning predictions [23] and value justice even when algorithm accuracy declines [34]. Female students also stress "legal compliance" and "accountability," reflecting their concerns about the ethical use of AI [18, 34]. These findings underscore gender-based differences in attitudes towards AI ethics and the importance of fair and responsible AI systems.

The study reveals that female students are more concerned with "Data Security and Privacy" within the "Non-malevolence" dimension of AI ethics than male students.

Research supports that women generally show greater sensitivity to these issues [35], [36], possibly due to historical social pressures [37]. Female students also worry about behavioral surveillance and control by AI, as they experience more personal data breaches [37]. These findings highlight the influence of social and cultural experiences on gender-based differences in AI ethics.

Regarding the "Privacy" dimension, students universally emphasized "Data control and sharing limitations," reflecting widespread concern regardless of gender [38]. The critical importance of "User-approved data access" was also noted, underscoring the need for user consent in data processes [17]. Male students particularly stressed the privacy and security of financial information, indicating their awareness of protecting such data from cyberattacks.

In the study's "Transparency" dimension, "User-friendly language" emerged as more critical for ES students than E students. This difference likely stems from the pedagogical emphasis on clear communication in education programs. ES students, trained to convey complex ideas simply, value understandable language in AI systems. In contrast, E students prioritize technical accuracy and detail in documentation [39, 40]. Themes such as "User Feedback and Complaints" and "Identifying Responsible Parties" were more frequently noted by ES students, reflecting their concern for AI's social and ethical implications. This concern may be due to their broader societal role in upholding ethical standards. Conversely, E students mentioned "User-Centric information" more often, highlighting their user-centered approach to problem-solving. These findings illuminate interdisciplinary differences in attitudes towards AI ethics.

In analyzing the "responsibility" dimension of AI ethics, students from both disciplines recognized the roles of developers, regulators, and users in ensuring ethical AI practices. Most students attributed responsibility to regulators due to their authority to establish and enforce AI frameworks [41]. Developers are responsible for designing and coding AI systems, while data providers supply training data, both required to ensure safe and ethical operation [42]. Notably, few students saw users as responsible, suggesting a perception that using AI does not necessitate technical expertise and that users may not be aware of potential risks.

The findings of this study align with and expand upon existing literature on the integration of AI in education, particularly within the context of higher education in the Global South. For instance, Baidoo-Anu et al. [43] explored the perspectives of Ghanaian higher education students on ChatGPT, identifying both academic benefits and concerns. Similar to our findings, their study revealed that while students recognized the potential of AI tools such as ChatGPT to support their learning, they also expressed significant concerns about academic policy violations, excessive reliance on technology, lack of originality in assignments, and potential security risks. Woithe and Filipec [44] also found that higher education students generally view AI tools favorably due to their utility, user-friendly interface, and practical benefits. However, they emphasized the need for ongoing research to address inconsistencies in findings related to AI's impact on effective teaching and learning. This aligns with our study's conclusion that while AI tools hold significant promise, their effective use in educational settings necessitates continuous evaluation and refinement to maximize benefits and mitigate risks, highlighting the dynamic nature of the field and the importance of adapting to new developments.

In conclusion, this study indicates that AI technologies are perceived differently within ethical principles such as fairness, non-maleficence, privacy, transparency, and accountability, shaped by sociocultural and educational factors. Strengthening collaboration among policymakers, educators, and technology developers is crucial to managing AI risks and enhancing public trust in these technologies.

5.1 Implications for engineering pedagogy

The findings of this study have significant implications for E pedagogy, particularly in integrating AI ethics into the curriculum. E students, who are likely to be the future developers and implementers of AI technologies, must be well-versed in AI's ethical considerations. This study highlights the importance of incorporating AI ethics into E education to foster responsible and ethical AI practices.

Firstly, including AI ethics in the E curriculum can enhance students' understanding of the societal impacts of AI technologies. This knowledge is crucial for developing AI systems that are not only technically sound but also socially responsible.

Engineering educators should emphasize interdisciplinary learning, combining technical AI skills with ethical and societal perspectives. This approach can prepare students to tackle complex ethical dilemmas in their professional careers. Lastly, practical applications such as case studies, workshops, and seminars focused on AI ethics are not just beneficial but crucial. They can provide E students with hands-on experience in addressing ethical issues, making them active participants in the learning process. These activities can help bridge the gap between theoretical knowledge and real-world applications, ensuring that students are better equipped to make ethical decisions in their future work.

6 LIMITATION AND FUTURE RESEARCH

This study makes significant contributions by highlighting gender and interdisciplinary differences in attitudes towards AI ethics. However, the research sample is limited to students from a single university, which restricts the generalizability of the findings. Future studies could improve applicability by including a more diverse participant group from various universities and regions. Additionally, data collection relied on online surveys and semi-structured interviews. Using specialized instruments could better clarify participants' familiarity with AI ethics and their prioritization of ethical dimensions. Broader socio-cultural and demographic factors should also be considered for a more comprehensive perspective.

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