

# An Analysis of Engineering and Computing Students' Attitudes to AI and Ethics

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# (WIP) An Analysis of Engineering and Computing Students' Attitudes to AI and Ethics

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## Abstract

The Artificial Intelligence (AI) revolution continues to engage with the engineering and computing education world. A machine learning algorithm, or AI application itself, does not always cater to human ideals or ethical considerations. There is a need to be aware of this lack of contextual knowledge in order to design models accordingly. When considering our modern world and striving for diversity, equity, and inclusion, it is essential to ensure that technology works for all. Even though there is an excitement for the advancement of AI, there is also a need to enhance our understanding and consideration of the ethical implications of AI to inform future generations and future AI technology. The education system has a significant role in molding the minds of future AI pioneers and engineers. Therefore, it is vital to understand the attitudes and beliefs of undergraduate and graduate students who will play a pivotal role in the ethical implications of AI advancements. This work-in-progress paper focuses on a survey analysis to examine engineering and computing students' perspectives on ethics in AI before and after taking a course that includes AI and ethics within the syllabus. The following research questions will guide this study: What are the attitudes of engineering and computing students before and after taking a course that covers AI and ethics? In addition, how do their attitudes vary by demographics such as age, gender, and experience? Our goal is to present our current research and survey instrument to the American Society for Engineering Education (ASEE) audience to receive insight and feedback before finalizing the Institutional Review Board (IRB) and distributing it on the target campus. This work-in-progress closes out with the next steps, future work, implications, and concluding thoughts.

**Keywords:** AI education, AI Ethics, Engineering and Computing Students

## 1 Introduction

Today's society is experiencing massive shifts and advancements in technology. Specifically, there have been many developments in AI technology, and it continues to advance and be a part of our daily lives. Many industries utilize AI to grow, develop, automate, and optimize. However, there are always concerns about whether more good than harm is done and the long-term implications. AI, in particular, is tricky relative to its automated aspect, and therefore policies surrounding this technology often lag its advancement. There have been many concerns about AI's ethical and social implications and whether it contributes to the greater good of the human species and the natural environment. There have been numerous cases of ethical violations due to AI technology. Some of these range from false impersonation to threats to human life, with the growing concern of whether the technology is responsible.

AI education has a critical role in producing individuals interested in developing AI technology in the most ethical manner that seeks to preserve and protect humans and the environment at large. A pivotal aspect is informing future generations by setting the correct and appropriate foundations and precedence to secure the future of humanity. AI has a vast spectrum of applications across medicine, business, and

meteorological studies. Stix (2021) posited that an assessment of the state-of-the-art energy-efficiency learning in AI would have value because it could ensure ethical considerations for future generations where the long-term cost of a technological solution can be flagged early in advance. Therefore, methodologies and plans implemented now can impact the future due to global issues of uncertainty like climate change. The education system's critical role in evolving the best practices in AI education across disciplines should not be overlooked. As part of this work-in-progress (WIP), we developed a first draft of the pre-and-post survey instrument to disseminate to students before and after taking an undergraduate or graduate-level course that includes AI and ethics within the syllabus at a large minority-serving institution (MSI). To build the survey instrument, our team used prior literature related to theories of AI and ethics and the Flourishing Ethics (FE) theory to help drive the final list of questions. The pre-survey will be distributed to the students at the beginning of Fall 2022, and the post-survey at the end of the semester (approximately three days before the last day of class).

## 2 Literature Review

### 2.1 AI Revolution

AI permeates many aspects of our daily lives, including our education system, through AI education and various teaching and learning modes. This concept of AI pervasion is often referred to as the AI revolution. The 4th Industrial Revolution (or Industry 4.0) is technology-driven and comprises the AI revolution. Kayembe & Nel (2019) described Industry 4.0 as having new systems that will replace existing ways of performing tasks with human labor by using machines. The nature of an AI application is essential to consider because this technology is inherently coded and dependent on the developer and how they design it. Butler-Adam (2018) stated that as the AI industry is supported and invested in, there will be a growing demand for highly trained professionals. Workforces will need people whose jobs are reimaged, enriched, or facilitated by the technology they work alongside. There are also critical lenses surrounding the AI revolution. Harari (2017) expressed that rosy overall statistics can hide disparate groups in the industry. Furthermore, the author gave an example by stating that automation might have a different impact on men and women, people of different age ranges, and the university-educated and the illiterate. That is a notable point to consider since AI that works for all is the desirable goal. With improvements and considerations for diversity, equity, and inclusion within workforces, classrooms, research, industries, and policies, it is direly important for AI technology to be aware of the context in which it resides. AI technology in a diverse world should operate in a diverse context. A context that does not seek to disenfranchise any human physically, socially, or mentally. Therefore, careful consideration of the ethical implications of AI could not be stressed enough.

### 2.2 Ethics

Ethics is a vast concept that encompasses many layers and dimensions. Siau & Wang (2019) defined ethics as moral principles that guide an individual or a group. Their definition is simple, but as technology evolves, so does the complexity of the meaning of ethics. There are many theories for understanding ethics, and they are often based on different disciplines. Ethical theories aim to find out the best possible action to take within a given context, which will result in less harm when compared to other alternative actions. In his book, Stahl (2021) described two popular ethical approaches: utilitarian - where the ethical solution is derived from the net utility obtained when disutility is subtracted from utility; and deontology - where the ethical solution is based on the agent's discretion of action. Stahl (2021) also stated that those are not the only ethical approaches applied to AI, but there are others, such as virtue ethics, feminist ethics of care, and religious ethics. There is also the concept of moral duty, which is heavily linked to ethics. According to Chan (2020), moral duty is described as if one fails to commit an act, they have done something morally wrong. Many concepts of ethics can influence people's views

on technology. Chan (2020) mentioned a significant point that positionality influences people’s ethical beliefs and considerations.

Another interesting topic in ethics is human flourishing theories. Terrell Bynum first coined the term flourishing ethics in 2006. Since then, many researchers have been applying flourishing ethics as their paradigm for AI ethics. In Stahl (2020) ’s book, he stated, ”The central thesis of this book is that flourishing ethics can enlighten AI ethics and guide the development of practical interventions. Another example is Reiss (2021), in his paper on the use of AI education, who argued that education should support human flourishing, which will widen to non-human surroundings since it benefits humans too. There are two general categories of Flourishing Ethics (FE) –1. Human-Centered Flourishing Ethics which focuses solely on humans, and 2. General Flourishing Ethics which focuses on every entity existing within the universe, including humans. Bynum (2006) initially came up with the concept of flourishing ethics, also known as human flourishing theories. He claimed that FE could solve the following three problems that traditional ethical theories, such as utilitarian ethics, cannot solve: 1. rejecting all ethical theories but one – e.g., enthusiasts believing that their ethical views are the only correct ones. This may result in a loss of respect or understanding of different cultures; 2. cases where injustices can be seen as correct; 3. difficulty dealing with non-human agents such as robots.

## 2.3 AI and Ethics

Hanna & Kazim (2021) described AI ethics as an attempt to guide the behaviors of humans who design and develop artificial machines by carefully formulating the principles that govern our individual and social commitments and our highest ideals and values. We briefly discussed ethics in the previous section, and now we will discuss a few reasons why AI ethics is a pressing concern. Walker-Osborn & Hayes (2018) wrote a special issue paper titled, Ethics and AI – A Moral Conundrum, where they expressed concerns about the effects of AI on human populations. They discussed bias, racial discrimination, and gender bias that can unintentionally occur by AI technology. They also highlighted global ethical challenges that AI has on different countries where various countries have other laws and standards related to the technology. Another key point they mentioned is that now is the time to consider ethical issues in AI before laws lag too far behind the technology. However, Siau & Wang (2019) stated that many AI practitioners still believe that the technology is far away from achieving human consciousness. Therefore, there is no need to consider ethical issues. There are existing global issues, as noted by Walk-Osborn & Hayes (2018); therefore, it is necessary to address ethical issues in AI before the number of the problems escalate or become catastrophic.

## 2.4 Ethical AI

Siau & Wang (2019) explained a list of AI-causing issues, such as voice impersonation, altered videos, fake news, and violation of human privacy due to big data, as viable reasons for the need to promote ethical AI. Despite the negatives, there are also positive reasons. Stahl (2020) conferred two AI benefits based on human flourishing ethics. The first one is the Sustainable Development Goals developed by the UN, and the second one is human rights which are currently being worked upon to create a global agreement on ethical AI. There are many AI Ethics guidelines from notable organizations such as AI at Google, Open AI Charter, and Microsoft AI principles. These guidelines seek to promote ethical standards when building AI technology. However, there is a noticeable need for more diversity in AI. Based on a paper by Hagendorff (2020), there are only 7 out of 22 AI Ethics guidelines that cover the issue of diversity in AI.

On the policy level, Stahl (2020) noted that there are many policy papers on AI ethics. Many international organizations have policy initiatives that seek to endorse the progression and development of AI while considering social and ethical issues. However, Hangendorff (2020) asked a fundamental question of whether the ethical guidelines can invoke change in individual decision-making regarding a

broader social context. He reviewed a recent study that found that the ethical guidelines have no impact on the change in behaviors of technology professionals. The study highlighted that it is due to the nature of business where speed is essential, resulting in the skipping of ethical principles.

## 2.5 Students' Attitudes and Beliefs

Psychologists define attitude as "a relatively enduring organization of beliefs, feelings, and behavioral tendencies towards socially significant objects, groups, events or symbols" (Hogg & Vaughan 2005, p. 150, as cited in McLeod, 2018). Belief can be defined as the mental acceptance or conviction in the truth or actuality of some idea (Schwitzgebel, 2010, as cited in Connor & Halligan, 2015). Attitudes tend to influence belief and vice versa. Many studies on the influence of attitudes on the belief suggest that attitudes have a harmonic effect on the change of beliefs (Marsh & Wallace, 2005). Attitude is a holistic concept that influences a person's behavior, beliefs, experiences, and feelings. Therefore, we study this concept concerning AI and ethics and the role education plays in the picture. Sanchez (2019) stated that practices in universities are obsolete and not being translated into skills that are applicable in workplaces. Later in his piece, he mentioned that data literacy, technological literacy, and human literacy would be vital in the future labor force, hence the need for a new form of language deriving from a constant flow of diverse data from diverse sources. Those are all reminders that we are currently drifting into a new era. Therefore, it is imperative that students entering leadership roles in the industry be adequately prepared to approach AI ethically. Do engineering and computing students feel adequately prepared and well taught by their university on the three literacies mentioned above? Including those literacies can help drive students' understanding and attitudes about ethical AI.

In addition, it is of great importance to consider the positionality of engineering and computing students and the diversity of their cultural backgrounds. That can undoubtedly play a role in their ethical values and how they plan to apply them in their careers. As mentioned before, AI ethical guidelines are practical on an individual level. Therefore it is essential to understand how engineering and computing students think and perceive these tradeoffs between ethics and advancement in AI technology. It is insightful to study this target student population's attitudes and beliefs around the changing industries related to ethics in AI. Taking into consideration the rapidly changing aspects of AI, ethics linked to AI, the conversation of Ethical AI, the role of engineering and computing students when considering these topics, and their preparation to enter the workforce utilizing such knowledge, this survey will capture their attitudes and beliefs related to ethics in AI. First, our team will collect (1) general demographic data on each student, (2) students' attitudes on AI and ethics, and (3) their positionality. The following research questions will guide this study:

1. What are the attitudes of engineering and computing students before and after taking a course that covers AI and ethics?
2. How do their attitudes vary by demographics such as age, gender, and experience?

## 3 Research Design

### 3.1 Survey Development

This work-in-progress comprises the development of a survey instrument that will be designed within Qualtrics and disseminated via email to the target student participants. This study will be in the format of a before and after sequence since it seeks to examine the impact of education and what are students' takeaways and prevailing attitudes to AI and Ethics. The students will take the questionnaire no later than the first week of classes, and they will retake it no later than the last week of the class.

## 3.2 Target Population

The target population for the survey will include undergraduate and graduate engineering and computing students taking a course that has a syllabus that includes AI and ethics. A course from the undergraduate and graduate levels is selected to collect data from undergraduate and graduate students. The commonality both courses have is that they are offered to engineering and computing students, covering topics on AI and ethics. The target courses and sections have historically held about 35 students each. This group of students will gain knowledge of ethics and AI from the course, many of the students will participate in some internship or co-op, and they are likely to enter the industry after earning their degree. Students who agree to the pre-and-post course survey will receive a unique identification number to connect their two responses via match-pair during analysis.

## 3.3 Institutional Review Board

Our team will submit an IRB after the ASEE 2022 conference once we receive feedback on our survey instrument and make final changes to the survey. A consent form will be drafted for students so that they understand why we are collecting this data. Information on the researchers will be included as well.

## 3.4 Proposed Survey Instrument

Below is a sample outline of the survey to be designed via Qualtrics and deployed to the target student population pre-and-post the qualified Fall 2022 courses. The three areas (demographic data, students' attitudes on AI and ethics, and positionality) will have a mix of Likert scale questions, yes or no questions, multiple-choice and open-ended responses. Students will not be required to share any identifying information such as first or last name, email address, or other contact information. At the end of the survey, we will ask if they would be okay with us contacting them to follow up on their responses. We will request their first and last name, email address, and best contact number if they confirm. Our individual information will also be provided so that they are aware of who we are. Figure 1 displays our proposed Pre-and-Post survey questions.

## 3.5 Instrument Data Reliability and Validity

To ensure reliability, data collection will be done by employing internal stability and comparing the responses from the participants. To ensure validity, the questions will be based on what was found in the literature and centered around the research question. Based on the results from the survey, our team will construct interview questions to get more details and insights. Our team will use descriptive statistics to analyze the quantitative data to find the mean, mode, median, standard deviation, and skewness of data from the pre-survey. That helps summarize and understand the participants' views based on their gender, experience, or age group. ANOVA and t-test inferences will be used to compare pre-and post-test responses, test for dependency, and determine when one influenced the other. Qualitative data will be analyzed using thematic analysis to find similar themes among open-ended responses and derive a general thematic understanding of the survey participants. Based on the results and analysis of survey data, our team aims to develop an interview protocol to understand better the student's beliefs and attitudes toward AI and Ethics.

## 4 Next Steps

The next steps will include presenting to a community of discipline-based education researchers (DBER) at the study's target institution to get insight into this study and the survey instrument. Following that, additional insight will be obtained at the ASEE 2022 conference while reviewing the literature to ensure that the survey instrument is valid and appropriate for this project. Post the conference, our team

<b>Pre-course Questions</b>	<b>Post-course Questions</b>
<p><b>Demographic Data (multiple choice)</b></p> <ol style="list-style-type: none"> <li>(1) What is your current level of study? (Graduate or Undergraduate)</li> <li>(2) What is your gender?</li> <li>(3) To which of the following age group do you belong? (12-17,18-24, 25-34, 35-44, 45-54, 55 years or older)</li> <li>(4) What is your ethnic identity?</li> </ol>	<p><b>Demographic Data</b></p> <ol style="list-style-type: none"> <li>(1) Please enter your unique identification number</li> </ol>
<p><b>AI and Ethics</b></p> <ol style="list-style-type: none"> <li>(1) Is this your first AI course? (Yes or No)</li> <li>(2) Rate your current knowledge of AI Ethics. (Likert-type scale from 1 to 5, where 1 is little to no knowledge and 5 is very knowledgeable)</li> <li>(3) Have you learned about AI Ethics in another course? (Yes or No)</li> <li>(4) How important is it to learn about AI Ethics while obtaining your degree? (Likert-type Scale from 1 to 5, where 1 is not important, 2 is somewhat not important, 3 is neutral, 4 somewhat important, 5 is very important)</li> </ol>	<p><b>AI and Ethics</b></p> <ol style="list-style-type: none"> <li>(1) Rate your current knowledge of AI Ethics. (Likert-type scale from 1 to 5, where 1 is little to no knowledge and 5 is very knowledgeable)</li> <li>(2) Please share what you learned related to ethics during the course?</li> <li>(3) Have you learned about AI Ethics in another course? (Yes or No)</li> <li>(4) How important is it to learn about AI Ethics while obtaining your degree? (Likert-type Scale from 1 to 5, where 1 is not important, 2 is somewhat not important, 3 is neutral, 4 somewhat important, 5 is very important)</li> <li>(5) Which of the following describes your AI Ethics learning activities? (Check box - exercise, class project, lecture, reading, writing)</li> <li>(6) Did you engage with other students as a part of the AI Ethics conversation? (Yes or No)</li> <li>(7) Did the course impact your views on AI Ethics? (Yes or No)</li> <li>(8) If yes, in what ways did the course impact your views on ethics?</li> </ol>
<p><b>Positionality</b></p> <ol style="list-style-type: none"> <li>(1) How do you personally feel about AI and Ethics?</li> <li>(2) What has been your experience with AI Ethics?</li> </ol>	<p><b>Positionality</b></p> <ol style="list-style-type: none"> <li>(1) How do you feel about AI Ethics now that you've completed the course?</li> <li>(2) Do you have any new thoughts or experiences with AI Ethics?</li> <li>(3) If so, please share any.</li> </ol>
<p>(1) Would it be okay for us to follow-up with you to gain more insight on your responses?  (2) If yes, please enter your information below: (First Name, Last Name, email and contact number)</p>	

Figure 1: Table displaying Proposed Pre-and-Post Survey Questions

will take the feedback, update the instrument, and begin the IRB process. We will work to obtain final approval from all qualified faculty who are teaching the section of AI courses that will include information on AI and ethics. Between late July and early August (before classes begin), our team will pilot the survey with graduate-level engineering and computing students and faculty who are not taking the course or associated with the course to get their feedback. By January 2023, our team will be analyzing the results from the study, highlighting descriptive findings, and comparing answers across the different demographic questions asked.

## 5 Implications, Future Work and Concluding Thoughts

One of our primary goals is to share results with the faculty members who taught/teach the courses. We hope that any information that would help support higher education engineering and computing students' experience of AI Ethics will be incorporated into their syllabus. If this is achieved, one next step to build on this work would be to continue surveying students taking the course, pre and post, during the Spring, Summer, or Fall of 2023. That would allow us to compare the results of students who took the course in Fall 2022 and after new or different information was incorporated into the class. Additionally, proposed future work could include qualitative analysis (individual or focus group interviews) of the students who agreed to be follow-up. Our team would have the survey results to help develop a high-quality interview protocol. Additionally, as AI continues to advance into academic and workforce areas outside of the technology sector, we must understand the positionality and viewpoints of engineers, computer scientists, and all the other individuals not in those spaces who are, or are being prepared, to work with AI.

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