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An analysis of the extent to which responsible technology is taught in R1 and R2 research Universities in Michigan.

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AN ANALYSIS OF THE EXTENT TO WHICH RESPONSIBLE TECHNOLOGY IS TAUGHT IN UNIVERSITIES IN MICHIGAN

by

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This work is in dedication to family, friends, mentors and professors who have supported me throughout my collegiate career.

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Abstract

Responsible technology development, use, and communication is crucial as technological innovations scale. An increasing topic of conversation in the technology and education industries is how to educate individuals to interact with technology in an ethical way, as harmful technologies and use of technologies are creating negative impacts on individuals, businesses, and society.

This research examines the extent to which responsible technology is taught in major Michigan universities.

An analysis of courses and course descriptions at 8 R1 and R2 universities shows that there is a lack of responsible technology education in business colleges, courses teaching technology development, and courses teaching technology communication. The analysis also shows a presence of responsible technology education in engineering and technology courses, liberal arts and social sciences courses, and courses teaching technology use.

Introduction

Capabilities of new technologies are exponentially advancing and changing the world we live in, for better or for worse. The fourth industrial revolution, labeled as a new revolution by Klaus Schwab, founder of the World Economic Forum (McGinnis, 2020), has come with new key technologies like machine learning and artificial intelligence, virtual and augmented reality, 3D printing, blockchain technologies, robotics, fast computer processing, and more. Some examples of how those new key technologies have been implemented into everyday life include applications like Siri from Apple, facial recognition, personalized advertisements, and advanced GPS systems. These are all incredible developments, but, with new technologies comes new challenges and threats. “If not responsibly directed… Fourth Industrial Revolution technologies have the potential to erode trust, exacerbate inequity, and cause harm to people and the environment” (Green et al, 2021, p. 3). So, to combat the negatives that have come with new technologies, “many companies are seeking ways to ensure technologies are designed, developed, and used responsibly” (Green et al, 2021, p. 4).

Potential Harms of Irresponsible Technology

Harms caused by irresponsible tech can impact business, individuals, and society as a whole. These harms scale with a variety of impacts and include declining mental health, identity theft, loss of privacy, cybercrime, abuse of consumer data, engagement with disinformation, massive data breaches, and more. Some of these potential harms are intentional acts of crime that are against the law, and some potential harms are not intentional, and could be mitigated with the help of ethics education.
In 2017, advertisers on Facebook were enabled to direct their ads to people who showed interest in the topics of “Jew hater”, “How to burn jews”, or “History of ‘why jews ruin the world’”. An algorithm created these anti-semitic interest categories, rather than people. Facebook’s product management director, Rob Leathern, states that “there are times where content is surfaced on our platform that violates our standards… We know we have more work to do, so we’re also building new guardrails in

our product and review processes to prevent other issues like this from happening in the future" (Angwin et al, 2017).

Moving forward to 2021, an example of a massive data breach and cybercrime surfaced with dating site MeetMindful. On January 20th, 2021, a file containing personal data from 2.28M people who use the dating site was breached. Cybercriminals gained access to this data through a vulnerability in MeetMindful's system, which caused the breach. Although MeetMindful has since resolved this vulnerability, the company may have never had this issue, had they considered hiring ethical hackers to find vulnerabilities before cybercriminals (Aaron, 2021). Situations like these suggest that as cybercriminals continue to hack, companies will be looking to hire individuals educated in technology ethics.

Each of these examples of technological harm were partially due to lack of ethical design and use of technologies, and could have been lessened or even prevented with the implementation of more responsible technology education. "It is of paramount importance to train future members of the AI community, and other stakeholders as well, to reflect on the ways in which AI might impact people's lives and to embrace their responsibilities to enhance its benefits while mitigating its potential harms. This could occur in part through the fuller and more systematic inclusion of AI ethics into the curriculum" (Borenstein & Howard, 2021, p. 61).

Addressing Responsible Technology Through Education

Harms caused by people using technology in an irresponsible way have caught the attention of the educational community, and shows the need to renew education's emphasis on ethical issues emerging in relation to advanced technology (Borenstein & Howard, 2021). There are various levels at which college students are exposed to responsible technology education, and these levels could be determined by several different variables. For example, responsible technology could be taught at the undergraduate or graduate level, in different academic colleges, or in specific dedicated courses to the topic or in parts of other courses. This research examines where the emphasis on responsible

technology education currently lies and where it is lacking, to join the conversation on the extent to which college students receive responsible technology education.

The main research question is to what extent is responsible technology taught in universities in Michigan?

There are four additional research questions that involve further examination of the different variables that determine the extent to which students receive responsible technology education:

1. Does institutional research classification play a role in which universities teach responsible technology?
2. Is responsible technology taught differently at the undergraduate level versus the graduate level?
3. To what extent is responsible technology taught in engineering & technology courses versus business courses versus liberal arts and social sciences courses?
4. Are responsible technology courses teaching more about the design, use, or communication of technology?

Each of these four research questions address the central question and assist in determining the extent to which responsible technology is taught in universities in Michigan. The research will explore responsible technology education in the United States, along with an analysis of the variables that determine which students receive education on responsible technology in universities in Michigan.

Literature Review

Defining Responsible Technology

Responsible technology is the idea to "ensure that emerging technologies are designed from the outset for freedom, openness and pluralism, with the right safeguards in place to protect our peoples" (Johnson, 2019). In this era of innovative technology, "we need to agree on a common set of global principles to shape the norms and standards that will guide the development of emerging technology" (Johnson, 2019). By educating collegiate students about responsible technology, students may go on to design, use, and communicate technologies that reject unverified and inaccurate information, while encouraging regulation that will "result in platforms that support pro-social communities of practice and block those that are pursuing goals of violence and hate" (Winter & Butler, 2022, p. 272). Responsible technology is defined by The Journal of Responsible Technology as:
Investigating responsible ways of developing, deploying and using emerging, new, and existing technologies, and factors affecting the design and use of technology, such as:

- Cultural and geographical aspects world-wide;
- Social, political, legal, and economic influences;
- Environmental, economic, and social sustainability;
- Social inclusion and diversity;
- Technology ethics, policy, and governance (Jirotka & Stahl, 2022).

Responsible Technology in Education

The high-tech industry has presented a common recognized issue. Technology is becoming pervasive and is reaching into so many facets of our lives that we, as a society, must confront its impacts (Borenstein & Howard, 2021). Although there is not a singular solution alone that can combat the harms we see, professionals in the field recognize that tackling the problem requires educating ourselves in the realm of ethical technology at the beginning stages of our interaction with these evolving

technologies. By emphasizing ethics education, students can learn to think not only about what technology they could create, but also whether they should create that technology (Grosz et al, 2018). Software firm Anaconda conducted an online survey regarding AI ethics in 2020 with over 2,300 respondents. Respondents included data scientists, product managers, data engineers, researchers, analysts, developers, instructors and professors, students, and more (Anaconda, 2020). Unfortunately, only 15% of those identifying as instructors and professors reported that they're teaching AI ethics, and just 18% of those identifying as students indicated that they're learning about the subject (Macaulay, 2020).

Certain groups and institutions across the United States have recognized this need to enhance responsible technology education, and have formed educational groups and materials to move toward more ethical technology development and use. Three groups that have addressed the problem and have begun educating college students in this area are the Public Interest Technology University Network (PIT-UN), Harvard University, and the Massachusetts Institute of Technology.

At the beginning of 2022, the Massachusetts Institute of Technology shared a new collection of original pedagogical materials developed through the Social and Ethical Responsibilities of Computing group in their College of Computing (Park, 2022). These materials are freely available to all universities in the U.S. and include active projects, in-class demonstrations and other resources, with a goal of enabling instructors across the country to incorporate them in their courses so that students can gain more hands-on training in ethical computing. All of the materials created have been collaborated on by MIT members in computing, data sciences, humanities, arts, and social sciences, to form an interdisciplinary approach in learning social and ethical responsibilities of computing. In MIT's news release of these materials, Park states that making sense of hard problems involving social and ethical responsibility is as important as the technology students are studying and developing.

Additionally, New America has developed a network of universities to form a collaborative approach in educating students in the field of public interest technology. This network, called the Public Interest Technology University Network (PIT-UN) is made up of 43 universities in the U.S. This group originated in 2019 with a purpose of providing a framework to educate students in responsible

technology so that they may become technologically fluent humanists and social scientists, on top of their education in engineering, computing, etc. (Zalatoris, 2022). As PIT-UN members, universities develop experiential learning opportunities, such as clinics, internships, and fellowships at the intersection of technology and public interest, in order to give students the opportunity to critically assess the implications of new technologies and develop technologies in service of the public good (University of Washington, 2022). A few schools in the network include University of Michigan, Stanford, Harvard, Pennsylvania State University and Arizona State University.

Professors of computer science at Harvard University have also been integrating ethical reasoning as a central element in their curriculum. This approach has been termed "Embedded EthiCS" (Grosz et al, 2018). The Embedded EthiCS approach adds ethics modules to computer science courses in the core curriculum to show students the extent to which ethical issues permeate almost all areas of computer science, the variety of ethical issues that arise across the field, and the opportunity to reason through these issues. Creators of the Embedded EthiCS approach realize that no single course can produce an ethically-minded technology designer, but they expect it will reinforce the importance of ethical reasoning to all aspects of computer science and technology design (Grosz et al, 2018).

Responsible technology education has been studied to different extents across major fields of education like business, philosophy, science and technology.

In business, researchers have called for more education in this area for several reasons, a couple being the questioning of the traditional vision that the economy is a "cold" mechanism that is out of human control (Patrignanie & Whitehouse, 2015), and the recent steep decline in public trust (Ferreira & Vardi, 2021). Previous research on technology ethics in business education has looked at the term Slow Tech, which focuses on the notions of good, clean and fair technologies. Business ethics is oriented to the bottom lines of profit, people, and planet. In merging each of the three components of Slow Tech and business ethics views, good information and communication technology (ICT) can be related to the capacity to make a long-term profit; clean ICT to consideration for the planet; and fair ICT to caring for the people that work along all points of the information and communication technology value chain (Patrignanie & Whitehouse, 2015).

In contrast, philosophy education is largely focused on elements of responsible technology like the interrelation between emotion, risk, moral emotions, and technology-engaged art. Specifically, studies of responsible technology in philosophy examine the role of emotions in the assessment and acceptability of technological innovations, the risks of moral emotions in technological development, and how the connection between emotions and art could impact technological risks (Roeser & Steinert, 2019).

Not surprisingly, an examination of the current literature suggests that a majority of the conversation around responsible technology is happening in the technology, computer science, and engineering fields. Two main and connected components are focused on in education of ethics of technology in science. One aim is to produce an ethically informed community, which the teaching ethics of technology to scientists and nonscientists can do directly. The second aim is to produce ethical scientists and technologists, in the sense of instilling ethical values in the students who will pursue careers in these arenas (Crosthwaite, 2001). Additionally, current research explains that studying the philosophy of technology can guide engineers in the ethical dimension. The philosophy of technology has fused the fields of engineering and ethics in considering the design features and social influences of technology (Cao, 2014).

What is unclear is the extent to which these conversations are having a tangible impact on actual education practices in local universities. To date, this research is the first to look specifically at major universities in a single state. For the duration of this research, eight universities in Michigan are used to analyze several variables that may play a role in determining where responsible technology is taught in collegiate academia.

Methodology

Sample and Data Collection Process

Data collection for this work began by determining the sample population. The sample includes R1- and R2- classified institutions in Michigan. "R1" refers to Doctoral Universities of Very High Research Activity, while "R2" refers to Doctoral Universities of High Research Activity (The Carnegie Classification of Institutes, 2021). The three R1 universities include University of Michigan, Michigan State University, and Wayne State University. The five R2 Universities include Eastern Michigan University, Michigan Technological University, Oakland University and Western Michigan University. Data was collected through each of the eight universities' course catalogs and webpages. Every course that had some mention of elements from the definition of responsible technology in either the course title or course description was copied into a master spreadsheet. There are 149 total courses within the eight universities of focus that had some mention of elements from the definition of responsible technology. Data recorded from each course included the course title, the course description, whether the course is offered at the Undergraduate or Graduate level, which academic college the course is offered through, and which academic department the course falls under.

In order to ensure each course recorded during data collection truly clears as a responsible technology course given this project's definition of responsible technology, each course description and title was analyzed against this definition. A course that qualifies as a responsible technology course for this research would mention, in the description or title, some element of teaching responsibility or ethics, and some element of teaching technology. The first half of the definition of responsible technology guides which courses will be counted as a technology course. Qualifying technology courses will include some element of developing, deploying, or using emerging, new, and existing technologies. The second half of the definition of responsible technology guides which courses will be counted as a responsible course. These courses will include some elements of cultural and geographical aspects; social/political/legal/economic influences; environmental/economic/social sustainability; social inclusion/diversity; or technology ethics, policy, and governance.

The following is an example of a course that showed some mention of the definition in its description, but did not show both elements of the definition, and therefore did not count as a responsible technology course:

Table 1: Example Course - Emerging Technologies

University	Michigan Technological University
Course Title	Emerging Technologies
Course Description	Focuses on understanding IT for competitive advantage and as an agent of transformation. Topics include managing IT infrastructure and architecture, facilitating information distribution throughout the enterprise, business applications for machine learning and artificial intelligence, and other emerging trends and technologies.

This course qualifies for the technology portion of the responsible technology definition by including elements of developing, deploying, and using emerging technologies. But, this course does not qualify for the responsible portion of the definition, as it does not include elements of cultural or geographical aspects, social/political/legal/economic influences, environmental/economic/social sustainability, social inclusion/diversity, or technology ethics/policy/governance.

The next example course comes from Michigan Technological University's science department:

Table 2: Example Course - Science, Technology, & Society

University	Michigan Technological University
Course Title	Science, Technology, & Society
Course Description	Examines the relationship between science, technology, society, and the environment. Topics may include effects of technologies such as computers, biotechnology, and chemicals on society and nature, science and technology policy, and the history of technology and its global consequences.

This course qualifies as a responsible technology course for this research by including both elements of the definition through its focus on computers and biotechnology and their effect on society, nature, and technology policy.

After analyzing each course to determine whether they were both responsible courses and technology courses, 111 courses were left as fully responsible technology-based courses.

Data fields added to each approved course assisted in answering the research questions. The two fields added include a core discipline focus of each course and the phase of technology development the course was focused on teaching in.

The core discipline focus had 3 fields: “Business”, “Engineering & Technology”, or “Liberal Arts & Social Sciences”. Discussions with the second researcher and analysis of academic colleges determined which discipline each course was allocated to.

The phase of technology also has 3 fields: “Design”, “Use”, or “Communication”. Courses could also be listed as some combination of those 3 phases. Analyzing keywords associated with each phase along with discussions with the thesis advisor determined which phase, or combination of phases, each course is allocated to.

Some examples of the determining keywords for each technology phase are:

Design: “Legal/Intellectual Property”, “Development”, “Deployment”, “Innovation”, “Planning”, “Programming”, “Philosophy”

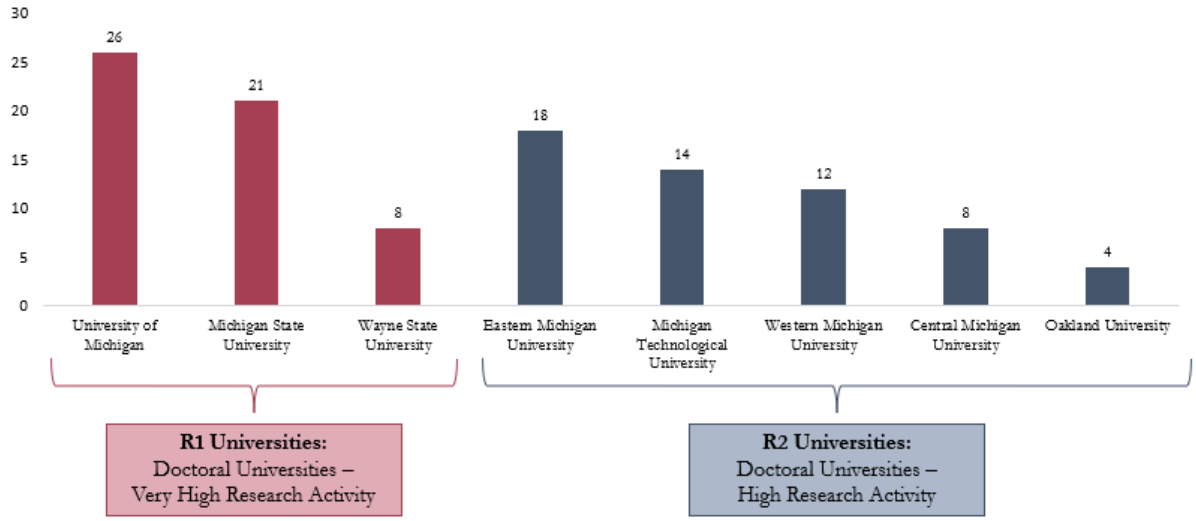
Use: “Applications”, “Optimization”, “Interaction”, “Practices”

Communication: “Communicating”, “News”, “Advertising”

Analysis and Results

The first research question to this research is: "Does institutional research classification play a role in which universities teach responsible technology?" This question's goal is to determine whether the Carnegie Classification of Institutes is a determining factor of the extent to which universities teach responsible technology. Course counts between R1 and R2 universities are provided in Figure 1. Three R1 universities are categorized together and five R2 universities are categorized together. The data shows that the three R1 universities have 55 total responsible technology courses, while the five R2 universities have 56 total responsible technology courses.

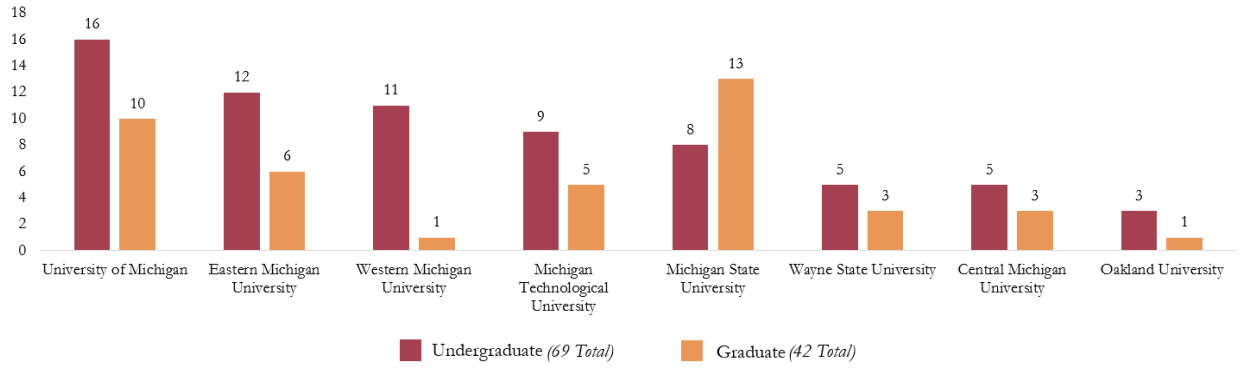
Figure 1: Responsible Technology Courses in R1 and R2 Universities in Michigan



University of Michigan and Michigan State University are both R1 schools and have the highest number of responsible technology courses. But, with Wayne State University as an outlier, R2 universities come next in highest numbers of responsible technology courses. There are 55 total responsible technology courses in the three R1 universities, with an average of about 18 courses per university. There are 56 total responsible technology courses in the five R2 universities, with an average of about 11 courses per university. These averages prove that institutional research classification does not play a large role in the extent to which universities teach responsible technology.

The second research question is: "Is there a difference in the extent to which responsible technology is taught in the undergraduate level versus the graduate level?" The purpose of this question is to begin determining which students have the most access to responsible technology courses, beginning with undergraduate versus graduate students. A pivot table including data fields of "University" and "Undergraduate or Graduate" provided results for question 2. The results are shown in Figure 2.

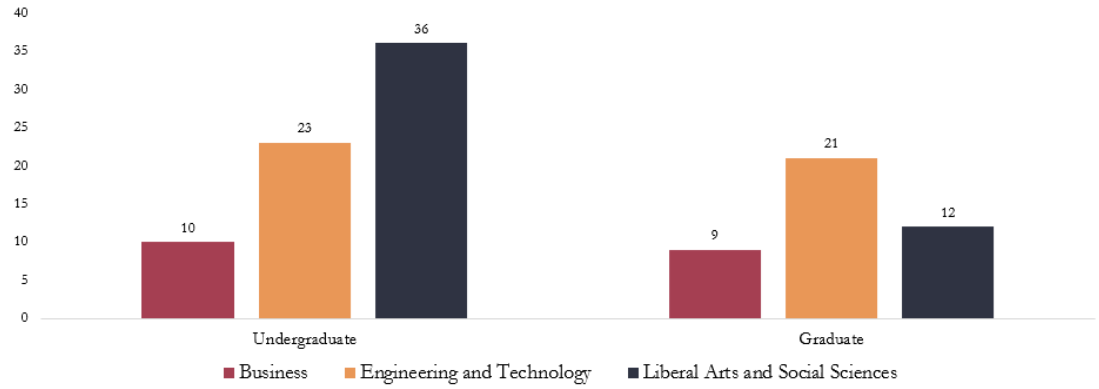
Figure 2: Undergraduate vs. Graduate Level Responsible Technology Courses



At the undergraduate level, there are 69 total responsible technology courses; at the graduate level, there are 42 total responsible technology courses.. These eight universities show an average of about 9 undergraduate responsible technology courses, and about 5 graduate responsible technology courses, which proves that in R1 and R2 universities in Michigan, responsible technology is taught more at the undergraduate level than the graduate level. The one exception to this trend is Michigan State University, with 5 more graduate courses than undergraduate courses

The third research question is: "To what extent is responsible technology taught in Business courses vs. Engineering & Technology courses vs. Liberal Arts & Social Sciences courses?" The purpose of this question is to determine which disciplines within universities are focusing most on responsible technology. The three disciplines each course could be allocated to include Business, Engineering & Technology, or Liberal Arts & Social Sciences. These allocations are based on the academic college that the course is taught out of. Appendix A shows the allocations of these colleges within the eight universities of focus. Figure 3 displays the course count for each discipline.

Figure 3: Amount of Responsible Technology Courses in Different Academic Disciplines



The data proves, first and foremost, that business schools provide the least amount of responsible technology education. There are 19 total responsible technology courses in the business discipline, 44 total responsible technology courses in the engineering and technology discipline, and 48 total responsible technology courses in the liberal arts and social sciences discipline. This means that there is an average of about two responsible technology courses being taught in business schools, about five responsible technology courses being taught in engineering and technology schools, and about six responsible technology courses being taught in liberal arts and social science schools, within the eight universities of focus. Additionally, undergraduate education of responsible technology is found more in liberal arts & social sciences schools, while graduate education of responsible technology is found more in engineering & technology schools.

The fourth research question is: "Are responsible technology courses teaching more about the design, use, or communication of technology?" The goal of this research question is to determine in which phase of technology is responsible technology being taught. The three phases each course could be allocated to include Design, Use, or Communication. In order to allocate each course to a phase, keywords from course descriptions were used.

Keywords that point to the Design phase include: "Legal/Intellectual Property", "Development", "Deployment", "Innovation", "Planning", "Programming", "Philosophy".

Keywords that point to the Use phase include: "Applications", "Optimization", "Interaction", "Practices".

Keywords that point to the Communication phase include: “Communicating”, “News”, “Advertising”.

Many course descriptions included keywords from more than one phase, so the analysis involved the three phases or any combination of those three. Table 3 shows the number of courses being taught in each phase of technology.

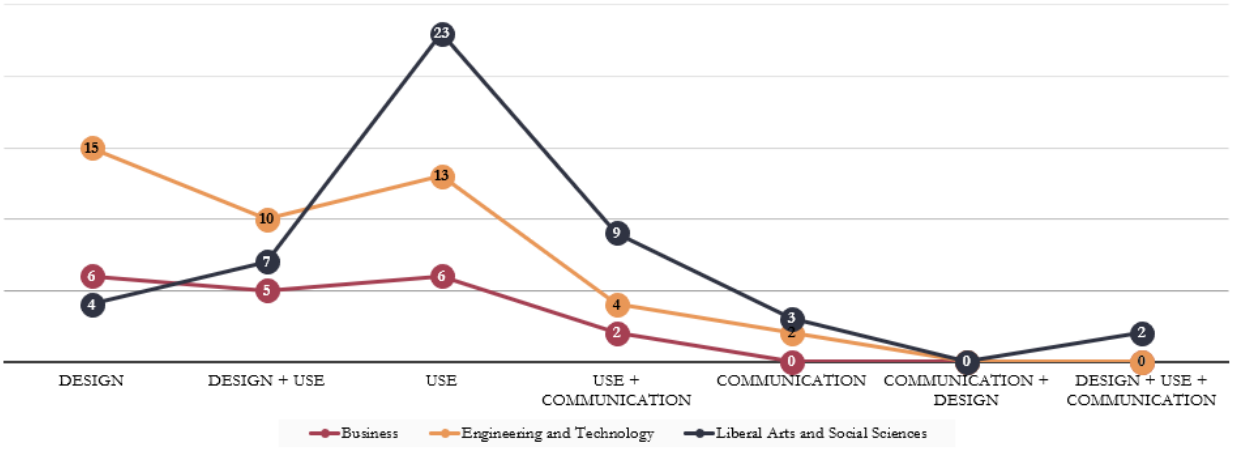
Table 3: Responsible Technology Courses by Phase

Phase	**Number of Courses**
Design	25
Design + Use	22
Use	42
Use + Communication	15
Communication	5
Communication + Design	0
Use + Communication + Design	2

Responsible technology courses are taught most in the Design, Design + Use, and Use phases of technology, with over 80% of all of the responsible technology courses falling in these phases. Very few courses are focused on teaching in the Communication phase of technology.

The extent to which each technology phase is taught in the different academic disciplines (mentioned in Research Question 3) is another factor analyzed in question 4. Figure 4 displays how the phase of technology focus differs between the 3 academic disciplines.

Figure 4: Extent to Which Each Technology Phase is Taught in Each Academic Discipline



Engineering & Technology courses focus primarily on the Design and Use phases, with 63.64% of their qualifying courses falling in between those phases. Liberal Arts and Social Sciences courses focus primarily in the Use phase, with 47.92% of their courses falling in this phase. Business courses focus evenly in the Design and Use phases, with 63.16% of business courses falling in those two phases.

Discussion

The culmination of this research provided three core findings.

First, there is a lack of responsible technology education in business courses.

Recognizing the lack of business courses that teach responsible technology, compared to engineering & technology and liberal arts & social sciences, is concerning. Being that business students typically become the customer-facing individuals with access to high-tech, educators need to be working more to advance these students' knowledge of responsible technology.

Another way to ensure all students are exposed to responsible technology education is to offer responsible technology courses as general education courses. This recommendation is pointed to universities as a whole, rather than one specific school within each university. Given that courses approved as responsible technology courses during this research are typically in a niche area of study, more students may gain access to responsible technology education, should they be offered as a general education course. For example: Western Michigan University could add an area in the general education requirements that revolves around responsible technology, and in turn exposes all WMU students to the topic at least once in their collegiate career.

The second core finding is that the extent to which responsible technology education in R1 schools and R2 schools is relatively similar.

The extent to which responsible technology is taught in R1 schools is not much greater than the extent to which this topic is taught in R2 schools. R1 schools are typically seen as more prestigious and desirable institutions, but, if R2 schools could differentiate themselves by focusing on this topic, that vision might change. Higher education institutions, especially R2 institutions, should recognize this area of potential differentiation and build an emphasis on responsible technology education. R2 schools should begin by looking to networks like PIT-UN and schools like MIT, who have produced public materials for learning, and use those materials as a benchmark for implementing responsible technology education. Forward-thinking groups and universities are already building responsible technology education and are doing so publicly. R2 institutions could benefit greatly from implementing these ideas into their curriculums, and therefore differentiating themselves from R1

universities. Additionally, R1 schools are frequently target recruiting schools for big tech companies. Increasing the amount of responsible technology education in these target recruiting schools may allow a direct impact on big tech itself.

Third, there is a lack of responsible technology courses in the communication phase of technology. Courses in the communication phase of technology represent those that teach how we use innovative technology to communicate with one another. This can range from courses about social media, to advertising, to the news, and more. A serious lack of responsible technology education is seen in this area, though many harms of irresponsible use of technology come from things like advertising and the news. This means that higher education courses and colleges that teach concepts in communication should recognize this deficit and build more responsible technology education into their curriculums. One way to mitigate this unequal distribution of education is for universities to create an interdisciplinary approach to responsible technology education. Universities should work across colleges to create interdisciplinary courses that would be beneficial to students of all majors. If the different colleges within each university would work together to create courses and materials around responsible technology, students would receive a more holistic education and view of responsible technology. Another concept universities should consider is the idea of responsible technology literacy. Just like those going into careers in communication, many people aren't going to become the builders of high technology. But, many technology issues and harms around misinformation are issues of citizen literacy. Emphasizing education around responsible technology literacy is not only crucial for the technology industry, but also society as a whole.

Limitations and Future Research

The extent and depth of this research was limited by a few variables. First, determining which courses counted and did not count as "responsible technology" courses was done by evaluating only the course title and description. Future research could improve by an examination of course syllabi, which is unattainable for some courses. Second, the allocation of courses to one of the three pre-determined phases (design, use, or communication) was also determined by course descriptions. The description

may not give an all-encompassing view of all elements taught during the course, so the course might fall in more phases than those that they were placed in for this study. Lastly, this research is solely descriptive, and proves only what the universities of focus are currently doing to educate their students in responsible technology. There is no research on the "right" way to educate students in responsible technology, this research is based on the assumption that responsible technology education is necessary for all students.

Should this research continue, there are several ways in which it could be expanded. First, schools like MIT and those involved in the PIT-UN could be further examined to determine how and why they are doing what they're doing, exactly what they are teaching, and their future plans for responsible technology education. Second, interdisciplinary approaches for responsible technology education could be researched to strategize how multiple students across various majors could all benefit from interdisciplinary courses. Third, analyzing why business schools are lacking in this realm could be a start to helping these colleges improve and build on responsible technology education. This work could benefit from further research on what the necessary amount of responsible technology education is, and what specific topics in this realm students should be informed about.

References

Aaron, J. (2021). The Worst Data Breaches of 2021 (Q1 and Q2). *Auth0.* https://auth0.com/blog/the-worst-data-breaches-of-2021-q1-and-q2/

Anaconda. (2020). *The State of Data Science 2020 Moving from hype toward maturity.* Anaconda. https://www.anaconda.com/state-of-data-science-2020

Angwin, J., Varner, M., Tobin, A. (2017). Facebook Enabled Advertisers to Reach 'Jew Haters'. *ProPublica.* https://www.propublica.org/article/facebook-enabled-advertisers-to-reach-jew-haters

Borenstein, J., Howard, A. (2021). Emerging challenges in AI and the need for AI ethics education. *AI Ethics.* 1, 61–65 https://doi.org/10.1007/s43681-020-00002-7

Cao, G. (2014). Comparison of China-US Engineering Ethics Educations in Sino- Western Philosophies of Technology. *Sci Eng Ethics*, 21, 1609-1635. 10.1007/s11948-014-9611-3

Crosthwaite, J. (2001). Teaching Ethics and Technology - What is Required? *Science & Education*, 10, 97-105. http://dx.doi.org/10.1023/A:1008757414097

Ferreira, R., Vardi, M. (2021). Deep Tech Ethics. *SIGCSE '21*, 1041-1047, https://doi.org/10.1145/3408877.3432449

Green, B., Heider, D., Firth-Butterfield, K., Kim, D. (2021). Responsible Use of Technology: The IBM Case Study. *World Economic Forum.* https://www3.weforum.org/docs/WEF_Responsible_Use_of_Technology_The_IBM_Case_Study_2021.pdf

Grosz, B., Grant, D., Vredenburgh, K., Behrends, J., Hu, L., Simmons, A., Waldo, J. (2018). *Embedded EthiCS: Integrating Ethics Broadly Across Computer Science Education.* Harvard Library. https://dash.harvard.edu/handle/1/37622301

Jirotka, M., Stahl, B. (2022). *Journal of Responsible Technology.* https://www.journals.elsevier.com/journal-of-responsible-technology

Johnson, B. (2019). Address to the UN. https://www.gov.uk/government/speeches/pm-speech-to-the-un-general-assembly-24-september-2019

Macaulay, T.: Study: only 18% of data science students are learning about AI ethics. *TNW.* https://thenextweb.com/neural/2020/07/03/study-only-18-of-data-scientists-are-learning-about-ai-ethics/ (2020)

McGinnis, D. (2020). What Is the Fourth Industrial Revolution? *Salesforce.* https://www.salesforce.com/blog/what-is-the-fourth-industrial-revolution-4ir/#:~:text=The%20Fourth%20Industrial%20Revolution%20is,quantum%20computing%2C%20and%20other%20technologies

Park, T. (2022). A new resource for teaching responsible technology development. *MIT News.* https://news.mit.edu/2022/new-resource-teaching-responsible-technology-development-0302

Patrignanie, N., Whitehouse, D. (2015). Slow tech: bridging computer ethics and business ethics. *Emerald*, 28(4), 775-789. www.emeraldinsight.com/0959-3845.htm

Roeser, S., Steinert, S. (2019). Passion for the Art of Morally Responsible Technology Development. *A Philosophers' Manifesto*, 85, 87-109. https://doi.org/10.1017/S135824611800070X

Silvergate, P., Kosmowski, J., Horn, H., Jarvis, D. (2021). Beyond good intentions. *Deloitte.* https://www2.deloitte.com/us/en/insights/industry/technology/ethical-dilemmas-in-technology.html

University of Washington. (2022). The Public Interest Technology University Network (PIT-UN). University of Washington. https://www.pit-un.uw.edu/

Winter, S., Butler, B. (2022). *Responsible Technology Design: Conversations for Success*. Perspectives on Digital Humanism. https://doi.org/10.1007/978-3-030-86144-5_36

Zalatoris, J. (2022). The Public Interest Technology University Network (PIT-UN) Welcomes Five New Member Universities, Celebrates Recommitment from Existing Members. *New America.* https://www.newamerica.org/pit/press-releases/pit-un-welcomes-new-members-celebrates-recommitment-from-existing-members/

Appendix

Appendix A

Courses within the following academic colleges are allocated to the Business discipline:

University	**College(s)**
University of Michigan	Ross School of Business
Michigan State University	Broad College of Business
Wayne State University	School of Information Sciences
Eastern Michigan University	College of Business
Central Michigan University	College of Business Administration
Michigan Technological University	College of Business
Western Michigan University	Haworth College of Business

Courses within the following academic colleges are allocated to the Engineering & Technology discipline:

University	**College(s)**
University of Michigan	School of Information
Michigan State University	College of Engineering
Wayne State University	College of Engineering
Eastern Michigan University	College of Engineering and Technology; College of Technology
Central Michigan University	College of Science and Engineering; School of Engineering and Technology
Michigan Technological University	College of Computing
Western Michigan University	College of Engineering and Applied Sciences
Oakland University	School of Engineering and Computer Science

Courses within the following academic colleges are allocated to the Liberal Arts and Social Sciences discipline:

University	**College(s)**
University of Michigan	College of Literature, Science, and the Arts
Michigan State University	College of Arts and Letters; College of Communication Arts and Sciences; College of Fine Arts; College of Social Science
Wayne State University	College of Fine, Performing & Communication Arts; College of Liberal Arts and Sciences
Eastern Michigan University	College of Arts and Sciences
Central Michigan University	College of Liberal Arts and Social Sciences
Michigan Technological University	College of Sciences and Arts
Western Michigan University	College of Arts and Sciences
Oakland University	College of Arts and Sciences