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Assessing the Impact of a Technology Ethics Course

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Abstract

Technology ethics is an essential topic in the IS/IT curriculum. It is relevant for students in all programs as new technologies continue to present our society with challenging questions about how to use technology in a manner that considers the impact of these technologies on society. This work discusses updates to a technology ethics course to address two concerns. First, results from using a traditional pre- and post- course survey showed little change in students' knowledge, while qualitative methods showed the course had a clear impact on students. Secondly, student feedback indicated that while students developed a better understanding of how technology affects them, they did not feel prepared to impact how technology impacts them personally. The work discusses the implementation of a post- then pre- quantitative assessment method that shows the course has a clear positive impact on students. This work also discusses efforts to make students aware of how they can change how technology impacts them, with quantitative results showing that the course increases students' actions to change how technology affects them in specific areas.

Keywords: ethics, ethics education, pedagogy, assessment.

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1. INTRODUCTION

Teaching students about the ethical aspects of the technology they develop and use is an important part of the IS/IT curriculum. However, it is also a challenging task. The importance of the topic can be seen from its inclusion in model curricula and also from the discussions that arise as new technologies are introduced, for example, current discussions about the ethical aspects of generative artificial intelligence tools.

There are several aspects to the challenge of teaching students about ethics and technology. One is shared with all topics in the IS/IT curriculum – the rapid evolution of technology, which requires frequent updates to course content. Another challenge is that students' work in a technology ethics class cannot be evaluated in the same way as students' work in technical classes. For example, in a programming course, student work can be assessed using specific test cases that can often be automated.

Another challenge with the technology ethics class is evaluating student performance over a longer term. For technical topics such as software development and database design, there is typically a later course where students apply skills learned in earlier courses, making it easier to identify skill gaps. Also, since topics in technical courses are typically new to students, pre- and post-course assessments can be used to assess student learning. Evaluating student performance is more challenging in a technology ethics course, as students often feel they are already well aware of the topics discussed in the class, while in reality, their knowledge may be limited to awareness of issues, but not their impact. For example, they may have seen headlines about ransomware attacks, but did not learn about how these attacks impact individuals and organizations. Additionally, experience shows that few students are aware of ethical theories that can be used to assess and discuss ethical issues.

A final challenge of teaching a technology ethics course is the inherent group nature of the topic. Discussions of the ethical aspects of technology use involve examining how technology affects our society and seeking consensus on how to address these impacts.

This work discusses the most recent revisions to a technology ethics class that sought to address two issues with the course. The first concern was that while discussions with students clearly showed a significant positive impact, this was not reflected in the surveys used to assess the course. The second issue was feedback from students, who reported that while they were more aware of ethical issues related to technology, they did not see ways for them as individuals to take action and effect change.

2. MOTIVATION

It is widely accepted that ethics must be part of any IS/IT curriculum, but it is important to consider the goal of including ethics in the curriculum. The goal is not to teach IS/IT students to be ethical. We should expect students to have a basic understanding of ethics that they have developed throughout their lives with guidance from their family, community, religion, and other sources. Instead, the IS/IT ethics course should focus on helping students apply ethics to evaluate technical situations. In addition to assessing the situation from an individual perspective, students also need to learn how to discuss ethical issues with others to develop solutions that all group members can agree on.

A starting point for ethical discussions is the statements of professional bodies, including ACM and AIS from the computing perspective and ITSE from a technology education view (ACM, n.d.; AIS, n.d.; ITSE, n.d.). We can also look at the model curricula that these bodies have developed. For example, the IS2020 curriculum added "Ethics, use and implications for society" as a required competency area, arguing that it has "become more and more relevant as the use of IS applications expands to all sectors in society" (Leidig & Salmela, 2021, p. 30). This statement illustrates that the motivation for a technology ethics course has also evolved from focusing on just IS/IT students, for example, to avoid another incident like the Therac-25 case, to the reality that decisions about the use of

technology can now be made by anyone, so the technology ethics class has value to students from all disciplines.

Instructors face several challenges when teaching an ethics course. The main challenge is that it is very different from the technical courses that make up much of the IS/IT curriculum. In technical courses, the assignments present students with a set of requirements, and the student uses technologies to implement a solution. The student's work can be evaluated by assessing how well they met the requirements. There are clear cases where a student's work does not meet the requirements, for example, a program that crashes. This approach can be used in a wide variety of courses, including programming, database, systems analysis, and networking.

In a technology ethics course, students' work for summative assessments often involves written and/or spoken work where they are asked to evaluate situations and propose a course of action. Here, there is usually no clear "correct" answer. Instead, the student's work needs to be evaluated on how well they have assessed the situation and the arguments they use to support their solution. The importance of written and spoken work also requires that instructors be comfortable assessing and providing feedback on this type of work.

The literature provides a wide variety of ideas that can be used while developing content and assignments for a technology ethics course. Taught for a broader audience, the technology ethics course has connections to core concepts of digital literacy, computer literacy, and information literacy (AACU, 2007; Buckingham, 2006). The literature on the different literacies advances many useful ideas. Many focus on technologies and tools, but several discuss ideas relevant to a technology ethics course, including social responsibility (Nelson et al., 2011) and intellectual property (Turk, 2011). The AAC&U report "College Learning for the New Global Century" (AACU, 2007) identified information literacy and ethical reasoning as two key skills, which are supported by the VALUE rubrics (AACU, 2009; AACU, 2009a).

Other works offer more specific ideas for use when implementing a technology ethics course. These include fostering creativity (Howard, 2007), using current events in a writing-intensive course (Hare, 2009), active student participation (Zaidman, 2010), bringing global perspectives into the course (Marchant, 2004), the concepts of micro- and macroethics (Herkert, 2005), and tasking students with developing a code of ethics (Brooks, 2010).

While these resources provide instructors good ideas for developing content and assignments for a technology ethics course, there is limited guidance on how to assess a course's overall impact on students. Unlike technical courses, where a student who earns a good grade but did not learn the content will have issues in later courses that assume knowledge of the content, students who failed to absorb the content in a technology ethics course will not face issues in later courses in the curriculum. This concern can arise when an instructor worries that students may be trying to provide what they see as the "right" answer rather than exploring and assessing an issue, and is reinforced by recent growth in students' use of artificial intelligence (AI) tools.

The author has used pre- and post-course surveys about course learning outcomes to assess student learning. However, these often showed little or no change in students' assessment of their knowledge of the learning outcomes. This contrasts with what students say in a final course assignment, where students reflect on their learning, comments in course evaluations, and discussions with students. These differences between the qualitative and quantitative assessment methods raised a concern that the pre- and post- course survey approach may not be appropriate if students' understanding of the survey questions is changed by their work in the course.

3. COURSE UPDATE

Two factors motivated the need to update the course. First was interest in exploring different quantitative methods for assessing the course to replace the pre- and post- course surveys. A second motivation was to address student feedback that while they felt more informed about the issues discussed in the course, they did not see how they could effect changes. For example, one student mentioned increased awareness of how his personal data was collected and used, but felt powerless to make any changes.

To assess the course overall, the pre- and post-course assessments were replaced with a retrospective assessment using a post-then-pre methodology (SFU, n.d.). The post-then-pre assessment creates "a consistent measuring stick for both pre and post assessments" (Hiebert et al., 2011, p. 9). With this method, students are

surveyed at the end of the semester and asked to complete the same survey twice. The first time, they answer based on their awareness at the start of the course, and the second time, they answer based on their current understanding.

To address concerns that students were learning the content but lacked ideas on how to act on the content, several modules of the course were revised using Fink's Significant Learning approach (2013). Fink's approach includes considering the connectedness of what a student is learning and focusing on making learning relevant to each individual. For the course update, this involved reviewing and updating course content to ensure that it provided learning that students could implement in their daily lives.

The course, "Technology, Ethics, and Global Society," is a required course for all IT students. It has also been reviewed at the university level and approved to satisfy part of the university's general education requirements in the humanities or social science area. This leads to enrollments with students from a wide variety of majors. The course is a 200-level course typically taken by IT majors in their second year of study. The only prerequisite for the course is the university's first-year composition course. Typical enrollment in the course is 20 – 25 students. This allows the instructor to use a discussion-based pedagogical approach.

Students in the course have limited technical knowledge. While students from the IT major can be expected to have stronger technical skills, the fact that IT majors typically take the class in their second year limits the technical knowledge they have acquired. To address this, class content is broken into eight main topic areas focused on broad areas of concern rather than addressing specific technologies:

- critical reasoning and moral theory
- computing professions and ethics
- privacy
- intellectual property
- trust, safety, and reliability
- how computing is changing who we are
- democracy, freedom of speech, and freedom of the press
- computing and vulnerable groups

The class spends at least one week covering each topic.

Prior to the initial class meeting to start a new topic, students complete required readings in the text and supplemental materials. Suggested study questions are provided with the reading, and students complete an online quiz that uses a few of the provided study questions. The quiz includes a question asking students to suggest content they would like to discuss in class.

The readings and quiz are designed to allow students to do an initial exploration of each topic. The in-person class meeting starts with a brief review of the topics suggested by students in the quiz. Then, students are broken into groups of four to five students. Each group is given a different case study to review. Students discuss the case, come to an agreement on the main issues of the case, propose an ethical solution, and then present a summary to the rest of the class. Where possible, the case study topics are chosen to match the topics suggested by students in the quiz.

Given the ever-changing nature of technology, this course requires regular updates. The main effort involves adding or replacing the supplemental readings and the cases discussed in class. This can include bringing current events into the course at short notice. More significant changes were recently implemented to address feedback that students wanted to learn more about how they could take action, especially for the topics of privacy, intellectual property, and freedom of speech. These changes focused on ensuring that the course content included resources and discussions related to actions students could take in their daily lives.

For the privacy module, the small group discussions were updated to include discussions about store loyalty cards and the permissions requested by the apps students use. In addition to discussions, students were asked to review the privacy settings of at least one app they regularly use. Most major apps provide resources to help with this, and students were also provided with links to independent online resources on securing their privacy.

To provide students with broader ideas about possible changes for protecting online privacy, a small group discussion on the European Union's General Data Protection Regulations and the California Consumer Privacy Act was developed. For the small group discussion, students were provided resources that outlined the main goals of these efforts, and were asked to discuss which they found most important, and what might limit them from being applied outside of the European Union or California (i.e., could they be implemented in the state where the course was being taught). The group summarized their discussion and shared this information through a discussion with the rest of the class.

For the intellectual property (IP) module, an activity was added where students inventoried the IP they had created. Also, a small group case study was added where students discussed a hypothetical proposal to publish content they had created without obtaining their consent. To help students understand how they could act to better control their IP and ethically use others' IP, content and activities about Creative Commons (CC), including how to apply a CC license to their content and how to use search tools to find images and other content licensed for reuse using CC (Creative Commons, 2023), was added to the course.

In the module that includes freedom of speech, the small group case studies were updated to include cases that explore the issues with misinformation and how rapidly it spreads. Case studies about voluntary and legal efforts to require content moderation were also added. Since there is no clear consensus on how to address misinformation, or even whether society should address issues caused by misinformation, the updates for this module could not provide students with clarity about how to address issues they see that affect freedom of speech.

4. ASSESSMENT

To assess the course outcomes after the update, an end-of-course survey was used in four sections of the course. The same instructor taught all sections. The survey used can be found in Appendix A. The survey asked the students to respond to the same questions twice. The first time, the students were prompted to answer the questions based on their awareness of the issues covered in the course before taking the course. The second set of questions prompted students to respond based on their current awareness of the issues. The survey included two additional questions about the ethical theories used in the course.

The survey questions focused on the course modules that had been updated: privacy, intellectual property, and freedom of speech. To address the concern from students that while the course increased their awareness of ethical issues with technology, they did not feel that they could do anything to effect change, the survey questions focused on both students' knowledge and awareness of the main aspects of each topic, for example, the intellectual property they create and use, and whether the students were taking action, such as being more ethical in their use of others' intellectual property.

The survey and a consent form were distributed in class during the final class meeting. The survey was optional. The following table shows the response rate for each course section. Five of these responses were discarded due to incomplete surveys.

Section	Enrollment	Response	Response Rate
1	22	17	77 %
2	13	11	85 %
3	16	11	69 %
4	17	14	82 %
Total	68	53	78 %

Table 1: Survey response rates

The survey data were analyzed to assess the overall impact of the course by examining the differences between pre- and post-course responses for each question. This was done using a paired Student's t-test. Appendix B presents the resulting *p*-values for all the questions. For all questions, the *p*-value was significantly less than 0.05, indicating that the change in values between the pre- and post-course responses is statistically significant.

In addition to assessing the overall impact of the course, the net change in responses to individual questions was also reviewed to identify differences in responses to specific questions. For example, did students have a stronger response to one topic, or was there stronger agreement with statements that asked about knowledge or awareness, and less agreement for statements about taking action? For each question, the results in Appendix B show the average response for the pre- and post-course responses, along with the difference between the two. A chart illustrating the pre- and post- responses for each question can be found in Appendix C.

The smallest change (0.3) was for awareness of the positive impacts of technology, but this was also the question with the highest rating (4.2) in the data from the pre-course responses. The next smallest change (0.6) was for the related question about the negative impacts of technology, which had the second-highest value (3.9) in the pre-course responses. These indicate that students already had a good awareness of the impacts of technology before taking the course.

Looking at the data for the post-course responses, two of the lowest values (4.1 and 4.2)

were for questions asking whether students were taking action on data sharing and the use of others' intellectual property. This can be expected, since taking action requires more effort than building awareness. This is also something that could require more time for students to encounter situations where they might take action. The other questions with low scores (4.1 and 4.3) pertained to students' concerns about the impact of technology on freedom of speech and our democratic ideals. This could reflect that younger people are less likely to vote (Nadeem & Nadeem, 2024; US Census Bureau, 2025) and are therefore less aware of this concern. Unfortunately, demographic information was not collected to determine if citizenship status might have influenced responses to this question.

For the two additional questions that were asked, students strongly agreed (4.4/5.0) that they found the ethical theories used in the course helpful in evaluating situations in their daily lives. And 81% of the students reported that before taking the course, they were not aware of any of the ethical theories used in the course.

5. CONCLUSION AND FUTURE PLANS

The survey results clearly show the value of using the post—then-pre survey method to assess the impact of a class like the technology ethics class, where student understanding of the topics in the survey can change significantly during the semester. Previous efforts using traditional beginning and end-of-semester surveys showed a positive impact, but with weak statistical significance. With the post-then-pre survey, the quantitative evaluation showed that the course had a clear impact on students, aligning closely with the qualitative assessments of the course.

Now that the post-then-pre survey method has shown promise, future work will include additional questions to explore students' responses further. Gathering demographic data would allow exploration of questions about what factors might affect a student's willingness to take action based on their knowledge gained in the course. It would also be interesting to conduct a follow-up survey later to see if more students take action over time.

The survey also revealed increases in students' knowledge of the topics from the revised privacy, intellectual property, and freedom of speech modules. While this learning cannot be attributed directly to the course revisions, it is a positive outcome. The survey also shows that the course had a positive impact on students' intent to take action to improve their privacy by reducing the data they share, as well as improving the ethics of their use of intellectual property. Discussions with students during the class support this conclusion, as multiple students shared actions they were already taking, especially in relation to protecting their privacy.

In retrospect, the value of ensuring that course content is relevant and significant to students' personal experiences is clear. However, this is something that IS/IT instructors may lose sight of, since this concept does not apply to a significant extent in more technical courses in the curriculum. The content in technical courses is relevant to students, but primarily for their future career plans. For example, unless a student is working as a software developer, it would be hard to make content in a Java programming course relevant to a student's current life.

The approaches used in the course update show promise and can be applied to other course modules. However, this will face the same challenges that were faced with the freedom of speech module, where there is a lack of clear agreement on how or even whether to control social media and other emerging technologies.

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APPENDIX A

We are near the end of the course. I am interested in gauging your awareness of some of the issues we have covered in the course. Specifically, as you look back on where you were at the start of the course, compared to where you are now, how might your awareness have changed?
Please think about your awareness before taking this class and answer the following questions.

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am aware of how companies and web sites collect data about me.					
I am aware of how companies and web sites use the data they have collected on me.					
I take actions to reduce the amount of data I voluntarily provide to companies and web sites.					
I am aware of the intellectual property that I am creating.					
I am aware of the intellectual property that I use.					
I take action to learn more about the intellectual property that I use.					
I make an effort to ensure that I use others' intellectual property in an ethical manner.					
I am aware of the positive impacts that technology has on our society and culture.					
I am aware of the negative impacts that technology has on our society and culture.					
I think about how the technology I use affects me.					
I think about how the technology I use affects my interactions with others.					
I am aware of the positive impacts that technology has on freedom of speech.					
I am aware of the negative impacts that technology has on freedom of speech.					
I am concerned about the impact of technology on freedom of speech.					
I am concerned about the impact of technology on our democratic ideals.					

Please continue on the back of the page

Please think about your awareness now and answer the following questions.

Question	After taking this course.				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am aware of how companies and web sites collect data about me.					
I am aware of how companies and web sites use the data they have collected on me.					
I take actions to reduce the amount of data I voluntarily provide to companies and web sites.					
I am aware of the intellectual property that I am creating.					
I am aware of the intellectual property that I use.					
I take action to learn more about the intellectual property that I use.					
I make an effort to ensure that I use others' intellectual property in an ethical manner.					
I am aware of the positive impacts that technology has on our society and culture.					
I am aware of the negative impacts that technology has on our society and culture.					
I think about how the technology I use affects me.					
I think about how the technology I use affects my interactions with others.					
I am aware of the positive impacts that technology has on freedom of speech.					
I am aware of the negative impacts that technology has on freedom of speech.					
I am concerned about the impact of technology on freedom of speech.					
I am concerned about the impact of technology on our democratic ideals.					

A couple of final questions.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I find the ethical theories used in this course help me evaluate situations I encounter in my daily life.					

Before taking this course, were you aware of any of the ethical theories used in the course?

_____ Yes
_____ No

APPENDIX B

Question	Pre-Course	Post-Course	Change	p-value
I am aware of how companies and web sites collect data about me.	3.4	4.6	1.1	< 0.001
I am aware of how companies and web sites use the data they have collected on me.	3.3	4.4	1.1	< 0.001
I take actions to reduce the amount of data I voluntarily provide to companies and web sites.	3.1	4.2	1.1	< 0.001
I am aware of the intellectual property that I am creating.	2.9	4.4	1.4	< 0.001
I am aware of the intellectual property that I use.	3.0	4.4	1.3	< 0.001
I take action to learn more about the intellectual property that I use.	2.7	4.1	1.4	< 0.001
I make an effort to ensure that I use other's intellectual property in an ethical manner.	3.2	4.4	1.2	< 0.001
I am aware of the positive impacts that technology has on our society and culture.	4.2	4.6	0.3	< 0.001
I am aware of the negative impacts that technology has on our society and culture.	3.9	4.5	0.6	< 0.001
I think about how the technology I use affects me.	3.7	4.5	0.9	< 0.001
I think about how the technology I use affects my interactions with others.	3.5	4.5	1.0	< 0.001
I am aware of the positive impacts that technology has on freedom of speech.	3.8	4.5	0.7	< 0.001
I am aware of the negative impacts that technology has on freedom of speech.	3.6	4.5	0.9	< 0.001
I am concerned about the impact of technology on freedom of speech.	3.3	4.3	0.9	< 0.001
I am concerned about the impact of technology on our democratic ideals.	3.3	4.1	0.9	< 0.001

Analysis results. Note that pre-course, post-course, and change values are rounded.

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APPENDIX C

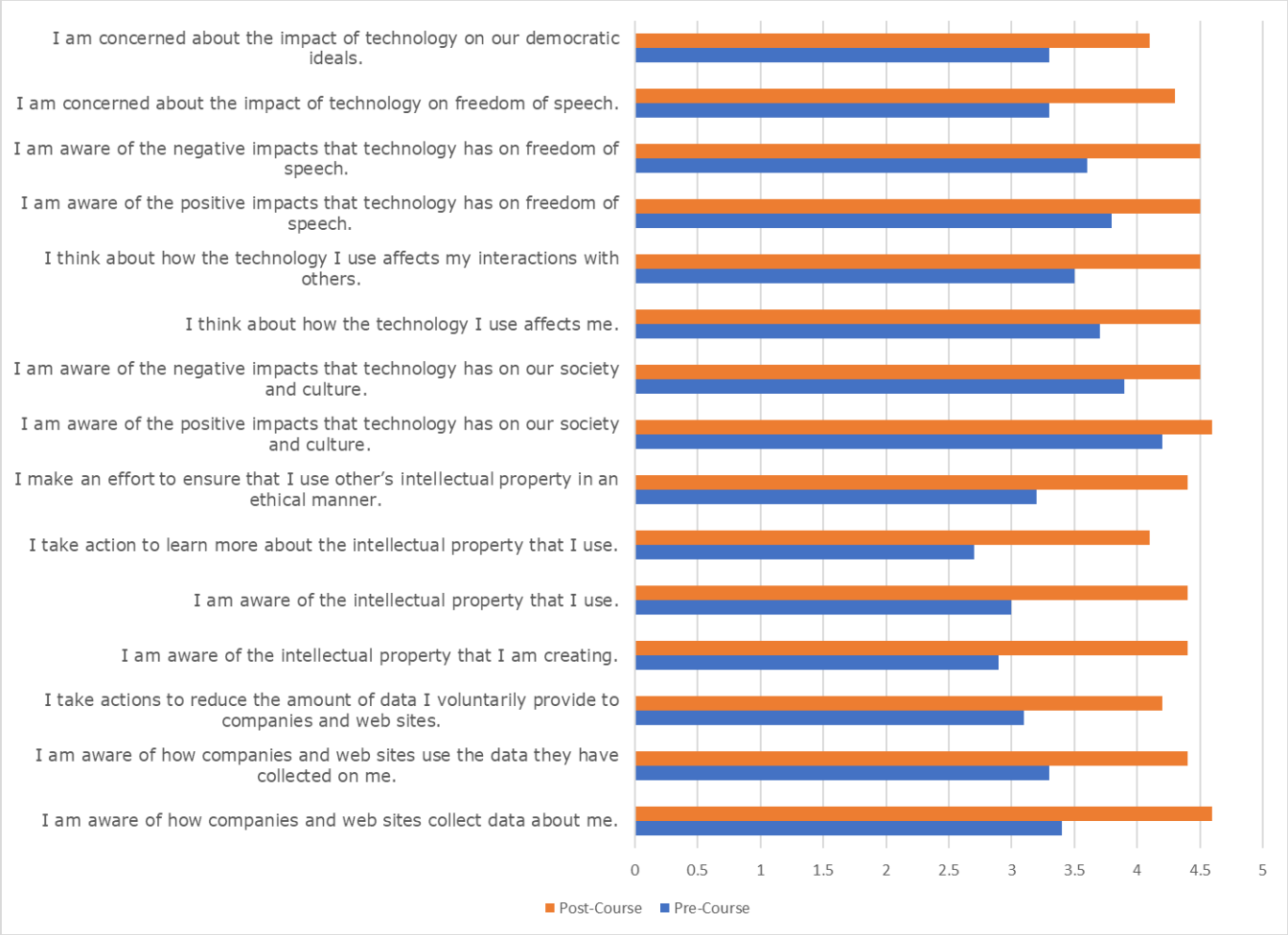

Chart showing pre-course (blue) and post-course (orange) values for each question.