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Teaching User Experience Design Ethics to Engineering Students: Lessons Learned

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Contemporary dilemmas about the role and impact of digital technologies in society have motivated the inclusion of topics of computing ethics in university programmes. Many past works have investigated how different pedagogical approaches and tools can support learning and teaching such a subject. This brief research report contributes to these efforts by describing a pilot study examining how engineering students learn from and apply ethical principles when making design decisions for an introductory User Experience (UX) design project. After a short lecture, students were asked to design and evaluate the ethical implications of digital health intervention prototypes. This approach was evaluated through the thematic analysis of semi-instructed interviews conducted with 12 students, focused on the benefits and limitations of teaching ethics this way. Findings indicate that it can be very challenging to convey the importance of ethics to unaware and uninterested students, an observation that calls for a much stronger emphasis on moral philosophy education throughout engineering degrees. This paper finishes with a reflection on the hardships and possible ways forward for teaching and putting UX design ethics into practice. The lessons learned and described in this report aim to contribute to future pedagogical efforts to enable ethical thinking in computing education.

Keywords: ethics, digital education, user experience design, digital health, human-computer interaction

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INTRODUCTION

Whilst computing systems have brought novel ways to work, communicate and play, the academic community is well aware of the emergent ethical concerns arising with the spread of digital innovations (Davis, 2020), especially in the context of digital health (Martinez-Martin and Kreitmair, 2018). The way such systems can persuade users' actions can be insensitive to vulnerable groups' autonomy (Ayobi, 2020). Language choices, technology literacy requirements and usability flaws can hinder broader access, going against social fairness (Costanza-Chock, 2020). Limited data sharing options can fail to recognize individuals' preference for privacy (Hutton et al., 2018), while lack of transparency can hide away limitations of digital interventions (Vilaza and McCashin, 2021).

As a consequence of the broader recognition of ethical issues, ethics education is currently deemed essential to forming future generations of designers and engineers (Skirpan et al., 2018; Hughes et al., 2020). For instance, experiential learning has been used to facilitate empathy-building toward accessibility issues (El-Glaly et al., 2020). A structured framework has been proposed to help

students to identify and articulate harmful limitations of machine learning projects (Saltz et al., 2019). Science fiction has been applied as a medium to entice moral imagination regarding the drawbacks of artificial intelligence (Burton et al., 2018).

Despite a wide variety of theoretical frameworks for ethical thinking, applying pre-defined ethical principles to design work is among the most often adopted approaches in the industry and academia. The development of "ethics checklists" is an increasingly common practice among companies as means of attempting to alleviate the difficulty practitioners face when operationalising abstract principles (Madaio et al., 2020). Past research has also emphasized that lists of normative ethical principles are frequently applied in the critical evaluation of AI developments within health care (Morley et al., 2020). Intending to understand how students in a prototyping activity might apply this approach, we conducted a pilot study.

This paper advances this research record on ethics education by reporting on the results of the pilot study investigating how engineering students learn from and apply normative principles when making practical UX design choices for digital health prototypes. After a 1-week project part of an introductory course on UX design at a technical university, 12 students were interviewed and inquired about their experiences. The following sections describe: the methods used in this qualitative study, the interview findings, and the discussion of results. The study contributes to understanding the benefits and limitations of using normative principles to teach UX design ethics to engineering students in a project-based learning setting.

METHODS

This pilot study consisted of semi-structured interviews with the aim of understanding the learning experience of engineering students after being exposed to materials and an assignment about UX ethics. The study sought to investigate how the educational approach has facilitated learning of ethics and which challenges were experienced by the students in the process. The report of the educational evaluation conducted in this pilot study intends to not only advance research on this topic but also inform future educational approaches in the department.

Participants

The participants were students at a technical university in Denmark, enrolled in a 13-week course on UX Design. In terms of course structure, every week, there were 1-h lectures followed by 3 h of supervised group work in which students were given a design brief and asked to prepare a set of deliverables (business model canvas, user story maps, interactive prototypes, and report on prototype evaluation). Then, the students carried out an estimated amount of 4–5 h of independent work in groups before the next class. The goal of these short weekly projects was to prompt the students to learn how to ideate and materialize design concepts along the lines of the pedagogical approach of "project-based learning" (Kokotsaki et al., 2016).

In the 7th week of the course, the weekly project proposed to the students consisted of designing a prototype for a smartwatch application that could collect, visualize and share heart rate data between patients and doctors. In addition, the assignment included a written report on ethical considerations of the design concept and the prototype. In order to prepare the students for this assignment, there was a lecture given by one of the teaching assistants in which the students were given an introduction to the potential negative impacts of user interface design choices on users' well-being, autonomy and diverse access. This approach was then evaluated through this reported study.

Recruitment for the study occurred only after students submitted the weekly project deliverables, as participation was voluntary and completely independent from the course assignment. This measure was necessary so that the students work during the assignment would not be influenced by the interview study. A verbal announcement and a message in the class online forum invited the students to be part of an interview about their experience working in the UX design ethics part of the project assignment. In total, 12 students expressed interest. **Table 1** shows the participants' characteristics.

Materials

Before the study, all students of the class were exposed to learning materials about UX ethics. First, there was a lecture illustrating core ethical challenges. Then, the students were provided with two templates (Google forms online): a checklist for self-reflection or team discussions and a questionnaire to gather feedback from peers or potential users (see **Supplementary Materials**).

The lecture and the templates purposely emphasized a set of five normative principles: choice, transparency, inclusion, well-being and reciprocity (see **Figure 1**). This set of principles was inspired by the ethical framework of Nebeker et al. (2019) highlighting beneficence (providing end-users with direct health benefits), justice (enabling diverse and inclusive access) and respect for persons (not harming individual well-being, providing choices and being transparent) as essential ethical requirements for the digital health context. This framework facilitated the creation of learning materials that could concisely and soundly introduce the topic to the students.

Procedure

In order to build rapport and protect students from feeling that the participation in the study might compromise their grades, a teaching assistant conducted the interviews and confidentiality from the primary course instructor was guaranteed. As this pilot study was not planned nor conducted by the main course lecturer, which meant that some distance could be maintained, as the goal of the study responsible was learning from this experience and not judging teaching performance. Three interviews were conducted in person and four remotely (through a video call). Participants who belonged to the same working group in class were interviewed together. Interview questions were based on a semi-structured script.

Participants were explained that the goal of the interview is to improve how the activity is carried out in future classes and, for this reason, their honest feedback was very important. Participants were asked about their experiences, challenges and learnings, and were compensated with a voucher of 100 DKK. In

TABLE 1 | Study participants' characteristics.

ID	Group	Programme	Nationality	Gender
P1	1	Design and Innovation Engineering (MSc)	Danish	Female
P2	2	Human-Centered Artificial Intelligence (MSc)	Colombian	Female
P3	3	Industrial Engineering and Management (MSc)	Greek	Male
P4	4	Design and Innovation Engineering (MSc)	Spanish	Female
P5	4	Design and Innovation Engineering (MSc)	Spanish	Female
P6	5	Design and Innovation Engineering (MSc)	Danish	Male
P7	5	Design and Innovation Engineering (MSc)	Danish	Male
P8	5	Design and Innovation Engineering (MSc)	Danish	Male
P9	5	Exchange student	French	Male
P10	5	Exchange student	French	Male
P11	6	Human-Centered Artificial Intelligence (MSc)	Spanish	Female
P12	6	Software Engineering (BSc)	Danish	Female

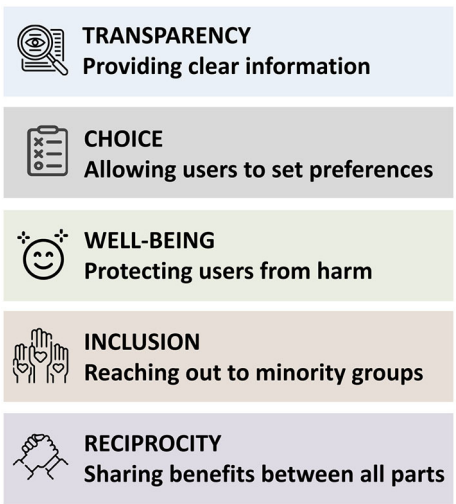

FIGURE 1 | Infographic illustrating the five normative principles emphasized to the students.

line with Danish research regulations, this study is not considered subject to formal ethical approval, yet the highest standard were adhered to including informed consent procedures and secure data storage following GDPR.

A Thematic Analysis was conducted by the first author, following the Braun and Clarke framework (Braun and Clarke, 2012); more specifically, it followed an inductive approach. The themes' descriptions and corresponding quotes were then used to report results as the narrative presented next.

RESULTS

The Approach Served to Raise Awareness and Interest

An important theme across the interviews was that ethics in design was perceived as a new topic not yet examined by many of the students until the course: "*It is the first time I hear about ethics in design*" (P2). Despite being a novelty, the educational materials were effective in bringing the topic to the students' attention: "*The lecture you gave raised some awareness. Since that lecture, ethics has been part of our work in the group*" (P1). Bringing this topic to class also changed some of the students' perspectives about technology design: "*We thought about ethics, but maybe not in a good way. We did the opposite with the previous courses. We thought: how can we be as evil as possible with this? How can we gather as much data? How can we blackmail the user the most? Now we think the opposite*" (P6). Despite being a novelty, most students were clearly interested in the topic: "*I have not thought about it, but as soon as I read it, I was like, okay, this is important, it is something that I really want to address because ethics is something that I care about*" (P11). Some also expressed an interest in learning more: "*I would like to see more about it because I am interested as a person*" (P3). Overall, these findings indicate that the educational approach was efficient in raising the students' awareness of the topic.

The Principles Helped to Identify Ethical Concerns

The interviews show that students understood how their prototypes could be designed to consider ethical aspects. In particular, issues of transparency and choice were often mentioned by the students as elements they have re-considered: "*We tried to add more things to the smartwatch regarding transparency and freedom of choice*" (P4). One of the students also mentioned adding more privacy settings to the design proposal: "*We were thinking that being able to know what you are showing and what you are not and having more settings, because, in the first app that we made, we did not have settings*" (P11). Harm to well-being was another concern tackled often by the students in their design process: "*The whole point is trying to make the users not feel bad if they have not done something they should have done. The notification could like tell them to go out for a walk without trying to make them feel bad and just try to stay positive*" (P10). In addition, when asked how they approached the evaluation of their prototypes, students reported that they used the templates as

a guidance: "*Going through the checklists. It was quite informative, it made it quite clear the things we should be looking for*" (P1) and "*What we did was to use the templates, and that is how we learned how to do it. Without the templates we would not be able to know what to change*" (P5). The use of normative principles, therefore, appear helpful in helping to identify specific ethical issues.

Ethical Design Was a New Topic to Many Students

A lack of previous knowledge on ethics was raised by the students as a source of insecurity when making decisions: "*I feel hesitant, doubtful, concerned because I have never heard of the topic before. Of course, it is something important, but I never thought about it*" (P2). Missing specialized domain knowledge that could help to make ethical findings actionable was also an issue for some: "*We felt a lack of knowledge because in this particular case, we need a doctor to say what is more important. Maybe it could be nice to have more health information because we know it is something we should take into consideration but as we do not know the potential damage*" (P4). Similarly, one of the students felt unsure about how to attend to disabled users' needs: "*How to include the handicap? I think it is important, but I have no idea how. You must be the blind person to understand the blind person*" (P2). Another student did not know how blind users could use mobile apps: "*One of the comments that we kept getting when we were reviewing each other's solutions was that blind people would not be able to use this but are blind users even able to use apps?*" (P1). Such findings indicate that despite the ethics lecture, they may still need more info in the course to grasp the concepts.

Ethics Was Perceived as an Antagonist for Success for Some Students

In contrast with previous themes, a few students were not entirely convinced that ethics should be a priority to design: "*I think it was a good add on to the course, but I do not consider it being a high priority*" (P1). These students believed that ethical ideals could conflict with business growth: "*I think it is rather unrealistic to incorporate ethics in such a corporate area. How would you ask big corporations or developing companies to be more aware of ethics if it is clear that their primary concern is money?*" (P2). In particular, a student remarked how ethics could be a barrier to profit: "*Data is money, and all I ever wanted is to make money. So we need all the data even if you do not want to share it, that was our app's logic: money*" (P7). Aligned with this finding, a student stated that getting a high grade was, in fact, the primary motivation to engage with the subject: "*In the end, we were caring about a good grade, so I am not going to lie this was the reason behind*" (P3). Such negative views of ethics illustrate the resistance of a few students to consider the importance of the topic.

Group Members Had Conflicting Views at Times

As the students were working in a group, social dynamics played a role in how discussions were held, with many students stating it was sometimes difficult to reach agreements: "*We have been able to agree on many things, but we are a group of people who do not know each other very well so we do not always turn out super compatible. It is hard to say: "I think you should change all the work you just did*" (P12). Some also reported that their group members did not consider the topic important, leading to a conflict of interest: "*We were more interested in it than the others. It is not that they were against it, they just did not care*" (P12). As an attempt to handle disparate views, one of the students mentioned that when conflict arises regarding the ethical implications of a certain UX design choice, the group decides to ask for feedback from end-users or peers: "*The moment one has a question and asks the group, but we cannot agree in a few minutes, we decide to validate the concept with others*" (P5). This lack of alignment within teams is another challenge to teaching and learning ethics in design projects.

Time Pressure Was a Source of Frustration

The fast pace of the course and the requirement for weekly deliverables, where time on purpose becomes a scarce resource and thus forces the student to prioritize hard, were nevertheless barriers to deeper discussions: "*At that point, we were too busy and concerned with the next hand-in. We were just going to leave it because we did not have much time. We were not making great philosophical discussions about everything, but if we had a longer time frame, we could do it*" (P2). In order to be more efficient within the time frame, one of the students suggested that seeing more examples could help making faster decisions: "*Maybe we could see some examples of how to implement it more quickly*" (P3). Besides lack of time, some students wished they had started considering ethical aspects at the beginning of the project, not as an after-thought: "*It felt stressful and frustrating because it was late in the process, and I feel like that is something that should have come earlier*" (P11). Therefore, time management was a significant factor in deciding whether to engage in ethical reflections during the course.

DISCUSSION

The educational approach evaluated in this paper was effective in raising students' awareness, which is in itself a very favorable outcome for classroom activities about ethics (Skirpan et al., 2018; Saltz et al., 2019). Results show that the selected set of normative principles was a helpful structure for analysis, as the principles functioned as reference points guiding the students' creative process. A previous study evaluating a similar framework of ethical questions for machine learning also found that a list of ethical questions acted as a catalyst to students' debate (Saltz et al., 2019).

Findings also provide evidence that the students can make some ethical design decisions once instructed. Such reports of applying ethical thinking to the design of prototypes are not usual in the literature on ethics. An exception is perhaps a previous study that observed how students re-shaped their design concepts after experiencing the vulnerabilities of data collection and visualization firsthand (Shapiro et al., 2020). As the goal of ethics education in computing is to provoke change in future technological developments, ethical insights should lead to observable outcomes in the design process (Bauer et al., 2017; Barry et al., 2020).

Despite such supportive indicators, the study makes evident that students faced challenges. Even though disparate views can

support debate and reflexivity, students could not perceive the group conflicts in such a positive light. Previous works have discussed that methods for "ethical mediation" are critical in decision-making so that arguments from conflicting views can be taken into account during team discussions (Gray and Chivukula, 2019), and our findings support the need to include that in the classroom. Past research has also highlighted that putting ethics in action is a demanding task, requiring an empathetic mindset, attentive to situational complexities (Munteanu et al., 2015; Frauenberger et al., 2017). Such a deep type of reflection can take time, and our observations indicate that it can be challenging to achieve more ethical design if time is too limited of a resource. Obstacles with group dynamics and time prioritization should still be used as pedagogical tools to prepare students for situations that may appear in their workplace, but course structures should consider including more concrete examples and tools to help students navigate the constraints of a design process more productively.

Findings also confirm previously discussed shortcomings of pre-defined checklist items and the limitation of atomistic normative frameworks. As previous research with employees working with artificial intelligence has argued, co-designing checklist items as a team is a more effective approach than providing professionals with pre-made broad guidelines (Madaio et al., 2020). However, checklists and normative principles may as well do not function as tools enabling more comprehensive ethical thinking, rather becoming manual tasks to be completed without genuine reflection. For this reason, if an approach based on lists of ethical principles is chosen, it is important to consider how to complement the method with other design inquiry methods, such as active stakeholder involvement and speculative prototyping (Friedman and Hendry, 2019).

Furthermore, results indicate that a one-time lecture and a prototyping assignment may not be sufficient to fill existing knowledge gaps. In fact, it has been argued that ethics education would greatly benefit from acknowledging the need to expose students to a diverse range of disciplines, skills and methodologies related to the topic throughout their studies (Raji et al., 2021). Aligned with such perspective, previous studies have proposed empathy-building tools and role-playing as ways to increase sensitivity to issues that are beyond a designers' lived experience, thus adding to their capacity to relate to their users (Matthews et al., 2014; Honary et al., 2018; Sas et al., 2020). The importance of empathy development is particularly relevant in the case of students who believe that technology should be "as evil as possible" (P6), as they might not have realized that, in the future, they might be victims of malicious technologies they built by refusing to act in solidarity with their users in the present.

Moreover, the analytical stance deployed by the students in this particular study is not the only way to engage with ethics. Active involvement of different stakeholders through participatory and emancipatory research methods are other options that can be used in UX education. An example is a study reporting on how the collaboration with communities and non-profit organizations was very effective in teaching students how to propose caring design concepts, more attuned to users' needs (Sabie and Parikh, 2019). Still, even though consulting others may be a way for students to seek different perspectives, it can also become a shortcut for making decisions without genuine reflection, which should not be the goal.

Regardless of the educational approach chosen, findings suggest that some misconceptions need to be addressed first if students are expected to produce concrete ethical designs in class. It is not easy to know exactly why some students seem to care less about ethics than others. However, a previous study on ethics education has found that students usually do not see themselves as political agents responsible for ethical work (Petelka et al., 2022). Previous works have brought to attention that engineering students may never come across topics of ethics during their education, which further complicates this problem (Saltz et al., 2019). The combination of standalone modules and the insertion of activities about the topic in multiple technical courses across secondary education programmes might prove to be the most effective approach in the long term, as advocated by previous research (Garrett et al., 2020). It is also fundamental to keep probing strategies for the challenging quest of turning indifferent students into caring ethical agents in their future careers.

Limitations and Future Work

This pilot study has methodological limitations. The fact that only students who volunteered to participate were recruited means that findings may not reflect the perspective of the whole class (sample bias). In addition, the empirical data comes from the students' reports of their experiences in retrospect, which can result in recall bias. Another limitation is that students had to share their views to one of the class tutors, which might have blocked the disclosure of opposing opinions despite our efforts to stay open to their feedback (acquiescence bias).

In order to complement and build upon the observations reported in this study, future work could consider the direct observation of students as they work on their projects and the discussion of the produced artifacts as additional empirical sources, as a way to evaluate the impact of the course based on the changes students bring into their processes. Further studies could also examine the preferences of students regarding different ethical frameworks, such as ethics of care. Finally, future research could consider more objective measures for the evaluation of pedagogical efforts, such as questionnaires and examinations.

CONCLUSION

This pilot study had the goal of learning from the experience of introducing students from a technical university to the concept of ethical UX design. Results were very insightful as they showed in practice the limitations and benefits of our approach. With the lessons learned through this study, we contribute to future pedagogical efforts to teaching ethics for UX design as the explicit statements from the students are powerful indicators of the challenges of teaching HCI ethics.

In summary, even though the educational materials could effectively raise awareness and guide some ethical decisions in the project-based learning setting, challenges remained. Some students seemed skeptical about the applicability of ethics in technology, and lack of interest was a significant barrier to a genuine engagement. Gaps in engineering education also became apparent as students reported feeling insecure with

their knowledge on the topic. Students also claimed time pressure and group dynamics as obstacles to more profound reflections that could lead to user interface designs that respect human autonomy, promote well-being and broader access to digital innovation.

Such findings emphasize the need to expose students more often to a more diverse range of teaching methodologies, design skills and ethical philosophies throughout their engineering education. With the broader recognition of complex moral dilemmas by the media and digital technology consumers, ethics education has become imperative for future professionals and it consists of one of the most critical design aspects of digital health interventions. Efforts to include topics on computing ethics in teaching materials should be encouraged, and the way these materials are delivered should be mindful of the challenges discussed in this paper.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

GNV has planned and conducted the research and written most of the manuscript. PB has supervised the research and contributed with content to the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

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