Crowdsourcing a Practical Toolkit for Embedding Ethics in the Engineering Curriculum (Work in Progress Paper)

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Analyzing the impact of a crowdsourced toolkit for embedding ethics in the engineering curriculum

(Work in Progress Paper)

Abstract

Integrating ethics in engineering education has now become a recurring item at engineering educational forums and discussions and is still growing in urgency. It is now no longer a question of whether ethics should be integral to curriculum design but how, who, what and why. How can it be incorporated? Who should be teaching ethics? What should we be teaching? And, more fundamentally, why are we teaching what we teach? The aim of this paper is to present how an internationally curated open source 'Engineering Ethics Toolkit' was developed by educators, for educators to embed ethical context within their courses and degrees, and to consider what could be examined further for future development of the toolkit. The engineering ethics toolkit provides guidance, resources, tools and frameworks for engineering educators at all levels of experience and roles in teaching ethics to engineers. It aims to answer the key questions mentioned above to integrate engineering ethics in curriculum design. The objectives of this paper are to a) explain the methodology of developing the engineering ethics toolkit b) present the metadata and user experience on how the toolkit is currently being used worldwide and c) identify future steps for the toolkit to develop further. The toolkit was co-created by a dedicated working group of educators from diverse higher education institutions: from new unconventional universities to traditional long-standing establishments and practicing engineers from various industries and businesses. The current toolkit content comprises of guidance, teaching resources (case studies and linked activities), an interactive curriculum map, and descriptions of practice. The toolkit was launched in February 2022 and the first steps of an impact assessment on the project are underway. Feeding into this assessment is metadata on the use of the website and toolkit, which is continually being collated. This includes collecting geographical and temporal data to identify regional interests in ethical topics and frequency of use to identify the level of focussed topics versus diverse topics. These will be used as a proxy for assessing regional relevance and urgency. Testimonials from four educators who have used toolkit resources in educational contexts have also been collected to evaluate the efficacy of the toolkit qualitatively. These user cases reflect both novice users introducing ethics and experienced educators' use of the toolkit, which comprises of guidance articles and resources to build knowledge and structure for curriculum delivery. This initial phase of the impact assessment of the engineering ethics toolkit has shown that it also helps to support educators to achieve the directive from professional bodies to imbue ethics into engineering degrees. Further work will explore how the toolkit could evolve through the active participation of other engineering ethics educators as well as engineering students and graduates.

Introduction

Responding to pressure from industry and scholars, and in response to high-profile engineering-related incidents like the VW emissions scandal, degree accreditors have revised

expectations for engineering degrees so that they are required to include elements of ethics teaching and learning. While most engineering academics applaud this change in principle, in practice there are still barriers to overcome. These have been well-documented in scholarship and include: perceived room in the courses for the inclusion of yet more content [1]; lack of confidence among educators that they are capable of and/or qualified to deliver teaching in this area [2]; and lack of research-informed pedagogical resources on ethics specifically designed for engineering teaching contexts [3].

An Engineering Ethics Toolkit was proposed to help overcome these barriers by specifically addressing the latter concern. This proposal emerged as an output of a high-level review of ethical culture and practices in UK engineering initiated by the Royal Academy of Engineering's Engineering Ethics Reference Group. The report on this review, "Maintaining Society's Trust in the Engineering Profession" proposed specific actions designed to facilitate a "more ethical culture in the UK's engineering profession" (Royal Academy of Engineering, 2022). One of these actions spurred the creation of an Engineering Ethics Toolkit Advisory group to focus on the educational resources in higher education required to achieve that aim. Formed in early 2022, the Advisory Group believed that developing high-quality engineering ethics teaching resources contextualised to fit into existing disciplinary courses would be the best approach to integrating ethics content into engineering teaching. To maximise their effectiveness, these resources would be open-source and freely available to anyone in the world but aligned to the expectations of the UK Engineering Council's regulations and standards found in the fourth edition of their Accreditation of Higher Education Degrees (AHEP) published in 2020, which helps students develop the competence and commitment expected of engineering professionals. The UK Engineering Council is a signatory of the global Washington Accord and therefore aligns closely to the Accord's engineering competencies, which are also adopted by national professional engineering councils in 23 countries across 5 continents.

The Ethics Toolkit consists of an Ethics Explorer to help users navigate the content according to their needs, 15 guidance articles focusing on teaching methods and approaches, and 25 detailed pedagogical case studies that are customizable and offer integrated learning activities. The Toolkit's aim is therefore to support educators to achieve the directive from professional bodies to imbue ethics into engineering degrees. It does this by putting engineering ethics education resources into the hands of educators and practitioners, where they themselves are also co-creators in this process. The toolkit does not try to *instil* or *improve* the ethical skills of students (e.g. ethical awareness, reasoning and judgement) and scholars have long contested whether we can or should be assessing ethics [4]. However, a clear distinction can be made between evaluating ethical reasoning skills and assessing actual values and beliefs, which is generally considered inappropriate [5]. This is particularly important in a global context where cultures, value systems and the socio-political, economic and environmental ecosystems that engineers operate in can be vastly dissimilar. Rather, assessing impact of the Ethics Toolkit lies in assessing the engagement, practical uses and feedforward loop from the engineering educators and practitioners that these resources were designed for. However, defining impact in engineering ethics education requires a move away from using the more quantitative measures common in technical engineering research. Instead, impact requires a wider lens that encapsulates the qualitative factors such as the user engagement, the observable shifts in behaviours that may occur to individuals and

communities, and changes to products/processes that result from the user experience. To accomplish this, the authors adopted the ENLIGHT Methodology and Toolkit 2.0 for Higher Education Impact Assessment [6]. This methodology provides a step-by-step process for establishing the transformation and value induced in a target group(s) by specific actions undertaken, and feeds into a continuous improvement process that can guide future actions. As a works-in-progress paper, we report here on the completion of phases 1 through 3 (purpose setting, scoping, data collection and analysis), and our initial work on phase 4 (impact value). The process has so far included in-depth interviews with Toolkit users to elicit information about their use of the resources and their value, and a metadata analysis using external metrics such as geographical reach and frequency of toolkit access as a proxy for user engagement. Through this study the authors will also reflect on the co-creation of new resources as the toolbox has evolved and identify any unexpected outcomes and impact as a result of user engagement and toolbox development.

Methods

Assessing impact of higher education initiatives has become increasingly important, with educators and institutions now frequently required to describe and sometimes measure the societal value of their projects. This is often especially important for publicly funded institutions or organisations that are member-supported. In recognition of this, an alliance of European universities called ENLIGHT recently developed a methodology for assessing impact in higher education as part of its commitment to a culture of impact within and beyond its universities. Its freely available toolkit was derived over several iterations and version 2.0 was published after a conference in 2023.

The authors of this study are using this methodology to assess the impact of the Engineering Ethics Toolkit because it provides a framework for research into demonstrable effects or changes over time which happen because of an intervention within the higher education environment, and it focuses on transformation of and value to stakeholders as key indicators. These measures have been identified by leadership at both the Engineering Professors' Council (EPC) and the Royal Academy of Engineering (RAEng) as critical to informing the future direction of the Toolkit and providing justification for ongoing financial support.

While it is recognized that "impact assessment is not a unidirectional nor linear process" [6, p. 7], the methodology is structured around 6 phases as depicted in Figure 1. In Phase 1, the justification for conducting the impact assessment is determined: why it is needed, and what is intended by doing it. In this case, the purpose is one of understanding and adaptation: to understand why, how and whether the Ethics Toolkit is bringing about an integration of ethics into engineering teaching across multiple contexts and disciplines, and guiding educators to prioritize ethics by changing the structure and content of lessons, courses, and/or degrees.

Figure 1: The phases of the higher education institution (HEI) impact assessment methodology. Adapted from [231024_D81_Methodology and Toolkit 2.0 (enlight-eu.org)]

Phase 2 of the impact assessment methodology is scope definition, which requires addressing several elements: 1) defining the impact pathway or causal chain of impact, 2) defining and classifying stakeholders, 3) deciding the scope of the impact assessment itself, and 4) deciding on the approach and composition of indicators. The causal chain of impact is shown in Figure 2. The Ethics Toolkit itself sits at the centre of this chain, being the "product" or output that derived from a variety of activities. The outcomes, or results expected to be achieved from the output that contribute to the desired impact, are that educators use and implement the Toolkit resources. The ultimate impact, or change brought about as a direct or indirect result from outputs and outcomes, is that engineering lessons, courses, and degrees, are revamped to include ethics as a fundamental (rather than tangential) component of engineering.

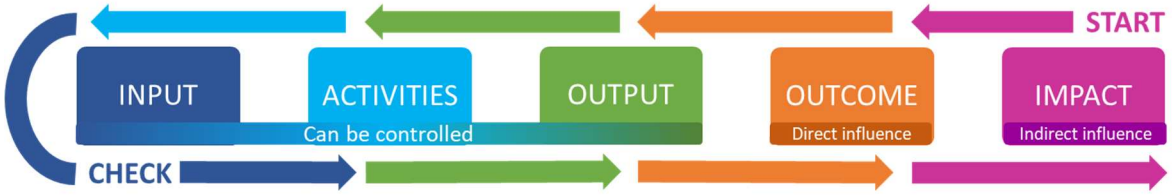

Figure 2: Causal chain of impact. Adapted from [www.erasmusplus.nl/en/impacttool-mobility]

For the Phase 2 element of defining and classifying stakeholders, we have identified engineering educators as primary stakeholders, with students, university management, and accreditors as secondary stakeholders**.** In the third step of Phase 2, we defined the impact assessment scope. For this impact assessment, we decided to look at short term (1-3 year) changes that are identifiable since the publication of the Toolkit online in 2022. We are mostly looking at impact within the UK, since that is the defined scope of the RAEng and EPC, but since the Toolkit is online and open-source, and several contributors were from other continents, we also attempted to understand further geographical reach. Our objective is

to understand the impact of the Toolkit on our primary stakeholder (engineering educators), but also the impact it has on the engineering curriculum. Finally, in part 4 of Phase 2, we decided to use a non-experimental approach that combines quantitative and qualitative techniques consisting of online metadata and stakeholder interviews that can both be analyzed to elicit the relationship between the Toolkit and its impact.

Phase 3 of the impact assessment methodology, Data collection and analysis, began with collecting metadata available from the EPC website, which hosts the Ethics Toolkit. The Toolkit was first launched in February 2022; however the EPC carried out a transition to a new website host in June 2022, where the Ethics Toolkit was published in Beta mode between June to September 2022. In September 2022 the Toolkit went live on its new site, with data analytics running from Google Analytics. Thus, all analytics data previous to September 2022 were unavailable. Therefore, usage data over a 16-month period from September 2022 until December 2023 (inclusive) were collated and analysed for this study. Data collated included: number of page visits, number of unique users, and types of resources accessed (articles, case studies, ethics explorer landing page). The top ten most visited pages were analysed based on number of views and number of users per month from September 2022 to December 2023. For high peak users visiting a specific case study, defined as over 200 users in a month, the users' locations by country over the whole EPC site were analysed week-by-week during the peak month. Unfortunately, it was not possible to extract the geographical location of the users visiting a specific case study page and therefore, the geographical location was used speculatively as a proxy for the ethics toolkit regional reach. The data collated was in accordance with the EPC policies on data protection and stored in accordance with the Data Protection Act 2018 and the UK's General Data Protection Regulation (GDPR).

The next component of data collection involved carrying out Microsoft Teams interviews with four engineering educators who have engaged with the Ethics Toolkit. Through a participant information and consent form, interviewees agreed to answer a series of questions that examined their motivations for contributing or using the toolkit resources. The interviews were up to 60 minutes long and data collected were anonymised for the impact study.

Results and Analysis

Metadata

The most popular ethics case study visited was a case study on implementing facial recognition technology, with 2276 views and 905 unique visitors recorded during November 2022 (Table 1). This was followed by a case study featuring the use of solar panels to provide green energy for oil extraction, with 205 views and 126 unique users in November 2023. The third and fourth most visited case studies were addressing glass safety in heritage buildings (139 views and 62 users) and a "water war" between farmers and a data storage facility (90 views and 52 users) in November 2022. When looking at a more extended period of use, the variation in access across the 16-month period aligns closely to typical Eurocentric teaching calendars with June, July and end of December showing the lowest number of site visits (figure 3). The guidance articles as expected were not visited with the same frequency as the teaching resources (case studies), however they were less subject to calendar fluctuations,

indicating their value in providing guidance and professional development outside of direct teaching.

Table 1: Number of views and users at the Engineering Professors Council (EPC) website showing a considerable peak and geographical shift from UK to China over the month of November 2022.

		Views		Users			top users on the site by country (number of users)				
week	Dates	Total views across site	case study facial recognition views	Total users across site	case study facial recognition users	% of total users across site	Number 1	Number 2	Number 3	Number 4	Number 5
1	1-7 Nov 2022	2618	41	460	23	**5%**	UK (363)	US (32)	China (18)	India (6)	Australia (4)
2	8-14 Nov 2022	1647	18	369	12	**3%**	UK (250)	China (38)	US (36)	Germany (6)	India (5)
3	15-22 Nov 2022	3651	1517	1153	678	**59%**	China (611)	UK (338)	US (65)	Australia (58)	Hong Kong (36)
4	23-30 Nov 2022	3433	700	1071	296	**28%**	China (377)	UK (266)	US (47)	Australia (30)	Hong Kong (18)

Analysing the geographical reach across the overall EPC website for months with high peak activity (November 2022, 2023) and low activity as a benchmark (December 2022, 2023, and June 2023) showed most users were by far based in the UK. However, during November 2022 where the spike in visits occurred at the facial recognition case study page, a change in geographical access was noted with almost double the number of visits coming from China compared to the UK (see Table 1). Although the geographic location of the visitors accessing the facial recognition case study *only* is not known, 59 % of the increase in site traffic is attributed to visitors accessing this case study page. Therefore, there is a strong indication the geographical shift would be attributed to this. Geographic analysis for the second most visited case study is not presented here as the site traffic to the case study page only accounted for 8% of the overall number of users at the site.

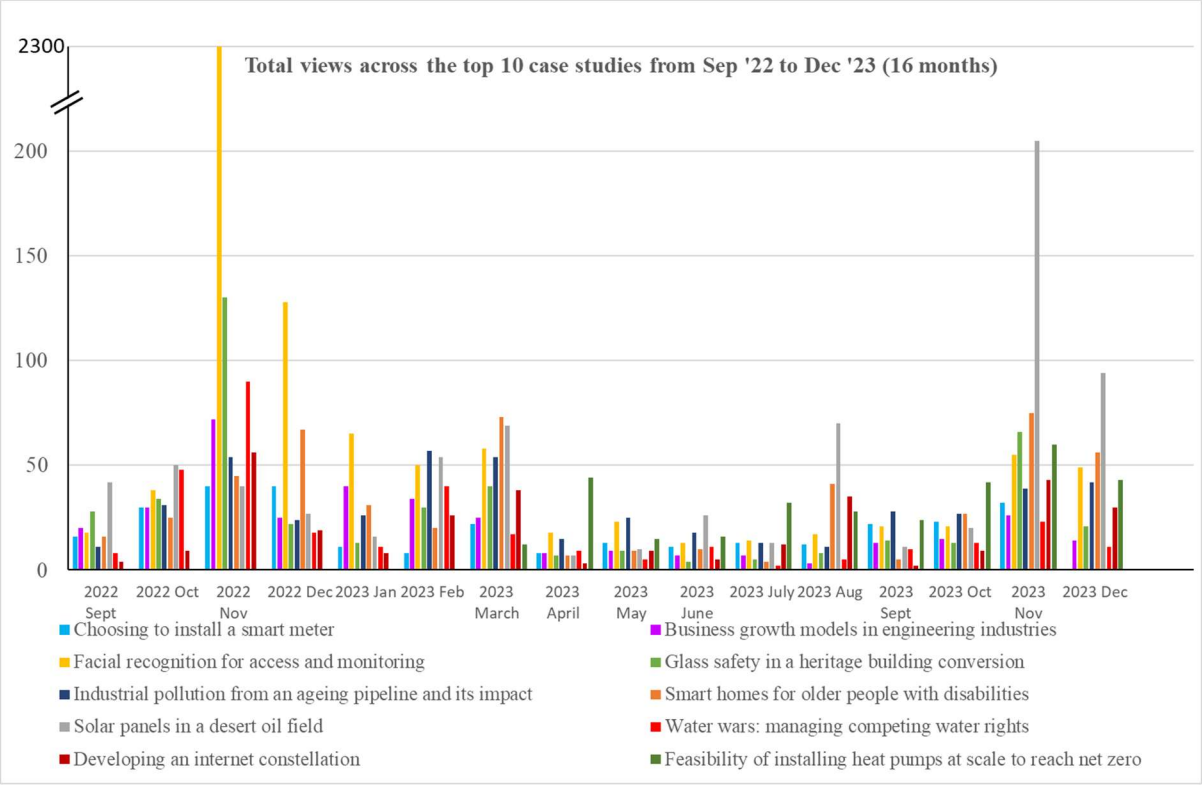

Figure 3: Page views of the top ten visited case studies on the Engineering Ethics Toolkit highlighting

which are attracting the most attention (facial recognition and renewables used in oil fields) and showing a general trend across the academic teaching calendar

When looking at number of visitors to the overall site by country over the 5 selected months (highest and lowest activities), after UK and China, the third highest number of users was from the US. When looking at peak data on a weekly basis, it was noted other European countries with a high proportion of English speakers were accessing the site, namely, Finland, the Netherlands and Germany. Due to the origins of the toolkit, the user base is currently Eurocentric and therefore expected.

Interviews

Four educators who had implemented Ethics Toolkit resources were interviewed as part of the data collection process of impact assessment. These educators represented a range of educational experience, disciplinary backgrounds, and institution types. Interviewees were asked questions in three categories: Need (their perspective on if and why the Toolkit is a necessary resource); Use (their description of how they used Toolkit resources); and Value (their perspective on why the Toolkit has value to engineering educators).

In terms of need, all interviewees mentioned accreditation criteria as a motivator. They were all aware of AHEP4's requirement that engineering students meet learning outcomes around ethics and were motivated to seek out Toolkit resources because of that. Two of the interviewees bore a personal responsibility for their degree meeting that expectation, as their job role requires them to oversee or manage the inclusion of ethics (and other AHEP criteria). One of the interviewees, though not responsible for ethics across the degree, was teaching a course on professional engineering which is where that accreditation outcome was to be met. The fourth interviewee is from a small institution that offers limited degrees and courses, and they spoke broadly about needing to meet accreditation standards in the context of the entire institution, and therefore the desire to weave ethics across the curriculum. Three of the four interviewees described the need to adopt active and problem-based learning approaches as another reason why they sought out Toolkit resources, because they found the "off-the shelf" activities and lesson plans were designed in a way that supports that pedagogy. Two interviewees pointed out that the Toolkit fills a gap because existing resources on engineering ethics in the UK often come from professional engineering institutions and these are framed for practicing engineers rather than for engineering students, and often are not geared toward general engineering learning. Indeed, another interviewee described the Toolkit as "a godsend because it was developed for someone like me and my needs." All interviewees also mentioned that there is a pressing need to educate students so that they are prepared for practicing engineering in a way that is required in the 21st century, and they viewed the Ethics Toolkit as a supportive resource for this aim.

Their use of Ethics Toolkit resources varied; for instance, one interviewee used one case study repeated in three lessons and another interviewee used multiple Toolkit resources integrated across an entire degree. However, all interviewees used a case study, and some used more than one and up to three different cases. One interviewee particularly noted their intentional use of different types of cases, where their first year students engaged with a case

study unrelated to their specific disciplinary area so that they could focus on the ethical issues around "people and relationships," and their third year students engaged with a discipline-specific case that allowed them to bring "social, technical, and economic factors" into their knowledge domain. Another interviewee described choosing learning resources from across different case studies, and then adapting them to their own lessons. Delivery style, too, spanned a wide range of contexts, from one 1- to 2-hour block in an online setting to hybrid delivery that incorporated the case studies and corresponding learning resources into a Virtual Learning Environment learning pathway across several weeks of a course, to in-person sessions of both large lecture and smaller group sessions. Notably, the interviewees were engaging with students at very different types of institutions, from a small engineering-only start-up with a couple hundred students to large traditional university with tens of thousands of students in the engineering degrees.

Several key points were consistent regarding what interviewees valued about the Ethics Toolkit. First was the importance of adaptability. The ready-to-use elements of the case study design enabled them to adjust the resources as needed to their teaching and learning context. One interviewee described them as "succinct but broad" and "not prescriptive but [they] direct you." Another valuable element was seen to be how the resources support and reflect authentic learning and assessment. This also relates to the interviewees' view that the Toolkit links to efforts around Sustainability and equality, diversity and inclusion (EDI), which all mentioned. The resources reference connections to these topics, adding to and complementing them by showing their relationship to real-world problems. One interviewee noted that the multifactor scenarios in the case studies mimicked real life in a way that allowed students to imagine "this could be me" and therefore was relevant to a future decision they might make. Interviewees also felt that the Toolkit resources encourage student participation in their own learning, with two interviewees reporting some of the highest levels of engagement during the delivery of case study content that they had experienced as educators. Another interviewee suggested that the opportunity for interactivity and reflection that is built into the case studies encouraged learning at a higher level of Bloom's Taxonomy. Finally, all interviewees agreed that the Ethics Toolkit was supportive of institutional and/or programmatic vision and/or strategy, and all said that they would recommend or already have recommended the Toolkit to other educators; indeed, two have referenced or featured the Toolkit in conference presentations about their teaching.

While all interviewees reported valuing the open-source nature of the Toolkit and the accessible style of its resources, they also noted that some potential challenges and barriers to use could still exist. For instance, one said that the Toolkit "can probably do 50-60% of the work for you, but you still need students to be working with authentic problems in the project space," suggesting that those educators still using lecture-only teaching formats might not see the material as easy to integrate. Two interviewees said that educators need to themselves be trained to some extent in engineering ethics and use the corresponding Toolkit guidance articles alongside the case studies, so that they're not so wedded to the concept that there has to be a right or wrong answer to the dilemmas presented. The same two interviewees also both mentioned that engineering educators can sometimes be uncomfortable with disagreement about the dilemmas (amongst students and teachers alike) and may also not be in the habit of engaging in reflection, but they agreed that these were important parts of learning how to address ethical issues and figure out a way to move forward. One interviewee

said, “I never thought I would be teaching [engineering ethics] and now I am really glad I am; I really enjoy it and am passionate about it.” This shows how engaging with the Ethics Toolkit can contribute to educator professional development as well as to student learning.

While interviewees acknowledged that it was impossible to know how learning sessions using the Ethics Toolkit will practically affect students’ work in the future as professional engineers (one hoped that a longitudinal study could be conducted), they all suggested that the resources promoted longer-term impacts. Some quotes alluding to this are: Students “left [the Ethics Toolkit sessions] with a greater understanding of what ethics will mean to them as a professional engineer;” the Toolkit “content . . . provides a good standard of education that will serve their needs as an engineer;” the resources “are great for professional and character development;” and the students will “be able to use [their experience with the Toolkit] in getting Chartership [a professional title for an engineer achieving the competencies set by the UK Engineering Council].”

Discussion

The ENLIGHT methodology describes several impact categories that can be assessed in Phase 4 of an impact assessment, and this study has confirmed that the Ethics Toolkit has had *primary* and *direct* impact, meaning that it has had an immediate incidence on its identified stakeholders which caused a transformation through a first-hand interaction with the output. Further research needs to be conducted to determine the *intensity* and *extent* of impact, that is, which percentage of identified stakeholders have made a demonstrable change to their integration of engineering ethics as informed by the Ethics Toolkit, and how many engineering programs or departments have integrated engineering ethics as a result of interaction with the Toolkit. Still, the meta-analysis reviewing the number of views, unique users and geographic reach of the online Engineering Ethics toolkit gave the authors a starting point on Phase 4 of this impact case study, assessing value through understanding patterns of engagement. It is important to note that the website access data is used as a proxy for toolkit engagement and does not reflect whether or not the case studies were actually used. However, the interviews provided some of the underlying narrative that supported the patterns observed and explores how the toolkit resources have directly been used in classroom practice. For example, the cause of the considerable spike in users from less than 50 views to almost 2300 views the following month, was found to be largely from China (Table1). This correlates with an interviewee delivering the facial recognition case study to a Master's class of largely international students, several of whom were from China. The facial recognition case study focuses on developing ethical awareness and judgement using topical developments in our current technologies and the sociopolitical, geopolitical or socioeconomic implications they will have. It grapples with the serious implications of using AI and monitoring with human safety and protection of personal data, which has been hotly debated internationally in recent years. The metadata and interviews, then, both show that developing engineering ethics resources that reflect relevant social and cultural issues is impactful.

The second most popular case study which addresses the ethical concerns of using renewable energy to support the oil industry brings important nuance to the clean energy debate and highlights the difficult lines to navigate during this energy transition era. With some

economies still oil-based with underdeveloped infrastructure during this transition, it also raises the question on whether there is a widening of the inequality gap, as renewables becomes politically enforced and economies face financial repercussions. Inevitably, this early metadata shows the resources created by educators for educators and students shows that these topical and sociopolitical concerns are valued in the engineering education space. This provides an entry point to further areas of study such as policies, reports and public opinion that can also enhance engineering education by involving other non-technical parties to the debate and can offer a way to engage across disciplines, a skill that is becoming increasingly required in engineering industries.

The third and fourth most popular case studies occurred in November 2022 and related to water wars and glass safety. In these cases, it was noted that the viewing numbers were double the users registered, indicating the case study was revisited more than once and likely to have been used in a classroom setting. This is likely corroborated by one of the interviewees who reported using the glass safety case with all of their first-year students. Other case studies showed similar trends where the view numbers were approximately double the user numbers. In the remaining months, the difference between views and users was less than half, indicating most site visitors did not return to these pages. In comparison, the view and user of numbers for facial recognition case study were considerably greater than the class size and therefore was likely to have been picked up by other interested parties overseas. It is not known whether these were educators, students, industry or none of these.

While Toolkit developers expected online engagement with case studies, they did not foresee the extent to which educators would revise, adapt, and place the content elsewhere, such as in their own VLE, their lecture slides, or as part of lessons or project briefs. This way of using the online resources makes them less likely to re-visit the site after the initial case study is found, indicating that the amount of online interaction with the Toolkit does not act as a proxy long-term for the extent of use of Toolkit resources that may occur elsewhere. This is a helpful finding due to the intention of empowering educators to use the resource and gain the confidence to develop them for their students and local context, and continues the ethos of co-creation into the classroom.

Although the online resource was designed for use in the classroom, it was not intended for students to access directly. However, this unintended outcome provides an opportunity to develop the toolkit resources with a new function and intended user. For example, one of the interviewees suggested the value of this online resource for both students and graduates to access when planning their professional development towards engineering chartership recognition. Although chartered engineering status is not strictly a legal requirement to work as an engineer, it is highly encouraged in the UK engineering profession, particularly when progressing to senior management roles.

Indeed, the Toolkit's relevance to the specific UK context seems clear, and the majority of the resources were developed by a largely Eurocentric advisory group with experience in working in global teams with English as the communication medium. This limits the reach and impact on global inclusion. This is a limitation that needs to be addressed more deliberately since both the metadata analysis and interviews reveal that the broader global context of engineering remains of high value. With 8 Toolkit contributors from outside the UK (4 of these from the US and Africa) and 6 case studies situated outside Europe, there was

an intention to develop resources that speak to this global context, such as the ethical business model case study set in the UK and Cape Town. The effort to co-create and develop educational resources to truly instil global ethical skills in engineering degrees that crosses cultures, nations, industries, and disciplines must continue [7]. Engaging a global team to co-create new resources that is linguistically sensitive, developed in native languages and from a native context is an exciting prospect that requires global support to develop, but which would significantly increase the Toolkit's impact.

The impact of universities should be in the creation, integration, sharing (i.e. teaching), application and reconsideration of new and existing knowledge [8]. Boyer argues persuasively that today's universities have become less relevant, with departments focussing on research metrics such as funding, publication and industrial applications for assessing relevance, impact and academic promotions. This suggests higher education institutions are losing touch with their primary role from the past 19th and 20th century: to address the current needs of society. Thus, he posits that universities must re-engage again to the most pressing social, civic, and ethical problems. If this premise is accepted, then our own university metrics for individual academic success (recognition of our expertise by peers, grant generation and quantitative impact) are in dissonance with the university's higher purpose and criteria for success. Above all, Boyer celebrates the university as a place for scholarship of *engagement*. He goes on to say: "...the scholarship of engagement means creating a special climate in which the academic and civic cultures communicate more continuously and more creatively with each other, helping to enlarge what anthropologist Clifford Geertz describes as the universe of human discourse [action] and enriching the quality of life for all of us" [8]. Indeed, these priorities were made explicit by the Toolkit Advisory Group, who believed its resources should be underpinned by teaching practices shown to promote student engagement [9]. These include providing students with realistic and authentic problems, putting them in the shoes of decision-makers so that emotion and empathy is required, and allowing for multiple levels of interpretation and application that can bring in various perspectives and disciplines at different depths. As initial results from this impact study have shown, the educators who have created and used Toolkit resources have embodied these values through their work. This suggests that when values and priorities are established and made transparent, crowd-sourcing educational resources can have impact to both students and teachers. A short study by Lajoie and co-authors [10] on the importance of creating a mindset shift in the engineering academic community posit that ethical instruction must be viewed as an integral part of engineering discipline to be taken seriously. For this to occur, there is a need for empowering and enabling academics to pursue engineering ethics research and, more importantly, re-examine how the impact in these studies are evaluated. Introducing such a resource as this ethics toolkit is only the beginning and requires on-going research on the impact and use of these tools, as well as the development and testing of new tools and approaches. Further phases of this impact assessment will involve developing a narrative of change to communicate results, and creating a strategy that can inform a process to scale the Toolkit for further impact. It is through this ongoing commitment that we will contribute to the understanding of ethics education and practice, making it integral to the engineering profession.

Conclusion

Now that two years have passed since the initial publication of the Ethics Toolkit, an impact assessment project has been launched to understand how it has affected engineering ethics teaching in the UK, and whether it has achieved its aim of helping engineering educators embed ethics in a way that helps them meet accreditation requirements. By following an impact assessment methodology that incorporates metadata analysis as a proxy for toolkit use and stakeholder interviews that provide insight into direct usage, the impact analysis highlighted the Toolkit as a high-value resource for ethics education instruction but also as a learning resource directly used by students as secondary stakeholders. Other uses such as a resource for UK engineering chartership has not been explored and offers new directions to develop the resource and tools. Furthermore, efforts to widen its reach towards the equality, diversity and inclusion commitment is needed.

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