ENGINEERING ETHICS EDUCATION FOR SYSTEMIC CHANGE: A CASE FOR SUB-SAHARAN AFRICA

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ABSTRACT

Unlike in the West, engineering practice in Sub-Saharan Africa remains mired in corruption, ethical malpractice, poor ethics governance and lack of effective leadership. This situation has, and continues to, negatively impact national infrastructure, health, education, and economies across Sub-Saharan African countries. Non-ethical engineering practices continue to occur despite the existence of national ethics legislation in Sub–Saharan African countries, and despite codes of ethics underpinning business operations in most public and private sector organisations that employ engineers. This is also despite the existence of codes of conduct and ethics prescribing professional engineering practice that have been developed, and are policed, by national engineering institutions and regulators. Increasingly, engineering education providers have incorporated engineering ethics education in their curricula. However, despite this, Sub-Saharan African engineering graduates transitioning into employment still face significant difficulties in dealing with the myriads of ethical dilemmas they meet in their professional practice. In this study we set out to establish the current state of engineering ethics education in Sub-Saharan Africa, and to assess the thoughts of engineering educators and researchers in the region on how engineering ethics education can be improved.

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1   INTRODUCTION

Throughout Sub-Saharan Africa, governments and ordinary people are increasingly becoming aware that unethical conduct by engineering practitioners has financial, social, and health and safety implications [1]. For instance, in 2016 an online news site linked some construction disasters that had taken place in Nigeria, Kenya and Ghana to unethical practices by the professionals responsible for implementing the construction works [2]. Examples cited by the publication include the collapse of a church building in Nigeria in 2014 that led to 115 deaths, and the collapse of a six-storey building in Kenya that resulted in three deaths. The publication concluded by suggesting that unethical practices are behind most engineering failures in Africa [2]. A 2010 study on building collapses in Nigeria suggests that approximately 40% of all building collapses are due to professional incompetence and fraudulent practices [3].

All the Sub-Saharan Africa countries that we looked at had codes of professional ethics that govern the professional practice of their engineers. These codes of professional ethics are comparable to Western codes of ethics, for example the IEEE Code of Ethics [4]. All these countries have legal frameworks that govern the conduct of professionals and they have institutions whose role is to enforce the legal requirements demanded for their professional practice. However, corruption and ethical misconduct are well entrenched, and often involve powerful individuals and organisations, which makes it difficult to resolve these issues.

Given the relative intractability of professional and ethical malpractice, a number of educators and researchers are exploring the possibility of ethics education as a tool to address the problem of ethical malpractrices in the long term. This includes Asheshi University College Ghana, whih was launched in 2002 with a mission to 'educate a new generation of ethical entrepreneurial leaders' [1].

In this study, we set out to explore from published works on engineering ethics education how the subject is currently being taught in higher education institutions in Sub-Saharan Africa.We also sought to establish from the identified published works what engineering ethics educators and researchers in Sub-Saharan Africa think should be done to improve engineering ethics education. We used the following research questions to frame our study:

1. How is engineering ethics education currently being delivered in Sub-Saharan Africa?
2. What do engineering ethics educators and researchers think should be done to improve the teaching of engineering ethics education in Sub-Saharan Africa?

2   METHODOLOGY

Guided by our two research questions, we carried out a semi-systematic literature review [5] to establish the current state of engineering education ethics research in Sub-Saharan Africa. We did this by carrying out searches in Google Scholar and Engineering Village. We identified two key search terms from our two research questions. These are "engineering ethics education" and "Sub-Saharan Africa". We took a sample of nine English-speaking Sub-Saharan African countries covering West Africa (Nigeria, Ghana, Sierra Leone), East and Central Africa (Uganda, Kenya, Tanzania), and Southern Africa (South Africa, Zambia, Zimbabwe). To cover these countries, we used the following search string on both databases:

"engineering ethics education" AND (Africa OR Ghana OR Nigeria OR Sierra Leone OR South Africa OR Tanzania OR Kenya OR Uganda OR Zambia OR Zimbabwe)

Running the search string gave us 142 potential publications. We then weeded out those publications whose titles were not consistent with our research questions, giving us 37 publications. Reading through the abstracts of these 37 publications led us to whittle down the number to 12.

3   RESULTS

Table 1 lists the publications that were identified in this study, together with the total number of researchers that we identitifed in each country.Only three countries are represented as our search could not identify any publications from the other six countries.

Table 1. Engineering Ethics Education Publications identified in this study

Country	Number of Publications	Number of distinct authors
Nigeria	3	7
South Africa	6	11
Ghana	3	7

3.1 Nigeria

Reference [6] is a review of ethics teaching in a software engineering course at the University of America in Nigeria. The review concludes that regardless of whether ethics is taught as a standalone course or embedded in other modules:

- Industry partners should be invited to present guest lectures on the specific ethics relating to their industry

- Industry partners should support higher education institutions in aligning their curricula to current and professional ethical concerns and how these concerns could be addressed and implemented in the workplace.

The authors of the review also suggest that rather than restricting ethics education to a single dedicated course, usually in the final year,ethics education should be embedded in course modules throughout the degree programme, and this should lead to a dedicated ethics course in the final year focussing on current ethical issues within the discipline.

Reference [7] presents a survey of ethical practices in the Nigerian construction industry that was admistered to final year civil/structural engineering students at the University of Benin. In line with the curriculum, these students had undergone three months of industrial attachment in the construction industry each year from the first to the third year and six months industrial attachment during the fourth year.Findings from this survey collaborate an earlier study of practising construction industry professionals [3] which found that unethical professional practice was the norm within the Nigerian construction industry. 50% of the surveyed students believed that it was OK for engineers to have vested interests in the projects they were advising on, thereby suggesting that they found nothing amiss with some of the unethical practices in the industry. To address this situation, the authors suggest

- all practising engineers should go on reorientation programmes on ethical practices
- the existing curriculum should be reviewed to place an emphasis on ethics
- Nigerian society needs to be reorientated to undergo mindset changes.

3.2 South Africa

Reference [8] is an analysis of ethics education within software engineering programmes offered by South African universities of technology. The study revealed that coverage of engineering ethics within computing qualifications is insufficient, incomplete and superficial, and provides only limited opportunities for students to develop software engineering ethical competence [8]. Another study by the authors finds that the majority of software engineering educators (54.5%) are not aware of the prevailing ethics codes in the software engineering industry, and as a consequence, coverage of the codes in teaching is minimal, and lecturers often fail to apply the codes practically during their teaching [9].

A survey of engineering ethics educators at two South African universities also revealed that whilst ethics education was viewed as important, ethics educators had different understandings of what should be covered in ethics courses [10]. Few of the engineering programmes explicitly highlighted ethics in learning outcomes or assessment procedures, and educators felt that they did not have the skills to teach the subject. The authors of the study subsequently suggested that engineering ethics educators needed more support to master their subject. In another study, the same authors also advocated the repositioning of ethics within the engineering curriculum as a transdisciplinary area that provides context and rationale for the selection and

practice of technical skills and knowledge developed in the discipline [11]. The authors suggest that such an approach will help to bring ethics from the periphery of curriculum design consideration to a position where ethics is viewed as the basis by which engineers make the necessary technical, mechanical and process choices in pursuance of their professional and ethical responsibilities and obligations. The authors believe that this strategy is best implemented by integrating ethics in engineerign education at the accreditation level to ensure that ethics is properly embedded within the curriculum.

Reference [12] makes the observation that in South Africa engineering programmes tend to teach ethics in an isolated module on "Professional Practice" which is mostly covered in the the final-year. The paper argues that ethics education could be improved by nurturing and discussing ethical behaviour throughout the undergraduate degree. However, the authors also indicate that the promotion of individualism within modern day society mitigates against ethics education, and suggest that a communitarian approach which emphasises the 'good for all' may provide a better learning environment. Such a proposal chimes in with proponents of ethics education approaches based on African communitarian philosophies such as ubuntuism [13].

3.3 Ghana

Reference [14] describes the architecture of engineering programmes at Asheshi University College Ghana. This architecture places an emphasis on ethics, leadership and civic engagement in addition to the typical science, mathematics and engineering courses found on traditional engineering programmes. This includes dedicated ethics courses, as well as a Code of Ethics and an Examination Honour Code.

First year students are also required to attend a not-for-credit seminar entitled 'Giving Voice to Values' where they learn ethical skills through role play and real case studies based on the experiences of the university's alumni [1]. The university believes that this focus on ethics and leadership will help to develop graduates who are more inclined to behave ethically in their professional roles. The effectiveness of this approach is still to be evaluated, however a study on the ethical attitudes of accountants carried out within the context of Ghana indicated that curricula that place an emphasis on ethics education have a positive effect on graduates' ethical behaviour and attitudes [15].

4   CONCLUSION AND FUTURE WORK

This study set out to identify research on engineering education ethics from countries in Sub-Saharan Africa. Nine countries in which English is an official language were identified. These countries ranged from West Africa, through Central and Eastern Africa down to Southern Africa. Most of the work identified in this study comes from South Africa, Nigeria and Ghana. This highlights the challenges of accessing published works from Sub-Saharan Africa focussing specifically on engineering

education ethics, as is the case with this study, and more generally on engineering education research.

In our thinking, there are three possible reasons for this, the first one being the likelihood that Sub-Saharan African reseachers in engineering education, in general, and in engerering ethics education in particular, tend to target regional and local journals and conferences that are not covered by Google Scholar and other mainstream research databases. Another possibility might be that Sub-Saharan African researchers may be prioritising technical engineering research at the expense of engineering education research. A third possibility may be that most African higher education institutions prioritise education at the expense of research, and high teaching workloads preclude many academics from research and publication. From our own experiences, we believe that all three factors contribute to the lack of visible publication on engineering education ethics from Sub-Saharan Africa.

Given the limited number of publications identified in this study, we intend to identify and collaborate with engineering academics who teach on ethics course modules in the nine countries that we identified. The advent of social media platforms like WhatsApp and video conferencing tools like Zoom has made networking across Sub-Saharan Africa easier, as evidenced by the recent establishment of the Engineering Education Research Network-Africa (EERN-Africa). We intend to use these platforms, alongside EERN-Africa, to identify and connect with Sub-Saharan Africa academics teaching and researching on engineering education ethics.

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