Ethical Decision-Making Ability and Cognitive Reasoning among Final Year Engineering Students in a Higher Education Institution in Malaysia: A Qualitative Study

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Abstract
Ethical decision-making is an important element in engineering profession. The objective of this study is to examine final year engineering students' ethical decision-making ability and cognitive reasoning skills. The research questions aim to investigate the considerations and general steps that students go through in a decision-making process. This study gathered qualitative data through written decisions and interviews. Twelve engineering students in a Malaysian private engineering school were asked to read two ethical vignettes and write down their decisions. This was followed by semi-structured interview questions, in alignment with the steps in an ethical decision-making model, to gauge the students' reasoning behind their decisions. The interview transcripts were analyzed and common themes that influence the ethical decision-making of students were identified. The analysis focused on ethical sensitivity and ethical judgement of students. Students demonstrated a decent level of ethical sensitivity emphasizing professional responsibility but their ethical judgment varied according to case study. In general, students were able to identify underlying issue and affected parties, but did not give much thought to potential course of action. This study draws reflection on engineering students' flow of thinking and cognitive reasoning processes when given a situation to deal with. The findings of this study stress the importance of engineering schools integrating relevant case studies or true accounts of engineering practices to develop ethical decision-making ability and cognitive reasoning among future engineers. This would prepare the engineering students to face the ethical challenges in their profession.

Keywords: Cognitive; Engineering students; Ethical decision-making; Ethical sensitivity; Ethical Judgement; Professional responsibility

Introduction

Ethical issues in engineering practice require engineers to make decisions concerning safety and sustainability of projects and products. It is common knowledge that engineers' ethical judgement is often put on test when facing varying, complex situations (Atesh, Baruah & Ward, 2016). Ethical behavior is particularly important in engineering because quality of the project design approved by engineers affect the safety of people as well as the environment (Kreiner, Flores & Krishnamurthy, 2004). A case in point at global level, is the banning of Samsung Galaxy Note 7 in United States flights due to fire hazard, as there were reports of overheating of devices and injuring people (CNN Money, 2016). Recently, Japan's steelmaker, Kobe Steel admitted that it had fabricated quality data of products sold to clients all over the world (BBC, 2018), which could compromise the safety of customers. In Malaysia, the investigations on 1993 Highland Towers landslide pointed towards human errors compromising on safety aspects in designing including inadequate drainage and failure of rubble wall (Kazmi et al., 2017). Tragic incidences could be avoided if ethics and professionalism are adhered by practicing engineers. Which is why graduates who enter the engineering profession need to be trained with knowledge and ability to be better informed for ethical decision-making, besides meeting their responsibilities towards society and global community (Kreiner, Flores & Krishnamurthy, 2004). Professional engineers are daily exposed to various situations, which would require them to have the ethical decision-making ability, be at workplace, laboratory, on-site field trip, or engaging in community projects.

In an increasingly globalized world, engineers' choice of option or decision would

carry huge impact to the society overall. A list of case studies and ethical concepts presented by Fleddermann (2000), among others, noted on the following:

a) Should defects be revealed to customers?
b) How can an engineer ensure the product is free of defects?
c) How can an engineer balance safety with cost?

These case studies illustrate that it is imperative for engineers to be equipped with skills for responsible decision making. Future engineers need to be trained to be ethically responsible when dealing with the impact of engineering solutions in a global and social context (Balakrishnan & Visvanathan, 2013). This explains why ethical leadership skills are crucial to shape professional competent engineers (Zhu, 2018). In recent years, ethical reasoning programs have garnered attention in learning institutions despite varied success (Ames et al., 2017).

Contextual Definition

For the purpose of this study, the following definition of terms are undertaken:

a) Engineering ethics

According to Martin & Schinzinger (1996), engineering ethics is defined as the study of decisions, policies and values, which are morally desirable in engineering practice and research. Accordingly, engineers need to be morally committed to uphold the safety, health and welfare of the public. Besides emphasizing safe and useful products, engineering ethics aim to develop engineers' ability to handle ethical dilemmas and to make clear reasoning.

b) Micro and macro issues

Engineers need to be prepared to handle both micro and macro issues. Micro issues refer to choices concerning individuals and corporations whereas macro issues deal on broader social concerns. Both micro and macro issues are interwoven (Herkert, 2005).

c) Ethical decision making, ethical sensitivity and ethical judgement

Rest's four-component model is an effective tool to explain the process of ethical decision-making. Past studies on ethics of undergraduate students (Atesh, Baruah & Ward, 2017; Rodzalan & Saat 2016; Saat, Porter & Woodbine, 2010), adopted the four-component model by Rest; which are ethical sensitivity (awareness), ethical judgment, ethical motivation (intention), and ethical behaviour (action/character) (Rest, 1994). Accordingly, the first component, ethical sensitivity, requires a person to identify the issues present in a situation in terms of possible actions, and affected parties for each course of action. The second component, ethical judgement, requires a person to reason out which course of action is justifiable in a given situation. The third component, ethical motivation, is the commitment to moral values above personal values to do what is morally right. The last component, ethical behavior (action), refers to perseverance and ego strength to persist in a moral task overcoming fatigue and flagging. This study focuses on the first two components only, which are, ethical sensitivity and ethical judgement.

d) Ethical reasoning

According to Martin & Schinzinger (1996), moral reasoning would require comprehending, clarifying and assessing arguments on opposing sides. In this study, I refer to this skill as ethical reasoning. According to Sternberg (2016), ethical reasoning is how one thinks through about issues of right and wrong. Sternberg argued that universities and colleges should teach ethical reasoning than just ethical principles, because the usual problem is not in knowing the ethical precepts but in knowing how to apply them. When confronted with a situation, students need to be taught how to go through the steps of an ethical decision-making model and to apply in a given situation.

e) Cognitive reasoning

It is the process whereby information and facts are used to make a decision. Higher level of cognition would enable students to analyze, synthesize and evaluate the given information.

Learning Outcomes in Engineering Program in Malaysia

In Malaysia, the Board of Engineers Malaysia (BEM) determines the professional code of conduct of practicing engineers. The code of conduct delineates the moral responsibilities of engineers. The Engineering Accreditation Council (EAC), a body delegated by the BEM, undertakes accreditation of engineering programs. The EAC prescribes to Outcome-Based Education (OBE) (Tshai et al., 2014). A

brief look at the 2012 Malaysian Engineering Program Accreditation Manual shows that students of an engineering program are expected to attain the following outcomes (EAC, 2012):

1. Engineering knowledge – apply knowledge of mathematics, science and innovation techniques
2. Problem analysis – identify, formulate and analyze challenges to arrive at viable solutions
3. Development of solution – conceive, design, implement and operate solutions with considerations for public health safety, culture and environment
4. Investigation – conduct research and investigation including experiment design, analysis of data and synthesis of information
5. Modern tool usage – create, select and apply appropriate techniques, resources and IT tools
6. The engineer and society element – apply reasoning informed by contextual knowledge to assess society, safety, health, cultural, legal, and economical issues and consequent responsibilities to the professional practice
7. Environment and sustainability – explain the global impact of engineering solutions and demonstrate knowledge for sustainable development
8. Ethics – apply professional and ethical responsibilities
9. Communication – effectively communicate both in oral and written form in technical and non-technical contexts
10. Individual and team work – function effectively as an individual and in multidisciplinary settings
11. Lifelong learning – recognize the importance of lifelong learning and engaging in continuous professional development
12. Project management – effectively manage projects in multi-disciplinary environments

It is worth noting that the engineering program outcome no. 6, 7 and 8 emphasized the importance for engineers to evaluate the societal, health and safety issues in professional practice, and the impact on environment besides recognizing the need for engineers to adhere to professional ethics. However, most engineering program are not aligned to support the attainment of these outcomes, as assessment and evaluation are at a purely mechanistic level (Mohd-Yusof et al., 2015). Hence, the disconnection between the OBE and students' ethical decision-making capability needs to be examined.

The closest study on ethical awareness among engineering students in public universities was conducted by Md. Som et al. (2006). Accordingly, the propensity to use ethical knowledge to solve problems varied among the students. In addition, their study demonstrated that the students' ethical level is largely influenced by external factors such as law and punishment rather than self-awareness. However, there is limited literature on how ethical decision-making skills and ethical reasoning are taught to engineering students. That is why this study focuses on the ethical decision-making ability among final year engineering students. The rationale behind selecting final year graduating engineering students is that they have been exposed to workplace ethics, where they have faced ethical challenges during their three months internship. These students were about to enter the job market and commence employment in a year. In addition, these students have also enrolled in the module related to ethics and professionalism, which is Professional Engineers & Society (PES), code ENG4623/61503. The learning outcomes of the module are:

a) to apply code of ethics and professional conduct of various learned societies and regulatory bodies to at least 2 case studies.
b) to analyze the role of an engineer in maintaining regulations related to safety, health and environment as well as quality management in at least 2 case studies
c) to evaluate the various roles of an engineer in modern society

The above mentioned module emphasizes higher cognitive reasoning skills such as application, analysis and evaluation. This study will explore whether the students have developed those skills as well as their understanding in applying code of ethics and analyzing ethical case studies concerning safety, health and environment.

Significance of the Study and Research Questions

There are not many studies on the decision-making ability of engineering students. A study

by Atesh, Baruah & Ward (2017) analyzed the factors that influence the ethical decision-making capabilities of engineering students. Students were subjected to ethical scenarios, which prompted them to make reasoning reflecting their ethical decision-making skills. The findings suggested that intrinsic (happy and guilt-free) and extrinsic (money, salary, job) rewards played important role in the decision-making process. A study by Rodzalan & Saat (2016) on the ethical level of undergraduate students in public universities in Malaysia was conducted by administering questionnaire consisting items measuring ethical behavior. The findings showed that engineering students have low level of ethics as compared to social science and science students. Similarly, a study by Saat et al. (2012) determined the ethical awareness of engineering students from two Malaysian local universities by getting the students to complete a survey consisting ethical situations. The findings showed that the engineering students are inclined to compromise on safety, have high tolerance to product design flaws, and not sensitive to workplace ethics.

While most studies focused on quantitative findings, the objective of this study is to examine final year engineering students' ethical decision-making ability and cognitive reasoning from the qualitative aspect. In other words, when faced with a situation requiring professionalism and adhering protocols in making a decision, how would the students deal? This study aims to answer the following research questions:

1. What are the considerations taken by engineering students when they go through an ethical decision-making process?
2. What are the protocols or general steps that students tend to focus in an ethical decision-making process?

Rationale for a Qualitative Inquiry

According to Elm & Weber (1994), the two means of measuring moral judgement are interview and defining issues test (DIT). The theory underlying both the techniques were developed by Lawrence Kohlberg, and later, James Rest expanded on Kohlberg's theory. Past studies relied on surveys, questionnaires, tick 'yes' or 'no' and Defining Issues Test (DIT), where the engineering students were given vignettes or case studies and were asked to indicate their agreement using seven point Likert scale ranging from 'strongly disagree'[1] to 'strongly agree'[7] (Rodzalan & Saat, 2016; Saat et al., 2012; Md. Som et al., 2006). The problems used in DIT are 'structured' problems, because it describes a particular situation and the considerations for the decision are all part of the ethical deliberation process (Clarkeburn, 2002). A well-established method is to provide students with case studies from engineering practice. Classes with real-life scenarios and open-ended questions promote discussion and will provide students with a more complete exposure to engineering ethics (Bairaktarova & Woodcock, 2017). However, a key problem is that the commonly-used cases describe the ethical problem in a way where the more obvious the wrongdoing is, the easier it is to determine what should have been done (Hoffmann & Borenstein, 2014). As such, there is no ethical 'challenge' because the ethical problem and its best solution are fairly obvious as compared to the complexities of the real-life situations that students will encounter, argued Hoffmann & Borenstein (2014).

According to Clarkeburn (2002), a suitable starting-point in measuring ethical sensitivity is to develop unstructured problems. It is therefore impossible to measure ethical sensitivity with a "tick-a-box" method. The nature of ethical sensitivity requires the test of ethical sensitivity to be qualitative, to allow subjects to respond to an unstructured problem with only minimal guidelines or pre-established thought-patterns. This type of qualitative data can be collected either verbally in an interview or in a written form (Clarkeburn, 2002). Interviews and focus groups turned to be effective in gathering students' feelings about professional responsibility (Hashemian & Loui, 2010), and exploring the factors that influence the ethical decision-making skills among engineering students (Atesh, Baruah & Ward, 2017).

This study does not use questionnaires or surveys, as the responses may be socially desirable. Instead, a qualitative inquiry is employed as research methodology, whereby the final year graduating engineering students were asked to read and analyze the ethical vignettes, which have grey areas, ambiguous and

not straight-forward. Cognitive reasoning is measured by allowing participants to write down their decision in response to two ethics dilemmas, which is followed by interviews. Semi-structured, face-to-face, and one-to-one interviews were conducted with the students to probe and gauge their reasoning for their decision. This study conceptualizes themes and provides in-depth understanding on the ethical sensitivity and ethical judgement of engineering students in general, and their ethical decision-making process in particular.

Ethical Decision-Making Model and Interview Guide

An analysis by Coughlin (2008) delineates that practical steps in ethical decision-making begin with assessing the available factual information, identifying the relevant ethical issues, identifying the stakeholders and values at stake, and identifying the available options and followed by selecting the best alternative supported by reasoning. Meanwhile, a practitioner's guide to ethical decision-making developed by Forester-Miller & Davis (1996) outlined the following steps in ethical decision-making:

Step 1: Identify the problem
Step 2: Apply code of ethics
Step 3: Determine the nature and dimensions of dilemma
Step 4: Generate potential courses of action
Step 5: Consider potential courses of actions for all options, and determine a course of action
Step 6: Evaluate the selected course of action [apply tests to ensure it is appropriate]
Step 7: Implement the course of action

Other notable works include the ethical decision-making process of Martin and Schinzinger (1996), which was adapted by Bero & Kuhlman (2011) to illustrate the parallelism with engineering design process via a step-wise technique of identifying pertinent ethical issues, moral theories, possible outcomes and a final decision. In recent times, the widely known ethical decision-making model is offered by Corey, Corey, Corey & Callanan (2015). The model outlines eight steps as the following:

Step 1: Identify the problem or dilemma
Step 2: Identify the potential issues involved
Step 3: Review the relevant ethics codes
Step 4: Know the applicable laws and regulations
Step 5: Obtain consultations [from peers]
Step 6: Consider possible and probable course of action.
Step 7: Enumerate the consequences of various decisions
Step 8: Choose what appears to be the best course of action

University of Texas Leadership and Ethics Institute (2012) condensed the ethical decision-making steps into six steps. From now on, I shall call this the ethical decision-making model (EDM). The steps are as follows:

Step1: Identify and state the problem (underlying issue)
Step 2: Identify relevant factors and players (and consequences for affected parties)
Step 3: Generate potential courses of action (and possible constraints)
Step 4: Test the options
Step 5: Make a decision and implement the course of action
Step 6: Evaluate the course of action

For this study, the framework for an appropriate decision-making model was derived from the aforementioned references. The steps in EDM was used as reference point in generating the research interview questions. Interviews were conducted with the students to probe and gauge their reasoning behind their decision. Students committed to a decision by writing down their decisions for the two case studies presented. This is to prevent the students from rationalizing and changing their decisions after being probed during the interviews. The interviews are meant to capture the articulation of steps involved in their thinking process, and seek clarification where necessary. In this study, the first 4 steps toward ethical decision-making is closely adhered, as outlined by University of Texas Leadership and Ethics Institute (2012). Generally, these are universally accepted steps in ethical decision-making. In Step 4 requiring respondents to test the options, students are free to reason out their considerations, and may base it on various test options, but not limited to the following:

1. harm test (as whether the option does less harm than the alternatives),
2. publicity test (as whether the option can be publicized),

3. organizational and professional test (as whether the option is accepted within organization and among colleagues)
4. defensibility test (as whether one can defend his/her choice of option).

This study does not quantitatively measure responses of students. Instead, this study intends to unlock the engineering students' decision-making and reasoning skills when assessing ethical situations. The students' responses are then examined for ethical sensitivity in understanding the underlying ethical issue (corresponding to Step 1 in EDM in methodology), and ethical judgment in reasoning out the possible course of action (corresponding to Step 2, 3, and 4 in EDM).

In this study, Part I of the interview questions followed a semi-structure guide, in alignment with Step 1 to Step 4 of the EDM.

Question 1: Tell me the underlying issue and relevant information in this case (*Step 1*)

Question 2: Tell me who are the parties affected and the consequences for the affected parties. What are the relevant factors involved and guidelines to consider in this case? (*Step 2*)

Question 3: Tell me what are the potential courses of action that can be taken and the possible constraints in taking those actions. (*Step 3*)

Question 4: What were your considerations before arriving to this decision? Tell me how would you justify your intention from various angles. (*Step 4*)

Part II interview: General question

When answering the questions, what are the resources you based upon? Please share.

Ethical vignettes

Responses are assessed qualitatively to determine how ethical considerations fit into decision-making (Ritter, 2006). Similarly, the focus of the interviews is on the responses of students, and their reasoning behind the decision; and not on their final decision per se. Case-study methods, in general, are particularly well-suited for learning situations where the issues are not clear-cut and contain some ambiguity (Coughlin, 2008). Moreover, case-study methods are often employed to teach ethics in engineering (Yadav & Barry, 2009). A vignette is a variant of case study method, which presents hypothetical situation to which research participants respond to. Vignettes are short descriptions of situations with information thought to be factors in decision-making (Alexander & Becker, 1978). Ethical vignettes appear to be effective in evaluating ethical sensitivity among respondents (Loo, 2002; Wilks, 2004).

In this study, two ethical vignettes were carefully derived from online engineering ethics resources, which are based on true incidents (Markkula Centre for Applied Ethics, 2018). The vignettes were adapted and modified to fit the purpose of study and worded according to local context, and characters are named according to local language. Colby & Sullivan (2008) argued that central emphasis within the broader category of the engineer's responsibility to contribute to human welfare are the overriding values of public safety and protection of the environment. Accordingly, central commitments of engineers as professionals include protection of public safety and the environment; integrity in negotiating multiple, often conflicting, loyalties; and other standards of honest and responsible practice (Colby & Sullivan, 2008). These categories were taken into consideration when selecting the case studies. As such, the first case study is based on a laboratory test work, and the second case is based on an engineer's project for community engagement. The two ethical vignettes in this study are closely related to public safety, falsification of data, and community's well-being. These areas are particularly pertinent to students' ethical behavioral development. Other areas of importance are explored along, based on the responses of the students.

Case study 1: Suresh works for a small company that tests electronics products before they are released to the market. The company performs independent quality assurance (QA) tests to certify that the products meet all government regulation standards. Suresh's company signs a contract with a large cell phone company; this contract is the first major contract the company has received and has the potential to greatly increase its revenue. Suresh is then assigned to conduct all the tests on the cell phone company's latest product. Suresh conducts all the tests and finds that the phone is up to regulation on almost all tests. However, the product fails to meet the regulation

requirements for interfering noise transmittance. Suresh knows that this test is not always reliable and repeats it a couple more times. While he is repeating the test, the president of the phone company visits Suresh in the lab to see how the testing is going. When Suresh tells him that the product is consistently failing one test, the president proceeds to tell him, "There are hundreds of people whose livelihood and jobs depends on the release of this new product." Additionally, he tells Suresh he has worked as a test engineer and knows the test is not always accurate, and it would be in everybody's best interest if Suresh could approve the phone. How should Suresh handle this situation?

Case study 2: Roslan has been working as a project engineer for a mechanical energy technology firm, and has recently been promoted to review projects for in-need communities in Sarawak (North Borneo). He has been put in charge of managing the current company's charity projects, and determining how to distribute the funding for them. Some of the projects are pretty straightforward in their mission and material requirement, but for one project, Roslan isn't sure whether the company should be funding it. The project's mission is to provide new solar panels for a tribal community but the project data suggests it is more practical to just install better lighting inside the homes. Roslan wonders whether to bring up this with his boss. Based on the company's research, the community desires better lighting system for their homes, and the solar panels would be an expensive and high maintenance project. Besides that, there was a previous project that (when followed through) resulted in equipment being stolen from the same region to exchange for money. Roslan understands their local sponsor would gain a great advantage in featuring solar panels in the community. It would also foster a good business partnership between the two companies. What should Roslan do?

Methodology

This study was conducted with the final year engineering students in a private engineering school in Petaling Jaya, Malaysia. The private engineering school follows the Washington Accord curriculum standards, for which Malaysia is one of the signatories. The school offers Bachelor Degrees in Chemical Engineering, Electrical and Electronic Engineering and Mechanical Engineering. For this study, faculty approval allowed research with final year students from Mechanical Engineering program. In addition, this study has addressed the recommendations by Rodzalan & Saat (2016) on the following:

1. Follow students who have been exposed with working experience or industrial training
2. Focus studies involving students in private university
3. Method of research to include interviews

As this is a qualitative inquiry investigating students ethical decision-making and cognitive reasoning processes, a total of 12 final year engineering students were identified through random sampling. Ten students were in the final semester, and another two students were in their second last semester. Although the sample is modest involving 12 students, it effectively focuses on the students' reasoning skills in a decision-making process. Prior to interviews, informed consent was obtained from the students, who agreed for their participation in the study and for subsequent publications. The author is also the researcher of this study. The duration taken by each respondent to read through the cases, write down their decision and respond to interview questions, is between 45 to 55 minutes.

For the purpose of analysis and to protect the anonymity and confidentiality of respondents, the students are coded as R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, and R12 respectively. The interviews were audio-recorded with the consent from the participants and transcribed verbatim.

Limitation and scope

This study provides an examination on engineering students' ethical decision-making and cognitive reasoning processes from a qualitative aspect. However, this study did not intend to look into the effectiveness of ethics course by conducting pre and post-intervention program on students, or making comparative study using a control group. These can be considered for future research. This study also did not attempt to discern the gender differences, which can be explored in future

work. Also, due to constraints in getting faculty approval, this study is confined to final year engineering students majoring in mechanical engineering. The qualitative data is based on the responses gathered from engineering students from one private university. Hence, the findings cannot be generalized. Similar study can be replicated in other universities. Although this study is limited to one higher learning institution in Malaysia, the findings have relevance in understanding the future engineers' ethical decision-making and cognitive reasoning processes, in today's time and age. It is in this context that this study is distinctive and has relevance in the higher education community.

Thematic Analysis

The responses from the students demonstrated key factors that influence their decision-making and reasoning for every case study. General thematic analysis was employed in this study. A theme highlights a significant patterned response within the data in relation to research questions (Braun & Clarke 2006). The data were cross-checked with the interview notes to gain full insights. The themes evolved and emerged from the study and were not pre-determined. The lines of the transcripts were numbered, and segments of the conversations were highlighted in search for common ideas/key phrases, which were then clustered into themes. For case study 1, phrases such as "safety", "data falsification", "regulation", "professional", and "responsibility" were identified as recurrent responses from the participants. Based on these, the master theme emerged from Case Study 1 discussion is "conform to standard regulations and quality", with underlying sub-themes. Similar procedure was repeated for Case Study 2. Phrases such as "technology", "cost" and "sustainable" were often mentioned by participants. The master theme emerged from Case Study 2 discussion is "improve well-being of community", with underlying sub-themes.

Findings

To address the first research question, in this section, the written decisions as well as verbatim text from interviews are presented for every case study. Data extracts from interviews are presented as how it was audio-recorded to retain originality. The themes emerged from data as a result of significant patterned response, allowing generalization for discussion to answer the first research question investigating the considerations taken by engineering students when they go through an ethical decision-making process. The responses of students from the interview sessions are clustered as themes, with their underlying key phrases identified as sub-themes. The themes and underlying sub-themes are shown in Table 1.

Table 1: Themes and underlying sub-themes

Case Study	Main theme	Sub-themes
Case Study 1	Conform to standard regulations and quality	Professional responsibility
		Prioritize safety of consumers
		Not to falsify data
		Conduct research for improvements
Case Study 2	Improve well-being of community	Educate community about technology
		Technology improves lifestyle
		Cost factor
		Sustainable solution for community

Theme 1: Conform to standard regulations and quality

The written decision of the students for Case Study 1 are provided in brief statements as below:

R1: *I will not falsify data to approve release of new cell phone. It is my company's responsibility to perform Quality Assurance test to certify that every product meets the standard. To maintain standard regulation, I would be strict in all the testing done.*

R2: *I will not falsify data as it might cause serious effects. If there is failure in testing, it might cause phone accidents and people [will] die.*

R3: *See how far is the test result from allowed standard. If result is not acceptable, I will insist to fail the product. Explain to President the consequence of passing the test.*

R4: *I shall not falsify the statement or misrepresent the profession in approving the cell phone.*

R5: *Tell the president of the phone company that I will not falsify the data and come up with info as clean as possible. Falsifying data from test experiments is violating the code of conduct based on Board of Engineers Malaysia rules and regulations.*

R6: *I will not approve the phone based on consistent failed tests. Although the livelihood of the employees is at stake, take the right decision as the effects of not meeting the regulations outweighs the release of the phone.*

R7: *It is important for product to conform to regulations for other's safety.*

R8: *Should not approve the product based on the test data. The reliability of the test data can be analyzed by statistical tools to determine that whether the failure is significant or not.*

R9: *As an engineer complying to standards, it is best that he works truthfully in delivering a product which will be beneficial and it is fully functioning.*

R10: *Provide information on how the failed test will affect the performance of cell phone and discuss with his boss. Propose any improvement to the product.*

R11: *Reject to falsify data as suggested by the President because it affects the quality of the product. All the tests should meet all government standards.*

R12: *Should not allow the phone product be released to keep the profession intact and for the safety of the phone users. It is engineer's responsibility to be open and honest to the President of the phone company on his thoughts so as not to jeopardize the consumers' safety.*

The underlying key phrases derived from the reasoning of the students for Case Study 1, can be further clustered under the following sub-themes: (a) Professional responsibility, (b) Prioritize safety of consumers, (c) Not to falsify data, and (d) Conduct research for improvements. The different sub-themes highlight the key factors that influence the ethical decision-making and reasoning of students for every case study.

A. Professional responsibility

The students generally spoke about the responsibility of an engineer towards the community and the profession itself. For instance, R2 said, "*You have to be responsible because not only me, hundreds of thousands of people [will be] using the phone."* Meanwhile, R4 said, *"The engineer cannot misrepresent his profession and company to approve any false statement"*

When probed further, on how one would handle the situation, R1 said, "*I won't be part of it. But, I will inform my superior that it is not suitable to release the cell phone. I just have to delay the release so that they have more time to solve the issue."*

There is a statement in the vignette that the test is not always reliable. On that note, R8 suggested to perform statistical analysis to determine if the failure is significant.

Meanwhile, R5 argued, *"Though the test is not reliable, it is still a responsibility for every engineer to stick to the regulation standards, especially in testing a product".* However, R5 did not rule out the fact that: *"If the new product is not released because it is failing one test, it build up on some loss to the phone company…and the trust between the two companies would be broken"*

A number of students were of the view that an engineer's responsibility is linked to community and therefore an engineer will be questioned if the product affects the community. R8 said, *"The end product would also affect the customers, which is the phone users. It is always the test engineer's fault and blamed if something goes wrong under their watch."*

Meanwhile R9, said that an engineer should know what is best for the consumer and reputation of the company. R9 also cited the banning of Samsung Galaxy phone as an example, and argued that any wrong act of an engineer affects the company. "*…like the Samsung issue last time, though it may not be the same case here, it could be one of the setbacks later which will impact the company later on, if they release such product to the market."*

B. Prioritize safety of consumers

Safety of consumers seem to be another main concern among the students. For instance, R1 said, "As an engineer, we need to perform testing even with new innovations. So, in testing, if product doesn't meet requirement, it means it is not safe, and not sustainable."

The students' concern mainly arise from the fact that the noise interference transmittance may cause health hazards and affect the mass community. For instance, R6 said, "The noise interference transmittance, could affect people, in the sense give harm to the phone customers in the long run."

When probed further on the fact that the livelihood of the employees is at stake if the phone is not released to market, the students said that the impact to the mass community is greater if the phone is released to the market. For instance, R3 said, "If I approve the product, it will affect more than 100 people".

Similarly, R7 said, "…when I read about the interfering noise transmittance, the first thing that comes to my mind is the community."

C. Not to falsify data

Generally, all students objected any attempt by Suresh to falsify data in order to approve the product. Most of the students viewed the attempt to falsify data as breaching quality control and regulations. R4 said, *"The phone fails one of the tests which is a requirement, about the noise transmittance. So, the product has failed to meet the regulation."*

Similarly, R9 said, "*Quality control is really important. After that, the question that comes to my mind is whether he should falsify the data, and one thing is you always want to make a product which is best for the consumer or the company*."

Students R11 and R6, also respectively said that the way the President of the phone company pressured Suresh is also unethical. R11 said, *"Suresh repeats tests a couple times, which is ethical being an engineer as he wants to justify the test results. But, when the President comes and imply that he should falsify the data, I think that one is very unethical"*

In addition, R11 also did not rule out the possibility that Suresh may also experience pressure from his teammates to release the product. R11 said, *"All the tests pass except for the noise transmittance. Product fails to meet regulation standards. Maybe some of the team members would pressure to falsify data, because they want to release the product."*

D. Conduct research for improvements

Interestingly, two students focused their reasoning on the need to conduct more research for product improvements.

For instance, R10 said, *"The engineer needs to do a research first before providing information to his boss. He needs to do statistics, on how the problem will affect the phone performance. From research, if he finds out that the problem does not affect much of the phone performance, then he can speak to his boss before informing the President of the phone company."*

Meanwhile, R12 said, *"Do more testing on function of phone in relation to noise transmittance…it is very important to at least learn what other alternatives could make this function work. If buyers get affected by this phone's product function, the sales will decrease*"

These two students, R10 and R12, are driven by research-conscience to improve product based on alternate solutions. However, it is not clear how they would be able to achieve that when they are subjected to pressure from the President and peers who want to see a quick market release of the product.

Summary

Overall, the students objected the attempt to falsify data to approve product. However, when probed further during interviews, their reasoning focused on upholding the professional responsibility of an engineer and giving priority to safety of consumers.

The students often used phrases like "safety", "customers", "regulation", and "responsibility" to express their reasoning. According to the students, they are intolerant towards any

attempt of falsifying data, and emphasized the responsibility of an engineer to adhere to standard regulations and safety of product users/customers. They also suggested the inclusion of teammates or superiors before making final decision. Besides, they also emphasized standard regulations, quality of product and safety of product users. They saw this as the engineer's responsibility towards community. In addition, a few students also suggested the need to look into reliability of tests conducted, and inclined to conduct more research for product improvement.

Past studies have shown that cheating, plagiarism and academic dishonesty are prevalent among engineering students. For instance, a study reported the influence of academic dishonesty and cheating on the ethical decision-making of engineers in professional practice (Harding et al., 2004). Besides, a study in Malaysia reported that engineering students have tolerance towards product design flaw (Saat et al., 2012). The concern is that this unethical behavior could lead to data fabrication and bribery in workplace. That is why many faculties incorporate ethical issues into their classroom by talking with students about cheating, plagiarism, and their institution's academic honor code (Colby & Sullivan, 2008). All the 12 students in this study objected to any attempt to falsify data, possibly because they have been guided and drilled in that manner during practical lessons.

Theme 2: Improve well-being of community

The written decision of the students for Case Study 2 are provided as brief statements as below:

R1: *Approve this funding to this project. The concern is about equipment being stolen, and this issue can be solved easily by improving the security service. This can further improve the tribal community's lifestyle.*

R2: *Using solar panel needs high budget but it is for charity, helping people. If it is charity project, ensure the company has enough budget. Try not to use low quality product.*

R3: *About equipment being stolen, explain to community about it, to be responsible for the item. They could not just stop improving the community area because scared of equipment being stolen.*

R4: *Should just follow the project's mission, which is to provide the new solar panels for tribal community service. However, it is good for the engineer to bring up this interior lighting installment idea with his boss.*

R5: *Follow the company's research to improve the lighting system for the tribal community and call off the idea to provide new solar panels. Since dealing with tribal community along with its limitations, it would be better to provide something more practical for them rather than giving something technological which is hard for them to learn.*

R6: *Take the matter to his boss about his concern. Say 'no' to sponsoring solar panels to the tribal community. If the community could not afford better lighting, they surely could not afford to maintain the solar system later on.*

R7: *As an engineer, reducing cost is one of the main concerns and lower the cost spent, the more economically viable the project is. Thus, the engineer should just propose to install better lighting as it would also prevent from further issues such as the equipment being stolen.*

R8: *Should consult his superior on whether the focus of managing such charity projects is mainly for the philanthropic side, solely benefitting the community out of good will or just a CSR exercise. If it is the former, then he should go ahead with redirecting the local sponsor to another potential project. If it is the latter, then he can opt to go ahead with the installation of solar panels despite it not being the choice of the community.*

R9: *Should thoroughly do more research regarding the project. The best way to deal with the issue is to do a test-case and follow up to see how the community takes it as a technological change for them.*

R10: *Come up with more research on the project. Research can include the statistics/calculation on how the project will benefit everyone.*

R11: *Bring up the issue to the boss. I would suggest to just use the normal, energy saving lighting instead of solar panel.*

R12: *Get the approval from his boss on redesigning a special lighting system that involves solar energy without having it to be an easy target for thieves to steal and sell in exchange for money.*

The underlying key phrases derived from the reasoning of the students for Case Study 2, can be further clustered under the following sub-themes: (a) Educate community about the technology, (b) Technology improves lifestyle, (c) Cost factor, (d) Sustainable solution for community.

A. Educate community about the technology

Most students expressed their views, that it is vital to teach the community on the know-how about solar panels. For instance, R5 said, "*The issue here is probably the fund the company needs to raise in order to make the solar panel project workable. The tribal community is the one who is going to use it, so at least they need to know how to use it and how to maintain it*."

Similarly, R4 also said, *"Get someone in the region who know about this solar technology to explain to the local community on how they can use it"*.

Interestingly, one student, who is also from the state of Sarawak (Borneo), related her experiences about the local community. R9 said, "*A solar panel is a big change. The community wouldn't know how it works. We are living in a world of technology. But, it is a bit slow for them. Do a small test, instead of installing lots of solar panels in one go, install a small one and go there and see how the community takes it, maybe explain to them how it works. Tribal homes have local leaders or "penghulu", when they find anything beneficial, they will have meeting with the local people*"

B. Technology improves lifestyle

Most students spoke on technological aspect, as they saw the solar project as means to transform the living standard of the community. For instance, R1 said, "*Solar panel is a very useful technology. If we try to explain to the tribal community, that it actually improves your lifestyle, either your home or your entire community, I think they would probably approve our action.*"

R3 said, "*If the community willing to accept the solar panel, then it will improve their lifestyle. If they don't accept it, and just want lighting it will solve their issue but their lifestyle remains the same level. It is just a solution [for now], but they are ignoring the future.*"

Generally, the students perceived the solar panel as a technological advancement for the community.

C. Cost factor

Majority of students spoke about cost as a determining factor. For instance, R7 said, "First, is definitely would be the cost. Because usually in any project, is to reduce cost. The lesser, the better."

Similarly, R11 said, "Because solar panels are expensive and high maintenance project. So, it would be a burden to the company to maintain the solar panels for the community. It would be expensive. It would be better to go for energy-saving lighting".

Also, R12 said, "Go for cheaper yet safer solution. I can see from the community's angle, they might not be too happy, with cases of expensive equipment being stolen."

Interestingly, one student linked cost factor with charity service. The company involved should not use cheap materials just because it is charity-based project. R2 said, "Because you are helping the people by doing this project. If the company has enough budget, then only do. Even for charity, don't use cheap material."

D. Sustainable solution for community

Most students leaned towards approving the solar project except for a few. For instance, R6 felt that a project mission should be able to solve an issue faced by the community. R6 said, *"This is not right, it is not logic, like those people living in poverty, what's the point with solar project. Why would you give something, which is not what they want? You give solar panel and they want lighting, so they still need to find lights.*

Meanwhile, R8, relating to her experiences as a community project leader, said, *"Sometimes, I see the way things are done, they are not called sustainable to the community we are reaching out to, and we still go on with it. Here [in this case], we will go and be sustainable, to provide better lighting. Redirect the local sponsor if the sponsor is willing."*

In similar context, R10 viewed lighting as basic needs as opposed to solar project. R10 said, *"We need to support our projects with research. My main considerations, is that there are not many solar projects…Secondly, the maintenance*

and the expensive cost. Better lighting and clean water, are basic needs."

Meanwhile, R4 proposed that the engineer should bring up the research data to the attention of both the company superiors. R4 said, *"I would say Roslan review his project data, whether to install lighting for the homes. Because the project data already stated that is more practical. So, he should bring this up to both the companies."*

Summary

The students used phrases like "technology", "cost" and "sustainable" to express their reasoning. For instance, they expressed their reasoning that installing solar panel for tribal community would bring technological change. As such, they suggested the need to educate the community to operate solar panel, and not to use cheap materials for charity projects. Some students also saw the need to inform both companies involved about the research data.

Nevertheless, most of them failed to understand the underlying issue is that the tribal community desire better lighting system. Specifically, R6 varied in his response from others, as his reasoning surrounded on affordability of community, benefits in the long run and interest of both companies. R6 therefore said his decision would be to not proceed with the solar panel project, considering that the community cannot afford the maintenance of solar panels, and that the benefits in the long run are unclear.

Meanwhile, a number of students reasoned out that the role of a project engineer is to reduce cost and provide sustainable solutions for mass community. Thus, they also saw the need to do research for improvements in community projects. Student R12, unlike the rest, proposed a win-win situation for Case Study 2, which is to come up with a solar panel project that also powers lighting, as to satisfy the needs of tribal community as well as to foster business partnership with local sponsor. However, R12 did not elaborate on the practicality in implementing the action plan.

This researcher found that although the students assessed the case study and expressed their reasoning either in favor or against the solar panel project, there are many other aspects, which they did not explore. First, in rural areas, the communities have to rely on gas powered generators for electricity or to go without electricity access. Two, the feasibility and efficiency of solar projects in rural areas need to be examined. For example, the potential of solar energy to promote 'rural electrification' and the feasibility of establishing a 'solar village' in rural areas (Ahmad et al., 2016). Further, the success of solar projects in rural areas depends on 'appropriate sitting' and local community approval, and also the social and economic factors (Borhanazad et al., 2013). As such, the macro-ethical aspects on social responsibility were not fully explored by the students.

Data Analysis

General Steps which Students Go Through in an Ethical Decision-Making Process

The following analysis and discussion aim to answer the second research question: What are the general steps the students tend to focus in a process of ethical decision-making? In general, all the students were able to think through the problems in both Case Study 1 and 2; but their responses may not necessarily constitute a protocol of an ethical decision-making process. Most students focused on a single solution, and were not able to reflect on multiple-pronged approaches, though the cases provided were not straight forward and involved three or more parties and multiples issues in every case. In general, all the students demonstrated a decent level of ethical awareness for both Case Study 1 and 2.

Theoretically, students are expected to reason out their decision-making process by taking into account, among others, the cost-benefit analysis, competitive motive, basic values in question, benefits and harms each course of action produce, rights of affected parties, self-interest, and risks. However, the findings revealed a more skewed thinking process of students, which is discussed in this section. Findings imply that ethical sensitivity and ethical judgment of students differ from case to case. This is evident when the majority of students reflected on the safety of customers (mass community) in justifying the decision in not approving the flawed phone to market in Case Study 1 but the same students deliberated that they will go forward with the solar panel project to bring technological change ignoring

the tribal community's desire for better lighting in Case Study 2. An exception was student R6, who said he would not go forward with the solar panel project because he felt that there is no logic to install solar panel when the community lacks basic lighting. The reason for the varied responses could be because most students lacked clear understanding of underlying issue and the social factors involved in Case Study 2, as they were more inclined towards bringing technological improvement to the tribal community. This study is consistent with the premise that ethical sensitivity of an individual varies according to the situation the individual deals with (Sparks & Merenski, 2000). In general, the students were able to analyze both cases by relating with their past experiences in carrying out charity projects and drawing lessons from their internships.

This study draws reflection and discussion on the following:

(a) Do the graduating students go through a protocol/flow of thinking on how to make critical decision?
(b) What are the students' considerations to come to a decision point?
(c) Are the students able to articulate the steps involved in ethical decision-making process?

The interview discussions enabled a reflection on the aforementioned questions. The EDM in methodology is the reference point. Details are as shown below:

Step 1: Identify the underlying issue and relevant information

In general, all the students were able to define underlying issue in every case study. For Case Study 1, the students identified that the phone failing the noise transmittance test. Also, the engineer is pressured to falsify data to launch the product to the market. In Case Study 2, students identified that installing solar panel led to equipment being stolen in the past, and the community desires better lighting system.

Step 2: Identify relevant factors, affected parties and consequences to them

The students were able to identify the affected parties in the case studies to a certain extent. Indeed, a number of students were able to identify the consequences to affected parties and constraints in taking actions. In Case Study 1, students identified the engineer and company, the phone company, the livelihood of the 100 workers, and phone consumers (community) as affected parties. In Case Study 2, students identified the engineer, local sponsor, and local community as affected parties. Students also briefly pointed out the consequences to affected parties.

Step 3: Identify potential courses of action and possible constraints

A large number of students, generally, lacked clarity in defining potential course of actions, and possible constraints, as they were focusing on a single solution. In Case Study 1, all students decided not to falsify data. In Case Study 2, most students wanted to proceed with the solar project. Only a few like R6 and R12 considered installing lighting to homes as better option. In both cases, students zeroed in on the solution as soon as they have identified the issue and affected parties, thus they did not weigh in potential courses of action. Here, the researcher would like to highlight that the students' lack of clarity in defining potential course of actions is not influenced by the time given to the students to write and respond to interview questions. This is because every participating student was given a reasonable time to respond. This goes to show that the students were not trained to go through steps of an ethical decision-making model and to apply reasoning.

Step 4: Test the options. Identify the considerations before arriving to a decision.

Students assessed the options without consciously knowing the various test options available in EDM. Most students assessed the harm test option, deliberating on safety of phone users in Case Study 1, but they were a little unclear in Case Study 2. An exception was R6 who spoke how the release of phone to market affects not only the customers but also the organization and profession if the effects of the product failure is significant. R6 deliberated on harm test, organizational test and professional test. Besides, a handful of students also stressed on minimizing cost, avoiding bad press, the question of who is going to absorb responsibility, and the importance of listening to community's needs. In that context, the students deliberated their reasoning weighing in organizational test,

harm test, and publicity test for both the case studies. Apparently, the students did not elaborate on the consequences if they decide to go against their project superiors, though a handful of students mentioned that the final decision relies on the team and not on an individual. However, it is unclear whether the students are fully aware of whistle-blowing policy and the effect of going against their superiors.

The interview discussion revealed that students do not follow a systematic way to analyze a problem. They should have identified all the issues in Step 1 before proceeding to subsequent steps, but most students were lacking in their cognitive level of recognition of protocol/steps in decision-making and hence, lacked articulation. During interview sessions, students applied basic reasoning skills. Ethical decision-making components were not apparent in their responses, which require them to have ethical sensitivity in understanding the underlying issue, possible actions and affected parties before reasoning out the ethical judgement on which course of action is justifiable. Occasionally, only a few students provided examples to support their reasoning, like the banning of Samsung phone for Case Study 1, and operations of "*Engineers Without Borders*" in Africa for Case Study 2. The students generally faced some difficulties when assessing ethical situations requiring high level cognitive task including analysis, synthesis and evaluation skills. The students demonstrated some weaknesses in their cognitive reasoning skills. On that aspect, this study concurs with Bero & Kuhlman's (2011) findings.

Recommendations

An observation from the interview discussions is that the students are more prone to make decisions in favor of completing a project. This is because they believe that they are governed by their responsibility to complete a project and to provide improvement to the community. This demonstrates their awareness for professional responsibility. However, being professionally responsible does not equate to being ethically responsible. This is because an engineer can still be professionally responsible but lacking in social responsibility.

During the interview discussions, the students responded based on two concepts, which are professional responsibility and social responsibility. However, the central emphasis of the students' discussion was more on professional responsibility of engineers such as adhering to code of ethics, conforming to standard regulations, conducting quality control, and performing duties to the organizations they represent, the employers, and the clients. On the other hand, the concept of social responsibility of engineers, including ensuring public safety, environmental protection, sustainable solution and well-being of the society, was not fully explored by the students. In recent times, numerous scholars have highlighted the importance of engineering students paying attention to social responsibility (Jing & Doorn, 2019; Punzi, 2018; Conlon & Zandvoort, 2011; Bucciarelli, 2008). While the attention has been on the decisions of engineers on micro-ethical issues (e.g. designing safe products, and not accepting bribe), there is a need to include macro-ethical perspectives (e.g. social responsibility, social impact and sustainable development) in engineering education (Herkert, 2005). Herkert proposed mechanisms to incorporate macro-ethical perspectives involving collective social responsibility of the profession. Similarly, Colby & Sullivan (2008) recommended engineering programs to define ethics and professional responsibility broadly, use active pedagogy, and integrate ethics with other learning goals to prepare students for ethical and professional development. Meanwhile, Newberry (2004) pointed out that the way to address systematic barriers is through a change in the nature of engineering education, to include a component on ethical and societal aspects. As stated by Ames et al. (2017), improving students' ethical reasoning skills would require the delivery of intensive educational program over an extended period of time, focusing on continuity and not on singular experience.

Discussion

This study also attempted to investigate the factors that could have developed the engineering students' ethical decision-making and cognitive reasoning skills. Interestingly, the students shared their learning experiences

during Part II of the interview session. The findings revealed that the numerous project-based learning approach throughout the 4 years have molded the students to be responsible engineers. They have been constantly guided not to falsify data during their laboratory practical work, and that has become an integral part of their ethical thinking. This explains why in Case Study 1, all the 12 students decided that the right thing to do is not to falsify test data to release the new phone to market and not to be affected by the President's pressure that the livelihood of 100 people depends on the phone release. Their experiences in practical work could possibly explain why most students were more sensitive towards Case Study 1 involving laboratory test work, as compared to Case Study 2 requiring them to have a different approach in evaluating community needs.

Besides that, the industrial training has prepared the engineering students to a certain extent. Project-based learning and community projects helped them to think through the case studies. Saat, Yusoff & Panatik (2014) reported that industrial training has minimum impact in improving ethical awareness of students. According to the authors, students who underwent industrial training may have observed certain behavior that they thought are acceptable in a workplace and this may have changed the way students perceived their acceptance on the situations. However, this study shows that in general, all the students reflected upon their internship experiences when relating to the ethical situations and exercising their decision-making ability in Case Study 1 and 2. Nevertheless, students agreed that the three months internship was not sufficient to create an impact on the students' awareness about the various ethical challenges in engineering profession.

During Part II of the interview session, when asked what resources they based upon, the students revealed that they developed their decision-making ability and cognitive reasoning through self-taught processes and self-learning. They drew lessons from their personal experiences, teachings from their parents who are in engineering profession, or guidance from their previous project supervisors. Hence, this study showed that apart from the engineering program, external factors played a vital role in shaping the ethical decision-making and reasoning skills among students.

This study is the first step in unpacking the engineering students' cognitive reasoning skills when asked to assess ethical situations. It appears that the learning exposures and practices have influenced the students' ethical decision-making and reasoning skills. More research needs to be carried out to understand how the curriculum, pedagogy and learning approaches can develop engineering students' ethical decision-making skills.

Effective changes can be made in the module and across the engineering program. For instance, a section should be specially dedicated for students to discuss case studies in engineering practice. Ethical decision-making model should be introduced early to engineering students so that they are aware of the general steps involved in a process of decision-making. The teaching and learning activities need to incorporate classroom exercises such as gathering feedback from group discussions reflecting on real life scenarios. By applying active learning pedagogies, students will not only be exposed to ethical framework, but they will also have the opportunity to debate, apply and internalize the context (Christensen Hughes & Bertram Gallant, 2016). Program instructor may consider running ethics courses and ethical reasoning workshops for engineering students to ensure that the ethical decision-making ability is one of the transferable skills among engineering graduates, who would soon be facing ethical challenges in their real profession. Even then, there is no assurance that the engineering graduates will put into practice the acquired ethical decision-making skills. However, that should not deter the program instructors from infusing ethics and ethical decision-making in the curriculum.

Concluding Remarks

This study, within its limitations, has offered valuable input in understanding graduating final year engineering students' ethical decision-making ability and cognitive reasoning. In that context, findings of this study conceptualized themes in understanding students' ethical sensitivity and ethical judgements when assessing ethical vignettes. Two themes emerged from research data. First theme is

"conform to standard regulations and quality" with underlying sub-themes are "professional responsibility", "prioritize safety of consumers", "not to falsify data", and "conduct research for improvements". The second theme is "improve well-being of community", with underlying sub-themes are "educate community about technology", "technology improves lifestyle", "cost factor", and "sustainable solution for community".

In general, students were able to identify the underlying issue and affected parties, but they tend to zero in on the solution without giving much thought to potential course of action and possible constraints. Students were also more comfortable in discussing micro-ethical issues rather than looking at the broader concept involving macro-ethical issues (public and local community). This research study opened up the minds of students to think about engineering issues from multi-dimensional ethical aspects. This study would be useful for students to understand the ethical norms, and professional responsibilities in engineering.

The findings of this study stress the importance of engineering schools integrating exercises of ethical decision-making with relevant case studies or true accounts of engineering practices to develop decision-making ability and cognitive reasoning among future engineers. Case discussions enable students to analyze problem in-depth and to look for the not so obvious solutions. This would prepare the engineering students for the ethical challenges (both in micro and macro level involving society), which they will encounter as professional engineers.

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