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Exploring the Role of Self-Efficacy in Entrepreneurial Decision-Making: An Action Research Study [WIP]

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Work-in-Progress: Exploring the Role of Self-Efficacy in Entrepreneurial Decision-Making: An Action Research Study

Abstract

In this study, upper-level chemical engineering students' written reflections on ethical dilemmas will be grouped according to three types of possible outcomes: client-based, company-based, and innovation-based according to their answers to corporate social dilemmas. Students will have a survey to determine what type of moral reasoning they adopt when they face an ethical dilemma. Students will be presented with an ethical decision-making scenario and answer it based on their own individuality. The pre and post activity reflections will be compared to verify any changes in perspective in addressing the dilemma. The EM component to this decision-making activity is not only mimicking decision-making situations as entrepreneurs, but it also includes the discussion of the entrepreneurial mindset framework to either encourage or solidify their self-efficacy of their ethical decision-making ability. We are particularly interested in knowing the percentage of students who demonstrated post-conventional moral reasoning. This study will focus on introducing concepts and situations studied in business and social studies degrees and adapted to an engineering setting as part of the chemical engineering curriculum. The impact of this study could shape the discussion in ethics and ethical decision making used by chemical engineering educators and chemical engineering employees other than simply engineering economics and quality control optional courses. The introduction of entrepreneurial mindset learning strategies to the chemical engineering curriculum can be seamless and have a great impact on student's self-efficacy.

Background

The development of abilities of societal decision-making has received little attention from engineering educators, who have prioritized teaching technical skills. Educators must choose the best content, methodology, curricular models, and outcome evaluation techniques to integrate ethics into the curriculum [1]. Conversations on ethics in engineering are typically guided by the National Society of Professional Engineers' (NSPE) Code of Ethics but they are often not realistic to the workplace where an individual faces contrasting demands.

Entrepreneurial mindset (EM) and ethical dilemmas are more commonly associated with other fields like business, philosophy, and medicine (especially the latter). Nonetheless, they hold similar value in engineering education and practice. Students learn and develop ethical decision-making skills through active thinking about ethical dilemmas, progressing from preconventional (least developed), conventional to post-conventional (most developed) levels of moral reasoning. An ethical dilemma is a conflict between alternatives, where choosing any of them will lead to a compromise of an ethical principle which may or may not lead to an ethical violation [2].

Entrepreneurship and corporate social responsibility, which are closely tied to entrepreneurial mindset, analyze common needs, economic issues, and social issues to improve society's quality [3]. The introduction of the EM framework [4, 5] in an ethical decision-making dilemma suggests a pluralistic framework for structuring the chemical engineering curriculum. It adapts concepts and situations studied in business and social studies degrees to an engineering setting, creating an applicable, critical interdisciplinary and reflective curriculum [6-8]. The aim of this study is to investigate how the integration of an entrepreneurial mindset into case-studies and course materials influences the perceptions of ethical dilemmas and develops critical thinking skills in upper-level undergraduate chemical engineering students. It also identifies how this complexity of the human factor and self-efficacy can be reflected in an assessment via a Likert scale survey and reflective journals.

Literature

Ethics modules covered in chemical engineering classes such as "process safety" or "introduction to engineering" tend to focus on the right and wrong answer. A study argues that engineering design decisions are more pervasive than initially thought, with three types of ethical justifications: consequential, deontological, and virtue-based [9]. What would happen if uncertainty were taken into consideration? A study showed that uncertain situations influence responses in ethical decision making. Respondents tend to react differently when there is an uncertain outcome. Results showed that uncertainty reduces preference for utilitarian versus deontological responses in moral dilemmas [10].

Why is uncertainty important? For every ethical case we discuss in class, there is an example in the media that highlights unethical organizational decision-making and questions people's perception and ethical judgement under stress. A study compared control participants to participants who were exposed to ethical decision-making tools. The tools used improved the identification of an ethical dilemma and their responses varied according to their perception of ethical problems, which was unlike the responses from the control group [11]. A cross-sectional study compared first-year and third-year doctoral students in clinical psychology [12]. Results showed that less experienced students rely more on personal constructs, while more experienced students integrate professional with personal expectations. Another important aspect found in the study was that less experienced students adopted a more sophisticated approach to ethical dilemmas.

The capacity to perform tasks is linked to self-efficacy. For students, the assessment is done by developing their critical thinking skills. In terms of ethical behavior and attitudes, self-efficacy might influence ethical cognition and perceptions. A study revealed that critical thinking leads to changes in perceptions of ethical problems, but with little to no effect on ethical cognition [8].

Ethical dilemmas and critical thinking

To capture the multiple dimensions of ethical dilemmas, specific contexts and situations must be considered when developing a model that frames the process of ethical decision-making in classroom settings. Nonetheless, a framework for preparing engineering students to make decisions based on complex ethical dilemmas is still missing [13]. A study conducted in collaboration with educators developed an ethical decision-making model which includes the following: 1) ethical dilemma, 2) identification of conflicts, 3) decision making, 4) justification for the decisions, 5) implications, and 6) alternatives [14]. Another study uses seven steps which are: 1) state the problem, 2) check the facts, 3) identify relevant factors, 4) develop a list of options, 5) test the options, 6) make a decision, and 7) review steps 1 -6 [15].

Somes studies identified three forms of thinking when ethical dilemmas were used in process safety discussions. They were categorized in pre-conventional, conventional, and post-conventional [16, 17]. These three forms of thinking revolve around personal concerns, direct circle, and surrounding communities or the environment, respectively. While these three forms seem to be coherent, there is the argument of human complexity and how virtues, empathy, fairness, and stakeholders influence the decision-making process on an ethical dilemma [14]. Critical thinking ability is by far the most valued skill in the engineering field. Critical thinking enhances decision-making, problem-solving and communication abilities by fostering logical reasoning, analytical skills, and a perceptive and dynamic mindset. While students reflect on complex ethical dilemmas, critical thinking ability serves as the guiding tool that leads to better judgements in the decision-making process.

According to the review study by [18], problem-solving in engineering is not only a technical process, but also a social one. The ability to make decisions depends on a variety of technical capabilities, social skills, leadership, and motivational factors. When talking about critical thinking, the most often listed skills were analysis, inference, explanation, evaluation, interpretation, curiosity, open-mindedness, and analytical skills. The review emphasizes two main points. The importance of a variety of pedagogical procedures and interventions and the value of a longitudinal strategy that outlines critical thinking to be purposefully encouraged and integrated within undergraduate engineering curricula.

EM framework

Over the past two decades, there has been a growing focus on preparing graduates to think critically, communicate effectively, the same abilities described in the previous section. Technical skills, the ability to recognize opportunities and add value are considered important components of Entrepreneurial Mindset (EM) by some researchers [3, 5, 7, 19-24]. The term "entrepreneur" encompasses both founding a company and helping an existing one advance. The adapted Kern Entrepreneurial Engineering Network (KEEN) framework defines EM in engineering as a blend of curiosity, connections, and value creation, rooted in collaboration and character [4, 25]. The possible outcomes described below are the basis of the EM framework of this study.

1. Related to curiosity

a) Develop a propensity to ask MORE questions.
b) Question information that is given without sufficient justification.
c) Recognize and explore knowledge gaps.
d) Recognize problems with an open mindset and explore opportunities with passion.
e) Be able to self-reflect and evaluate preconceived ideas, thoughts, and accepted solutions.
f) Explore multiple solution paths.
g) Gather data to support and refute ideas.
h) Suspend initial judgement on new ideas.
i) Take ownership of, and express interest in topic/expertise/project.

2. Related to connections

a) Understand ramifications (technical and nontechnical) of decisions.
b) Identify and evaluate sources of information.
c) Connect life experiences with dilemmas.
d) Connect content from multiple courses to solve a dilemma.
e) Integrate/synthesize different kinds of knowledge.

f) Consider a problem from multiple viewpoints.
g) Explain why a discovery adds value from a range of perspectives (technological, societal, financial, environmental, etc.)
h) Understand how elements of an ecosystem are connected.
i) Identify and work with individuals with complementary skill sets, expertise, and so on.

3. Related to creating value
a) Identify the needs and motivations of various stakeholders.
b) Express empathy in identifying problems and exploring solutions.

4. Collaboration
a) Recognize their own strengths, skills, and weaknesses, as well as those of others.
b) Be able to teach and learn from peers.
c) Be able to network and see the value in everyone.

5. Character
a) Recognize and evaluate potential impacts while making informed ethical and professional decisions.
b) Accept responsibility for their own actions, and credit the actions of others.
c) Work toward the betterment of society.

When introduced into a classroom setting, EM could influence an engineering student's ability to identify a problem and develop an approach (innovative problem-solving skill) to address societal problems. This, also aligned with ABET outcomes can be seamlessly introduced in a chemical engineering curriculum with ethical decision-making scenarios [4, 15, 16]. The EM framework in the ethical decision-making process fosters a climate which favors a corporate socially responsible environment [3, 19, 22, 23]. An ethical decision is accompanied by moral values and norms which are placed and regulated by their professional organizations. However, real life scenarios are more complex than a simple right and wrong answer. This means that common solutions are not meeting the best outcome of a decision and they might, in fact, become obsolete tomorrow, as new problems and new ethical decisions must be taken in an engineering context.

The *EM framework* of **curiosity** might help students explore multiple perspectives in an ethical decision-making scenario. The finding of new perspectives is not enough. Students must integrate that knowledge to find an innovative solution. This is done by establishing **connections** (their previous knowledge → new knowledge). When students understand that the innovative solutions have an impact on stakeholders, they can **create value** in a diverse context. Therefore, by developing an entrepreneurial mindset that values social responsibility, engineering students and entrepreneurs can navigate complex challenges and make decisions aligned with their values and goals. The implications of this study for students are significant. The findings suggest that developing a strong sense of self-efficacy can positively influence ethical decision-making in an entrepreneurial context, that is, creating businesses that have a positive impact on society [8]. Furthermore, by promoting ethical behavior and social responsibility, students can address some of the world's most pressing challenges.

Methodology

This work uses a mixed methodology to address the research question: How is chemical engineering students' ethical decision making impacted by an entrepreneurial mindset activity? A quantitative scale to estimate ethical reasoning ability is used to inform a qualitative analysis of student resolutions and reflections on an ethical resolution. The Walthers et. al [26] Q3 framework will be used to validate data handling during the research process.

A population of undergraduate chemical engineering students will be solicited through email and classroom advertisement to participate in this study. All students contacted through classroom channels will be informed that participation in the study is both anonymous and not a requirement for the completion of coursework.

A set of three ethical dilemmas will be presented to participants for them to resolve and reflect on their reasoning process. Their written resolutions and a written reflection about their reasoning process will be qualitatively coded for the entrepreneurial mindset (EM) constructs of curiosity, connections, creating value, collaboration, and character. Several researchers will code to increase validity of interpretations of the texts. In addition, the presence of client-based, company-based, and innovation-based resolutions will also be qualitatively coded to describe the orientation of student resolution.

After the initial dilemma reflections, participants will complete the ethical reasoning identification test (ERIT) to estimate their ability to engage in ethical reasoning. This scale was chosen because it "represents a wide range of traditional philosophical perspectives and religious beliefs." [27] This estimation of ethical reasoning ability is conducted after the initial dilemma resolutions to not bias participants to utilize the reasoning structures presented in the test. Participants will then be categorized into high and low ethical reasoning ability to inform the qualitative evaluations of ethical dilemmas.

After completing the ERIT evaluation, participants will take part in an entrepreneurial mindset module designed for chemical engineering participants. This module will last approximately 60 minutes and will involve an overview of EM constructs as well as a group discussion about applying these constructs to ethical reasoning. Participants will be presented with a new set of three ethical dilemmas and be asked to resolve and reflect on their reasoning. These will also be coded using EM constructs and will be compared against the resolutions from before the module.

Implications

The potential impact of critical thinking skills and how ethical dilemmas are addressed in a professional chemical engineering setting could influence the number of incidents related to process safety. This is because behavioral ethics and moral reasoning are most likely overlooked. The ability to introduce these dilemmas in a classroom setting could complement the study provided by [16], and which focuses on understanding how chemical engineering students (mostly seniors) apply their critical thinking skills on process safety discussions.

The Engineering Process Safety Research Instrument (EPSRI) has been the only validated instrument to be applied on process safety ethical dilemmas, which reiterates the need for ethical discussions on almost all courses of the chemical engineering curriculum [17]. A transdisciplinary study assessed a validated tool [28] and determined that with deliberate instruction, students from engineering, nursing and health courses could develop ethical reasoning confidence. Ethics education which includes social responsibility, entrepreneurship and dilemmas contribute to the development of complex and creative competencies which, in turn, provide comprehensive, inclusive, social, and humanistic solutions [24]. A seamless transition between engineering design and social responsibility is often reflected in current situations which will not necessarily lead to engineering disasters. Most engineering design courses employ case study methodologies; yet research [9] revealed that engineers attach virtues and vices that conflict with their own actions and thinking. Students may be able to incorporate engineering ethics into their critical thinking abilities better through reflections on role-playing exercises.

The assessment of all EM framework outcomes as described in this paper would be extremely difficult. Longitudinal assessment is challenging. Comparing data from different institutions might also be complicated. Therefore, the primary focus of this study is to identify which outcomes are more commonly found in certain groups and determine any trends on the students before and after EM strategies are applied in the classroom. We expect that once the outcomes and skills are identified we could determine the impact of EM in students' ethical decision making.

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