How to Build a Better Engineer: An Analysis of Integrated CS Ethics Modules

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Honors Research Project

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by

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Table of Contents

Abstract

Starting in 2019, Point Loma Nazarene University professors Dr. Lori Carter and Dr. Catherine Crockett recognized a need for integration of ethics into computer science (CS) and data science courses, so they have been developing a series of ethics modules to be embedded throughout CS curricula. These modules introduce four ethical frameworks – virtue ethics, analogies, utilitarianism, and deontology - for evaluating ethical dilemmas. Then, in upper-division courses, they are used to discuss relevant social issues pertaining to the topic of the class. Similar approaches to ethics have been made in other fields including medicine and business.

Moral psychologists have long argued that practicing language-based reasoning through analyzing ethical dilemmas shapes a more ethical person; however, more recent work has shifted focus from the emphasis on moral reasoning to a development based more on quick emotions and intuitions as the proponents of moral action. To build moral development, those papers recommend having communities that foster moral behavior, learning from moral exemplars, and regularly practicing moral virtues.

This paper evaluates the effectiveness of the CS ethics modules by analyzing the current responses from teachers and students, similar approaches to teaching ethics in accounting, and current developments in moral psychology. It is concluded that the modules could benefit by maximizing class discussion time by using pre-class activities, clarifying how the modules should taught, reframing the ethical frameworks in the introductory modules, and creating an additional open-ended module for students in internships.

Introduction

In 1991, the Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE) came together to define computer science curricula and to call for its inclusion of social and ethical issues. As a result, the ImpactCS Project developed curriculum that year to meet the need for ethics in the computer science classroom (ACM/IEEE, 1991; ImpactCS Project, 1991; ImpactCS Curriculum, 1991). However, technology and modes of classroom instruction have continued to evolve since the nineties. Since then, technology has increased its influence over political, social, cultural, and legal issues (Cheeseman, Lynch, & Willis, 2018; ACM/IEEE, 1991). Current students now thrive with shorter lectures, more variety, and increased classroom interaction (Kalkhurst, 2018). As a liberal arts school, Point Loma Nazarene University recognized this need for ethical engineers, so the math, computer science (CS), and information systems department required each of their software engineering majors to take a general ethics course offered by the school's philosophy department. Although helpful in its own right, this class did not offer the direct applicability to their work that students needed. To address this issue, Drs. Lori Carter and Catherine Crockett have been developing a series of ethics modules tailored specifically for computer science and data science courses.

Others Work in Incorporating Ethics and CS

Following the ImpactCS Project and further calls from the ACM curriculum guidelines to promote ethics inclusion, there have been many varied attempts to integrate ethics into the CS classroom (ACM, 2008, 2013). At Illinois State University, Professors Califf and Goodwin were told by their department head to integrate ethics in their curricula, and they successfully did so in four separate cases for programming classes, but they lacked the coordination to avoid repeating material between different professors (2005). Drs. Daniela Inclezan and Luis Pradnos chose to

focus on ethical issues related to ecological problems by creating three activities for the first week of their databases class; however, their paper showed no evidence of any further ethical considerations in this course (2014). At the University of Colorado Boulder, professors called for integrating ethics across CS education and started by piloting their work in a Human-Centered Computing course. However, like the other researchers before them, they ultimately called for more resources for professors to integrate ethics directly into CS classes (Skirpan et al., 2018).

In the same timeframe as Dr. Carter and Dr. Crockett's modules were being developed, Harvard computer science professors worked with philosophy post-graduate students to create a series of ethics modules tailored to individual computer science courses which they titled Embedded EthiCS. These modules are to be taught by the philosophy students to the CS classrooms. Each of those modules introduces a different concept from ethics, like the value of autonomy in belief formation, while analyzing subjects like game theory, privacy, or expanding algorithms (Grosz et al., 2019).

Overall Structure

With these previous integration efforts in mind, Dr. Carter and Dr. Crockett set out to create a series of modules that would be standardized across CS curriculum. They have prioritized making these modules cumulative by utilizing introductory module tools in later modules yet independent so that students and professors without those foundational introductory modules can still easily understand. To keep students' intrigue, maximize relevance, and cover as many ethical dilemmas that engineers may face as possible, these modules are designed with specific courses in mind. Ethical dilemmas are defined in the modules as events where the morally right course of action is not clear. The current modules are built with four fundamental

concepts in mind – early introduction, continued discussion in most courses, integration of topics within the courses, and maximum coverage with minimum overlap (Carter, Crockett, 2019).

Early Introduction

The early introduction of these modules means that first-year modules introduce why ethics is important to computer science, identify what values are important to students in the workplace, and begin defining and utilizing four frameworks for ethical dilemmas. In the first module, "Why Ethics," students split into groups to brainstorm jobs for people with computer science backgrounds then analyze a scenario in which software engineers' design choices affected a group of people. Group examples include events like the U.K.'s Child Support Agency and Department for Work and Pensions conflicting software, which caused damages of over one billion dollars (BBC, 2003). At this early stage, students are not expected to assess the ethicality of the situation, only to draw from the scenario how software engineers were involved in the event and how principles of software design, like creating consistently reliable code that is easy for peers to understand and use, can be applied to their code. Following this basis for why ethics is relevant to computer science, the subsequent first-year modules introduce the four ethical frameworks that are employed throughout the rest of the curriculum: virtue ethics, analogies, utilitarianism, and deontology.

The second module defines virtue ethics as "a way to decide the ethicality of a situation be determining if the action in question upholds or violates one of your personal (or societal) virtues." In this module, students pinpoint what values resonate most with them from a given list of virtues, such as authenticity, compassion, dignity, and others, and how those values determine their moral views. The hope is that prioritizing of virtues gives students a better understanding of themselves. Afterwards, the students analyze ethical dilemmas using the frameworks in these

modules involving scenarios that may be familiar to underclassmen, such as “A student waits until the last minute to complete her program, so she finds a program on the internet that solves the problem she was required to solve and turns it in with minor modifications. Did the student act ethically?” Then, for this particular module, the student fills out what virtues are upheld in this scenario and what virtues have been violated.

At the time of writing this paper, the rest of the introduction modules are being rewritten; however, they are currently still intended to introduce the analogies, utilitarianism, and deontology as tools for evaluating ethical dilemmas. Analogies are not often included as a potential framework in conversations about teaching ethics; however, as many of the concepts discussed are new and intangible (i.e. stealing a cryptocurrency is less physically involved than robbing a bank), analogies help people visualize and analyze abstract concepts by comparing them to known concrete ideas. A common analogy used in cyber security compares hacking to robbing a home (Granja, 2002). While it may not be clear if hacking into a system without influencing any harm is wrong, one may compare that to breaking into someone’s home to only look around. We know that breaking into someone’s home is wrong because it is an invasion of privacy, so we can extend that knowledge and feeling to hacking into a system.

Next, the students learn about utilitarianism. Utilitarianism is commonly defined as a way of finding the most ethical solution by determining which one brings the most good to the most people. One thing about utilitarianism that is not directly noted in the modules is that it is a form of consequentialism – meaning that the ethicality of a choice is determined by the choice’s consequences rather than the person’s intentions (Driver, 2014). The trolley problem is a common example of utilitarianism being used as it involves making a choice based on the amount of people to be saved. In it, a trolley is about to hit a group of people and a person

deciding whether it is ethically better for him/her to redirect the trolley to hit fewer people instead. While there is heavy guilt associated with redirecting the trolley to hit more people, from a strictly utilitarian viewpoint, redirecting the trolley is the more ethical decision.

To conclude the frameworks, deontology is introduced to give students a clear guide of ethical behavior according to rules that have been previously established – rules such as the ACM Code of Ethics. Other fields elaborate deontology to mean more than only rule following. While utilitarianism measures ethicality by the outcomes of an action, deontology can measure ethicality by the nature of that action (Greene, 2008). For an extreme example, where lying about hiding a Jew from a Nazi may bring about the greatest amount of good in the utilitarian view, the nature of the act would not be justified in a strictly deontological view because lying is wrong. Together, these four frameworks give students different perspectives of ethical dilemmas and different methods for explaining their own beliefs.

Continued Discussion and Integration

Following the first-year modules, the rest are more focused on applying the frameworks to concepts that relate directly to their coursework. There are currently at least ten available upper-division modules. These cover the concepts of system reliability, accessibility, professional ethics, diversity, transparency, data cleaning, data visualization, digital nudging, avoiding algorithmic bias, and hospitality. Thus far, many of these upper-division modules have been used by different professors at Point Loma Nazarene University. To give an idea of the content of some of these modules and their applicability, the system reliability and professional ethics modules have been developed in partnership with Dr. Michael Leih and implemented with great classroom discussion in his project management course. The accessibility module regarding how open source and proprietary sources relate to ensuring that products are accessible to wide

populations, including those with disabilities, has been used in a few different operating system courses by Dr. Lori Carter, one of the professors who developed this curriculum. Dr. Carter also used the data cleaning module in her data management class and a diversity module in her architecture course for students to analyze how having or lacking diverse voices behind technological development affects the product's use and the business's publicity. The hospitality module that addresses how developers balance writing clean, well-documented code while working on a tight schedule has been used in a software engineering class by Dr. Benjamin Mood. Also, Dr. Jesús Jiménez has implemented the data visualization module and personalized elements of it to his students' activities in his service learning class. Each upper-division module uses a variety of activities that involve the students learning about the given subject and ethical dilemmas associated with that topic before using the frameworks to assess the given scenarios.

Template

The template for the instructor's copy of each module was designed to be consistent and easily understood. Each module begins with the brief ethics background that is required for the discussion, the relevant subject matter, the module's intended placement in the student's academic career and within the order of the modules, and the time required inside and outside of class for students to complete the module. Following those descriptions are the learning objectives, the module overview with the ethical dilemma to be considered, and a bullet point list of the exercise flow. Next, there is the instructors guide which acts as a loose script for the teacher to follow, giving questions for the class along with possible student answers. If there are any additional worksheets for the module, the student versions are included in the template as well as instructor's keys with more possible student answers.

Why Frameworks

One of the earliest goals in developing the ethics modules was to give students a way to voice their moral views and to see ethical dilemmas through other perspectives. When presented with an ethical dilemma – such as if one student, Sally, should send her homework answers to a sick friend – many students have a gut-feeling of whether that action is right or wrong, but they have trouble articulating why exactly that choice is or is not justifiable. This insistence on a moral choice determination without having the reasoning to back it up is similar to what psychologist Jonathan Haidt refers to as "moral dumbfounding" (2001). The four ethical frameworks give students this voice to say that "Because sending her homework violates the virtue of integrity, then the scenario is unethical." The ethical frameworks also give students better understandings of other points of view. For example, with that same scenario, another student may argue that Sally would be following the virtue of care by helping her ill friend understand what he missed in class. Likewise, someone else may find other frameworks to be entirely more applicable to this situation saying, "Because sending her homework violates the classroom rule," or "Because sending her homework would not do the greatest amount of good for her friend," or "Because sending her homework would be similar to giving her friend a fish instead of teaching him how," then this action is still unethical. Although the data cannot be represented here for privacy issues, professors report that upper-division students with particular modules do a great job of understanding and utilizing different applicable frameworks in their test answers.

Early Assessment

Early module assessment was done through focus groups, surveys, and test questions. Prior to the modules being used in an introduction to programming class in 2019, a survey was

given to the 55 students, and of those students approximately 35% were unable to name an ethical dilemma in computing, and of the students that did, about 70% listed an issue involving security or privacy. Some 87.5% of the first-year students surveyed agreed that it was important to integrate ethics into their classrooms. These students have not yet graduated, so there is not yet matching data to assess how much these modules have changed their views. Professors have continually reported having great classroom participation from the time with the modules, and some students have noted that they have felt more comfortable contributing to the ethics conversations than the regular classroom technical discussions. Four focus groups were also conducted in 2019, and they yielded some interesting results. After the focus groups, the majority of participants agreed that these modules were helpful to their view of software engineering. After some confusion regarding the structure and usefulness of the frameworks, documents summarizing the frameworks with descriptions of each and examples were given and proved to be more effective in those limited environments. These documents are available for each module, but currently are not used by students and professors in classroom settings. Participants noted that the various activities were stimulating and aided their broader understanding of each concept. Despite efforts to keep each module as concise as possible, each module section of the focus group and each classroom implementation has run over the initially desired ten to twenty-minute mark.

Early Changes

As the modules have been tested in different settings, changes have been made to suit student needs. Originally, the modules introducing the ethical frameworks were all created surrounding the same theme – plagiarism. With limited implementation, having the same topic for four different modules proved too repetitive, so a more general format was created for

introducing the ethical frameworks. One common question received throughout the focus groups was, “Why teach ethics in computer science?” With class time already being filled with so many vital topics, it is important that the purpose of the modules is answered for students as soon as possible. Thus, Dr. Carter created the earlier mentioned “Why Ethics” module to be presented before any of the other modules in the introductory course. By presenting this module first, students are given a direct purpose for the modules, and in their attempts to analyze the given ethical situations with only their initial feelings, students have the opportunity to understand how having the tools to analyze the ethical dilemmas would be helpful before they learn about the frameworks.

Accessibility to Other Universities

Since their inception, these modules have been presented in multiple formats at conferences and other universities, and work has been started to ensure that they will be made openly available. Google Drive has been used to store current forms of the modules. The virtue ethics module has been used in classrooms outside of Point Loma Nazarene University and outside of the CS department. It has been adapted for the same ethics in accounting course that is discussed in part three of this paper, and used by a professor at Calvin University in another introductory CS course. Although these modules were created with a Christian perspective, it is important to the authors that this work is available to public universities as well, so additional faith-based material (including a form with verses corresponding to each virtue used as initial bases for the modules) were created as supplemental information.

Length

One compromise that has had to be made to the modules is their length. Although it was initially hoped that the modules would only take ten to twenty minutes (Carter, Crockett, 2019),

they often run for closer to half an hour or more both in classroom and focus group settings. Often, this is an intentional choice by the professor as he or she values the stimulating conversations that are started by these modules, so the professor allocates the all or most of the class session for the discussion.

Some professors have also found that the length of the documentation for the modules was longer than desired. Efforts have been made to ensure that the preparation time for presenting each module is manageable for busy instructors and that the material may be easily understood regardless of background in ethics; however, some of the length that comes from explaining the modules thoroughly enough to be used and answer any potential questions is difficult to abbreviate.

With this series of ethics modules being created and used, this project focuses on assessing their effectiveness. It is one thing to tell students about ethics, but it is another to raise morally-minded individuals. By analyzing how psychology recommends teaching ethics, along with the successes and current approaches of teaching ethics in another field, affirmations and recommendations will be made to improve the success of the current ethics modules.

Part Two: Psychology Literature Review

Moral psychologists have long struggled with figuring out how to promote a person's ethicality. Some have argued that there are progressive reason-based moral stages of development based on how participants respond to moral dilemmas (Kohlberg, 1981), while more recently, others have argued for an approach that considers the identity of the person making the choice and how their quick emotions carry more weight to how they will act in response to a present ethical dilemma than their reasoning when given time to reflect on a hypothetical dilemma beforehand in a neutral environment. These latter moral psychologists

would believe that becoming a better engineer, or more accurately becoming a better person, is not only about being able to figure out the answers to an ethical dilemma in an external environment, but also living with an attentiveness of the potential ethical dilemmas in the world and taking the correct moral actions when in those situations. Moral attentiveness, moral intuition, moral identity, moral emotions, moral virtues, and moral judgment are all key components to influencing moral behavior.

One important clarification needs to be made before exploring concepts from moral psychology. As is often the case with interdisciplinary work, some of the definitions used in the modules differ from those in this section. For example, virtues in the modules come from a list of values which students identify as most important to them. In moral psychology, virtues also consist of a similar list of values, but they are further specified as skills that can be trained. According to Leffel and Oakes-Mueller, moral virtues act "like scripts that specify how-to act (and not merely reason) in particular situations" (Leffel et al., 2014; Haidt & Bjorklund, 2008; Haidt & Joseph, 2004). Furthermore, virtues can be separated into lower-order virtues, such as the ones listed in the modules, and high-order virtues, such traits involving willpower and integrity (Blasi, 2005).

Moral Attentiveness

Being able to analyze moral dilemmas is not very useful if they are not recognized in life. The concept of moral attentiveness was developed by Dr. Reynolds based on the social cognitive theory, and it refers to how much an individual perceives "morality of their everyday decisions and how much an individual regularly considers moral matters" (2008). Part of Reynolds' argument is that instead of focusing on ethics being a matter of someone having a right or wrong view, ethics constructs should be focused on the more abstract idea of how much people

recognize ethical dilemmas in the first place. Fiske and Taylor (1991) argue that the amount of attention someone pays to moral matters is determined by the contextual significance of the stimuli, how inherently interesting the stimuli are, and the individual's capacity to recognize the stimuli. Moral attentiveness consists of one's initial feelings towards a stimulus and how one reflects on the stimulus at a later point (Reynolds, 2008). In order to measure one's level of moral attentiveness, Reynolds developed a series of statements responded to with a Likert scale of how much each state represents an individual, with one being not at all representative and three being very representative. These statements are all very direct in observing one's daily interaction with ethical dilemmas and ranged from "In a typical day, I face several ethical dilemmas," to "I often find myself pondering ethical issues" (2008).

Moral Identity

Aquino and Reed define moral identity as the "mental representation of one's character that is held internally and projected onto others" (2002; Leavitt, Zhu, & Aquino, 2013). Moral identity refers to how much one identifies oneself as a moral individual. Aquino and Reed posit that because someone identifies themselves as a certain moral attribute, such as honest or kind, they will be driven to act consistently with that attribute in order to preserve their identity (Aquino & Reed, 2002). Moral identity can be primed or triggered by simple environmental stimuli such as wall art or water marks on forms (Leavitt, Zhu, & Aquino, 2013). Even a poster of a woman winning a race was enough to enhance performance in a call center (Shantz & Lathan, 2001). In these scenarios, it is hoped that triggering a person's moral identity will encourage ethical decision making.

Moral Judgement

Where moral identity asks the question, "Who am I?" moral judgment asks the question "What is right and wrong?" (Reynolds & Ceranic, 2007). Moral judgement is the determination a person makes regarding the goodness or badness of a situation (Lind, 2008). Some, like Reynolds and Ceranic, pose that depending on how much society has a generally accepted view of right or wrong for a certain dilemma, people will lean on moral identity and/or moral judgement to determine their action (2007). Within the debate between the Rationalist and Intuitionist approaches to teaching ethics, the Rationalist camp believes that good moral judgment, and moral behavior by extension, comes from cold, cognitive-based reasoning, separate from emotionally-based hot reasoning (Leffel et al., 2014). However, in Jonathan Haidt's work "The Emotional Dog and Its Rational Tail," Haidt uses neuroscience and social psychology to argue for a social intuitionist model of moral action based on moral intuitions, moral emotions, and moral virtues (Haidt, 2001; Leffel et al., 2014).

The Moral Intuitionist Model

In their work "Relevance of the Rationalist-Intuitionist Debate for Ethics and Professionalism in Medical Education," psychology professors Dr. Leffel and Dr. Oakes-Mueller worked alongside Dr. Curlin and Dr. Yoon to propose the moral intuitionist model of virtuous caring for teaching medical students. At its core, the moral intuitionist model uses Haidt's social intuitionist model aiming to utilize a person's intuitive sense, or "gut-feeling," of right and wrong to help them notice morally relevant situations, feel motivated enough to take action in those situations, and choose the most ethically correct action in that situation. The first element of the moral intuitionist model is moral intuition. The Moral Foundations Theory (MFT) offers five possible types of intuition bases – care/harm, fairness/reciprocity, ingroup/loyalty, authority/respect, and purity/sanctity. This initial "good-bad evaluation" is amplified by

complementary moral emotions – such as compassion. Moral emotions both amplify sensitivity to moral issues and energize moral actions. Following the quick decision to approach a situation and energy to act, moral virtues act as a script for how-to act in the situation. It is important to understand that much of this process is at the fringe of consciousness (Leavitt, Zhu, & Aquino, 2013), so teaching moral intuition is much more complicated than teaching a series of facts to be memorized, as moral intuition is to be felt more than recited.

Summary of Teaching Methods

Two of the earlier mentioned papers discuss how to raise morally-minded individuals in a classroom setting. In "Relevance of the Rationalist-Intuitionist Debate for Ethics and Professionalism in Medical Education," Dr. Leffel and Dr. Oakes Mueller list the following as ways to boost moral intuitions, emotions, and virtues. For boosting the moral emotion of compassion, Leffel and Oakes-Mueller reference mindfulness meditations based on work from the University of Wisconsin (Davidson et al., 2003). Both Leffel et al. and Lapsley in "Moral Self-Identity as the Aim of Education," stress the need for virtue exemplars and building moral intuitions and moral identity though rich communities of learners. Virtue exemplars are people who embody virtues in life – they may be especially caring, brave, or just (Walker & Hennig, 2004). The virtue or moral exemplar acts as a role model to learn from and experience practicing virtues alongside. In addition, having a social group that is focused on moral development through community involvement promotes a stronger moral identity (Lapsley, 2014). Leffel et al. also discuss how encouraging a medical student to reflect on his/her worldview and others' worldviews through "reflective journaling, educational portfolios, small-group case discussions, and other activities" helps students become more aware of their moral selves (2014). In summary, the current direction of moral psychology leans not only towards preparing students

for making moral judgments, but also towards nurturing the intuitions, emotions, and identities that contribute to living a moral life by creating a social environment that promotes those practices and feelings.

Part Three: Related Ethics Works

Purpose of Ethics in Accounting Course

The Certified Public Accountant exam, or CPA Exam, is a sixteen-hour test used for qualifying public accountant positions (AICPA, 2021). The exam consists of four parts followed by a separate, state-certified ethics portion that has fifty multiple-choice questions. In contrast to the other four sections being taken at testing centers, aspiring CPAs have eleven hours to take the ethics portion at home with a 300-page study book available to them. However, just because the ethics portion is open to outside resources does not mean that it does not require preparation. Test-takers need a 90% on the ethics section in order to pass. This means that there is only room to miss five questions and still pass the ethics test (CalCPA, 2021), and according to Professor Elizabeth Holbrook, many who take the ethics exam fail on their first attempt. Beyond the exam, a four-hour ethics training is required every two years in order to keep CPA certification.

But why is ethics important to accounting in particular? CPAs are trusted individuals who help "individuals, businesses, and other organizations plan and reach their financial goals" (AICPA – FAQ, 2021). CPAs may be responsible for helping file taxes, auditing, or accounting for an industry. Each of these positions comes with its share of responsibilities in order to please clients and follow laws. The American Institute of Certified Public Accountants (AICPA) consisting of 400,000 CPAs, created a Code of Professional Conduct with principles of guiding CPAs in their professional responsibilities (AICPA, 2021). There are also several other organizations across the globe that have established their own codes of conduct which are part of

the International Federation of Accountants, or IFAC (Klein, 2015). Ethical dilemmas arise as CPAs decipher the various rules listed in the codes of conduct and interpret those regulations to fit their particular situations. This need for ethical decision making led to the inclusion of the ethics portion of the CPA Exam and the development of the ethics in accounting course by Elizabeth Holbrook for Point Loma Nazarene University.

Approach

Professor Holbrook's course follows the textbook *Ethics in Accounting: A Decision-Making Approach* by Gordon Klein, in which there are four main sections: an introduction to ethical frameworks, discussion of unethical behaviors, professional rules of conduct, and other responsibilities of accountants (2016). The first few weeks are dedicated to learning about the ethical frameworks they use, namely utilitarianism, deontology, and virtue ethics. Then, the majority of the course is spent discussing particular ethical situations that accountants may find themselves in. Professor Holbrook designed the concluding unit to focus on the dilemmas specifically associated with being a Christian in a secular work environment. Whereas in the first units, students discuss issues related to general ethical principles such as stealing money from a company, in the last unit, students are posed situations where the values they associate specifically with their faith may be tested. For example, some Christians, especially those of the Nazarene tradition, believe that they should not drink alcohol, but if an accountant is invited to a happy hour with their coworkers, they may be put in the uncomfortable situation of declining the offer altogether or not drinking with others. This curriculum structure gives the majority of time to productive conversation of practical issues.

Before the move to remote learning, Professor Holbrook evaluated the students learning through a midterm and final exam along with three case studies. Her tests are largely multiple

choice to mimic the format of the ethics portion of the CPA Exam. For the case studies, students are required to read about an accounting or finance ethical issue and to write on those dilemmas in a professional manner so that they can practically apply what they learned. A fair amount of the students' grades is also based on participation in classroom discussions. All of the work being assessed by Dr. Holbrook, including the discussions, case studies, and tests, is relevant to what the students will use in their careers.

Drawback of the Current Ethics in Accounting Curriculum

Much of what Professor Holbrook expressed regarding the course was very positive; however, there was one notable trait that has not worked out as well as intended. Beyond the first unit of the course that explicitly addresses the ethical frameworks, students have not naturally utilized utilitarianism, deontology, or virtue ethics in classroom discussion without explicit instruction. This concern aligns with the earlier argument for emphasizing more readily transferable moral character development over dilemma analysis. Reasoning without emotional influence does not come as naturally as hot reasoning in personally involved situations, so keeping the use of the ethical frameworks will require a way of making them more natural.

Successes of the Current Ethics in Accounting Curriculum

With this class structure utilizing engaging topics and having upper-classmen in these courses, many of the conversations are very productive and offer a variety of opinions. Professor Holbrook expressed that many of the students are of junior or senior level, and they offer experiences that they encounter during their internships to relate to the analyzed scenarios. She also noted that the students are both highly competitive with each other and highly empathetic towards the subjects being discussed, which leads to a high amount of classroom participation. Although some dilemmas that the students analyze have a "right" solution, students are

encouraged to weigh the practicality of that choice and speak about what they actually could do in that scenario. One example Professor Holbrook gave of this was "eating time." According to Holbrook, the term "eating time" describes how accountants, or any workers, will often spend long hours working off the clock in order to finish projects in a timely manner. When asked about the ethicality of "eating time," her students flatly stated that this practice is wrong because not putting in work hours is not being honest to the amount of work being done. Professor Holbrook often counters this first idea by reminding the students that "eating time" is a standard practice for many accountants and not doing so could cause their employers to view them as inefficient. Then, students have the open-space to reevaluate their initial stances. Overall, this class has been very successful in encouraging conversations and acquainting accounting students with the myriad of dilemmas they may face.

Comparison to the CS Modules

Professor Holbrook's overall set up for this course is very similar to the basic structure laid out by Dr. Carter – introduce ethical frameworks as tools for examining ethical dilemmas and then apply those frameworks to relevant ethical dilemmas. The ethics in accounting approach differs because it is limited to one course as opposed to being spread out through the entirety of a student's undergraduate career. Additionally, as a class that is being used at Point Loma Nazarene University specifically as opposed to being available to the academic public, it has a unit addressing moral issues that are specific to being a Christian in a secular workplace. According to Professor Holbrook, unlike the current CS modules, once the ethical frameworks are addressed in the introduction section, they are not reexamined again. The ethics in computer science curriculum also includes analogies as a way of analyzing ethical dilemmas, while the

accounting course does not. The idea behind both of these curricula that each respective field requires practical, ethical thinkers has led to their similar approaches.

Part Four: Analysis & Application

Cognitive Assessment

From a cognitive viewpoint, the structure of these modules is very effective for giving the ethical frameworks as tools for analyzing the many different ethical dilemmas that software engineers may come across, and this is supported by the current response to the modules and similar approaches undertaken. Bloom's taxonomy of cognitive learning is often used in the field of education as a means of understanding teaching cognitive concepts within a series of levels. The revised taxonomy translates these levels to active verbs that progress from simply remembering information, to applying concepts, to creating ideas (Armstrong, 2010). As Dr. Michael Leih noted in an interview of his experience with the modules, the structure of the modules follows this approach well of defining the frameworks and ethical dilemmas first, then moving towards evaluating ethical dilemmas. Dr. Leih also noted how in the assessment of the students' understanding through questions on their final exam, most upper-division students understood and used the frameworks well. Additionally, students in an upper-division computer architecture course who had some experience with the modules were able to recall and explain the purpose of frameworks well without specified prior preparation. Due to maintaining students' confidentiality, the exact data for the students' test answers could not be distributed for this study. Although the earlier mentioned Harvard work lacks the cumulative nature of these modules by not having specific introduction modules and not keeping the same ethical frameworks throughout, the fact that this similar approach of adding related ethics material to

existing CS courses was used shows that other universities can see the value of this embedded, modular approach.

Timing

One prevailing drawback from the modules has been the amount of classroom time used on them. Although originally intended to be only ten to twenty minutes in class (Carter & Crockett, 2019), many, if not all, of the modules take more time. Again, this may be due to the professor's intention with the module; however, a way to limit the class time spent on the upper-division modules would be having more pre-class learning. Some of the modules, including the accessibility module and the professional ethics module, already have pre-class activities, which include reviewing the frameworks in groups and finding reliable sources about the module's subject. According to Dr. Leih, having activities done before class allows the students to struggle with the material on their own and have more meaningful conversations once they enter the classroom.

Moral Exemplars – Classroom Environment

As discussed in the moral psychology section, the exposure to and imitation of moral exemplars contributes to the adoption and growth of virtues (Leffel et al., 2014). The closest moral exemplars in the CS classrooms could be the professors, so it is important that those who teach the modules understand their purpose well and are passionate about the curriculum. In her book, *Ethics in the First Person: A Guide to Teaching and Learning Practical Ethics*, Deni Elliot elaborates that it is imperative in the moral classroom that teachers offer a positive experience when teaching morality (2006). If the modules are taught begrudgingly, it could be worse than not having them taught at all. It should be noted in the modules' documentation that their use should be determined by individual professors, rather than being required by departments.

Mindfulness

Dr. Leffel and Dr. Oakes Mueller reference practicing mindfulness as a way to increase moral emotions, such as compassion, and other researchers have recently promoted practicing mindfulness for software engineers in tech companies and schools. A 2016 study found that students regularly practicing mindfulness sessions had better problem-solving skills, demonstrated by creating significantly better UML diagrams than those in the control group (Bernárdez et al., 2016). Although this does not have an obvious fit into the current ethics modules, practicing mindfulness may still be studied more for training ethical engineers.

Application Module

One of the positive features of Professor Holbrook's ethics in accounting course is that the students had work experience to draw from during class discussions. Additionally, another recommendation that was previously listed from moral psychologists was to get practice in seeing and applying moral virtues. To further promote this practice in the CS ethics modules, a simple, open-ended module should be made for internship courses. This module should let students find a morally relevant event in their workspace and practice reflecting on it and writing about their experience. While this additional module might not directly offer the same course-relevant material as the other modules, it could still be an important culmination of the curriculum.

Reframing the Ethical Frameworks

While the moral intuitionist model disapproves of teaching moral enhancement through dilemma solving, the value of the modules' structure and methods can be seen through the students' responses and involvement. Professors who have used the modules have experienced the great classroom discussions that have stemmed from this material, and the relevance to each

course makes it easier for them to fit into their busy class schedules. The current modules give tools to analyze ethical dilemmas and a space to practice ethical deliberation.

All of the good that has come from the modules' structure with ethical frameworks does not mean that those frameworks cannot benefit from some simplification. In an assessment of an introduction to programming class following their use of the "Why Ethics" and "Virtue Ethics" modules, 49 students were given an ethical dilemma and asked to evaluate it using virtue ethics. Of those 49 students, 42.85% missed points on the question because four of them left the question blank (possibly due to time constraints) and the other sixteen students either did not use virtue ethics or failed to directly claim if the action was ethical or not. This misunderstanding of the frameworks was not reported with upper-division students. However, to help first-year students recall and understand the frameworks better and use a more self-based perspective, the author proposes associating key phrases with the introduction of each of the frameworks.

Virtue Ethics

The virtue ethics module starts with the students identifying which virtues resonate most with them, but loses this individualism once it transitions to analyzing ethical scenarios. By simply changing the wording of the question, this individualism can be kept and the student can have a simple way to remember how to use the framework. The original question is

> Choose one scenario, outside of those completed for you, where you believe that the main player acted unethically. List the virtues that were violated, and explain why the action violated that virtue or virtues.

By adding in a prompt for the students to fill in and repeat in other answers that says "because I am ____" or "because I value _____, this is un/ethical," (with the blank spaces being filled in with virtues) students can practice creating an autobiographical link to their moral identity in a

similar manner to how Lapsley suggests in his work (2014). Whereas answers to the original question can take an external view of saying, "because honesty is good, it is wrong to cheat," adding this prompt transforms the thinking to, "because I am honest, I will not cheat." The latter statement reflects more of the ideas of moral identity and is thus convicting if not carried out (Aquino & Reed, 2002). Including the prompt "because I am ___, this is un/ethical" not only ensures that students start their answers by using virtue ethics to directly evaluate the dilemma, but also would give room for them to elaborate on why that virtue is important to them and why it directly applies to the given scenario.

Drawbacks to Reframing

Putting some of the frameworks into a self-based perspective does lose some of the original intentions of giving students a way to see and rationalize other points of view. Although this prompt naturally works best for the virtue ethics framework, other short phrases can be used for the sake of summarizing and remembering the other frameworks. These phrases could be as simple as, "Because I follow _____, this choice is un/ethical" (with the blank space being a rule set). However, this reframing should give first-year students a simple tool for remembering the ethical frameworks with their limited exposure. Because the upper-division students have reportedly done better at demonstrating their understanding of the frameworks' applicability, these reframings should not be as necessary for them.

Summary of Recommendations

All of the given recommendations for the current ethics modules from this paper are summarized as follows:

- To maximize the quality of class time, more modules should have pre-class activities to reacquaint students with the frameworks and given them a view of the module's subject.

- It should be noted in the modules' "READ_ME" documentation that use of the modules should be determined by the person teaching them with the hope that the professor will act as a moral exemplar and to ensure that the modules are presented in a classroom environment that promotes ethical learning.
- In the introductory modules, frameworks may be presented with phrases similar to "Because I am," or "Because I follow" so that students will have a simple, identifying phrase to associate with each framework.
- An additional open-ended module should be added to an internship course so that students have practice identifying and evaluating their own morally-relevant situations.

Conclusion

One cannot split the rational mind of the engineer from the passionate mind of the individual. According to Lapsley:

> If one links moral functioning to our deeper human nature – to personality, to the self and its desires, passions, and inclinations, then one risks divorcing morality from its most prized possession, which is rationality. But if one emphasizes reason and judgment as the sole moral motives, and casts into darkness those features close to our bodily nature, then one risks divorcing morality from the person. The trick is to ground moral psychology on a realistic conception of the person but in such a way that the rational character of morality is not lost. (2014)

As demonstrated by the conversations they stimulate and their student interaction, these ethics modules currently succeed at providing students with an awareness of the many dilemmas in the world of technology. While more work can be done to foster the emotional side of moral

behavior and decision making, these modules already provide a solid foundation for building better engineers.

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