Academic Integrity among Engineering Undergraduates: Seven Years of Research by the E^3 Team

The E^3 Team (Exploring Ethical decision-making in Engineering) is a group of engineering educators and educational researchers who have worked collaboratively since 2000 to understand the underlying causes of academic dishonesty in engineering undergraduate populations. The team was especially motivated by decades of others' work showing that, when surveyed, engineering students were among those most likely to report frequently cheating. This paper summarizes some of the team's more important findings from three major studies that surveyed a total of 1300 engineering and humanities undergraduates at eleven institutions. The paper also describes the next phase of the team's research and presents implications of that work for engineering education.

Introduction

Academic dishonesty (i.e., cheating) is widespread in the United States. A 2006 report by the Josephson Institute for Ethics indicated that 60% of 34,000 students surveyed in high school admitted to cheating on an exam at least once in the previous year[35], and 35% did so two or more times. Academic dishonesty is also evident on college campuses, with upwards of 80% of undergraduates reporting that they have cheated at least once during college[8, 10, 41, 42, 55]. Although the percentage of undergraduate students who report having cheated during college has remained relatively consistent (from 82% in 1963[8] to 84% in 1993[42]), participation in several *specific* types of cheating has increased over thirty years. For instance, the percentage of students who admits to collaborating on assignments has increased from 11% to 49%, and the percentage who admits to copying on examinations has increased from 26% to 52%.

It has been well documented that the rate of undergraduate cheating differs by college major[4, 8, 9, 31, 33, 40, 44, 49, 52, 53], and for the E^3 Team, the pattern of cheating among *engineering* students is of particular interest. The findings in this regard are consistent, and they reflect those reported by McCabe[40]–the percentage of undergraduates who report engaging in any type of cheating is highest for those students enrolled in "vocationally-oriented majors such as business and engineering": business (91%), engineering (82%), social sciences (73%), and natural sciences (71%).

Over the past seven years, the E^3 Team has designed and completed several empirical studies to address its concerns about the high levels of cheating in engineering undergraduates. The work ranges from identifying factors that influence engineering students' decisions about cheating to analyzing the relationships between this decision and unethical behavior in the workplace. Major findings from these studies are presented in this paper.

The PACES-1 Study

The E^3 Team designed the first Perceptions and Attitudes about Cheating among Engineering Students (PACES-1) Study to investigate general issues related to undergraduate cheating. The team conducted an extensive review of literature on the subject and developed the PACES-1 Survey primarily based on the work of two researchers[16, 40]. It is a seven-page instrument that

includes 139 questions in seven parts. Part 1 addresses students' definition of cheating and the frequency with which they have engaged in cheating activities. Parts 2 through 5 investigate psychological and situational factors that might affect students' decision about cheating. Part 6 addresses deterrents to cheating and students' perception of their effectiveness. Finally, Part 7 addresses student demographics. The survey was administered in engineering and pre-engineering courses at eleven institutions in the United States, Puerto Rico, and Saudi Arabia, including large public universities, small private universities, and community colleges. 643 undergraduate students completed the survey.

Findings

The PACES-1 Study resulted in four main findings. First, *many factors that influence students' decisions about cheating vary by context (e.g., exam and homework cheating)*. The overall variance explained by a model of the frequency of exam cheating reached 36%, while the same estimate reached only 14% for homework cheating. The variance explained by individual factors of the models also differed by context. For instance, seniors were more likely to report cheating on exams than were other students, but this difference by college level was not evident in the context of homework cheating. In addition, past cheating in high school and being on scholarship both were strong predictors of self-reported cheating on exams but not on homework. Similarly, situational variables predicted exam cheating well but were not even significant in predicting homework cheating. This finding is consistent with differences in prevalence of cheating by context that have been reported by others[4, 8, 9, 17, 21, 34, 40, 43, 56, 57, 60] and with published classifications of cheating behaviors by context for teachers who deal with academic dishonesty[9, 38, 60].

A second major finding is that, *despite these differences, there are many common factors (primarily psychological factors) that influence students' decisions about cheating in both exam and homework contexts*. For example, a strong sense of moral obligation (described by Ajzen[2] as "personal feelings of … responsibility to perform, or refuse to perform, a certain behavior") and a propensity to experience shame (described by Tangney and Dearing[58] as a moral emotion that results from negative experiences and self-hatred) were unilateral deterrents to cheating across context. This emphasizes the importance of understanding how psychological constructs, such as moral obligation and shame, inform students' decisions about cheating.

Third, this study demonstrated that *there is a clear relationship between students' attitudes toward a behavior and their self-reported propensity to engage in that behavior*. For example, only 35% of the students who defined *permitting another student to look at your answer during a quiz or exam* as "cheating" admitted to engaging in that behavior at least once. On the other hand, 67% of those who defined it as "unethical but not cheating" and 78% of those who defined the behavior as "neither" admitted to doing it at least once. This trend is similar for other behaviors, and it suggests that students who have a more permissive attitude towards a behavior are, not surprisingly, more willing to engage in that behavior. This is consistent with work of Ajzen[1, 2] who proposes a model of the decision-making process in which "attitude toward behavior" plays an integral role in explaining the relationship between intention and action.

Finally, this research showed that *students often rationalize their cheating behavior using instructor-based neutralizations.* Respondents were presented with a list of twelve possible rationalization statements (e.g., "It is wrong to cheat if …"), and the top five statements with which students disagreed were all instructor-based neutralizations (in order, the instructor did an inadequate job of teaching the course, the instructor wrote unfair exams, the instructor did not grade fairly, the instructor assigned too much material, and the instructor didn't seem to care if I learned the material). This correlates well with students' belief that it is primarily the instructors' or the institution's responsibility to limit cheating and not the students'. This is significant because it indicates that an individual instructor can take steps to minimize cheating in his/her class. As such, practical pedagogical methods to help students avoid the pressure of cheating need to be identified and widely disseminated.

This research underscores the need to carefully consider context in issues related to cheating, and it suggests that the most successful deterrents to cheating may involve having instructors explain what cheating is, rather than focusing on what they can do to prevent it. This research also shows that attitude towards a behavior and moral obligation, both psychological constructs, influence actual behavior. As such, it supports the use of a theoretical model of the decision-making process and the resulting behavior to examine cheating, and it illustrates the need for a common model that is flexible enough to account for differences in context. Additional information about the PACES-1 Study, including detailed statistics and results, can be found in other reports published by the E^3 Team[12, 13, 14, 19, 27, 47].

The Work Experiences Study

Results from the PACES-1 Study revealed that high school cheating is a strong predictor of exam cheating in college, and this lead the E^3 Team to examine the connection between college cheating and unethical behavior in other settings. Others have shown that students who admit to cheating in college are more likely to admit to dishonesty in the workplace[45, 54], and because of the importance of engineering decisions to the public welfare, this finding especially raises serious concerns for *engineering* students. To investigate this phenomenon and to more deeply probe the factors that influence student decisions about engaging in unethical behavior in both the academic and professional settings, the team conducted the Work Experience Study (WES).

The E^3 Team designed WES to provide primarily qualitative data regarding engineering students' decision-making processes in instances in which they are tempted to engage in unethical behaviors in academic and professional settings. It is a thirteen-item questionnaire consisting of three sections. The first section contains questions related to background variables, including those that measure the extent to which respondents worked in the past year and the frequency with which they cheated in high school. The second and third sections include questions about decisions regarding ethical behavior in the college classroom and the workplace respectively. In each setting, respondents are asked to contemplate a specific instance in which they were tempted to behave unethically (i.e., cheat in the classroom or violate workplace policies), to describe any pressure(s) they felt to engage in the behavior and any hesitation(s) they felt not to engage in the behavior, and to describe the ultimate decision they made in this specific instance. Because the focus of this study is engineers in college and in the workplace, the sample included undergraduate engineering students at two technical private universities

where students either participated in an intensive cooperative education program or were non-traditional students working in engineering settings. 130 students who worked full time an average of 6.8 months during the previous academic year responded to the survey.

Findings

The three major findings of WES are presented here. First, consistent with the PACES-1 Study, this work confirmed that *participation in past unethical behavior may be a strong predictor of future participation in unethical behavior*. Here, students who reported a prior tendency to cheat in high school were more likely to report cheating in a specific college situation and to report violating workplace policies. Of those who reported *never* cheating in high school, almost 70% decided *not* to cheat in a specific instance in college, and 50% decided *not* to violate workplace policies. On the other hand, of those who reported *frequently* cheating in high school, less than 40% decided *not* to cheat in a specific instance in college, and less than 10% decided *not* to violate workplace policies. This suggests that individuals who have cheated in the past are more likely to cheat in the future. As such, to the extent that changing individuals' present behavior will have a lasting effect on their future behavior, then affecting individuals' behavior in one setting (i.e., college) could have a significant effect on the future behavior in another setting (i.e., workplace).

A second major finding of WES is that *there are common factors that influence students' decisions about engaging in unethical behaviors in the classroom and in the workplace*. Namely, common *pressures* in both settings include insufficient resources, importance of success, and projection of blame (i.e., the sentiment that others "deserved" the behavior); and common *hesitations* include moral obligation, conscience, and risk of detection or formal sanctions. This finding indicates that there are similarities in the decision-making process used by respondents in these two settings, and it is consistent with Nonis[45] who found that students who self-reported engaging in dishonest acts in college were more likely to report engaging in dishonest acts in the workplace. This also supports PACES-1 results in which moral obligation and shame were identified as unilateral deterrents to cheating across context.

Third, *the* context *in which the decision is made is very important regardless of setting*. In the academic setting, less than 15% of those who were tempted to cheat in an exam situation did, while more than 45% of those who were tempted to cheat on homework did. Similarly, in the professional setting, less than 55% of those who were tempted did falsify records, while more than 70% of the respondents who were tempted to improperly use company supplies did. Assuming that respondents randomly contemplated scenarios in which they did or did not ultimately engage in unethical behavior, then this data might represent the frequency with which the respondents succumbed to temptation. In the academic setting, this implies that some students may be more likely to justify cheating on homework than for exams, perhaps because the benefits of cheating outweigh the negative implications for homework but not for exams. Similar logic can be applied to the professional setting in comparing falsifying records and improperly using company supplies. This observation echoes results of the PACES-1 Study.

These results confirm that past unethical behavior can predict current participation in such behaviors and that similar factors may be involved in decisions about engaging in unethical

behavior in academic and in professional settings, implying that the decision-making process for college may well extend to the workplace. Results are also consistent with research that has shown that students who cheat in college are more likely to shoplift[6], cheat on income taxes[18], abuse harmful substances[7, 36], cheat in graduate and professional schooling[5], and engage in unethical work-place behavior[32, 45, 46, 54, 59]. Therefore, studying the decision-making processes that influence cheating among *undergraduate engineering students* and investigating the interventions designed to deter it could help to reduce unethical behaviors demonstrated by engineers in the workplace. Additional information about the WES, including detailed statistics and results, can be found in other reports published by the E^3 Team[11, 22, 23, 24, 25, 26, 28].

The PACES-2 Study

The E^3 Team engaged in the PACES-2 Study to develop and test a *theoretical model* of the decision-making process that students use when deciding whether to engage or not engage in unethical behavior in college and to investigate how this model differs in explaining cheating for engineering and humanities students. The team applied a modified version of Ajzen's Theory of Planned Behavior[2, 3] that includes the variables of Ajzen's original model (attitude toward behavior, subjective norm, perceived behavioral control, and intention) as well as measures of past behavior, demographics, behavioral context, moral obligation, and moral judgment (described by Kohlberg[37] as the process by which an individual reasons about moral issues when presented with a moral dilemma).

To validate the model, the team designed a two-part survey instrument. The first part of the instrument, the PACES-2 Survey, consists of appropriate demographic questions, items to assess the variables of the original Theory of Planned Behavior model, and items about self-reported college cheating. The survey also includes questions to address moral obligation, frequency of high school cheating, social desirability bias (measured by the Balanced Inventory of Desirable Responding (BIDR)[48]). Because previous work by the E^3 Team highlighted the importance of context, all questions (except demographic ones) are posed in two separate contexts, exams and homework.

The second part of the instrument, the DIT2, is a multiple-choice test that presents five moral dilemmas. Originally developed by Rest[50, 51], the test is based on Kohlberg's Theory of Moral Development[37], and it provides a score of how an individual reasons when faced with a moral dilemma. Respondents are asked to identify concepts important in resolving each of five dilemmas representing modern social problems, and a report is generated for every respondent that includes an individual moral judgment score for each of five dilemmas as well as an average moral judgment score. Respondents with higher scores have an understanding of justice that moves from egocentric to societal to principled, where what is considered to be fair or morally right serves larger communities, including strangers. The DIT2 has been shown to have good internal and test-retest reliability and has shown discriminate validity.

The instrument was pilot tested to develop reliable, internally-consistent scales from the PACES-2 Survey and to identify how the scales relate to scores generated by the DIT2. Because research has shown that students in humanities tend to self-report cheating at rates lower than students in engineering[8, 31, 40], the E^3 Team administered the instrument to first-year and senior-level

students in both the engineering and humanities disciplines. 527 undergraduates at three different institutions participated in the study.

Findings

Though data analysis is still underway, the PACES-2 Study has resulted in three major findings. First, *results not only corroborate reported differences in rates of cheating between engineering students and those from other disciplines, but they also show that these differences are independent of the number of opportunities an individual student has to cheat*. In the sample, the percentage of engineering students who reported cheating on a test "at least a few times they took tests during the previous term" is about twice that of humanities students (33% versus 18%). Similarly, when queried about cheating on homework, the percentage of engineering students who reporting cheating "at least a few times they worked on an assignment" is about twice that of humanities students (60% versus 36%).

A second major finding is that *differences in cheating rates of engineering and humanities students exist only in college, not in high school*. Both groups of students reported cheating in high school at statistically identical rates. This implies that the historically higher rates of cheating reported by engineering students are more likely a result of the engineering curricula or academic environment than any inherent difference between engineering students and students from other disciplines.

A third major finding is that *the PACES-2 Study confirms the use of the modified Theory of Planned Behavior for understanding why students cheat*. The model, which incorporates the variables of moral obligation, attitude toward cheating, perception of norms, and moral reasoning accurately predicted an individual's intention to cheat, and it did so independently of context. In particular, it explained 58% of the variance of *intention* to cheat for both the exam and homework context. Similarly, the model explained 39% and 27% of the variance in actual exam cheating and homework cheating, respectively. The model lacks additional contextual influences, though, that could further increase its ability to predict behavior. Additional information about the PACES-2 Study, including detailed statistics and results, can be found in other reports published by the E^3 Team[20, 29, 30, 39].

The SEED Study: Future Research

The E^3 Team is poised to use its findings to develop practical strategies to improve ethics instruction at the undergraduate level, in turn resulting in a more ethical engineering profession. With funding from the National Science Foundation, the E^3 Team has begun plans to conduct a national assessment of educational experiences and student context that positively influence the ethical development of engineering undergraduates in the United States.

Using its theoretical model, the team will study three components of ethical development (i.e., knowledge of ethics, ethical reasoning, and ethical behavior) in engineering undergraduates who have experienced various modes of ethical instruction in diverse learning environments. Results will provide a better understanding of how formal and informal curricular experiences affect ethical development, even when accounting for differences in student characteristics and

institutional culture. In particular, the team will conduct focus group interviews with faculty, students, and administrators to learn about formal and informal curricular experiences associated with ethics instruction and to determine the range of student characteristics and institutional culture that exist. The team will combine this information with variables of its model of ethical development to design the SEED (Student Engineering Ethical Development) Survey to assess the impact of educational experiences and student context. After pilot testing the survey, the team will administer the survey to more than 4,000 engineering undergraduates at all class levels at sixteen diverse institutions nationwide.

The team is confident that this analysis will ultimately identify activities in the formal and informal curriculum that have the most profound influence on the ethical development of current engineering students. Subsequent research will further elucidate the effects of these successful activities and will develop best practices for teaching ethical decision-making.

Implications

Within the engineering education community there is considerable agreement that developing engineering students' awareness of ethical issues is a critical necessity. Many new teaching materials and strategies have been developed to address this need, but rigorous analysis of the efficacy of these materials is lacking. Further, there is little understanding of both the way in which students develop ethically and the way in which that development can be enhanced. To address these issues the E^3 Team has applied a methodical and deliberate approach to understanding the ethical decision-making process of engineering undergraduates. To date the team has focused on defining and validating a model of this process in an effort to assess the effect of various factors on students' decisions about cheating. Future research will involve extending the model to address the developmental aspects of students' ethical decision-making.

Perhaps the most important finding from the team's research is that, while the context in which ethical decisions are made clearly plays an important role in the ultimate behavior of engineering undergraduates, many factors that influence behavior (such as moral obligation and shame) appear to act independently of context. This suggests that approaches designed to affect the ethical decision-making process in one setting could extend to other settings if they are based on common underlying factors. While the E^3 Team's current research does not yet indicate which such approaches might be most effective, results of the SEED Study will likely provide valuable insight in this regard for engineering educators.

Other findings that have more practical and immediate implications are that students' attitude toward a behavior is an important predictor of their propensity to engage in that behavior and that students frequently rationalize their behavior by blaming the teachers. This presents an opportunity for individual instructors to curtail cheating in their classrooms by making sincere efforts to improve teaching and to show concern for student learning.

One especially intriguing finding of this work is that undergraduates in engineering do cheat more frequently than do those in humanities, independent of the number of opportunities to cheat. Although the reasons for this difference are unclear, one possible explanation involves variations in the kinds of teaching practices and assessments used in the two disciplines.

Specifically, the traditional engineering focus on the application of knowledge (versus the development of critical thinking skills) and the quantitative nature of engineering exams and homework (as opposed to the qualitative nature of essays, reports, and projects in humanities) might create a culture in which academic dishonesty is seen as an effective means of succeeding in engineering. These ideas have practical implications in that emphasizing higher-order thinking skills by implementing teaching practices such as project-based learning and using assessment measures such as report writing and short answer assignments may be a useful classroom strategy to reduce cheating.

Seven years of research about academic integrity by the E^3 Team has resulted in many interesting findings and some practical strategies for reducing classroom cheating. However, much remains to be known about engineering students' decisions about cheating. Future work of the team will lead to research-based strategies for improving ethics instruction at the classroom level and will, in the long-term, result in a more ethical engineering profession.

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