

What Do First-year Engineers and Others Consider Cheating?

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Abstract—This paper reports student responses to a short survey presented within the first few weeks to a variety of first-term students including both engineers and non-engineers. Survey results for first-year engineering students from 2014 ($N_{Eng2014} = 85$) have previously been reported [1] and were included in this analysis. In 2015, an additional one hundred and seven engineering students ($N_{Eng2015} = 103$), thirty-eight nursing students ($N_{Nur} = 38$), and sixty-four biology students ($N_{Bio} = 63$) completed the same survey. The purpose of this survey was to build a dialog between faculty and students regarding ethical classroom behavior and to gain further insight into student attitudes regarding activities that may or may not be considered cheating. Students were anonymously asked to rank their level of agreement with eleven statements related to working with others on assignments, using solution materials for homework, and appropriate behavior for exams including the use of technology. After analysis indicated that the two engineering groups were not statistically different, the 2014 engineering group was combined with the 2015 engineering group. The results of these student surveys have been used to guide continuous improvement of the engineering program and will inform efforts to address ethical topics for future discussions campus-wide.

I. INTRODUCTION

A recent article in ASEE's Connections newsletter by Mary Lord [2] discussed cheating in engineering classrooms. Other researchers have similarly focused on various subgroups of students [3-9]. Based on anecdotal experience and a brief survey of the literature, engineering undergraduates are clearly not immune to the pressure to gain advantage via ethically gray means [10-12]. One motivation for this study was to provide a baseline for understanding first-year student preconceptions of academic integrity issues at Pitt-Johnstown so that discipline specific strategies to reduce cheating on campus could be improved.

II. BACKGROUND

The results of studies to both define cheating and to assess incidence rates [1, 13-18] have been reported with data collected across many disciplines and numerous institutions of various sizes and characteristics. The literature includes studies of engineering students [3, 6, 8, 9], nursing students [7, 19, 20], and natural science students [6, 13, 14]; however, most studies have not focused on early-career students whose

preconceptions may not have yet been influenced by college-level experiences.

As reported by McCabe [6], several studies [13-15] have indicated that students self-report higher cheating rates for more vocationally oriented majors such as business or engineering versus majors such as natural or social sciences. For many of these studies researchers used definitions of cheating taken from the literature or, as was done for this paper, by choosing typical behaviors that faculty might consider to be cheating. An underlying assumption to incident rate survey studies is that all respondents share a common understanding of the appropriateness of the behaviors presented to them. Higher cheating incidence rates across various groups imply either that characteristics of a group leads its members to be more likely to cheat or that members of a group with a higher incidence rate believes that a surveyed behavior is not cheating and thus leads them to make what they believe to be an ethical choice, perhaps in opposition to faculty perceptions [1, 5, 21]. There are several factors that contribute to students attitudes regarding what is and is not considered to be cheating. Among those factors are preconceptions related to academic integrity issues, college experiences such as peer behavior, environmental effects such as the presence of an institutional honor code, and formal ethics training or classroom discussion. Student attitudes evolve with experience to create the framework within which decisions to cheat or not are made. A purpose of this study was to better understanding differences in preconceptions among students from three different majors at Pitt-Johnstown and to compare those findings with incidence rates reported in the literature to identify opportunities to influence behavior and to facilitate communication and educational strategies to reduce cheating.

III. SURVEY DESCRIPTION

Eleven questions were presented to students as illustrated in TABLE I. Possible responses included Strongly Disagree (SD), Disagree (D), Neither Agree nor Disagree (N), Agree (A), Strongly Agree (SA), or Not Applicable (NA). Students were also permitted to leave individual questions blank but such responses were considered equivalent to an NA response. Due to institutional privacy requirements and the nature of the survey questions, no questions were asked that could be used to identify students and they were informed as

such. Questions were consistently worded such that SA and A responses would indicate activities that respondents considered cheating while D and SD responses indicated the opposite to minimize the possibility that students would accidentally misapply the scale. Questions were purposefully situationally vague meaning that students were not given details to enrich their interpretation since preconception attitudes were of interest. A reduced set of survey questions was chosen to maximize participation rates among both student respondents and faculty survey administrators with the specific eleven questions chosen to allow comparisons with previously collected responses [22]. Cheating incidence rates were not of interest for this study so students were not asked to self-report cheating activities; rather, questions covering preconceptions regarding a range of behaviors from relatively innocuous to what other researchers have labeled “serious examination cheating” and/or “serious written cheating” [6] were included for both in-class and out-of-class activities.

TABLE I. SURVEY QUESTIONS AS POSED TO STUDENTS. ALONG WITH NA RESPONSES, UNANSWERED QUESTIONS WERE EXCLUDED FROM ANALYSIS. HIGHLIGHTED QUESTIONS WERE NOT CONSIDERED CHEATING BY MOST STUDENTS, REGARDLESS OF DISCIPLINE.

Q1	Working on homework with another person is cheating.
Q2	Copying homework solutions from another student is cheating.
Q3	Copying from an online solution manual to solve homework problems is cheating.
Q4	Asking other students questions about homework problems outside of class is cheating.
Q5	Asking the instructor questions about homework problems outside of class is cheating.
Q6	Looking at another person’s test to help you solve a problem during an exam is cheating.
Q7	Allowing another student to look at your test during an exam is cheating.
Q8	Sending text messages during an exam, even if they do not concern the exam, is cheating.
Q9	Using your phone to access online materials or solutions during an exam is cheating.
Q10	Using a programmable calculator to store potential test data to be accessed during an exam is cheating.
Q11	Emailing your finished assignment to another student to help them finish their assignment is cheating.

Four groups of students were polled using the survey. All groups were first-year students with no prior programmatic ethics instruction. Two sets of engineering students, one set from the fall of 2014 and the other from the fall of 2015, were surveyed. The 2014 set included eighty-five students ($N_{Eng2014} = 85$) while the 2015 set included 103 students ($N_{Eng2015} = 103$). Engineering student classroom surveys were administered to different sections of the same course and no students who repeated the course were included in the 2015 set. One nursing faculty member administered the survey to thirty-eight nursing students ($N_{Nur} = 38$) who had just begun the program in 2015 and one biology faculty member collected sixty-three survey responses from first-

year biology students ($N_{Bio} = 63$) also in 2015. Surveys were either administered during regular class meetings or via an online portal typically used for homework submissions. The response rates for engineering and nursing students were well over 90% while biology students had the lowest participation rate at approximately 80% all of which are well-above typical survey response rates as reported in the literature.

Survey responses were accumulated using JMP Pro 12.1.0 and analyzed by recoding the categorical responses to ordinal responses such that SA = 1, A = 2, N = 3, D = 4, and SD = 5. The validity of this recoding approach has been debated extensively in the literature [23-30] due to potential inconsistent or unclear assumptions regarding the relationship between response categories and respondent intentions. However, since this survey was only intended to better understand and compare attitudes of similarly-aged/experienced first-year college students, the linear assumption for weighting response categories seemed a minor potential source of error given the assumption that all responses were from a similar population of students, all of whom were likely to treat the survey categories in a similar fashion. The numeric scale also provided data that could be more easily examined for insight into differences among student-types. Comparisons among groups were performed using JMP’s Categorical Response Analysis tool with a statistical significance level of $\alpha = 0.05$ set a-priori. There were no-statistical differences found for any question between the 2014 and 2015 engineering student groups and further Rater Agreement analysis made it clear that these two groups could be and thus were combined for all further analysis. The finding that first-year engineering students appeared to respond consistently from one year to the next further validated the recoding assumption and, especially given the relatively large numbers of engineering students surveyed, indicated that any between-student group differences would likely not be due to year-to-year changes in the underlying student population.

Average responses between 1 and 2.5 were interpreted to indicate that an activity was considered to be cheating, average responses between 2.5 and 3.5 were likely not consistently viewed as cheating, and average responses between 3.5 and 5 indicated the behavior was not considered to be cheating). To gain insight into the range of student responses about the mean, especially for responses with averages in the 2.5 to 3.5 range, the standard deviation of responses was also examined.

IV. RESULTS AND DISCUSSION

As summarized in and graphically illustrated in and , regardless of student-type, responses to Q1, Q4, and Q5 as well as Q2, Q6, Q7, Q9, and Q10 were qualitatively similar: all student-types agreed that certain activities either were or were not cheating, even when average scores were statistically different from each other. For example, although

biology student responses to Q1 were statistically different from both engineering and nursing students (they were slightly more likely to consider the activity cheating), the mean response values for all student types indicated that working with another person on homework was considered to be an acceptable behavior.

TABLE II. NUMBER OF RESPONSES (N), MEAN VALUES AND STANDARD DEVIATIONS FOR RESPONSES TO QUESTIONS BY STUDENT TYPE. QUESTION RESPONSES WERE RANKED SEQUENTIALLY FROM 1=SA (CHEATING) TO 5=SD (NOT CHEATING) TO CONVERT FROM CATEGORICAL TO ORDINAL RESPONSES. SIGNIFICANT DIFFERENCES AMONG STUDENT GROUPS IDENTIFIED USING $\alpha = 0.05$.

	A) Engineering			B) Nursing			C) Biology			Significance		
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	A	B	C
Q1	188	4.33	0.74	38	4.45	0.69	63	4.00	1.06	C	C	A,B
Q2	188	1.72	0.70	38	2.03	0.59	63	1.44	0.53	B,C	A,C	A,B
Q3	188	2.15	0.93	38	2.89	1.03	63	1.73	0.85	B,C	A,C	A,B
Q4	186	4.55	0.60	38	4.68	0.47	63	4.35	0.81	C	C	A,B
Q5	185	4.81	0.55	38	4.92	0.27	61	4.82	0.39			
Q6	187	1.18	0.40	38	1.21	0.47	63	1.13	0.34			
Q7	187	1.33	0.54	38	1.42	0.64	62	1.19	0.51		C	B
Q8	184	2.63	1.14	38	2.76	1.15	62	1.85	0.99	C	C	A,B
Q9	188	1.28	0.46	38	1.24	0.71	63	1.12	0.34	C		A
Q10	188	1.77	0.90	38	1.71	0.87	63	1.35	0.63	C	C	A,B
Q11	187	1.98	0.84	38	2.58	1.00	63	1.60	0.77	B,C	A,C	A,B

Other activities that respondents indicated were likely not cheating included asking other students about homework problems outside of class (Q4) (again, biology students were slightly less accepting than other groups) and asking the instructor questions about homework problems outside of class (Q5). Conversely, copying homework solutions from another student (Q2), looking at another person's test (Q6), allowing another student to look at one's test (Q7), using one's phone to access online materials or solutions during an exam (Q9), and using a programmable calculator to store potential test data to be accessed during an exam (Q10) were universally considered to be cheating. Significant differences were again found among student types for some of these questions, but those differences were differences without distinction. Students indicated that emailing a finished assignment to another student to help them finish their assignment (Q11) was cheating but nursing students were significantly less convinced. If one were to take these responses at face value it would appear that students believe that talking about homework with anyone, including the professor, is acceptable while using another's work is generally unacceptable. Research by McCabe [31] suggests students are more likely to cheat on homework (40% admitting to working with others on homework) because they either don't consider such activity cheating (70%) or because they consider such cheating to be minor which seems to agree with student responses to Q1.

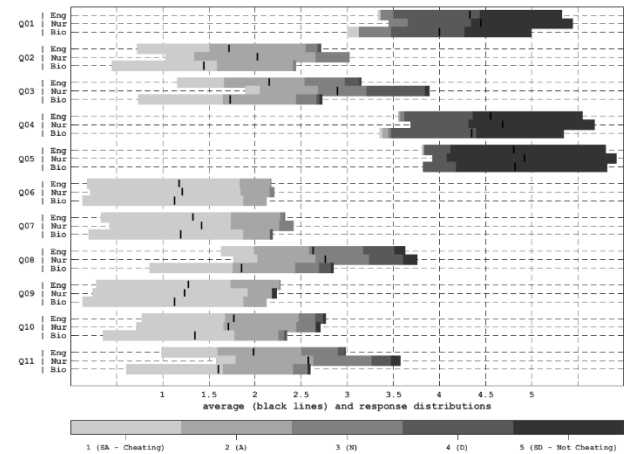


FIGURE 1. RESPONSES TO QUESTIONS 1-11, CATEGORIZED BY STUDENT TYPE. SHADED AREA LENGTHS ARE PROPORTIONAL TO THE PERCENTAGE OF EACH RESPONSE LEVEL. BARS ARE CENTERED HORIZONTALLY AT MEAN VALUES AS ILLUSTRATED BY SHORT VERTICAL BLACK LINES.

As illustrated in and perhaps even more clearly in , biology students responded that the presented behaviors were cheating with an average response lower than both other groups for all but Q5. For Q5 their average response was still lower than nursing students and, were it not for one hapless engineering student who responded that it was cheating to ask their professor questions about homework problems outside of class, biology student responses would likely have been the lowest on that question as well. Conversely, although nursing and engineering student response were statistically similar for all but Q2, Q3, and Q11, nursing students responses appeared to be consistently higher than other groups for all questions except Q9 and Q10 for which they were a close second to engineering students. Since Q10 asks whether it is cheating to store data on a programmable calculator, one wonders if the question is relevant for nursing students that they may have limited need for programmable calculators in their coursework which could affect their responses to that question.

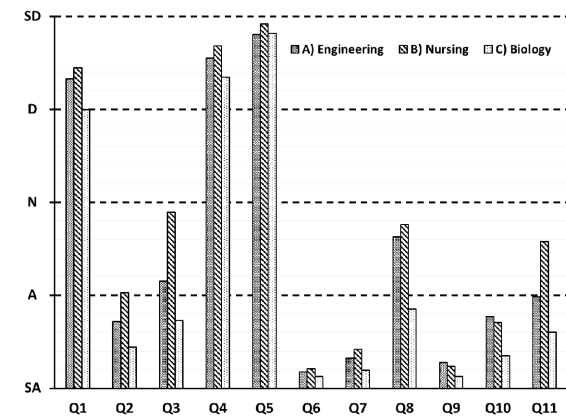


FIGURE 2. AVERAGE RESPONSES TO QUESTIONS 1-11 BY STUDENT TYPE.

The obvious question raised by the results of this study is “why would these three groups of similarly-aged students have differing opinions regarding what is and is not considered cheating?” The possibility exists that there was/is something inherently different about how these groups of students completed the survey. The engineering and biology students all completed the survey via an online portal to an electronic copy of the questions with radio buttons for the responses. The nursing students completed paper copies of the exact same survey with questions and responses exactly matching the on-screen analogs including images of radio buttons for responses. The font size and text field dimensions matched as well.

Another possibility is that there is something about nursing, biology, and/or engineering students that predisposes them to view contentious behaviors in a slightly different manner. One such trait might be the gender [14, 32, 33] of the respondents. The percentage of female engineering students has historically been lower than in many other fields (19.9% female undergraduates in 2014 according to ASEE [34]) and the percentage of male students in nursing has historically been low as well (15% depending on the nursing program according to the National Nursing League, 2014 [35]). In 2009, according to the NSF the percentage of females studying biology was roughly 60% [36]. Although progress toward attracting a more diverse collection of students to those fields of study is being made, historic trends persist. For the classes surveyed, the percentage of female engineering, nursing and general biology students was 9-10%, 87%, and 67% respectively. Unfortunately, because survey responses were anonymized, it is not possible to further quantify gender-specific response rates. Therefore, any conclusions that survey responses were influenced by gender would be conjecture based on the underlying assumption that representative percentages by gender participated in the survey. However, if survey responses could be explained by gender, one would expect that engineering students would be at one extreme while nursing students would be at the opposite which was not the case. Rather, nursing and engineering students were statistically similar on all but three questions; Q2, Q3 and Q11. For Q2 both groups qualitatively considered copying homework solutions for another student to be cheating while on Q3 and Q11 the two groups did not agree.

The biology student group presented statistically different responses to seven questions (questions 1, 2, 3, 4, 8, 10 and 11) compared to both nursing and engineering as well as a statistically different response to Q7 when compared to nursing students and a statistically different response to Q9 when compared to engineering students. However, statistical significance does not tell the whole story. Qualitatively, biology student responses were similar to engineering student responses for all but Q8 and nursing student responses were qualitatively similar to engineering student responses for all but Q3 and Q11. These three statistical and qualitative responses differences merit further discussion.

A. Question 3

Nursing student responses did not indicate a strong conviction that copying from an online solution manual to solve homework problems (Q3) was cheating (mean response of 2.89) while engineering students did (mean response of 2.15) and biology students dramatically more-so (mean response of 1.73). The standard deviation of responses for that question indicate that biology students were in better agreement than the other student groups as well ($StdDev_{Bio} = 0.85$ versus $StdDev_{Eng} = 0.93$ and $StdDev_{Nur} = 1.03$) with nursing student responses including several more D and several fewer SA responses than others. Copying homework solutions from online solutions manuals/sources has been reported as being viewed as acceptable by many students [3] with almost all realizing that copying homework is cheating, yet more than half will have done so at least once per term. Ellaway [4] communicated that students attempt to apply a strategic approach to maximizing gain while minimizing effort – something that most educators have likely seen in their classrooms. Perhaps the range of responses to this question indicate that students have already begun to rationalize their behavior? This survey was taken by first year students, early in the fall term with both biology and engineering students indicating an understanding that this is unethical. Without guidance, it is likely that, as these students progress through higher level courses with more demanding academic requirements [37], many will change their perspective to more closely match the neutral average response from the nursing group to maximize the return on their time investment. It is unclear why first-term nursing students might already have that different perspective.

B. Question 8

Sending text messages during an exam, even those not related to the exam (Q8), was considered to be cheating by biology students (mean response of 1.85) with a much larger percentage of SA responses than the other groups. Engineering and nursing students were less likely to agree (mean responses of 2.63 and 2.76 respectively) that Q8 presented a clear case of cheating with widely ranging responses as indicated by the highest standard deviations for this question for both of these students groups ($StdDev_{Eng} = 1.14$ and $StdDev_{Nur} = 1.15$). This wide range of responses suggests moral ambiguity which could be a source of conflict between what some students consider acceptable and what professors typically prohibit as previously discussed [1, 9, 21]. It is unclear why more biology students would believe that this is cheating. Students have become accustomed to, some to the point of addiction, being continuously connected to their social networks. According to Roberts et al. [38] as summarized by Lord [2], student addiction to cellphone use is a serious issue - as high as 60% according to one non-scientific online survey [39].

C. Question 11

Finally, emailing a finished assignment to another student to help them finish their assignment (Q11) received scores

following the same pattern as Q3 – nursing students were not as convinced that the activity was cheating (average response of 2.58) while engineers were (average response of 1.98) and biology students were even more-so (average response 1.60). The continuum of responses () indicate that nursing students were less likely to rank their opinion as SA (1) than the other two groups which shifted their average higher. If this response indicated a different degree of empathy that nursing students have for their classmates, one would expect to see a similar response for Q7 but that was not the case.

V. CONCLUSION

This survey provides a starting point for a dialog with incoming students about ethical behavior which has been suggested to be one positive method to reduce cheating [40, 41] and has expanded that dialog to faculty members from across the Pitt-Johnstown campus. As suggested by Lord [2], Choi [12], and others, by talking about expectations early, long-lasting boundaries can be set. The discussion spurred by this survey dovetails nicely with a chapter on engineering ethics from a recently adopted textbook for the first-year engineering course from which students were surveyed. This book chapter includes sections related to ethical decision making, plagiarism, the Code of Ethics for Engineers (via the National Society of Professional Engineers), specifically the Engineer's Creed and the Fundamental Canons of the Code (<http://www.nspe.org/resources/ethics/code-ethics>), as well as numerous in-class discussion activities. In addition, by sharing the survey and resulting data with faculty members from across divisions, a common understanding of ethical issues has begun to be more widely discussed.

The survey obviously provided insight into student attitudes that will inform future efforts to guide students toward appropriate behaviors moving forward. Specifically, based on the survey results (and research done to prepare this manuscript), additional topics for discussion have been identified including student attitudes about the use of cell-phones in the classroom and nuances related to the use of on-line resources supporting homework and exam activities. In addition, the results of this survey provide a clearer understanding of student preconceptions resulting from their pre-college experiences which can help faculty tailor discussions and guidelines, especially when student attitudes and faculty opinions diverge. It is hoped that in addition to continuing to administer this survey to first-year students in years to come, this same survey will be administered to upper class students to assess how attitudes change throughout the educational experience. Continuing to administer the survey will provide data to guide curriculum modifications to help students graduate with a strong professional ethical foundation and should also help to keep the conversation fresh and ongoing such that academic integrity remains an integral component of a Pitt-Johnstown education.

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