# ETHICS IN ENGINEERING EDUCATION

**Dr. Steve Dusseau**

*Indiana Institute of Technology, Fort Wayne, Indiana; Email: spdusseau@indianatech.edu*

## 1. ABSTRACT

Assessment data from internal and external stakeholders show that professional ethics is one of the top six desirable general education outcomes for graduates of Indiana Tech. A pilot study was conducted to determine the current level of professional ethics among traditional and adult learners in an engineering program. Statistical tools were used to explore the similarities and differences in ethical perceptions among the sample groups. The survey included an analysis of the students' perceptions of themselves and others in nineteen different situations. The survey and subsequent release of results allowed for on-going engagement of engineering students in discussions regarding professional ethics.

## 2. LITERATURE REVIEW

Research conducted to compare the ethical differences between accounting majors versus business majors found that there were no significant differences (Atlow and Ulrich, 1980). However, one study determined that accountants did score lower than their business student peers (Fulmer and Cargile, 1987). When compared to other majors, business students have been found to score lower than other majors (Hawkins and Cocanougher, 1972; Goodman and Crawford, 1974; Newstrom and Ruch, 1976; Shuptrine, 1979).

More specific to this research, a study of business students versus engineering students was conducted and found that there were differences between the two sample groups (O 'Clock and Okleshen, 1993). Additionally, the self-versus-others difference (perceptual gap) was noted by previous research (Baumhart, 1961; Newstrom and Ruch, 1975; Ferrell, 1978).

This study builds upon former research by determining the ethical differences between engineering students in two different age groups. In addition, the perceptual gap is quantified.

## 3. METHODOLOGY

An ethics survey (Jaunch, et. al., 1986) was given to 29 traditional-aged ("day") students and 24 adult ("evening") learners in the same Industrial and Manufacturing Engineering program. The survey presented nineteen statements of behavior. Students indicated the frequency with which they would engage in the behavior (labeled "*self*"). In addition, the students specified the number that best described how others they knew would behave (labeled "*others*"). The following scale was used:

1 = always
2 = often
3 = about half the time
4 = seldom
5 = never

This methodology allowed for the analysis of several components:

- Student responses as each group measured their own behavior for each question. Both day and evening student means were calculated. This topic is labeled as *self* and is the content of section 4.1
- Student responses as each group considered other people's behavior for each question. Both day and evening student means were calculated. This topic is labeled as *others* and is the subject of section 4.2.
- The difference between student responses for *self* and *others* for each question. These differences are labeled "S-O gap" (*self* mean score minus *others* mean score). An S-O gap is determined for day and evening students separately. This is the content of section 4.3.
- The difference between day student responses for *self* and evening student responses for *self*. These differences are labeled "S-S gap" (day *self* mean score minus evening *self* mean score). This is the subject of section 4.4
- The difference between day student responses for *others* and evening student responses for *others*. These differences are labeled "O-O gap" (day *others* mean score minus evening *others* mean score). This is the content of section 4.5.

From a reliability standpoint, the instrument was found to have "temporal stability" by giving the survey to the same group of students twice in one week. A two-sample t-test showed that there was not a statistical difference between the means of the two groups (day *self* to evening *self* p-value = 0.557; day *others* to evening *others* p-value = 0.463).

The survey questions are below:

1. Blaming an innocent person or a computer for errors
2. Passing on information that was told in confidence
3. Falsifying quality reports
4. Claiming credit for someone else's work
5. Padding an expense account
6. Taking home office supplies for personal use
7. Accepting favors in exchange for preferred treatment
8. Giving favors in exchange for preferred treatment
9. Asking a person to violate company rules
10. Calling in sick to take a day off
11. Hiding errors
12. Taking longer than necessary to do the job
13. Doing personal business on company time
14. Taking a longer lunch hour without approval
15. Seeing a violation and not reporting it
16. Overlooking boss's error to prove loyalty
17. Asking someone to lie about one's whereabouts
18. Telling co-workers that one is going somewhere but actually going somewhere else
19. Not obtaining permission to use company information/materials for a personal job portfolio

## 4. FINDINGS

Using a two-sample t-test, the following general results were determined for the means of each question:

- Overall engineering *self* versus overall engineering *others* are not statistically similar (p-value = 0.000). Therefore, engineers in this study viewed themselves as ethically different compared to others they know.
- Day engineering *self* versus evening engineering *self* are statistically similar (p-value = 0.637). In other words, the two groups view themselves the same.
- Day engineering *others* versus evening engineering *others* are not statistically similar (p-value = 0.004). Hence, the two groups view other people's ethical level differently.

*4.1 Analysis of Self*

Figure 1 is a bar chart which illustrates the descending order of scores for the day students when they considered their own ethical behavior.

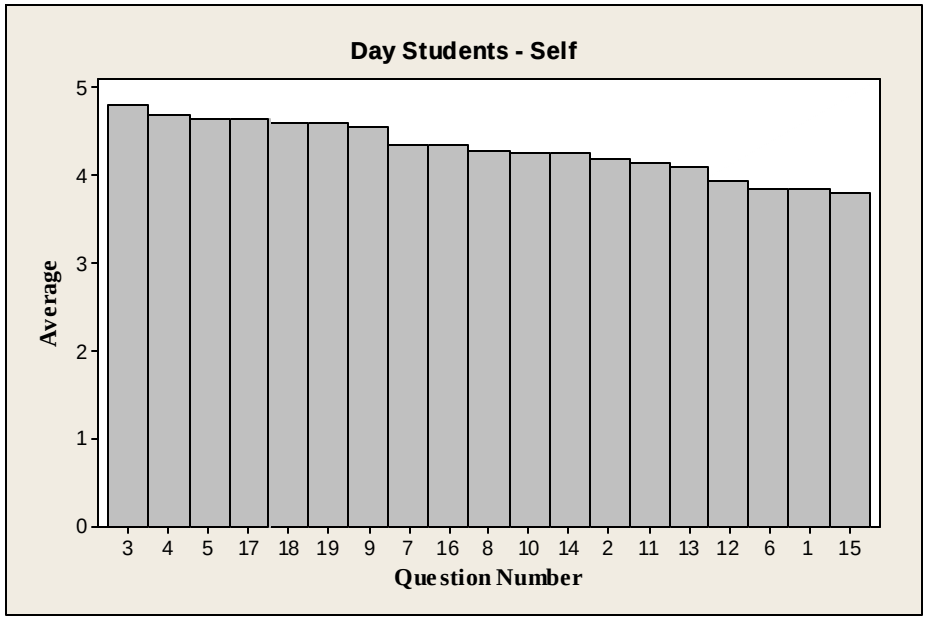


Figure 1: Bar chart of day student responses for *self*

Likewise, figure 2 shows the responses from evening students when considering their own ethical reaction.

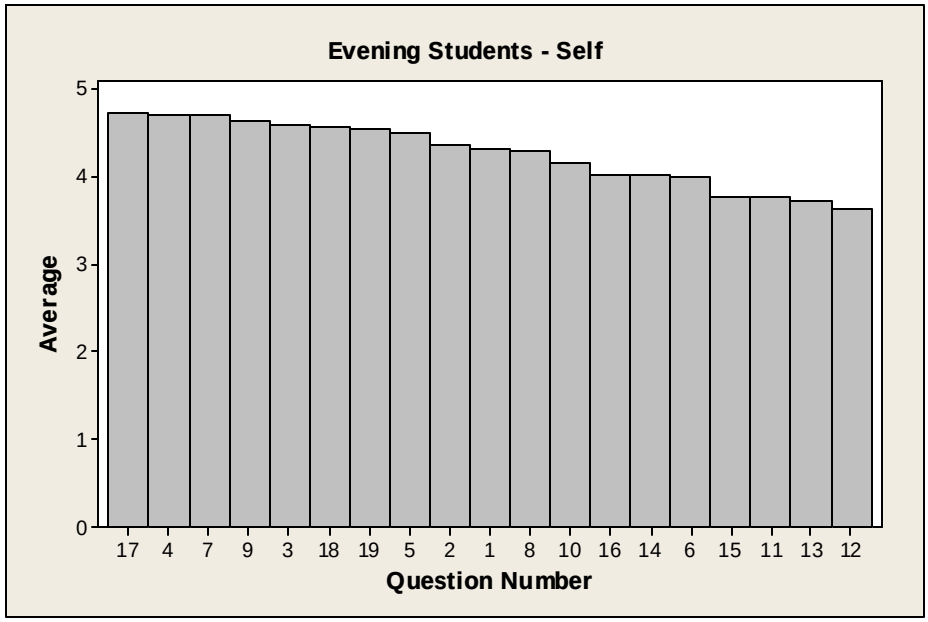


Figure 2: Bar chart of evening student responses for *self*

Table 1 summarizes the three highest and lowest average responses for day and evening students when considering their own ethical behavior.

Table 1: Highest and lowest mean scores for self

| Results | Question Number (mean score) | | |
|---|---|---|---|
| Day students - self, three highest scores | 3 (4.80) | 4 (4.70) | 5 (4.65) |
| Evening students - self, three highest scores | 17 (4.73) | 4 (4.69) | 7 (4.69) |
| Day students - self, three lowest scores | 6 (3.85) | 1 (3.85) | 15 (3.80) |
| Evening students - self, three lowest scores | 11 (3.76) | 13 (3.73) | 12 (3.63) |

The mean score for day students was 4.31 and the mean score for evening students was 4.26 on a five-point scale. Table 1 illustrates that there is only one question that was similarly ranked in the top or bottom three. Question 4 (claiming credit for someone else's work) was considered second highest by both the day and evening students.

*4.2 Analysis of Others*

Figure 3 is a bar chart illustrating scores for the day students when they considered other people's ethical behavior.

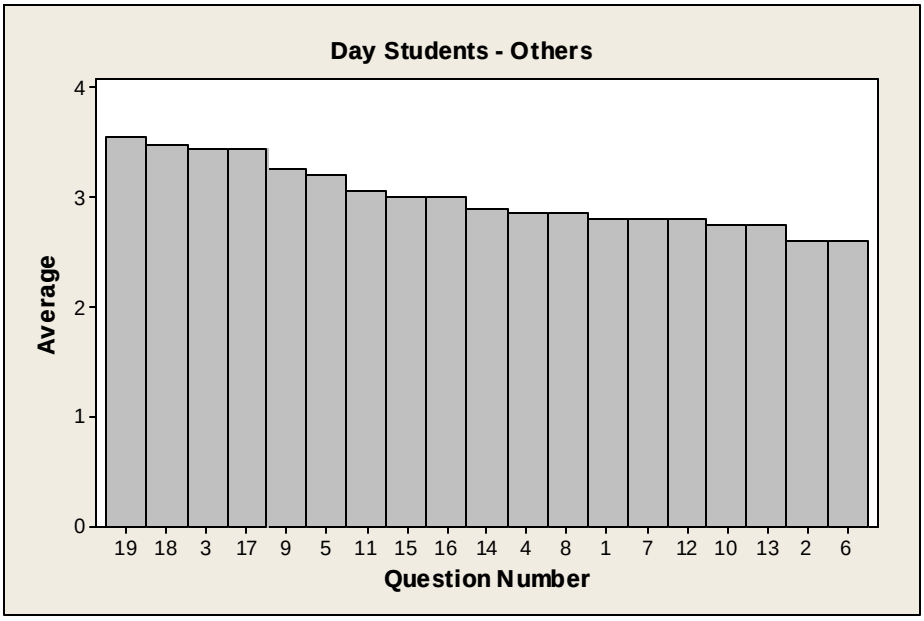


Figure 3: Bar chart of day student responses for *others*

Comparatively, figure 4 illustrates the scores for evening students as they consider other people's responses.

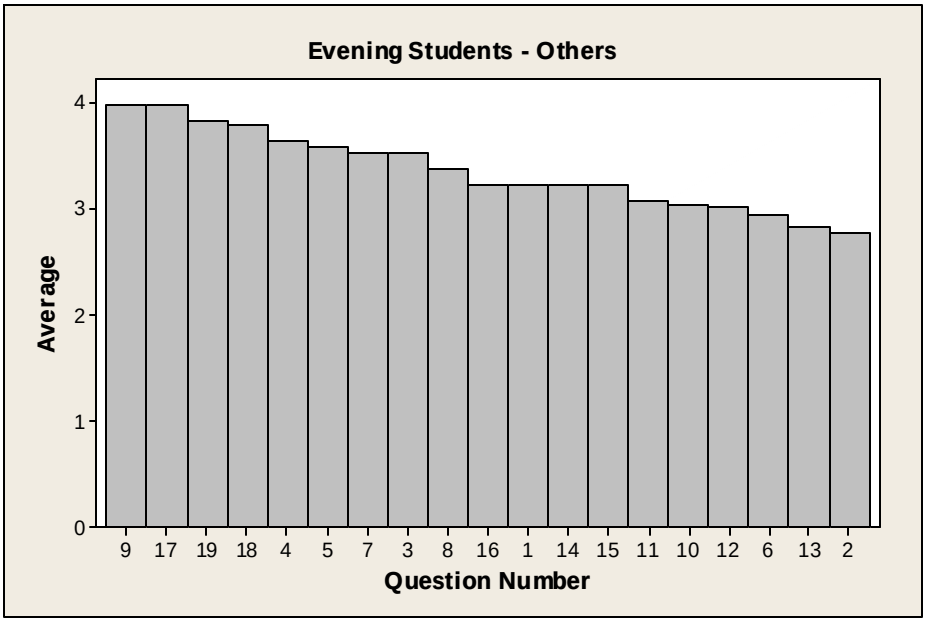


Figure 4: Bar chart of evening student responses for *others*

Table 2 summarizes the three highest and lowest average responses for day and evening students when considering other people's ethical behavior.

Table 2: Highest and lowest mean scores for others

| **Results** | **Question Number (mean score)** | | |
|---|---|---|---|
| Day students - others, three highest scores | 19 (3.55) | 18 (3.48) | 3 (3.45) |
| Evening students - others, three highest scores | 9 (3.98) | 17 (3.96) | 19 (3.82) |
| Day students - others, three lowest scores | 13 (2.75) | 2 (2.60) | 6 (2.60) |
| Evening students - others, three lowest scores | 6 (2.95) | 13 (2.82) | 2 (2.76) |

The mean score for day students was 3.01 and the mean score for evening students was 3.35 on a five-point scale. Table 2 illustrates that only question 19 (not obtaining permission to use company information/materials for a personal job portfolio) was ranked in the top three by both groups. This shows that both groups believe that people they know are less likely to engage in that behavior than many of the other activities in the list.

However, both groups had questions 2 (passing on information that was told in confidence), 6 (taking home office supplies for personal use), and 13 (doing personal business on company time) ranked in the bottom three. Given the mean scores less than 3.0, this can be interpreted that both groups believe other people engage in those three activities over half the time.

*4.3 Gap Analysis of Self to Others*

Table 3 summarizes the largest and smallest difference when students consider themselves and others with respect to each question. The table includes day and evening data.

Table 3: Self (S) to others (O) gaps

| Results | Question Number (mean score) | | |
|---|---|---|---|
| Day students - three biggest S-O gaps | 4 (1.85) | 2 (1.60) | 7 (1.55) |
| Evening students - three biggest S-O gaps | 2 (1.59) | 7 (1.18) | 10 (1.10) |
| Day students - three smallest S-O gaps | 1 (1.05) | 19 (1.05) | 15 (0.80) |
| Evening students - three smallest S-O gaps | 9 (0.65) | 12 (0.61) | 15 (0.56) |

Table 3 indicates that both groups see their ethical behavior for questions 2 (passing on information that was told in confidence) and 7 (accepting favors in exchange for preferred treatment) as the most different when compared to others they know. In addition, only question 15 (seeing a violation and not reporting it) ranked as the closest to their own behavior for both groups.

Another significant finding is that out of 53 students who answered the survey, only one student rated themselves lower on average than others. Moreover, the average *self* to *others* difference is 1.07. To state it another way, all students thought they were 1.07 on a 5-point scale (21%) more ethical than everyone else they knew. Splitting this data out for the two sample groups, day students perceived themselves 1.31 (26%) more ethical than others they knew. Likewise, the evening students perceived themselves 0.91 higher (18%).

*4.4 Gap Analysis of Day Student Self to Evening Student Self*

Table 4 summarizes the largest and smallest difference between day and evening students when comparing ethical responses for themselves on each question.

Table 4: Day vs. evening self-to-self gaps*

| Results | Question Number (mean score) | | |
|---|---|---|---|
| Day to Evening students - three biggest S-S gaps | 1 (-0.46) | 11 (0.39) | 13 (0.37) |
| Day to Evening students - three smallest S-S gaps | 15 (0.03) | 4 (0.01) | 8 (0.00) |

* Absolute values were taken for ranking purposes

Table 4 shows that there are not any similarities in the question numbers for the biggest and smallest gap for day and evening students.

*4.5 Gap Analysis of Day Student Others to Evening Student Others*

Table 5 summarizes the largest and smallest difference between day and evening students when comparing ethical responses for others on each question.

Table 5: Day vs. evening others-to-others gaps*

| Results | Question Number (mean score) | | |
|---|---|---|---|
| Day to Evening students - three biggest O-O gaps | 4 (-0.78) | 9 (-0.73) | 7 (-0.71) |
| Day to Evening students - three smallest O-O gaps | 13 (-0.07) | 3 (-0.06) | 11 (-0.01) |

* Absolute values were taken for ranking purposes

Table 5 shows that there are not any similarities in the question numbers for the biggest and smallest gaps for day and evening students. However, one interesting point is that the evening students consistently saw others as more ethical than the day students did. This is seen in the negative numbers since the gap was calculated as (day mean score) – (evening mean score).

By comparing results in tables 4 and 5, additional observations can be made. First, questions 11 (hiding errors) and 13 (doing personal business on company time) yield very large S-S gaps and very small O-O gaps. In other words, the largest difference in day *self* and evening *self* also produces the smallest day *others* to evening *others* in questions 11 and 13.

Conversely, question 4 (claiming credit for someone else's work) produces a very small S-S gap and a very large O-O gap. To clarify, question 4 produces a small difference in day *self* and evening *self*, but yields a large difference in day *others* to evening *others*.

## 5. SUMMARY

The research presented in this paper shows the similarities and differences of ethical perceptions among day and evening students. Both groups see themselves at about the same ethical level. Also, with only one exception, there isn't much similarity when considering which questions they see themselves scoring highest and lowest among the nineteen situations.

While each group differs in what situations others are most ethical in, they agree on which situations others behave most unethically. There are several situations that both groups see others as acting unethically more than half the time.

There were several common questions ranked highest among day and evening students when considering the largest gap between how students saw themselves and others in each situation. Likewise, there was only one common question when the two groups considered the smallest gap between how they saw themselves and how others behaved in the situations. In addition, all but one student saw themselves as more ethical than everyone else (21% on average); regardless of the situation.

When considering their own behavior, there were not any similarities in the question numbers for the biggest and smallest gap for day and evening students. Likewise, there were not any

common questions when ranked for gap size when the two groups considered how other people behaved. In addition, evening students see others as being more ethical than day students do.

There were some questions that yielded a very large gap when day and evening students considered their own ethical behavior and yielded a very small gap when the same groups evaluated other people's responses given the same situation. Also, the converse was seen to be true with one situation on the survey.

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