

Work in Progress – Assessment of an Engineering Ethics Video: *Incident at Morales*

Michael C. Loui

Department of Electrical and Computer Engineering, and Coordinated Science Laboratory,
University of Illinois at Urbana-Champaign, Urbana, IL 61801 loui@uiuc.edu

Abstract - A new engineering ethics video, *Incident at Morales*, was assessed with two different instruments: the standard Defining Issues Test and a short ad hoc survey. According to pretests and posttests with the Defining Issues Test, viewers of the video increased the sophistication of their moral reasoning skills. According to the survey, viewers changed their opinions about the most important responsibilities of engineers and about meeting environmental regulations when working overseas. From these results, it appears that the video is effective in teaching engineering ethics.

Index Terms – Assessment, engineering ethics, video

INTRODUCTION

Cases are used extensively in the teaching of engineering ethics [1]. Cases, both text and video, are effective because they capture students’ attention, foster critical thinking, draw on both affective and cognitive skills, offer opportunities for collaboration among students, and enliven the classroom [2].

In 2003, the National Institute for Engineering Ethics and Great Projects Film Company collaborated to produce a new video, *Incident at Morales*, which dramatizes a fictional but realistic case in engineering ethics. In this case, a company decides to construct a new chemical plant in Mexico to minimize the cost of environmental controls. During the design and construction of the plant, legal, financial, safety, and ethical issues affect technical decisions about sensors, valves, piping, and environmental controls.

The video is intended to be used in a single session of 90 to 120 minutes, or over two to three 50-minute class sessions at a university. How much can a viewer learn about engineering ethics in this short time? It seems unlikely that a viewer’s moral reasoning skills would improve significantly. But a viewer’s opinion or attitude might change.

In this project, we assessed the effectiveness of *Incident at Morales* in achieving basic instructional goals in engineering ethics.

METHOD

We selected two different assessment instruments: the Defining Issues Test and a five-item survey of statements about engineering practices.

In the five-item survey, each statement is motivated by a pedagogical goal of the video:

Five-Item Survey

For each statement below, circle 5 (Strongly Agree), 4 (Agree), 3 (Neutral), 2 (Disagree), or 1 (Strongly Disagree).

1. The first obligation of an engineer is to fulfill an assignment from the employer, or a contract with a client.
5 4 3 2 1
2. When working in a foreign country, an American engineer should comply with local regulations and should avoid imposing more stringent American standards for safety.
5 4 3 2 1
3. Ethical considerations are an integral part of making engineering decisions.
5 4 3 2 1
4. A code of ethics can provide guidance in making engineering decisions.
5 4 3 2 1
5. Many ethical problems encountered by engineers have technical solutions.
5 4 3 2 1

The survey was administered to 39 professional engineers and surveyors, and to a total of 162 engineering students at the University of Illinois at Urbana-Champaign and at Texas Tech University. Nearly all students were undergraduates, and they came from a variety of engineering majors. Participants took the same survey before and after they watched the video.

The Defining Issues Test is a standard paper-and-pencil multiple-choice test of moral reasoning. The DIT presents six stories with moral dilemmas. Subjects answer questions about the most important factors that affect their judgments about the dilemmas. The DIT has been validated through hundreds of studies with thousands of subjects [3]. Using the DIT, Self and Ellison [4] demonstrated that students who complete a full three-credit course on engineering ethics experience a significant increase in the level of their moral reasoning skills. Self and Ellison asked whether a shorter experience might also produce a measurable increase.

To assess the effect of *Incident at Morales* on students’ moral reasoning skills, we used the new version of the DIT, the DIT-2. Compared with the original DIT, the DIT-2 has only five stories, and these stories reflect contemporary issues. Among the scores provided by DIT-2 test, the most important are the P score and the N2 score, both on a scale of 0 to 95. The P score measures how strongly the subject uses

postconventional moral reasoning [3]; the P score is comparable to the original DIT score. The N2 score incorporates both the subject's preference for postconventional reasoning and the subject's rejection of self-centered reasoning.

We administered the DIT-2 to a total of 48 students at the University of Illinois at Urbana-Champaign and at Texas Tech University. One week after they took the DIT-2, the students watched the *Incident at Morales* video; one week after the video, they took the DIT-2 again.

RESULTS

Five-Item Survey: Professional Engineers

Because the normality tests rejected the normality assumption, the sign test and the signed rank test were used. Based on these tests, we drew the following conclusions for significance of differences ($p < 0.05$):

- For Statement 1 and 2, there were significant differences between in responses before video and after video. The direction of the change was in the negative direction, that is, the engineers were more inclined to disagree with the statements after watching the video.
- For Statements 3, 4, and 5, there were no significant differences between before video and after video.

Five-Item Survey: Students

We tested for statistically significant differences ($p < 0.05$) before and after watching the video. The sign test and signed rank test were used.

- For Statements 1, 2, 3, and 5, there were significant differences before and after watching the video. There was no significant difference for Statement 4.
- For Statements 1 and 2, the change in direction was negative, i.e., after watching the video, students were more inclined to disagree with the statements. For Statements 3, 4, 5, the change in direction was positive, i.e., after watching the video, students were more inclined to agree with the statements.

Defining Issues Test

Four of the students were purged from the data set by the DIT-2 reliability checks. The average P scores and N2 scores before (pretest) and after (posttest) watching the video are shown in Table I.

TABLE I
CHANGES IN DIT-2 SCORES

All students (n = 44)	Pretest	Posttest	Change	Significance
Average P score	36.4	39.0	+2.5	$p < 0.1185$
Average N2 score	35.4	39.7	+4.2	$p < 0.0056$

Four statistical tests accepted the normality assumption for the P scores and the N2 scores. Therefore, the paired *t*-test was used to determine whether the pretest scores were

significantly different from the posttest scores. The change in P scores between the pretest and the posttest were not statistically significant ($p < 0.1185$), but the change in the N2 scores was statistically significant ($p < 0.0056$).

DISCUSSION

Because the DIT-2 is designed to measure changes in moral reasoning skills over long periods of time, we expected that the pretest scores would approximately equal the posttest scores. Contrary to our expectations, the DIT-2 scores changed significantly from the pretest to the posttest: the posttest N2 score was significantly higher than the pretest N2 score. If the N2 score measures the developmental level of the subject's moral reasoning, then a single viewing of the video produces a significant increase in the level of moral reasoning.

From the results of the five-item survey, it appears that watching the video is sufficient to produce a change of opinion on Statements 1 and 2 of the five-item survey. Both the professional engineers and the students were less inclined to agree with Statements 1 and 2 after watching the video. They realized that though engineers should complete assigned tasks, engineers have more important responsibilities to the public; engineers should sometimes apply more stringent standards than legally required for environmental safety.

This study indicates that *Incident at Morales* might be effective in improving viewers' moral reasoning skills and in changing viewers' opinions about some specific aspects of engineering ethics in the short term. We cannot tell whether these changes are stable over the long term, however. It is difficult to assess the long-term impact of the video because many other experiences can influence an individual's moral development. Further study will be needed to establish whether a single brief intervention has a lasting impact.

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