Assessment of the Impact of the Use of Engineering Case Studies in an Undergraduate Ethics Course

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Abstract

This paper describes the implementation of a case study in an engineering ethics classroom of one hundred and ninety five students at the University of Florida. The engineering case used for this study was developed through the Laboratory for Innovative Technologies and Engineering Education (LITEE). Although case studies have been used in business courses since their development at the Harvard Business School in the nineteen fifties, the development of comprehensive case studies in engineering education has been relatively non-existent outside of some isolated individual efforts. The hypothesis of this study is that comprehensive real-world engineering case studies that are developed with the cooperation of engineering industry companies and that are presented in a multimedia format provide a better platform for learning and also for acceptance by students than do conventional methods of teaching under similar conditions. Although one of the modern approaches to teaching engineering ethics is through the use of case studies, the cases currently being used are either of hypothetical cases or well known industry cases such as the cargo door failure on the DC10 or that of the Ford Pinto. Both of these types of cases are ordinarily provided to students with general information and leave students with many unanswered questions. These types of offerings do not have the advantage of cooperative input from the industry in developing a comprehensive and detailed account of an actual case that includes dialogue with the participants. In most ethics texts currently in use, the cases generally provide only limited information which often leaves students with too many unanswered questions in order for them to feel comfortable and confident in making an ethical choice. In this study students were given the Challenger space shuttle case study as presented in a well known ethics text. Students were then provided with the STS 51-L (Challenger) case study developed through the LITEE and presented in an interactive multimedia format. Students were asked to evaluate both methods for presenting ethical issues and to provide feedback regarding benefits and disadvantages of each method used. Students were tested as to understanding of the case based on each delivery method and then interviewed to determine the effectiveness and acceptability of each of these approaches. The results from this study indicate that there are significant advantages in using case studies developed with the cooperation of an industry partner and presented in interactive multimedia format. Student input also indicates that there are many opportunities for further development and enhancement of this type of delivery system.

Introduction

A great deal of work has been done in the past decade in attempting to improve engineering education; not the least of these is the acknowledgment of differences in students’ learning styles. It is now recognized by academic researchers that the different learning styles represented in engineering classrooms require those of us in engineering education to take stock of our course conduct methodology and recognize that what we may have considered to be an outstanding method for delivery of material on our part was probably not reaching all of the students in the way we had hoped or even believed. One of these recognized learning styles is characterized by visual learning. Fortunately for us, studies have indicated that most engineering students are visual learners so the application of multimedia would seem to be a good fit when we seek to develop new methods and new materials for engineering education (Wankat). Unfortunately, however, most university professors still have not been educated

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in the application of course delivery methods that address different learning styles and still simply adopt a text which the students are required to read and from which lectures are developed and presented in class. Fortunately for the educational community this may be changing as studies in engineering education (Felder) have been conducted over the past decade that address these issues with the specific goal of bringing new methodologies to those of us who are teaching and to provide us with new tools that will allow us to change methods to address the critical finding from educational research in many areas to include differences in the way that students learn.

One of the successful studies has been that of the Laboratory for Innovative Technology and Engineering Education, LITEE, at Auburn University. This NSF sponsored research has focused on the development of including case studies to be used in engineering classrooms. Along with the case studies, innovative and interactive methods for presentation of the material were also developed. One such case study developed through the LITEE is used in this study; that case is the STS 51-L study better known as the Challenger. The Challenger disaster is well known, not only in the engineering community but by every American and most of the developed world. This case, along with some other high profile ethics cases that deal with engineers’ involvement resulting in disaster, such as the Kansas City Hyatt Regency walkway collapse, is consistently used in engineering ethics classes. Because of this common usage in engineering ethics classrooms, the Challenger case was well suited for use in this study.

Hypothesis

In beginning this study it was felt that new methods and approaches in engineering education (Felder) could be applied to courses outside of the general engineering curriculum where students’ interest and stimulation for learning did not appear to be at a high level. Because of this perceived lack of interest in subjects outside of engineering, it was felt that application of different methods could be tested for measuring student interest and then follow up with a measurement of the degree of learning in order to determine if there were ways to increase students’ intellectual development. The hypothesis of this study is that the use of interactive multimedia is the better way to present engineering ethics cases to facilitate the development of student interest and learning. Engineering faculty who haven’t taught a course in ethics might imagine the difficulties in getting students to take an active interest in this subject material. The study has two parts: the first, which is the subject of this paper, addresses the degree of student interest in the subject based on the type of delivery methodology to which they are exposed; the second part, which is a follow-up study, will be to determine differences in student learning associated with each of the course delivery methodologies. The first part of this hypothesis will be tested using the LITEE developed case study of the STS 51-L (Raju). The methodology for the second part, learning, is being developed and is a logical extension of the first part based on the hypothesis that without first stimulating student interest in a subject, learning will be diminished. Research indicates that learning will follow the stimulation of interest (Wankat).

Methodology

To test the hypothesis that different delivery methods could stimulate students’ interest in the subject to lesser or greater degrees, it was first necessary to develop an acceptable evaluation method. Having had mixed results in other studies when asking students’ to “rank” their feeling for a particular subject or activity, it was felt that having students provide a written response in their own words regarding their feelings on a subject might prove more beneficial and perhaps more accurate. This subjective method is often used in social science surveys and is know as “content analysis” (Babbie). In this method, narrative responses are extracted from students and these are analyzed for key words and phrases. Then, using “affinity diagramming,” (GOAL QPC) these key words and phrases are sorted into a logical order or category. In this study, these categories represent the areas of concern/interest to the students and form the basis on which student interest is evaluated.

Students were provided with introductory information related to the Challenger space shuttle disaster through a lecture outlining the basic elements of the case and the engineering involvement. A common method of content delivery in an ethics class is to have students read the case in a textbook as a means of developing an initial understanding of engineering ethics and professionalism. Then, students are either given assignments dealing with the reading or they are required to participate in interactive class discussions, or both. Required student analysis of
the cases from the text is supported by readings in ethical theory which has also been provided in the text. Various aspects of the cases are related to the theory as illustrations of good and bad behavior by engineers in addressing moral conflict. As will be seen in some of the comments from students, the significant cases such as the Challenger are provided in a somewhat fragmented manner in the text with small parts of the case presented in the chapter in which that particular ethical theory is being developed with no complete treatment of the case in any one chapter. This is not true with all ethics text, but is common with most.

In order to evaluate possible differences in degrees of interest when using different delivery methods questions were asked of students to compare the use of the multimedia presentation of the Challenger, STS 51-L - Case Study, the Challenger case as presented in the text. The material developed for each case by the LITEE includes a written case description in a separate casebook, and a multimedia CD presentation that includes dialogue between parties in the case as well as important documents and a time-line and details of events that led to the tragedy. For this study I should point out that students were not provided with the written description from the LITEE case book, “Educating Engineers for the Information Age,” but only the multimedia CD. The reason for this omission was that the students were already provided with a written version of Challenger case through the course text book and it was my aim to determine whether cases were better understood, appreciated, and stimulating to students through use of text only, multimedia CD only or some combination of the two. If combination of text and CD were the preferred choice, then it can be assumed that the LITEE text would, or could, provide sufficient written information to compliment the CD just as well as any other written engineering ethics text. The obvious shortcoming of eliminating the students’ current textbook altogether would be in the development of ethical theory which is brought up as a concern of some students as we shall see through the responses.

Students were divided into teams consisting of from four to six members. Half of each team was to first study the case using the text only while the other half of the team used the multimedia CD. All students were then given a copy of the case assignment that required students to address a series of questions related to the shuttle disaster. Students completed the assignment based on their knowledge gained from studying the particular medium assigned to them. Students were then asked to review the case using the medium that they did not use in the first response and while doing so, to think about the usefulness of each system related to the students’ ability to appropriately address the questions to which they had previously responded.

The teams were then required to come together and discuss their experiences with each medium and to formulate a response, as a team, to a series of questions intended to determine the merits of each of the systems related to understanding, acceptability, and learning. The student responses to these questions constitute the basis on which a preliminary evaluation of the mediums’ merits regarding its ability to stimulate the students’ interest in the study of ethics cases is based.

Response

After reviewing the two presentation formats for the Challenger case, specific questions were asked of the students related to their interest in the subject and their learning based on use of each of the two mediums. Here we see that students addressing how well the material facilitated their learning related to different specific educational goals.

The data were collected from all students as teams and collated into specific categories of response through performing an affinity diagram analysis of all of the responses to each question. Table 1 shows the breakdown of the categories that were established in this manner.

The results of this study are provided in Table 1. In this table, the categories identified as important from the affinity diagramming are listed in a matrix format for each of the eight questions that were asked. For each of the questions as it relates to a specific category, a “T” indicates that the text was preferred over the multimedia; an “M” indicates that the multimedia was preferred over the text; and a “B” indicates that neither of the media were significantly preferred over the other. Blank spaces in the matrix indicate either no response of that this category was not germane to the question. Following the Table is a listing of the students’ responses to eight questions as they relate to the categorical concerns determined from affinity diagramming.
Table 1. Categories of response for student data.

<table>
<thead>
<tr>
<th>STUDENT CATEGORICAL RESPONSE</th>
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<tr>
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<td>Content</td>
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<td>Multimedia</td>
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<td>Negative</td>
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<td>Organization</td>
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<td>Technical</td>
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<td>Time-Line</td>
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<td>Visuals</td>
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T = Text significantly preferred over multimedia
M = Multimedia significantly preferred over text
B = (both) neither significantly preferred over the other
Void space = category not germane to the question

**Describe Advantages/Disadvantages Of Medium Related To:**

1. *Understanding the Case*

   NOTE: It would be helpful in understanding the student responses if a reader would first read the definitions of the Categorical Responses.

**Interactive Multimedia**

NEGATIVE - The negative comments from students related to how well the case was understood using only the multimedia address issues dealing primarily with content but not also with issues of format of the presentation. Content issues are not directly related to the usefulness of the medium to provide information in a way to make the material more understanding however. Of other concern was that the format of the links included in the multimedia were redundant in providing previously seen material when new material was expected. This also is not directly
related to effectiveness of the medium, but in how the presentation was put together. A few of the students found that the multimedia was difficult to navigate, but they were in a distinct minority. Other content issues addressed the lack of focus on the launch decision as was provided in the text. These negative revaluations from the students are valid for the study, but are not germane to actual effectiveness of one medium over another.

TIME-LINE - Students were very impressed with the organization of the multimedia using an interactive time-line. This observation by the students is relevant to the effectiveness of one medium over another and is significant in that 100% of the teams mentioned this in their response. Students found that this visual presentation with the interactive ability to go back and fourth and skip around within the sequence of actions was extremely useful in understanding the case. A typical student reaction was, “Interactive time-line provided a great advantage in understanding the case.”

VISUALS - Comments regarding the visual component of the multimedia presentation were unanimous in expressing an appreciation for visual and audio presentations to present much of the material. Students seemed to feel that their level of understanding of the case was significantly enhanced through the use of audio and visual elements. A typical student reaction was, “Great visuals of exactly what happened made it easy to understand; particularly the problem with the o-rings.”

MULTIMEDIA - This refers to the student’s appreciation of the interactive nature of the material rather than simple a Powerpoint-type presentation. Students seemed to feel that the more interactive the presentation, the more they enjoyed it and the more they were able to get from it. A typical student reaction was, “Easy to go back and review some action or information that might be needed to understand what is currently being viewed.”

TECHNICAL - Students were challenged with understanding a good deal of technical information in this case. Students unanimously indicated that the presentation of the technical information, in particular the memos and reports, were very helpful. The technical aspects of the problem with the o-rings was also reported as being much more understandable using the multimedia over the text. A typical student reaction was, “Comprehensive history of the o-ring problem was much easier to understand by seeing through the videos and schematics provided in the multimedia.”

GENERAL - The general comments related more to types of materials provided rather than to the effectiveness of the medium. A typical comment here was, “Makes it easier to understand that something could have been done early on to prevent the tragedy.”

**Text Material**

NEGATIVE - Students negative comments related to the use of the text related principally to the lack of visual aids. Even though some pictures were provided students seemed to feel that the general visual nature of the multimedia was significantly better for understanding the issues than the text although it is obvious that a text could be enhanced with more visual aids. These negative comments indirectly indicate that students prefer the visual medium regarding obtaining a better understanding, particular with technical matters such as are involved with this case. A typical student comment was, “Lack of graphical representation was a big handicap.”

ETHICS - Student comments about use of the text in regard to understanding the ethical issues of the case were almost unanimous and was expected. The multimedia did not provide much in the way of developing any ethical theory but reserved this to providing a link to some general ethical information. Students were well prepared to address ethical issues from study of ethical theory in earlier chapters. Although these comments are valid, it does not preclude ethical theory from being presented in a multimedia format, but it does seem to justify using a combination of medium in teaching engineering ethics. A typical student comment was, “Better presentation of the difference between engineering decisions and management decisions and overall the ethical issues are much better addressed in the text.”

ORGANIZATION - A small number of students commented related to the organization of material but none expressed this element as important in consideration of the multimedia regarding understanding the case. This
categorical element, organization, does not directly relate to the medium used, but, once again, is a valid student 
comment regarding their study of the case. A typical student comment was, “Was easy to read and easy to 
understand the decision-making process leading to the disaster.”

CONTENT - Comments regarding content are also not directly related to the usability of the medium being used, 
but on how the medium was used. Student comments on content indicated that some things were included in the 
multimedia that were not included in the text and visa-versa. Both medium could be changed to address this concern 
without affecting the acceptability of the medium itself. A typical student comment was, “Text reviews the 
aftermath of the case with the Rogers Commission while the multimedia ends on the day of the launch.”

GENERAL - A comment that is significant (somewhat in this technical age) was, “As a student, you can take the 
text anywhere you want to in order to study.”

2. Developing Impressions and Understanding of the Ethical Issues Involved

Interactive Multimedia

NEGATIVE - Of primary concern to students was the fact that the text provided a background of theory that was 
necessary to understand the specific ethical considerations of the case whereas the multimedia did not provide much 
in the way of addressing ethical theory. This observation does not preclude a multimedia presentation from 
including ethical theory and thus does not relate to what the medium can do for a student regarding to stimulation or 
understanding. A typical student comment was, “Did not address the central issue of management v. engineering 
decision-making.”

VISUAL - Once again students commented on how much understanding was facilitated with pictures. These were 
particularly directed at the information provided in the internal memos and post flight reports of other shuttle 
missions. A typical student comment was, “The video and memos helped to convey a lasting impressions and a 
better understanding of the situation.”

MULTIMEDIA - The comments regarding multimedia provide some very useful comments and showed a majority 
of students fell that the multimedia is of great help in understanding the case. A couple of typical student comments 
were, “One main advantage of using the multimedia is that is can be updated on the Web whenever needed,” 
“Provided much better information that could be used in decision-making and therefore was the better medium if it 
had just taken a more ethical focus.”

GENERAL - The student comments falling into this category were not related to the information sought regarding 
the effectiveness of the medium. A typical general comment from students was, “Gave the impression that the 
problem was understood but bureaucracy and “group think” let to the ethical problems.”

Text Material

NEGATIVE - The negative comments, as in most of the questions, are not relevant to the usefulness of the medium, 
but are valid student concerns for this study as an assignment. Negative comments related to the text were 
surprisingly unanimous in their observation that the book is biased toward engineers and does not seem to present a 
neutral position when presenting the case. This seems to be important to educators teaching engineering ethics 
although it is not significant in goals of this study. A typical student comment was, “Text seemed to be biased 
toward engineers and did not fully develop the management decision-making process.”

ETHICS - Students were unanimous in their feelings that the text was much better at addressing the ethical 
components and issues of the Challenger case than the multimedia. In particular students were impressed with the 
development of a change in rules by management as problems developed. This change was seen in the ethical 
theory presented in the text of “normalized deviance” where management continually changed the rules thus adding
additional risk to the program. A typical student comment was, “Provided specific examples of types of ethical
behavior such as “normalized deviance,” “acceptable risk,” “groupthink,” and others.”

GENERAL - Only a few comments fell into this category and were not relevant to the goals of the study. On
comment was, “Provides the case more as a story which makes it seem more personal.”

3. Understanding the opportunities to Prevent Making Poor Engineering Decisions

Interactive Multimedia

NEGATIVE - The negative comments dealt with the lack of some information that students got from the text but
wasn’t presented in the multimedia. This primarily dealt with the in-depth treatment of the activities on the evening
before and day of the launch. This information could have been included in the multimedia and thus does not have
relevance to the differences in effectiveness of the medium. A typical student comment was, “Did not go into detail
about the launch decision-making.”

VISUAL - Students comments here regarding the visual effects of the multimedia were positive regarding their
ability to see where decisions were made and where opportunities to prevent poor decisions occurred. The
comments almost all dealt with how helpful the time-line was in tracking the milestone points that led up to the
disaster. A typical student comment was, “The time-line presented an excellent picture of the development of the
problem and where it could have been addressed much earlier.”

MULTIMEDIA - Comments on the multimedia in relationship to this question were mostly negative. The
negativity dealt with the fact that the multimedia did not address ethical issues as well as the text did. Once again,
this is a development problem, not a problem inherent in the medium and thus does not relate to how well the
multimedia could have presented the ethical issues. These comments, therefore, are not relevant to the outcome of
the study. A typical student comment in this section was, “Multimedia does not clearly show the final launch
decision-making in enough detail.”

GENERAL - Very good general comments related to the study, but not to the impact of the medium. A typical
student comment was, “Illustrates that the role of an engineer in industry is not appreciated as “professional” as in
private practice.”

Text Material

NEGATIVE - Student comments here were related to the content or lack of content and not to the effectiveness of
the medium. Students did not feel that the text did as good a job of providing background, as did the multimedia.
This is not to say that text could not have been added and provided just as much background information, as did the
multimedia. A typical student comment was, “Focused only on the launch problem but not much on earlier
opportunities for prevention.”

ETHICS - As in the other questions, students were complimentary on the text for providing the necessary ethical
theory and focusing the presentation of the case more specifically on ethics. The responses here do not contribute to
a perception of which medium provides better understanding and is therefore not relevant to the study. A typical
student comment was, “Text defines standards that are followed in ethical decision-making and provides examples
of good and poor decisions.”

GENERAL - The general comments are also unrelated to effectiveness of medium. These comments are relevant to
the assignment as seen by a student however and are of interest. A typical general comment here was, “Text
provides the opportunity to follow along with the specific person involved which is excellent for a student who will
also be a single individual involved in ethical situations.”
4. Understanding the Difference between Engineering and Management Influences in Making Moral Judgments

Interactive Multimedia

NEGATIVE - Students comments here are related mostly to content or lack thereof. Students seem to have been influenced by the text which spends a great deal of time addressing the important issue of management decisions versus engineering decisions and which should prevail under what circumstances. This is also content and not relevant to the goals of the study but is important to student assignment requirements. A typical student comment was, “Does not specifically address that there are engineering decisions (professional) as opposed to managerial decisions for a company.”

GENERAL - These comments are important but not relevant to the study; only relevant to the assignment. Students again address the lack of depth of focus by the multimedia on the ethics as opposed to the in-depth treatment in the text. A typical student comment was, “Left the impression that engineering decisions are technically based and management decisions only relate to business yet did not expand this into an ethical or moral issue.”

Text Material

NEGATIVE - These student comments again addressed the bias that they uniformly felt was presented in the text toward engineers and did not give management a chance to defend the decisions that were made by the managers. A typical student comment here was, “Text shows a bias toward the engineers in this process and does not give enough justification for the management decision.”

GENERAL - In contrast to some student comments above (negative) some students thought that the text presented the engineering v. management decisions well. Both the negative and general comments however, don’t relate to the effectiveness of the medium but are relevant to the assignment and analysis of the case as to content. A typical student comment was, “Text addresses proper engineering decisions (PED) and proper management decisions (PMD) and the differences.”

5. Which of the Two Methods of Case Presentation is Preferable and Why (what makes one better than the other) or, is Understanding Better Using Both Text Information and Multimedia Presentations?

Interactive Multimedia

NEGATIVE - The negative comments deal mostly with what might have been rather than what was included but not effective. Students seem to indicate that the multimedia was the preferred medium but, on the negative side, could have been done better with the navigation, etc. A typical student comment here was, “The players were confusing, but could be presented in a dynamic organizational chart and be much more effective than the text.”

VISUAL - The visual aspects of the multimedia were unanimously in agreement that the visual presentation was the preferred method for presenting a case such as the Challenger. The feedback here is significant to the study. A typical student comment was, “It made the case more easily understood; primarily because it held one’s interest.”

MULTIMEDIA - Again, students were unanimous in their preference for use of the multimedia as a method for presentation. Students indicated that the information was more clearly understood with audio and visual combined and that the interactive nature made navigation back to recheck some information very helpful. A typical student comment was, “Provides a more efficient way of presenting material in a shorter period of time.” “Easily provides many more necessary facts and details related to the case and is much preferred.”
**Text Material**

NEGATIVE - The negative comments here were obviously from very visual students who did not appreciate the text. They are, however, relevant to the study in that they indicate some students preference for the visual presentation over the text. A typical negative comment was, “Text is a little dry and does not hold one’s attention.”

ETHICS - Almost all of the ethics comments to all of the questions relate to content and the fact that ethical theory and ethical issues were much better covered using the text and that the multimedia presentation did not include enough in this regard. These comments do not relate to the goals of the study. A typical student comment was, “Ethics covered here, but not in multimedia.”

GENERAL - Just as with the negative comments above, it appears that these students in the general section were very approving of the text as a preferred medium. This is relevant to the study in addressing the preference for a medium. A typical student comment was, “Text narration makes it easy to understand the personal aspects.”

**Both Interactive Multimedia and Text Material**

GENERAL - A majority of students indicated a preference for using both of the mediums in presentation of the cases. Most students indicated that they would like to see the text used to develop ethical theory, but that the cases themselves should be presented using the multimedia format. This is extremely relevant for the study. A typical student comment was, “More information can be provided through the multimedia which would take up way too much space in the text; therefore, it would be better to use the multimedia for presenting all the case information and the text for ethics theory and making the ethical decisions.”

**6. What Did You Understand Better from Each of the Methods and Why?**

**Interactive Multimedia**

TECHNICAL - Students felt that the technical information, in particular the o-rings, was presented much better using the multimedia. That is, the students felt that the technical information was much better understood with the visuals and audio provided in the multimedia which could not be presented in the text with the same effect. A typical comment was, “Invaluable for understanding the technical issues so necessary for case development.”

TECHNICAL - The multimedia was much preferred by students over the text with regard to understanding of the technical information in the case. A typical student response was, “Invaluable for understanding the technical issues so necessary to develop the case.”

TIME-LINE - Students felt that the time-line was one of the most useful features of the multimedia presentation since it was so interactive and provided paths to supplemental information and navigation links to videos and other enhancements. A typical student response was, “The clear structure of events was great in facilitating understanding.”

VISUAL - The visual nature of the multimedia presentation was preferred by students over the text. This is significant in addressing the hypothesis of this study. A typical example of student comments was, “Visuals allowed an unknowledgeable reader to easily understand the technical matters in the case.”

MULTIMEDIA - Again, students overwhelmingly preferred the multimedia to the text in understanding of the case. This also is significant in addressing the hypothesis of the study. A typical example of student comment was, “Much better at showing the issues from previous launch problems which was very important in relation to the decision-making process.”
GENERAL - This category provided student perceptions from the case rather than evaluation of the medium. A typical general comment was, “Better understanding of how bureaucracy can slow down and complicate problem solving.

**Text Material**

NEGATIVE - This is a repeated comment from some other question responses. The typical negative response was, “It was difficult to understand the technical matters without visual aids.

ETHICS - Once again the text is the preferred method when it comes to the presentation of the ethical theory and problems. As has been stated before, the text may be the best method for presenting ethical theory, but it does not preclude ethical theory from being presented even more effectively using multimedia. Therefore, these comments are not relevant to the study. A typical response to this was, “Defined the relevant ethical concepts with examples, particularly “Normalization of Deviations.”

GENERAL - As with most of the general comments, these deal with content and format rather than to medium effectiveness. A typical student response was, “The text provided more detailed information related to individuals involved in the decisions.” Another comment worth considering was, “The team understood the case better after having gone through both of the mediums.”

**7. What Recommendations Would You Make as to Presenting the Challenger Case for a Better Understanding by Students?**

**Interactive Multimedia**

ETHICS - The majority of students felt that the multimedia did not provide enough in regard to the ethical considerations, but were still enthusiastic about this being the preferred method for presenting ethical cases. This validates the use of multimedia for being the method that stimulates interest and provides a better understanding of the case. A typical student response was, “Make the multimedia presentation include more ethics and it would be the complete medium that is needed.”

DETAILS - One concern of students throughout the evaluation has been that of content. Students address here what they would like to see in order to make the presentations more usable. Once again we see that students are reaching out to the multimedia as a preferred method by recommending changes that would allow for using the multimedia as a stand alone preferred method. A typical student comment was, “A list of key players should be provided with an audio explanation of who they are, what they do, and how they were involved; this would make the multimedia the desired method.”

MULTIMEDIA - For the overall multimedia presentation, students made recommendations based primarily on their concern for content that they felt was included in the text but left out of the multimedia presentation. A typical response was, “Have the text included electronically and link the multimedia presentation to the text to provide supplementary information on the ethical theory and ethical analysis.”

FORMATTING - Students felt that the multimedia presentation was not formatted as well as it needed to be. This is not a problem with the medium, but a problem with, as indicated, formatting the presentation within the medium. A typical response was, “Omit or better define some of the technical terms that students may not have been introduced to at this time.”

GENERAL - In the general category, the students suggested that better explanations could be provided in the multimedia such as audio definition of the glossary terms to accompany the written list. One of the better comments that supports the multimedia form of presentation is, “Use the multimedia version because it holds the students’ attention; the book puts them to sleep.”
VISUAL - Students seem to feel that visuals are needed to present engineering cases. This holds true for evaluation of the text where students continue to suggest that the text provide more visual information. A typical comment was, “The text needs more pictures such as were provided with the multimedia.”

GENERAL - Students commenting on the text seemed to use this venue for suggesting the use of both text and multimedia. One typical suggestion was, “Use the text for ethical analysis and the multimedia for background information.”

8. What Recommendations Would You Make for Presenting Any Ethics Case for Better Acceptance by Students?

VISUALS - In recommending how to present any case, the students unanimously suggest the use of visuals and endorse the multimedia as the preferred medium. A typical response was, “Add more visuals to explain any technical material which seems to be best done with the multimedia.”

MULTIMEDIA - Students also strongly recommended the multimedia in general for presentation of any engineering case. A typical response was, “We strongly recommend use of the multimedia because it really facilitates understanding.”

CONTENT - Students address the content issue again which sort of deviates from the intent of evaluating the medium for its potential to stimulate interest, understanding, and learning. However, most of the comments were an endorsement of the multimedia method of presenting cases as seen in this typical response, “If the multimedia could be made to include more on ethical theory and made easier to navigate, without a doubt it would be the preferred medium.”

DELIVERY - The students comments on delivery show concern for individual preference in the presentation of the material and does not deal with either of the mediums applicability. A typical example concern was, “Use class time to show multimedia (go through it) and then have students read the text outside of the class, but make both sources of material available on the website.

CONCLUSIONS AND RECOMMENDATIONS

This was not a highly sophisticated statistical study, but a “strawman” used to test the wasters of student acceptance of the implementation of interactive multimedia case studies in engineering classes. In this simple study, students consistently embraced the use of interactive multimedia as the preferred method for better understanding of case studies. The main elements associated with this preference were the Visual presentation of materials that the text only explained with words; the general multimedia which allowed students to navigate through and back into information presented in video, audio, still pictures and text was strongly endorsed by the majority of students. Use of the interactive time-line was a student favorite in regard to understanding of what actions occurred and when, and what decisions were made early on that could have prevented later complications. Students seemed to unanimously agree that the technical information of this case, particularly the o-ring problems, were understood much better using multimedia rather than text alone. Students seemed to be stimulated using the multimedia and expressed boredom with reading and excitement in using the visuals and links in the multimedia. As was discussed early in the paper, students have different learning styles and I am sure that there are students out there, and even in this class, who can’t stand the multimedia presentation and are very comfortable with the book. However, I do feel that this study has provided a strong indication of the fact that students’ interest is stimulated and they become more interested in subjective material such as ethics and will learn more through the implementation of interactive multimedia in the presentation of cases in engineering classrooms.

I would recommend that everyone who reads this paper try an interactive case study in their classroom and see what sort of reaction they get from students in relationship to the method that you are currently using. My next part of
this study is to determine the level of learning using the case study vs. the learning using only the text. No, I didn’t forget using both of these fine methods and I will try that too when I finish with the learning study. One thing I will try during the Spring term however is to have student teams divide a case into manageable parts and then have each team develop a multimedia presentation of an individual piece of the case as an assignment. Then I will put the pieces together as a single case study and see if it can be used in future classes or simply be a good student exercise for the class. Whatever happens, I’m confident that the use of multimedia will be the thing of the future for providing the most information in the most understandable and enjoyable format in the least amount of time to students who have become interested in a very dry and most of the time boring subject

References


Felder, Richard, “A Survey of Faculty Teaching Practices and Involvement in Faculty Development Activities.”

Felder, Richard, “Matters of Style”, An article in ASEE Prism outlining the principles and applications of four learning style models (Felder-Silverman, Kolb, and models based on the Myers-Briggs Type Indicator and the Herrmann Brain Dominance Instrument).

Raju, P.K., and Chetan S. Sankar, “Educating Engineers for the Information Age.”

Wankat, Phillip C. And Frank S. Oreovicz, “Teaching Engineering.”
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