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Arranged Stories Reflecting the Thinking of Students in Engineering Ethics Case Study Method

Mitsukuni Yasui†
Division of Applied Chemistry, Muroran Institute of Technology

ABSTRACT

Engineering Ethics is a fundamental and essential subject and the understanding of ethics is of great importance for students in engineering courses and professional engineers. Most courses would consist of ethical tests, decision making opportunities, case studies, case methods, and group discussion. It is important to consider each case carefully, so we offer a number of hypothetical short stories to students as case methods that they cover in detail. We check the behavior decisions of students as they read the hypothetical short stories. In this study, the short story was about 200 words in length. This paper shows how, with the addition of minor changes to the text, some students changed their behavioral decisions. For example, with the addition of "if you take financial liability for the losses," some thought that they would not want to carry the debt. Other cases showed how some students disliked the majority rule. The paper shows that this arranged hypothetical short story method can often guide student's decision-making process, and can result in decreased undesirable decisions.

Keywords: Engineering ethics, Group discussion

I. Introduction

Engineering ethics is the field of applied ethics and is a system of moral principles that apply to the practice of engineering. The field examines and sets the obligations of engineers to society, to their clients, and to the profession. Most engineering failures are much more involved than simple technical miss-calculations and involve the failure of the design process or management culture. However, not all engineering failures involve ethical issues. Incidentally, some say that as there are many rules in society or a company, you should obey them. We ought to always act on the rules that if generally followed would produce the most good for the people. Individual actions are right when they conform to such rules. As sometimes we cannot adapt the fact to any rules, we must morally behave by ourselves. Good judgment in moral matters lies at the core of all virtues, including self-respect. Moral judgments relate to the virtue of professional responsibility.

The profession of engineering is aimed at promoting public good, public safety, health, and welfare. If moral problems were always simple and clear, there would be little justification for taking valuable time to study ethics. However, there are some complexities, vagueness, conflicting reasons (moral dilemmas), and disagreements. It may be clear which moral principles apply to one situation. The difficulty instead might be that two or more applicable principles come into conflict.

The problems of complexities, vagueness, conflicting reasons (moral dilemmas), and disagreements suggest a need for several steps in approaching dilemmas. 1. Identify the relevant factors and reasons. 2. Gather all available facts that are pertinent to the moral factors involved. 3. If possible, rank the moral considerations in order of importance as they apply to the situation. 4. Consider alternative courses of action as ways of resolving the dilemma, tracing the full implications of each. 5. Talk with colleagues, seeking their suggestions and alternative perspectives on the dilemma. 6. Arrive at a carefully reasoned judgment by weighing all relevant moral factors and reasons in light of the facts.5)

As ethics education has moved from didactic instruction to more learner-centered methodologies, new and innovative techniques are being used to teach students how to address ethical dilemmas. Case-based instruction has been successfully

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† Corresponding Author: yasui@mmm.muroran-it.ac.jp

used within various professional fields such as medicine and business as a way to teach ethical issues [1]. Cases provide a situational context for students to connect ethical questions with theoretical concepts. Engineering ethics requires individuals to make decisions in a complex environment, where problems are open-ended and vague. However, using original cases can make it simple.

2. Methods

We made a short original case derived from the Snow brand disaster and applied it to students. They would make their decisions from a regular story but it was thought that any stress would influence their decision. The additional stress was achieved with only 10 words, and it affected their decision. We asked students to select one implication from seven. The subjects were 448 students who were in their third year of college, majoring in construction, mechanics, electricity, or applied chemistry. We prepared two types of stories and sent one to each student.

Food poisoning caused by dairy products such as the "low-fat milk" produced at the Osaka plant of Snow Brand Milk Products Co. left 14,780 people ill after it was first reported on June 27, 2000. The original cause was attributed to a toxin generated by increased bacteria during a power outage that stopped the production line at the Taiki plant in Hokkaido where the raw material was produced. This toxic material was sent to the next level of the production line without being discarded and created toxic skim milk powder. Dairy products that contained the toxic material were produced and shipped from the Osaka plant and caused an outbreak of food poisoning. This case became an historic outbreak of food poisoning in Japan.

3. Results and Discussions

"The campus festival Pot-au-feu (ODEN) stall" was the hypothetical short story derived from the Snow brand food poisoning case (Table 1). The "type A case" consisted of about 600 words (see Appendix). This story had the following implications.

(1) Students had incomplete knowledge about food poisoning.
(2) They felt strongly about "Mottainai," which in English is "wastefulness," regarding food.
(3) They did not have a lot of time to make their decisions.

After reading the story, students had to select one answer from the following: "If you were student C what would you do?"

(1) I would sell the pot-au-feu at the campus festival and hope it would be safe.
(2) I would check the taste and smell before deciding to sell it or not.
(3) I would decide it an hour after sampling.
(4) I would sell it, carefully checking the situation.
(5) I would discard it because it was made from food that had been stored overnight.
(6) I would discard it because I'd be anxious about it.
(7) I would discard it if the majority ruled so.

Each implication has the factors of selective priority and reason (Table 2).

Table 1 Comparison of Snow brand disaster and this case

CASE	Snow Brand Disastr	Pot-au-feu shop
Organization	Snow Brand CoLtd.	campus festival
Trouble	power outage	left over
Decision-maker	plant manager	student C
Obstacle	Cost	Cost
Deletion	Know ledge	Know ledge

Table 2 Implications and concerns

Implications	Proiority	Reason
1. I would sell the pot-au-feu at the campus festival and hope it would be safe.	1.cost	Optimism
2. I would check the taste and smell before deciding to sell it or not.	1.Healthy 2.Copt	retention
3. I would decide it an hour after sampling.	1.Healthy	retention
4. I would sell it carefully checking the situation.	1.cost 2.Healthy	Optimism
5. I weould discard it because it was made from food that had been stored overnight	1.Healthy	logically
6. I would discard it because I'd be anxious about it.	1.Healthy	crisis evasion
7. I would discard it if the majority ruled so.	1.Healthy	majority rule

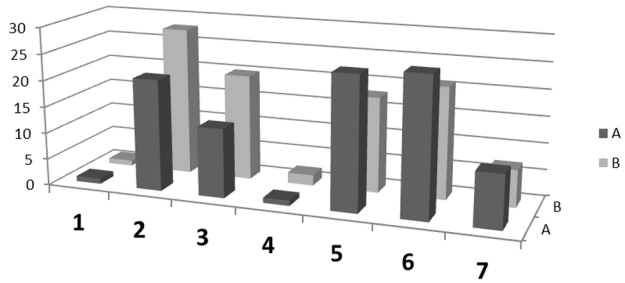

Fig. 1 Selected answers (I would do it)

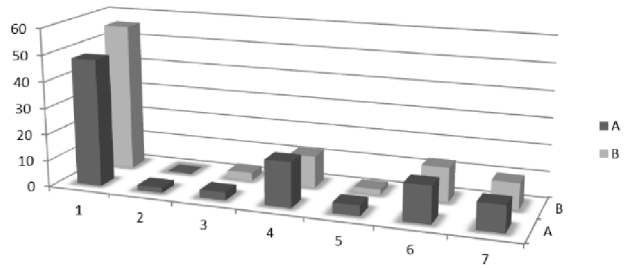

Fig. 2 Selected answers (I wouldn't do it)

Most students selected answers 2,3,5,6 and 7. It was good they didn't select answers 1 or 4 as those answers would present a clear and present danger to the public. Many students selected answers 5 and 6 as the best answers even though they knew they would lose a lot to maintain safety. In Figure 1 (type A), we can see that student B and student C did not consider the dangers associated with food poisoning. But student A had some knowledge about food poisoning. As there was no leader who had decisive power, disposing of the food was a heavy responsibility.

We arranged the story to study whether students would change their decision regarding their responsibility. The type B story had the additional phrase "We'll throw it out if you take financial liability for the losses." (Appendix and Figure 1, type B). This sentence affected the decision making process of students. Some changed their answer from 5 to 2 or 3. They now thought it was a good way to check and sell it, thus avoiding disposal and waste. Others changed the way they looked at majority rule (7) and avoided it because they didn't think others should overrule their deft decision-making skills.

Figure 2 shows what students thought were unsuitable selections. Answers 1 and 4 could induce food poisoning and answer 6 was not a logical decision. Answer 7 also was not logical. Students wanted a logical outline for their decisions.

In the original disaster, the factory manager of the Taiki plant decided to use the toxic milk to make skim milk powder, as he thought he would avoid a poor personal evaluation in the company for avoiding waste.

Students belonged to of the departments of construction, mechanics, electricity, or applied chemistry, which became notable in the different responses. Each student in the law department had the same tendency to answer with 1 and 4. Both answer 2 and 3 take priority "Healthy". They made

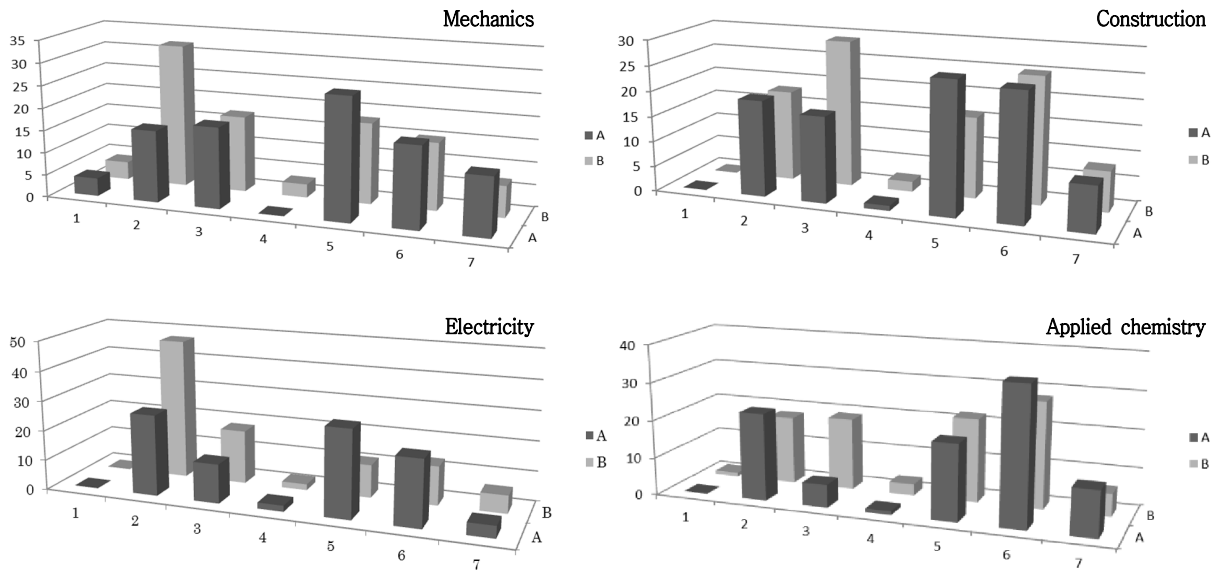

Fig. 3 Selected answers (I would do it)

decision immediately after tasting in answer 2 and took an hour in answer 3. If they would sell the pot-au-feu, they wanted show responsibility to taste by themselves.

The following was deduced:

(1) Construction students tend to make decisions independently, according to the change to answer 3.
(2) Mechanics students tend to make decisions considering cost, according to the changes between types A and B.
(3) Electricity students tend to make decisions considering cost, according to the changes between types A and B.
(4) Applied chemistry students tend to make decisions dependently, considering public health, according to their answer of 3, 6 and 7.

4. Conclusion

We propose that the arranged hypothetical short story method can guide students' decisions, and can decrease undesirable decisions. And students showed their responsibility even take cost.

5. Acknowledgements

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Appendix

Original Case: "pot-au-feu (ODEN) shop in campus festival"

Type A

Student A is one of the people in charge of a food stall selling Japanese "oden," which is translated as "pot-au-feu," at a campus festival. After the first day finished, they had a lot of leftover oden. Three students, including student A, are discussing what to do with the leftovers.

A: We have so much oden left over. It was hot today so people probably didn't want to eat hot food. We'll have to try hard and somehow sell it all tomorrow.
B: We can do it tomorrow because it will be colder and because it's Sunday, too.
C: What will be do with the leftovers?
B: I've heard it said that oden is better if you leave it overnight. I think we are sure to sell it tomorrow.
A: The executive committee of the campus festival urged everyone not to sell old food.
B: We'll say the pot-au-feu is marinating overnight and is not "leftovers."
C: Let's start cooking for tomorrow.
B: It is easy to mix the leftovers with new food.
A: I'm not convinced about the sanitary conditions because our stall is only a temporary one.

The next day

C: I forgot to add one other ingredient.
A: I think that is in refrigerator.
B: The fridge is empty!
A: Here it is! It was in the styrene foam box. But it is not cold.
C: You can mix it in pot.
A: Wow! You have already put it in.
C: Yes
B: What are you worried about? I think it will be safe if we boil it.

Type B

Additional Phrase

A: Are you sure? Maybe we should throw out the leftovers.
C: We can dispose of them if you take financial liability for the losses.

"If you were student A what would you do?"

(1) I would sell the pot-au-feu at the campus festival and hope it would be safe.
(2) I would check the taste and smell before deciding to sell

it or not.
(3) I would decide it an hour after sampling.
(4) I would sell it carefully, checking the situation.
(5) I would discard it because it was made from food that had been stored overnight.
(6) I would discard it because I'd be anxious about it.
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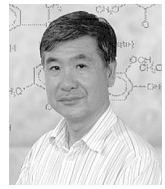

Mitsukuni Yasui
Associate Professor, Applied Science, Muroran Institute of Technology Received BS (1982), MS (1984) and DS(1987) from OASAKA University Current research focuses on Engineering ethics, SOD from thermophilic bacteria, Biomass utilization using enzyme from white fungus.
Phone: 0143-46-5748
E-mail: yasui@mmm.muroran-it.ac.jp