Proposal of Practicing Education for Engineering Ethics using a Safety Activity

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Abstract

Engineering ethics is a response to the public's opinions, and "Awareness", "Autonomy", and "Practice" are its basic elements. In Japan, Engineering ethics education is offered at a lot of schools, but actually many of these studies are provided by the lecture method. By using this teaching approach, it is difficult for the students to acquire the three basic elements of engineering ethics. Even if the student understands the content, he feels that he obtained knowledge only, and thus may forget the content of study by the time he/she graduates. Moreover, the time when engineering ethics is really needed is when the student finds employment in an enterprise. Until that time, the engineer should experience continuous motivation toward ethical actions, similar to the soldier in the Trojan horse. We propose adding a fieldwork component with the theme of safety to the engineering ethics education class. To address the problem concerning safety, the students should fulfill this responsibility by communicating and acting in regards to their surroundings. The students' independent behavior in the fieldwork experience should help them acquire the necessary awareness, autonomy, and practice for the basic elements of engineering ethics.

Introduction

Life esteem and environmental preservation are common problems throughout the world, as well as basic demands of the public. The engineer's role and responsibility to solve these problems are demanding. Recently, engineering ethics education has been offered at many colleges and universities, and the approach of the scientist and the engineer in regards to the public's ethical demands has become more active. Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) are planning to execute the scientific study on the influence that genetically engineered organisms (The plant, the animal, and the microorganism are included) exert on the environment [1]. This is a good example of scientists and engineers trying to provide answers to the uneasiness surrounding genetically engineered organisms.

Japan is a member of APEC (Asia-Pacific Economic Cooperation) with Australia, engineering qualifications that are valid throughout in the APEC region can be acquired in Japan. It is thus vital that the engineering trainees in Japan understand engineering ethics from a global perspective. The Japanese people strongly desire and expect peaceful use of science and technology, after an atomic bomb was dropped on Japan in World War II.

In Japan, the JABEE (Japan Accreditation Board for Engineering Education) was recently established based on ABET (Accreditation Board for Engineering and Technology and Inc.) of the United States, and engineering ethics education is delivered to students who study science as part of their engineering education program. However, there are various problems with current engineering ethics education in Japan.

WHAT ARE ENGINEERING ETHICS ?

Engineering ethics are a response to the public's opinions [2]. The Public demands that the engineer will prevent disaster or damage, and announce
danger. This will promote the engineer's trust by the public. The engineer
should notice the danger in his work, plan to prevent danger, and talk
about danger and its measures sufficiently with the public to answer these demands. Even if it might be difficult, the engineer should put plans into action, obtain results, and achieve public safety. It is necessary to receive evaluation of the results from the public. Engineering ethics thus covers a series of actions. A feature of engineering ethics is that the engineer actually rushes into action, to obtain a concrete result, rather than simply making value judgments.

“Awareness”[3], “Autonomy”[4], and “Practice” are necessary elements of the engineering ethics. “Awareness” is to identify problems of danger and scandals, etc. at work or at organizations to which they belong. “Autonomy” means not submitting unconditionally to the opinions and the policy of the group, but to act based on their own sense of values. “Practice” is to have not only an ethical desire but also to negotiate on danger with others, and to act toward the achievement of safety measures. Thus, it is important in that engineering ethics education pass on “Awareness”, “Autonomy”, and “Practice” in the form of skills and information to be acquired by the students. However, there are some problems with current engineering ethics education. I will address this problem in the next chapter.

PROBLEMS OF ENGINEERING ETHICS EDUCATION

(1) Difficulty of continuing education and training for a long term necessary for training “Awareness”

“Awareness” in engineering ethics is characterized by the ability to divide an ethical element into various ethical issues, and it is very effective in the prevention of the accidents or scandals. However, since this ability is not necessarily natural, education and training are necessary. Moreover, it is difficult to acquire this ability in the short term even with intensive training. Young students should have educational training for “Awareness” over a relatively long period.Åientrance Å`graduationÅ` finding employmentÅ`career formationÅj. As a result of such continuous education, when an event happens, the engineer should be able to identify the ethics problem and to act practically. For this purpose, in engineering ethics education, programs should be targeted not only at the student but also at members of society. For educational content, schools and enterprises should have the shared understanding and recognition. However, it is difficult to maintain education of engineering ethics with the same conceptual consistency after schooling, on to achieve united agreement about the concept of ethics on both the management side and technological side.

(2)The engineer is in a workplace environment that is not “Autonomy” friendly.

In the evaluation of values regarding an event to which engineer ethics are applied, the judgment is different in the case of the individual and the organization. This value gap is caused by the difference in perception of the public, the enterprise considers the public as a market while the engineer considers the public as a civilian.

It is normal for an engineer to do business such as designing and manufacturing as an employee in an enterprise etc. In the office, first of all, the engineer should act as an individual when ethics are involved.

However, the sense of belonging to one’s enterprise is especially strong in Japan, and engineers are consider themselves to be not engineers but employees in their office. So, even when their sense of values differs from that of the company, their stated opinion often follows that of the group.

(3) Formalization of engineer ethics to make practice desire lost

Lecture on engineering ethics might touch on various events by mentioning cases and examples, but the student doesn’t has no experience as a member of society and it is thus difficult for them to understand the social issues behind the event. There is also a concern that engineering ethics are misunderstood as a formal liberal arts subject by them. After the student graduates and enters an enterprise, they feel that they should actually follow to the culture of the office, and follow the customs and standards of the office. Before long, they come to embrace the standpoint of the organization and the office, and engineer ethics that were understood and acquired in the school days cannot be applied to the business; a “polite fiction” theory of ethics is feared.

The ethics education that they receive in the enterprise mostly concerns compliance. The engineer experiences conflicts with the public regarding complaints, and before long they will come to recognize that “The public is defended from the activity of the organization” and “The organization is defended from the public’s activity”. This is similar to the conflicted feeling when entering an enterprise after the product liability (PL: Product Liability) method as public protection is learnt and product liability prevention (PLP) and product liability defense (PLD) are learnt as corporate risk management.

MEASURES TO IMPROVE ENGINEERING ETHICS EDUCATION

(1) Necessity of object lessons

There is a limit to the acquisition of Awareness, Autonomy and Practice taught by lecture study in the classroom. Combined coordinated education of knowledge and the body and mind is necessary in engineering ethics education.

Moreover, it is also necessary that education continues even after starting one's adult life. It seems that a program that combines fieldwork with classroom study is ideal.
However, one problem here is how to choose the theme. It is difficult to plan a concrete action policy even if engineer ethics are chosen as the theme of the fieldwork. When thinking about the features of engineer ethics, a serious problem and matter that relates directly to the individual and a problem that can be addressed continuously in the future is necessary as the theme of the fieldwork. Judging from the above, a safety issue is appropriate as the theme.

(2) Safety as a common view that exceeds standpoints
A safety problem is adopted as the training theme in engineer ethics. The sense of values differs according to the person and the standpoint but the safety problem allows problem recognition by everyone. There is no enterprise that does not offer safety education and training and measures for safety. So, by using a safety problem as a center theme of the engineering ethics training, common recognition that exceeds standpoints and time is obtained by all participants.
An ethical element is inherent in a safety problem, so safety can be addressed up as an ethical issue.
And, goal of devising a method for the public to be defended from harm can be clearly displayed, so the student can understand the purpose of the subject as a common view of society. Moreover, it is easy to image the situation when he behaves as a subject.

CONCRETE METHOD

It is difficult to acquire Awareness, Autonomy and Practice for the
student that has not worked in an office where risk is present and who has not witnessed an actual industrial injury. We have thus devised an achievement method involving motivation of another type that even the student can have understand.
For "Awareness" we train the discipline by exercises in class. For "Autonomy" we encourage students to show a positive approach in developing a sense of responsibility, and for "Practice" we enhance the student's motivation with a numeric target. In this way , we convert motivation concerning Awareness, Autonomy, and Practice into activity for Discipline, Responsibility, and Evaluation. In doing so, the student becomes able to behave independently, voluntarily, and ethically. Cooperation of the student who receives the education and the staff of the school is vital, and it is indispensable to offer an appropriate orientation to the activity by a safety specialist and make the activity part of the management cycle to achieve an educational effect.

(1) Discipline
To identity an ethics problem is to find a problem in or our job, as stated above, and it is important in the ethics activity to make this a custom.

Subject ___

Student number

Name

Describe danger in school that you found.

Fig.1 Questionnaire Concerning Hazard(5)

The custom in this case is to have a habit of "Noticing" the risk.
To nip danger in the bud , it is necessary to be able to discover the bud, and at the same time it is important to make a habit of not forgetting to find the bud. "Awareness" is supported by developing customs (=discipline) through repetition of the maneuvers and training.
For an example of training, the author asks students to find danger existing in the campus at Kyushu Institute of Technology. Each student fills out a form "Dangerous place for us and dangerous states" like Figure 1. This questionnaire is completed at the end of the class and modify the perspective of the hazard in every case to "Danger of school" and "Danger of experiment or practice" and "Danger of machines and electric equipment".

To respond to the questionnaire, the student should actively search out danger. This becomes training to discover danger. They will have to guess at first. At the start, they might recall their own experiences, and answer

creatively. But, as time goes on , they come to consider danger in all their areas of activity to respond to questionnaire. Before long, students are made to be able to do training for discovering danger outside the classroom (for instance, workshop etc.). This becomes training in the discipline of discovering danger whatever the situation, and before long, it is connected with acquiring the custom of being aware of ethical issues.

(2) Responsibility

Autonomy is the freedom of an individual to act or make decisions independently from others. One of the causes of difficulty in solving safety problems is the idea that accident prevention is the responsibility of others. In disaster prevention, it is important for us not to blindly follow this general idea but to have a sense of responsibility for society, so that we may help prevent or become involved in disaster aid.

Then, we replace autonomy, one of the attainments of engineer ethics, with a responsibility concerning safety and training. For that, we give the student a role concerning safety, and give them a student "Sense of responsibility" concerning the safety activity, so we promote basic attainments that will develop into "Autonomy" in the future.

We give students roles concerning safety activities using names such as "Safety committee" and "Safety team", and allot roles of experiment officer, practice officer, the subject officer , and the school year officer, etc, in addition, we divide the allotment of work such as report member, investigator, total members, and preparation member for each group. When necessary, we introduce a duty system such that responsibility falls to all members in turn as much as possible. As points of concern in this case, we are clarifying the content of work performed by each role, and "evaluation of surroundings" is transmitted to the student in drafting announcements by the school to the public, or transcripts, or the activity reports filed in this personal histories. And it is also important that we have the next generation continue this system.

(3)Practice

For safe action in the factory, as the next step torwards realizing one's responsibility we practice disaster prevention as "Our responsibility" for safety activity and safety measures execution, and the organization makes the result a safety result and it is evaluated. In other words, it is practice = evaluation, and the result of practice not seen actualized as an evaluation numerical value. Thus, we replace "practice" in engineering ethics education with "evaluation", and we make the system such that the student cannot help out behave. And, we have the student actually experience the difficulty and the feeling of moving the body and physically practicing a safety plan.

Thus, the student can obtain the practical ability that will be needed in the future.

"Evaluation" concerning safety as the fieldwork is concretely done by grading the student's activity. That is, we have the student count the number of dangers that he encounters , and students applies higher points to greater dangers. Thus, students confirm their safety every day. When the student does an excellent safety activity hard, a low number will be counted, and the school gives good grades to students with low counted numbers. Thus, the student's safety activity is evaluated as a fixed quantity.

Through this action, the student comes to recognize that he should voluntarily move his body and act forward safety achievement, while a third party evaluates the result.

The purpose to put the safety result is his risk situation is always understood by confirming my safety point every day, and It has recognition of "My safety is defended for myself". With this method the daily approach and the evaluation by the third party are important. Students should always carry a safety card etc. It is good for the third party such as staff of the school to check it every day. An example safety grading card is shown in Figure 2 .

Fig. 2 Risk Discovery Card(5)

	The first week	The second week	The third week	The fourth week	Total during month
Experiment	H	H	S	S	
Practice	S	S	2 H	S	
Campus	S	H	S	S	
Class	K	S	S	S	

Another	S	S	S	S	
Total of S	3	3	4	5	15
Total of H&K	-3	-2	-2	0	-7
Total	0	1	2	5	8

S: No danger(=1), H: dangerous(=-1), K: injured(=-2).

CONCRETE ACTIVITY AND RESULTS

Actualizing the content of this proposal will be attempted in the future. However, the author has already verified the effects of some basic elements in this proposal in safety education and training in an auto components supplier and the University.

The following results were obtained regarding responsibility. In the new style of training in the auto components supplier where the author was working, roles and the responsibility actions by the committees were considerably effective. And so it is recognized that this is an effective method for Vocational Training.

Moreover, in Department of Engineering at Kyushu Institute of Technology, the author recognizes safety ethics as a subject of engineering ethics and plans to improve the student's desire to learn and goal setting by using safety as a teaching material for engineer ethics education. Concretely, we are giving the students the following objectives at all times. .

1) Enumerate dangerous locations in the school.
2) Think about measures for safety at the dangerous locations.
3) Your responsibility and role in the measures for safety
4) Action agenda and trouble for measures for safety
5) Forecast of results of your behavior and evaluation

By maneuvering like this, we think that students can become conscious of ethics problems by recognizing that risk is a familiar problem, noticing the ethical problem, being conscious of his responsibility and role, taking the trouble to address it, and thinking about the measures according to the progress of the lecture.

As shown in Figure 3, we are finding that students consider the practical policy, and can experience the necessity of a social evaluation of results from finding an ethics problem to extrapolating the results.

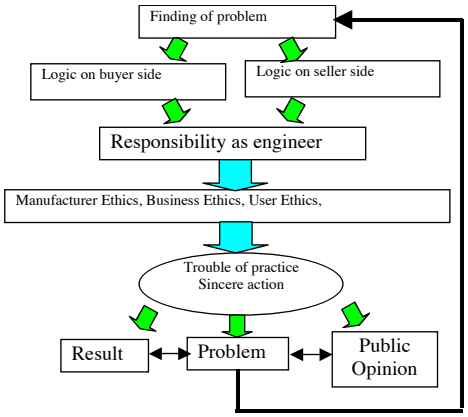
FUTURE TASKS

In Japan, the employment situation has recently picked up with the economic recovery of manufacturing. However, the occurrence of industrial injuries has not increased, and expansion of licensing of technology to and from foreign countries may lead to a stagnation of the safety technology.

In this economic ambience, students graduating from science courses will not feel so mach economical unease, and may not appreciate the necessity of engineering ethics.

To raise engineers of global caliber, we should improve the engineer's concept of responsibility in his school days. I think that it preferable that engineering ethics education begins with young people before the university.

Fig.3 Practice System of Engineering Ethics(6)



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