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Raising Standards of Engineering Ethics through Student Teams

Abstract Reducing the frequency of engineering accidents is a “people’s responsibility.” Increased attention to engineering ethics is inevitable. Engineering ethics are a stance, attitude or outlook, not easily learned by lectures. This article explores the utility of student teamwork by applying the Theory of Planned Behavior and acknowledging the benefits of professional knowledge and professional ethics possessed by the professional teachers, under professional teacher guidance, in order to improve levels of engineering education ethics. There are 5 key points: ① team member recruitment standards; ② team size; ③ team name and motto; ④ team group activities; ⑤ extending the spirit into the post-graduate period.

Keywords: engineering ethic, professional teachers students’ team, engineering management

1 Preface

“The social responsibility of self-exploration is the basic rule for the university to maintain the school tradition of human nature and humanity” (Chong, 2013). After university graduation, many engineering management major students will enter the construction industry and greatly effect the security and quality of construction projects by being construction crew members, contractors, supervising engineers, cost engineers, design consultants, and public servants.

The increasing number of construction projects in China brings an increasing number of engineering accidents. The

construction industry has become the third highest risk industry following traffic and the coal-mining industry. The data for civil engineering accidents in China during 2008–2011 was shown in Table 1.

Most of the accidents measured here are “responsibility accidents” in that human factors are the main reason for the accident (Li, 2013). Encouraging students to create and maintain a proper engineering ethic is becoming more and more important for the engineering management majors which is educational imperative.

It is an ethic formed by value judgments and responsibilities.

2 Engineering ethics as fundamental for engineering managers

“The engineering method has its limits, human-factors will be more important” (Chen, 2013). Individuals will only take responsibility for goals thought to be meaningful. Ajzen (1991) stated that the possibility of human behavior depends on the personal will and targets which are reachable by attitude or personal judgments. Planned behavior theory posits that personal value judgments produce will, and that will leads to behaviors. *Figure 1* presents the logical relationships.

Ajzen’s theory of planned behavior posits that those participating in engineering construction, particularly engineering construction majors, establish their personal value judgments on their engineering responsibility, social responsibility, and historical responsibility, to reduce accidents caused by an absence of concern or awareness.

Professional instruction is critical to ethics education. The teacher will teach the “Dao”, but which “Dao” is it? Kazuo describes “Dao” as conscience — a basic rule for people in society. His formula is

$$\text{Results(or outcomes)} = \text{attitude} \times \text{enthusiasm} \times \text{talent}$$

“Attitude”, or inclination, refers to one’s personal values or how one views things and how it results in judgments and behaviors. It scores from 0 to 100. Enthusiasm and

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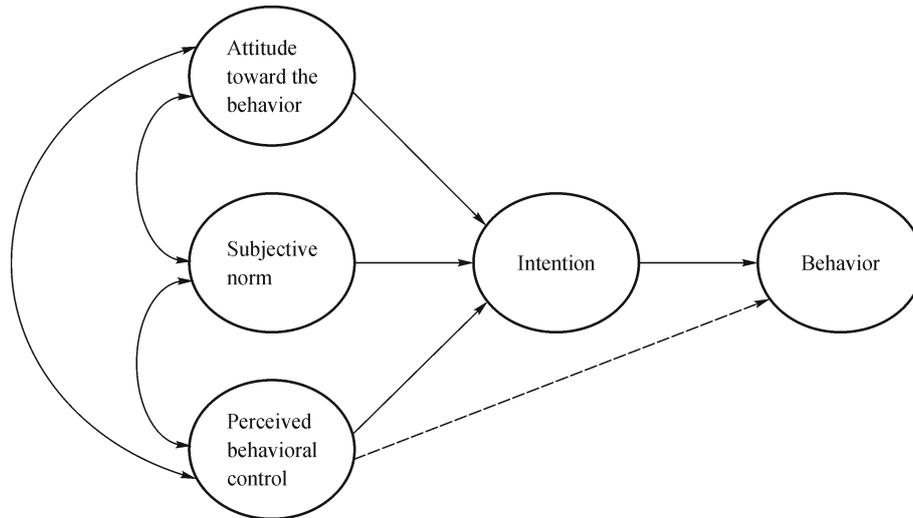
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Table 1*Civil Engineering Accidents in China 2008–2011 (Li, 2013)*

Year	Metro/tunnel		Road/bridge		Housing	
	Accidents	Casualties	Accidents	Casualties	Accidents	Casualties
2008	80	37	800	666	37	29
2009	52	29	581	514	45	32
2010	61	30	656	543	34	27
2011	61	32	668	538	34	25

*Figure 1.* Planned behavior theory. Adapted from Icek Ajzen (1991).

talent rank from 0 to +100. Personal values determine life “outcomes” (Kazuo, 2010). An engineering “Dao” would be part of any construction engineering process. Construction engineering includes many conflicting values. It is a disposable in that all participants will attempt to establish as much value as they can.

The construction side tries to scrimp on safety training, to build cheaply and to subcontract promiscuously; and owners try to contract illegally, to minimize project time, to minimize supervision, and to obtain lax government regulation; and the supervision side tries to do nothing for fear of trouble. The occurrence of each of these behaviors increases the probabilities of serious construction safety accidents and/or poor quality problems.

A “Dao” of construction ethics sets construction safety and quality above any personal gains or losses. It allows the construction which an individual has participated in to withstand social, and historical, trials. Each specific construction event creates opportunities for corrupt self-enrichment resulting in a great strain on individual conscience.

However, this type of construction ethic needs long years of study and practice.

The question of how to improve student ethical baselines in a construction management major has become a

necessary teaching research topic.

3 The necessity of professional teacher guidance in building student teams

Universities have many student teams, many of which have the following problems: ① no professional teacher guidance; ② continuing instability; ③ no systematic values training; ④ a narrow focus exclusively on social skills practice.

3.1 The expanding in the size of education cause the block in the communication between teachers and students

Education is a long process, “the truth of university lies in illustrating virtue and striving to excel until reaching perfection”. Educational results are hysteresis quality and dynamic (Miao, 2011). It requires devoted teachers with proper professional ethic and skills. A “teacher is the person to proselytize, instruct, and dispel doubts”. In a student’s life and career development, professional teachers not only teach but are also models to establish a healthy mind and a professional ethic. This cannot be done by young assistants.

Currently Chinese universities have grown so quickly that the growth in teachers cannot match student growth. This causes more and more difficulties in teacher-student communication (Zhu, 2007). This is especially true in new campuses where many undergraduates live far from their teachers, making the situation worse. The lack of time and place for teacher-student communication will no doubt influence proselytizing, instructing and dispelling doubts.

3.2 Team building enhances teacher-student communication

Recently some universities have established tutorial systems for undergraduates. Different from postgraduate tutorial systems, most of the undergraduate tutorial systems have become formalistic, making it difficult to build a close relationship, and little chance for collaboration. The traditional course system, classroom education and professional practices generally have not continuously provided skill or ethics training. Attention should be paid to professional teacher personal effects, encouraging them to build student teams according to their own will and abilities with some kinds of effective explorations.

Unlike common teaching or group activities, teachers would more easily strengthen the thinking way and professional ethic which they had taught in class by arranging activities with their teams. A teacher's prior team-building experience gives them a greater understanding to the students' individualities and characteristics. This understanding will help them give more targeted advice during their courses or when they give career advice. Given time, students' puzzlement about education and social problems can also be answered by team activities.

4 Key points in teacher-led student team building

4.1 Team member selection criteria and trust building

A professional teacher can create an experimental group with students who have identified the principles and ethics taught in class and who select each other. The teacher, as the leader, has identified the members, and the members have identified others who hold similar viewpoints. Understanding and trust issues problems in the team can be more readily solved. Trust is the team's operating basis.

4.2 Team size and operational basis

Each team must have a proper size in order to assure that the energy and ability is effectively directed so that the team can achieve its best. Should there be too many members, teacher energy will be limited and not all members will be given enough attention. If too few, some activities are not possible. Proper team size assures that

everyone can be tended by the teacher and that everyone can speak in research discussions. Generally 8–15 would be an appropriate number.

Unlike common groups, and because the team spontaneously self-organizes, hierarchical management is inadvisable. Instead, organizing around the project or using all-channel communication without levels is to be preferred. Each member will have the same chance to lead or organize and carry out a project so that each can experience the practice of personal value judgments and responsibility.

4.3 Name and slogan selection, modeling values

All team members jointly select the team name to show its independent identity. A team slogan is needed and should be selected by all the members. Its functions are similar as the university's slogan does by "transmitting the key information on its own education goal, principle, style and so on" (Sun, 2011). The slogan can show the goals and principles of the team while distinguishing it from other teams. For example, my team "Origin" has the slogan "joy from origin, sailing from now", expressing our wonderful wishes and dreams that "start from origin, derive all the sunshine, rain and dew, take root deeply in order to create extraordinary curve". The picture shows the emblem of "origin team".

When the team has its own name and slogan, it will then have the life power to take root and develop. Members will then also have feelings of belonging to and dependence upon the team. Meanwhile the name and slogan will nourish member responsibility to develop the team through their efforts. It initiates the students into learning how to be responsible for larger and larger responsibilities such as engineering construction, enterprise, country and the nation.

4.4 Team activities and demonstrating team principles

Student group activities can be divided into: professional activities, cultural activities, campus activities, and extra-curricular activities. The specific forms are not so important, but the purposes are. Professional engineering management activities relate mainly to "calculating engineering quantity, valuation", "project management sand table", "preparing project tender documents", and other professional knowledge and skills. Benevolent activities include "sharing good books", "researching social events", "personal dream project" and others. "The purpose of education is to nurture a whole human" (Cao, 2011). Learning only the basics is not only teaching the skills, but more importantly, the spirit and soul (Li, 2010). We can assist students in their understanding and realization that the only way for someone to continue developing is to have their own moral code.

In addition, professional teachers need to establish a stable and daily communication by using their own

relationships outside the university. Inviting the same people to communicate with the students is insufficient; students must leave campus to do social practice outside. Members can modify their value system by these valid social experiences.

4.5 Post-graduate team purposes and activities

A special value of teacher-led teams' purpose is that students can maintain team identity after graduation. It could also be called "post-graduate teamwork", which means the students would benefit from their teacher's spiritual accompany in such a special and close relationship.

The interim between leaving school and entering society is quite difficult for most students. Many cannot adapt society. Classroom education is limiting. An example is described in the phrase "I was given oral instruction, but no documents. What do I do now?" or "What do I do upon finding defective construction if the supervisor knows. Do I tell the Director or not? If so, how can you keep your job; if not, how do you live with your conscience?" All of these complicated ethical questions need to be answered by using a moral norm. In these situations, professional teachers need to communicate with the students about aspects of professional knowledge, career ethics and also personal communications in order to help the students understand that there are more possibilities and how to establishing their own engineering ethics. So the team's qualities established and nurtured by the professional teachers will expand into the post-graduate period and the team can be a spiritual home which develops all students over a long time.

5 Conclusions

Preventing civil engineering accidents is a "responsibility of the people". An aim of engineering management undergraduate education should be to imbue professional talents with a high sense of responsibility, and serious career ethics. Professor Yan-fu Jiang said "A person is a whole, even as a kind of animal who can create the fortune, he will also be controlled not only by the knowledge and views of his career but also outside his career." (Cao, 2011).

Thus an undergraduate curriculum should include moral ethics education that focuses on value systems and responsibilities.

A team built by professional teachers could have several positive effects on guiding students to build personal and social value systems. These value systems, led by moral ethics, would, in the end, guide good behaviors. Our society will also develop well under such good behavior. The domain of engineering construction, when the professional engineering construction students also have engineering construction ethics participate in the activities of engineering projects, will be benefit positively by reducing the number accidents and improving the quality of the engineering. Universities should modify their teacher evaluation systems to include in the evaluation those who build student teams and focus on communication with, and guidance of, students after class instead of exclusively class quality and research. How to modify the evaluation needs further exploration.

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