



Using Personal Case Studies to Raise Construction Safety Awareness among Construction Management Students

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The development of effective strategies in preventing work accidents in the construction industry is an important topic not only for the industry sector but also for higher education programs. The current literature supports the view that training is a major factor in sustaining and improving safety performance. Particularly, learning is an important dimension of training. Traditional students, due to their youth and inexperience, often believe that they are invincible and that accidents will not happen to them. Construction Management and Civil Engineering programs are faced with the challenge of raising awareness among students about the frequency and severity of construction accidents and increasing their knowledge regarding social responsibility towards safety.

In order to raise awareness about construction accidents, student enrolled in a Construction Safety Management course completed two case studies exercises. The first one was an in-class case studies group activity and the second an individual case study report including a presentation. For the in-class case studies group activity, the students were divided into four groups (6 students per group). Each group was required to review four case studies and they were instructed to discuss the physical and psychological effects of the accident on the injured, their family and coworkers. At the end of the activity, the instructor facilitated a general discussion in which the last group that had each case study commented on the answers provided by the whole class.

The individual case study assignment examines students' personal experiences with construction related accidents. Students were asked to write a case study of a construction accident that they had experienced or witnessed. Students were also given the choice to interview somebody that had either experienced or witnessed a construction accident. The objective of the assignment was to increase awareness about the magnitude and frequency of accidents among people that they personally know who are involved in construction (co-workers, professors, family members, etc.). The assignment consisted of two parts: a written report and an oral presentation in the class. The interview and written report allowed the students to have in-depth knowledge about at least one construction accident that had involved somebody that the students personally know.

After both the group and individual case studies were completed, the students were asked to complete a survey about their perceptions of the assignment's effectiveness in increasing their knowledge of social responsibility towards safety. The results of the survey indicate that students perceived that the second case study was more effective increasing their knowledge regarding social responsibility towards safety. The personal connection in the individual case study is essential for students to understand that accidents can happen to anyone. Also, having to present the results of these cases studies to the class provides more opportunities to students to reflect about the incident or accident. Particularly, students reflect during their oral presentation about incident/accident impact and how it could have been prevented.

Introduction

Construction worksites are among the top three most dangerous worksites in the United States [1]. Construction workers are an increased risk of injuries and fatalities due to the nature of their work and the lack of adequate training and safety awareness. According to the Bureau of Labor Statistics, the private construction recorded more than 775 fatalities in the year 2012, which is slightly more than two fatalities per day of the calendar year [2]. In addition to the fatalities, many construction workers are injured on the worksite which results in loss productivity and a decrease in the quality of life of the workers and their families. Young workers such as undergraduate students who work as interns and recent graduates are at an increased risk of accidents due to their limited workplace experience [19]. In order to reduce the risk of injuries and fatalities among all construction workers, effective training is necessary to increase safety awareness with the goal of identifying and eliminating hazards before they result in accidents. This paper explores construction management students' perceptions about the effectiveness of case studies as a tool to increase safety awareness and knowledge of social responsibility towards safety. Overall, training is a major component in sustaining and improving safety performance, which is discussed in the next section.

Background

According to Hislop (1999), training should be an integral part of all safety programs because regular communication of hazards, control measures, and safe work practices can systematically reduce the incidence rate of work injuries [10]. In 1993, safety training was included as a major attribute of an effective safety program [13]. The CII Task Force "Making Zero Injuries a Reality" confirmed the 1993 report, including safety training as "safety education: orientation and specialized training" and adding four additional key safety management techniques, management commitment, staffing for safety, worker involvement, and subcontract management [3]. Nelson (2005) asserts that safety training can occur only when management and employees are taught how certain tasks must be accomplished in order to prevent injury, including specific training on how to develop an adequate work-execution and pre-task safety plan [18].

Typically, construction companies faced several challenges associated with safety training that they need to be overcome. For instance, the extent to which workers' learning experiences are affected in safety training sessions and the extent to which workers learn safe practices in training sessions is among these challenges [6]. In addition, the language barrier is another challenge that interferes with learning in safety training, particularly experienced by non-English speaking workers. However, intense safety training and the passage of time allow mental habits to develop and change, ultimately allowing a safety culture, such as zero accidents, to become a fundamental part of the organization [9]. The most common methods used by companies to transfer safety knowledge are orientation and training sessions, toolbox talks, informal safety communication among workers, and formal presentations by safety managers [8].

For higher education programs, the education of construction safety leverages very little numerical calculation but emphasizes the (a) identification, analysis, and control of work hazards, and (b) interpretation of safety regulations []. In construction safety classes, students are often asked to demonstrate their hazard recognition abilities by taking and critiquing on-site images, or reporting a job site visit. Visits to construction sites are unique experiences that

cannot be completely replaced by other learning methods. However, they come with a number of constraints (sometimes even safety hazards) and cannot be arranged as often as needed [12].

Many of the key technical principles that students should learn can be illustrated through case studies [20]. Normally, these cases can help students to (a) begin to acquire an understanding of construction hazards grasp difficult technical concepts and; (b) understand how safety science changes over time as a project is observed and lessons are learned; (c) analyze the impacts of technical decisions on the execution of the project; and (d) appreciate the importance of ethical considerations in the design and construction decision-making process. Case studies are also useful in the education of the engineer and construction manager since they provide an opportunity for students to appreciate the problems of stakeholders to the construction process [21]. Other researchers have integrated case studies into engineering curriculum for different purposes [4, 16]. These include:

- Introductions to topics: Use the case to illustrate why a particular failure method is important; examples include the I-35W bridge collapse on road-users in the twin cities metropolitan region [24].
- Class discussions: Link technical issues to ethical and professional considerations; example includes the Hyatt Regency Walkway collapse [11].
- Group and individual projects: Have students research the cases in depth and report back on them. The most successful case studies are those that inspire students to go out, do their own research, and learn more about their chosen profession [5].

Research Approach

The methodology selected for this study included case studies. Case studies can be used to gain insight on in-depth personal perspectives about attitudes, behaviors, meanings, and experiences by obtaining details from a number of relevant or involved sources related to a project [22, 23]. The study was divided in three steps as shown in Figure 1.

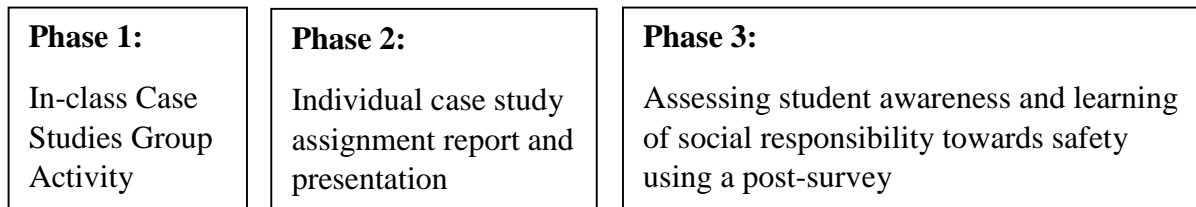


Figure 1: Phases Involved in the Study

Phase 1: In-class Case Studies Group Activity

For the in-class case studies group activity, the students were divided into four groups (6 students per group). Each group was provided with a case study of an event that was covered in the news. Table 1 shows the title, source and learning objectives for each case study. The following instructions were also provided: Discuss the physical and psychological effects of the accident on the injured, their family and coworkers. Also discuss how the accident could have been prevented and how we can prevent accidents like this one from happening in the future. Record the group answers on the paper. When the students were done with first case-study, they were asked to give the case study including their answers to the next group clock-wise. The next group

was instructed to revise or expand on the previous group’s response. This process continued until each group had commented on all four case studies. At the end of the activity, the instructor facilitated a dialogue in which the last group that had each case study commented on the answers provided by the whole class.

Table 1: Learning objectives for each group case study.

Learning Objective	Case Study Title and Source
<ul style="list-style-type: none"> • Raise awareness that accidents can happen to anyone. • Case study was chosen because the injured was a college student to whom the students enrolled in the course can relate. 	“Female CSU student loses both legs trying to hop aboard train in Longmont” (Mitchell, 2011)
<ul style="list-style-type: none"> • Raise awareness about psychological effects of accidents. • Case study was chosen to highlight psychological scars produced in the workers by being trapped for an extended period of time even though there were no physical injuries to them. 	“Trapped Chilean miners told rescue could take months” [15]
<ul style="list-style-type: none"> • Raise awareness about health hazards. • Case study was chosen because the Hantavirus in Yosemite caused widespread panic among visitors. 	“Yosemite tent cabins are locked as hantavirus source is traced” [17]
<ul style="list-style-type: none"> • Raise awareness about the importance of empowering workers to report unsafe conditions. • Case study was chosen because workers knew something was not right prior to the accident. 	“Crew argued over drilling plan before rig explosion” [7]

Phase 2: Individual Case Study Report and Presentation

This assignment examines construction management students’ personal experiences with construction related accidents. Students were asked to write a case study of a construction accident that they had experienced or witnessed. Students were also given the choice to interview somebody that had either experienced or witnessed a construction accident. The objective of the assignment was to increase awareness about the magnitude and frequency of accidents among people that they personally know who are involved in construction (co-workers, professors, family members, etc.). The assignment consisted of two parts: a written report and an oral presentation in the class. The interview and written report allowed the students to have in-depth knowledge about at least one construction accident that had involved somebody that the students personally know. The authors believe that the personal connection is essential for students to understand that accidents can happen to anyone. The second part of the assignment consists of a two to three minute oral presentation to the class where the students describe the accident, its impact and how it could have been prevented [14]. After the students turned in their case studies, the case studies were classified based on the role the student played in the accident (experienced, witnessed, interview) and the type of accident. A large number of students reported that they have either experienced or witnessed construction accidents. The leading causes of accidents were power tools closely followed by falls.

Phase 3: Assessing Student Perceptions towards Case Studies

The purpose of the post-survey was to assess student perceptions towards the value of case studies in increasing their safety awareness and their knowledge of social responsibility towards safety. The first question asked students to indicate their level of agreement that in-class group case studies increase their safety awareness and their knowledge of social responsibility towards safety. The second question asked students to indicate their level of agreement that individual case study assignments increase their safety awareness and their knowledge of social responsibility towards safety. A Likert-scale was used where 5= strongly agree; 4= agree; 3= neither agree nor disagree; 2= disagree and 1= strongly disagree. At the end of the survey, students were given the opportunity to elaborate on the previous questions. A paired-sample t-test was used to compare students mean responses to the survey questions evaluating their perception of the effectiveness of the two different methods for using case studies.

Results

The post-survey was completed by 37 students enrolled in an undergraduate course in the Department of Construction Management at Colorado State University. The survey was given at the end of the class and the response rate was 100%. Students were asked to indicate their level of agreement that in-class group case studies increase their safety awareness and their knowledge of social responsibility towards safety using a Likert-Scale. As it can be seen in Table 2, the mean for this question was 3.70, the mode and the median were 4 and the standard deviation was 0.87. Sixteen percent of students surveyed indicated that they strongly agree that in-class group case studies increased their safety awareness and their knowledge of social responsibility towards safety; 49% of students agreed; 24% of students neither agreed nor disagreed and 11% of students disagreed. When the responses in the categories of strongly agree and agree were group together, they accounted for 65% percent of responses which indicates that the majority of students perceive in-class case studies as a good exercise to increase their safety awareness and their knowledge of social responsibility towards safety.

Table 2: Case Study Post-Survey Results

	In-Class Group Case Studies	Individual Case Study Assignment
Response	n (%)	n (%)
5 = Strongly Agree	6 16.2%	10 27.0%
4 = Agree	18 48.6%	23 62.2%
3 = Neither Agree nor Disagree	9 24.3%	2 5.4%
2 = Disagree	4 10.8%	2 5.4%
1 = Strongly Disagree	0 0.0%	0 0.0%
Total	37 100%	37 100%
Statistics: Mode	4	4
Median	4	4
Mean	3.70	4.11
St. Dev.	0.87	0.73

The second question asked students to indicate their level of agreement that individual case study assignments increase their safety awareness and their knowledge of social responsibility towards

safety. As it can be seen in Table 2, the mean for this question was 4.11, the mode and the median were 4 and the standard deviation was 0.73. Twenty-seven percent of students surveyed indicated that they strongly agreed that the individual case study assignment increased their safety awareness and their knowledge of social responsibility towards safety; 62% of students agreed; 5.5% of students neither agreed nor disagreed and 5.5% of students disagreed. When the responses in the categories of strongly agree and agree were group together, they accounted for 89% percent of responses which indicates that the majority of students perceive in-class case studies as a good exercise to increase their safety awareness and their knowledge of social responsibility towards safety. As shown in figure 2, when the results of the two questions were compared, students perceived that the individual case study assignment was more effective in increasing the students' safety awareness and their knowledge of social responsibility towards safety.

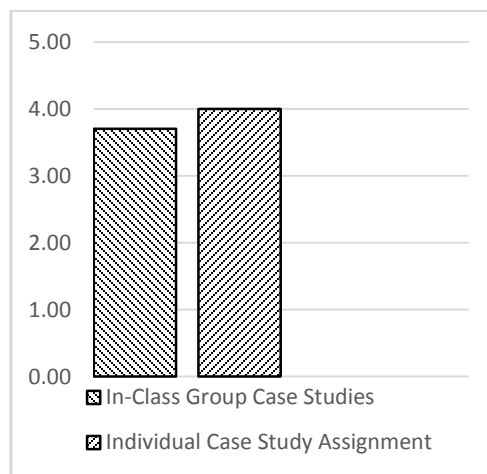


Figure 2: Post-Survey Results of Student Perceptions of the Effectiveness of Case Studies

The means for students' responses to the two questions were compared using a paired-sample t-test. The results ($t = -3.091$, $df = 36$, $p < .01$) indicate that a statistically significant difference exists between students' preference for the in-class group case studies and the individual case study assignment. Based in these results, the student participating in this study significantly preferred the use of individual case study assignments over the in-class group case studies.

At the end of the survey, students were given the opportunity to elaborate on the previous questions. Only a few students provided additional feedback. Examples of feedback received by students include "Enjoyed the case study assignment and presentations by fellow classmates. It was fun and interactive", "I think the hands on activities really helped. I would recommend doing more site tours as a class along with the final project" and "More case studies of construction accidents".

Conclusions

The majority of construction management students will work on construction jobsites while there are pursuing their undergraduate degrees to supplement their income and gain valuable experience in the industry. Once students graduate from college, they typically work full-time for construction companies in managerial positions. Due to the hazardous nature of the construction

industry, students and graduates must be aware of the safety hazards that they may encounter on the jobsite to reduce the risk of workplace accidents that may lead to injuries or fatalities. Previous studies indicate that integrating case studies into engineering and construction curriculum is an important tool. This study investigated student perceptions regarding the effectiveness of in-class group case studies and individual case study assignments to increase their safety awareness and their knowledge of social responsibility towards safety. Based on the results of this study, it can be corroborated that case studies are an effective tool to incorporate in undergraduate construction safety management courses to increase safety awareness and knowledge of social responsibility towards safety. Further, students perceived the individual case study assignment as significantly more effective (as shown in the results of the paired-sample T-test) in increasing their safety awareness and their knowledge of social responsibility related to safety. This finding can be used by faculty who teach safety management courses to incorporate case studies into their curriculum. Future studies will include investigating the effectiveness of additional activities and tools that can be incorporated into the course to provide continuous improvement that benefits the students enrolled in the course.

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