



## Construction Safety in Technical Education: A Deadly Oversight?

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### Introduction

In a study conducted among laboratory environments in the vocational/technical institutions across the nation, the National Safety Council estimated that in a one year period more than 24,000 accidents were sustained by students. These figures represent only accidents which were reported, caused property damage, or resulted in the loss of at least one half-day of school by the student. Moreover, the United States Department of Health and Human Services stated that actual accident figures for students in vocational/technical institutions would be much greater in number today if:

- All accidents were reported
- Records were kept on the increasing number of vocational students participating in industrial/vocational education programs throughout the nation
- The accidents were reported that do cause injury but do not cause serious property damage or result in the loss of at least one half-day of school.(NSC, 1)

In a personal communication to *Tech Directions* magazine, Albert Huntley (a vocational/technical educator at Cascade Middle School in South Bend, OR) focused on the effects of the current increase in the number of students participating in industrial/vocational education programs in his state. With the financial constraints facing instructors, it is impossible to purchase the equipment needed, alleviate overcrowded classrooms, and create an environment that would be laid out safely to facilitate all the different activities in which students are involved. This leads to an important question (Huntley, 57).



## Who is Responsible for Accident Prevention in Construction Education?

Nichols stated that “while the immediate job of preventing accidents in industry is usually the responsibility of the foreman or safety supervisor; in educational laboratories the job falls upon the shoulders of the teacher” (Nichols, 2). Such is the case in the secondary vocational education residential construction laboratory. In order for teachers (the *most* influential individuals in the effective implementation of safety programs in this environment) to efficiently reduce accidents, they must gain a complete understanding of the significance of a systematic approach to locating, evaluating, and controlling factors which are primarily accountable for accidents and their subsequent effects (USDHHS, 2).

### **Anatomy of a Student Fatality**

An example of an insufficient laboratory safety program is evident in the case of Dutcher vs. Santa Rosa High School District. The case involved a student in a high school automotive laboratory class utilizing an oxygen/acetylene torch in close proximity to an automobile gas tank. The gas tank had been removed and placed a short distance away from the vehicle. Two other members of the class had paused to observe the work of the student utilizing the oxygen acetylene torch when a stray spark from the torch caused the nearby gas tank to explode. The resulting explosion was responsible for the death of one pupil, and another sustained major injuries. (Williams, 95).

Had the instructor for the automotive laboratory completed a routine hazard analysis and attempted either to remove the unsafe act/mechanical hazard (in this case the automobile gas tank) then the resulting accident might not have occurred. This removal may have constituted an act as simple as placing the gas tank in an isolated area within the laboratory, safe from residual sparks.



## **Teacher Liability**

An area of great concern to residential construction instructors in vocational education is that of legal liability. Numerous examples of instructor and facility litigation exist. Zirkle provides several examples of cases involving teacher liability.

- A Tennessee court found that a vo-tech teacher acted negligently when he failed to instruct students in the proper use of a specific drill bit, failed to warn them of the dangers associated with its improper use, and was absent from the lab when a student was injured.
- In New York, a teacher was found negligent when a 15-year old student employee stole chemicals from an unlocked cabinet in a lab and left them outside in some bushes. An eight year-old boy found the chemicals and was burned when he tried to light them with a match.
- In a case that illustrates the risk involved in modifying equipment, a Kentucky teacher was found liable when a student was electrocuted while using a whirlpool. During his modification of the whirlpool, the teacher failed to install a ground fault interrupter, even though the National Electrical Code requires one (Zirkle, 32).

Another type of legal liability, which is of concern to teachers, residential construction students, and educational institutions, is product liability. According to Colangelo and Thornton, the manufacturer has a responsibility to produce a product that will function properly, safely, and reliably. The equipment, which both the instructor and student utilize in the educative process, is not only prone to potentially hazardous malfunction, but also to misuse (Colangelo and Thornton,1). The National Electronic Injury Surveillance System (NEISS), states that in 1998 there were an estimated 36,136 injuries to consumers attributed to power tools. This figure includes tools that are commonly associated with the residential construction laboratory (U.S. Consumer Product Safety Commission. This figure does not include injuries resulting from the use of workshop power saws. NEISS estimates that in 1998 there were 91, 771 injuries resulting from the use of workshop power saws, and 113, 675 resulting from the use of manual/hand-held tools (USCPSC, 4). Each of the previously listed tool groups presents teachers and students in the residential construction laboratory with a myriad of hazards and hazardous situations that teachers must attempt to prevent.



## Ways to Minimize Liability

Gregson states that "...trade and industrial education teachers are now more likely to be involved in legal action if one of their students suffers an injury than at any other time in educational history" (Gregson, 36). Kigin relates several strategies which both educators and institutions may utilize in order to avoid potential negligence or liability charges. Kigin refers to these strategies as a "Prescription for Litigation Immunity."

- Be present in the classroom at all times when a class is in session.
- Maintain a neat, orderly, and safe classroom environment.
- Instigate a comprehensive and continuing safety program.
- Correct all known hazards and defective conditions.
- Review safety policies and procedures on a regular schedule.
- Provide a good personal example, particularly when demonstrating power equipment.
- Equip and maintain all machines with guards that meet or exceed industrial standards.
- Insist that guards be in position and used whenever a machine is in operation.
- Be particularly alert and in a close proximity to power machines when students use them.
- Require 100% eye and face protection of all students and classroom visitors.
- Establish safety zones around all power equipment.
- Use visual safety aids (posters, films, and printed material) as an integral part of classroom instruction.
- Don't assume that students will perform in a safe manner without adequate supervision.
- Predetermine a plan of action in the event of an emergency.
- **Stay in the classroom!!** (Kigin, 26)

Zirkle expanded on many of Kigin's principles, and added concepts which can also protect the instructor from liability outside the laboratory environment.

- Post your classroom/lab rules and regulations in a conspicuous place.
- Post fire/tornado drill information in a conspicuous place.
- Provide appropriate instruction.
- Keep proper records.
- Keep private information private.
- Follow school discipline codes—don't create your own.
- Avoid "touchy" situations. (Zirkle, 34)



It should be noted that both Kigin and Zirkle specify that legal liability is sometimes unavoidable, and is a constantly present threat in the residential construction laboratory. However, both authors also contend that by following these guidelines, and adjusting them to accommodate each instructor's particular class environment, the degree of liability which teachers and facilities face may be greatly reduced. Are current vocational teachers aware of techniques for safe student behavior and have these instructors faced student fatalities?

### **Method of Conducting A Study of Current Vocational Teachers**

A doctoral dissertation study was conducted by the author to examine the perceptions and beliefs of secondary vocational education teachers in residential construction (where safe practices can be *taught*). The study focused on the relative importance instructors assigned to cognitive, affective, and psychomotor factors which have a significant influence in governing the safe behavior of their students in performing work activities in the lab setting. Additionally, various factors relating to the content, procedures, and policies that they believe are essential elements of an effective school laboratory safety program were studied. Also analyzed were the effects of demographic information on the perceptions of these teachers.

In this study, vocational training programs in residential construction were defined as courses involving frame and finish carpentry (including floors, window sills, etc.). Information examined in this study was gathered through the use of a mailed survey instrument. The methodology utilized in this study was the descriptive method of quantitative research. According to Gall, Borg, and Gall (1996), the descriptive method of quantitative research is defined as "...a type of quantitative research that involves making careful descriptions of educational phenomena" (p.374). Furthermore, Gall et



al. also state that “descriptive studies are concerned primarily with determining what is” (p. 374). The goal of this research was to fulfill each of these definitions.

Several types of data were accumulated through this study. These types include various demographics and the instructors’ perceptions and beliefs regarding the relative importance of these factors. Additionally, information regarding selected factors relating to the content, procedures, and policies which instructors believe are essential elements of an effective school shop safety program were also collected. A pilot study was instituted in order to ensure instrument clarity and question validity. The prototype survey instrument was distributed to the author’s dissertation committee and a panel of educators from the Department of Occupational Safety and Health at a major university. The pilot study was distributed to twelve postsecondary residential carpentry instructors in the states of Arkansas, Maine, Vermont, and Oklahoma. Following their comprehensive review, suggestions were incorporated into the survey instrument from each of the previously mentioned entities. The resulting instrument was sent to 459 secondary carpentry teachers (as identified by the various states’ Trade and Industrial Education representatives in the continental United States of America, Alaska, and Hawaii). A total of 183 (42%) survey instruments were returned. Statistical calculations were computed utilizing the SPSS (Statistical Package for the Social Sciences) computer program.

It is important to assess and analyze the current perceptions and/or beliefs of secondary vocational education teachers in residential construction concerning effective laboratory safety programs and discover if selected demographic information has a significant effect on these teachers’ perceptions and/or beliefs about safety. Profiling the secondary residential construction teachers and their perceptions of safety programs in their laboratories is the first step in determining the status and remediation of problem areas in such safety programs.

The assessment and analysis of the perceptions and/or beliefs gathered in the study of secondary vocational education residential construction teachers established a



basis for judging the current outlook of teachers regarding effective safety programs, as well as the overall effectiveness of these programs.

The relative importance that teachers assign to selected psychological or human factors have a significant influence on the safe behavior of their students in performing work activities in a laboratory situation. More specifically, students' actions are a direct reflection of the teachers' efforts in promoting and maintaining an effective safety program (Nichols, 1971). The resulting behavior of the teacher will *lead to* the final accomplishment of the implementation of an effective safety program. This effectiveness may be measured in terms of the increase or decrease of differing types of accidents, injuries, or fatalities suffered by the students, the increase or decrease of identifiable hazards in the laboratory setting, or other factors relating to safety determined by institutional management and/or the teacher (Nichols, 20).

The relative importance that teachers assigned to students' ability to perceive hazards, aspiration to behave safely, attitude toward safety, knowledge of safety procedures, spatial perception, mechanical comprehension, and general intelligence was explored. Furthermore, the relative importance that teachers assigned to techniques of accident reduction involving student motivation, supervision, testing, and hazard assessment was investigated.

Categories of factors that they believed needed to be addressed in their respective lab settings were also discerned. Factors analyzed in this part of the study involved teachers' assessment of the conditions of areas relating to safety equipment, budgets, materials, methods, educational opportunities, curriculum, tools, and laboratory design in their respective settings. Finally, the demographic areas of age, level of education, teaching experience, residential construction work experience, and the number of students enrolled in teachers' respective classes were determined to have significant effects on the perceptions of respondents in the sample.



## **The Survey Instrument**

The final version of the survey instrument (which was four pages long) developed by the author was divided into two parts. These parts included Likert Scale-based, multiple choice, and open-ended, short answer questions. Part One, entitled About Safety, consisted of questions based on the Likert Scale format. Part Two, entitled "About You", contained multiple choice and open-ended, short answer questions. To

ensure respondent confidentiality, all survey instruments were destroyed following data assimilation. Nine surveys were mailed to participants in each state. The total number of surveys returned was 183.

## **Results of the Study**

The majority of teachers in the sample population (90 percent) believed that instilling a positive general attitude within students regarding safety is the most important affective factor in establishing a successful safety program. The majority of teachers also believed that, once this attitude is established within students, the remaining cognitive, affective, and psychomotor factors listed become secondary in importance as a result.

An average of 75.4 percent of teachers indicated they received their present safety information and training from various written sources easily accessible to them and from their personal experience working in residential construction. Thus, it may be surmised that the amount of formal instruction each instructor provides their various classes regarding safe work practices in the classroom/lab *fluctuates* with each instructor in terms of its depth and scope.

## **Significant Factors that Impacted the Laboratory Programs Studied**

The respondents reported that a *majority* (60.7 percent) of teachers currently utilize a curriculum in their classrooms or labs written by themselves. That is, the data showed that residential construction teachers utilize no uniform, written, currently existing curriculum. The majority of teachers in the sample population (70.4 percent) also believed that the area which needed the greatest attention in their labs was that of safety instruction as it related to large mechanical equipment, followed by an increased amount of support regarding lab safety from their respective state levels of administration (69.9 percent).



The age of each teacher also displayed several significant interactions, including how important teachers believed that applying penalties to students for breaking safety rules was to maintaining an effective safety program. The *younger* the teachers in the sample population were (those aged 21-40 or 41-50), the *more important* they believed punishing students for breaking established lab safety rules was to maintaining an effective safety program. The *older* the teachers in the sample population were, (those aged 51+) the *less important* they believed this policy was to maintaining an effective safety program.

Age also displayed a significant interaction with how often teachers reported students under their supervision were involved in a classroom/lab accident. Teachers aged 21-40 reported *most often* that their students had been involved in a classroom/lab accident *in* the last year. Teachers aged 51+ reported *more often* that their students had been involved in a classroom/lab accident in the last five years. Teachers aged 41-50 reported *least often* that their students had been involved in a classroom/lab accident *in the last five years*.

### **Budgeting for Students-The Dollar Factor**

Additionally, the number of students teachers reported having in their respective classrooms and labs displayed a significant interaction with how often teachers reported that the budget needed attention. To purchase safety equipment and maintain an effective program, teachers reported a need for more money to be allocated. Teachers who reported having less than 10 students in their classes reported most often that their budgets needed attention. Teachers who reported having 21+ students in their classes reported least often that their budgets needed attention. These results indicated that the number of students teachers have in their classes affected how teachers viewed the condition of their respective budgets for safety equipment. The number of students also affected the problems with their equipment supply and quality of safety education materials. Perhaps the amount of money allocated is based on the number of students in the class.

### **The Teaching Experience Factor**

The respondents' teaching experience in residential construction also displayed a significant interaction with the importance they attached to the student utilization of analytical tools. Tools such as the Job Safety Analyses (JSA) are frequently used to maintain an effective safety program. Results of the survey showed that the teachers in the middle of their teaching careers believed these tools were more important than those teachers at the beginning or end of their respective careers.



A significant interaction was also displayed in the respondents' teaching experience and how important they believed students' attitude toward safety was to maintaining an effective safety program in their respective classrooms and labs. Teachers who reported having 15-21 or 22+ years of experience believed that students' attitude was very important to maintaining an effective program. Teachers who reported having 1-7 or 8-14 years of experience believed that students' attitude was less important to maintaining an effective program. These results indicated that the number of years each respondent possesses in teaching residential construction affected how important they believe students' attitude toward safety was to maintaining an effective safety program. Teachers with more experience believed students' attitude toward safety was more important to maintaining an effective safety program than those with less experience. The teaching experience factor also displayed a significant interaction with how important they believed students' opinions of other students' actions (peer pressure) were to maintaining an effective safety program in their respective classrooms and labs. That is, teachers at the beginning of their teaching experience did not believe that peer pressure was an important factor. However, teachers at the middle to end of their teaching careers believed it to be a significant factor in maintaining an effective program.

### **More Demographic Interaction Factors**

The average age of each teacher was approximately 41+ years. The average construction experience of each teacher (in other words, actual experience on residential construction jobs) was approximately 31+ years. The average level of education of each teacher was more than a four-year degree. Each teacher in the survey possessed an approximate average of 15-21 years of teaching experience. The average number of students each teacher had per class was approximately 16-20.

All of the respondents reported that they had never experienced a student fatality in their classrooms or laboratories. Interestingly enough, however, teachers reported an average level of involvement in legal cases relating to a student's personal injury within the last year. Finally, an average number of teachers indicated that they had students involved in classroom/lab accidents in the last five years.

Specific demographic information on the perceptions of secondary vocational education teachers in residential construction was also examined. Based on these results, it is the conclusion of the author that the teachers' level of education had the greatest significant effect on the perceptions of teachers in the sample population, and the subsequent manner in which they responded to questions on the overall survey instrument. That is, teachers with higher levels of education for example, referred to technical publications for safety information, whereas, teachers with more work experience than education referred to data from their previous jobs more frequently than to professional publications. These results show that although many teachers (42 percent) indicated that they relied solely on their previous work experience in residential construction, a majority (82 percent) indicated that they utilized safety information and training gained from professional publications and experience in their present teaching



positions. Furthermore, it is the author's opinion that how each of these teachers received their present safety information and training directly affects the design and performance of each teacher's respective safety program. Teachers with ten students or less had significant problems in obtaining adequate materials.

### **Psychomotor Skills and The Student Attitude Factor**

Teachers assigned the lowest average level of importance to the psychomotor factor of students' speed in completing jobs. It is the author's conclusion that teachers assigned the highest rating to students' attitude due to the fact that teachers believe once a positive attitude toward safety is established in students within their respective classrooms or labs, that the remaining cognitive, affective, and psychomotor factors become secondary in importance. Therefore, teachers in residential construction should strive to discover elements in their courses and instructional methods that they believe are important in fostering positive attitudes toward safety.

Finally, it is the opinion of the author that secondary residential construction teachers should utilize methods of positive reinforcement (such as safety incentive programs) to promote safe behavior among their students. Additionally, it is also the author's opinion that if secondary residential construction teachers incorporate a program that recognizes their students' positive achievements in the area of laboratory safety into the curriculum of secondary residential carpentry classes, more effective safety programs will ultimately result.

### **Where Can Teachers Go for Information?**

Teachers were asked to identify where they would go to find information relating to safety and the residential construction curriculum concerns. Most refer to professional publications, information from their respective state departments, their own teaching experience in residential construction, and on-site visits to industrial facilities. Thus, there is no singular, all-inclusive source for safety and information training available that the majority of teachers utilize exclusively.

In conclusion, through the performance of this study the author discovered the relative importance that secondary vocational education teachers in residential construction assigned to various cognitive, affective, and psychomotor factors. Furthermore, the author ascertained what content, procedures, and policies these teachers believed were most/least important to include in the design of an effective laboratory safety program, as well as the factors that these teachers believed needed to be addressed or improved within their respective laboratory settings in order to establish and maintain an effective safety program. Finally, through the use of statistical analysis, the author derived the significant effects of selected demographic information on the perceptions of the teachers.

Construction teachers may utilize the information here to begin a systematic implementation of a safety program, or begin to evaluate and improve the effectiveness of their current instructional programs, and perhaps reduce the amount of legal liability they face in the future. The utilization of the findings of this study will further help teachers understand the importance of specific factors such as the student's positive attitude toward safety in the realization of a consistently safe laboratory environment.

It is the hope of the author that teachers, administrators, and other educators in the area of residential construction will find this study useful in designing and maintaining effective safety programs within their respective classroom and laboratory settings. It is only through the cooperation of individuals such as these that accidents in the laboratory environment may be reduced.



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