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AUTHOR	Lacina, Dale Robert
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ABSTRACT

The effectiveness of team building as a strategy for improving students' concern for safety in a production technology laboratory was examined in a study involving a group of grade 9 and 10 production technology students from an urban, lower-middle-class community in western Illinois. Students' safety test scores, teacher checklists, and disciplinary referrals had documented that the students behaved in an unsafe manner in their work laboratory. A strategy to improve the students' concern for safety was devised by synthesizing information gathered during a literature review and consultation with knowledgeable persons. The strategy incorporated the principles of heterogeneous grouping and cooperative learning. After the instructor demonstrated the laboratory safety rules, students shared responsibility for learning them. Safety supervisors were assigned within each group to help monitor group members as they worked in the laboratory, and an assessment sheet was developed for the group to use when analyzing the causes of safety violations and identify remedies. Data collected after the intervention confirmed that the intervention strategy increased the targeted students' sense of responsibility to monitor the safety of their laboratory work environment. (The bibliography lists 22 references. A safety rule progress chart, safety violation assessment sheet, and safety rule violation checklist are appended.) (MN)

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IMPROVING STUDENT CONCERN FOR SAFETY IN A PRODUCTION TECHNOLOGY LAB THROUGH THE USE OF TEAMBUILDING

Dale Robert Lacina

An Action Research Project Submitted to the Graduate Faculty of the

School of Education in Partial Fulfillment of the

Requirements for the Degree of Master of Arts in Teaching and Leadership

Saint Xavier University

Field-Based Master's Program

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ABSTRACT

Author: Dale R. Lacina

Date: May, 2002

Title: Improving Student Concern for Safety in a Production Technology Lab

This report describes a program to improve the student level on concern for safety in a high school production technology class. The targeted population consisted of ninth and tenth grade production technology students located in an urban, lower middle class community in western Illinois. Student safety test scores, teacher checklists, and disciplinary referrals had documented the problem of students being unsafe in their work lab.

Proof of probable cause data revealed that direct instruction of the safety rules and instructor monitoring of the students for unsafe actions led to a decline of student concern for the safety of their work environment.

A review of solution strategies suggested by knowledgeable others, combined with an analysis of the problem statement, resulted in the selection of the following intervention: heterogeneous grouping of the students to develop team building with jig sawed safety rule study, group members being responsible for identifying unsafe actions and developing solutions to the causal factors.

Post intervention data indicated an increase of safety conscious behavior. The team building and leadership roles within the groups increased the targeted students sense of responsibility to monitor the safety of their lab-work environment.

SIGNATURE PAGE

This project was approved by

H. Nancy Frakes, Ph.D.

Advisor

John G. Mulen, Ed.D.

Advisor

Beverly Gulley

Dean, School of Education

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CHAPTER 1

PROBLEM STATEMENT AND CONTEXT

Problem Statement

The students of the targeted production technology class demonstrated a lack of concern for the safety rules required to maintain a safe environment in the work lab. Evidence for the existence of the problem included teacher observations during lab activities, anecdotal observations, referrals to the administration, and safety tests. These observed and documented areas of concern indicated a potential for serious injuries.

Local Setting

The targeted student population attended an urban, lower middle class high school in western Illinois. The school district's student population consisted of grades 9 through 12 with an enrollment of 1,877. The racial and ethnic background of the population was as follows: White Non-Hispanic 77 %; Black 7%; Hispanic 15%; Asian 1%; and Native American 1%.

The high school's low-income population was 33%, while the Spanish-speaking, bilingual program was 1% of the total population. The attendance rate of the school was 94%. The chronic truants were classified as 3%. The student mobility rate was 17%. This was lower than the state average of 18%. The average class size was 28, which was higher than the state average of 18.

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The high school staff consisted of 98 teachers, 11 administrators, 5 teacher aides, and 6 counselors. Teachers having a master's degree or higher was 57. The racial/ethnic background of the teaching staff was 85% White, 1% Black, and 3% Hispanic. There were no Asian or Native American teachers on the staff. The average teaching experience was 15.5 years. The gender ratio was 40% males and 60% females. The average teacher's salary was $44,846. The average administrator's salary was $82,686. The average instructional expenditure per pupil was $3,956.

The daily schedule was a 7 period day with each period being 50 minutes in length. The faculty was provided at least one duty-free, planning period each day. The high school offered a wide variety of subject areas to students along with the core subjects of English, mathematics, social sciences, and science. Students had access to six computer labs for the various subject areas.

The school was built in the early 1960s and had two floor levels. In the 1980s an area career center was built to offer training in many diversified vocational occupations leading to full time employment. Student activities included band, clubs, choir, and sports.

Community Setting

The targeted high school was located in a city with a population of 20,147 of which 51% were female. A breakdown of the distribution of ages was 34% were 24 or younger, 41% was 25 to 54 in ages, and 25% were 55 or older. The racial/ethnic orientation of the city was White 83%, Black 10%, Hispanic 10%, Asian 1%, and Native American 1%.

The city was located in a metropolis with four other cities of equal or larger populations. The fact that the Mississippi River flowed through the middle of this cluster of cities provided both opportunities and problems shared by all. A wide selection of work/career opportunities were available including manufacturing, transportation, construction, communication, finance, health service, and public administration. The distribution of employment was: manufacturing with 22%, wholesale and retail marketing with 25%, and professional services with 20% of the labor force.

A study of adults 25 years and older living in the area of the high school showed that their level of educational attainment divided into three main categories. The categories were adults having a high school diploma or less at 77%, adults having some college with no degree at 4%, and adults having a college degree or higher at 19%. This would tend to indicate a blue-collar workforce.

Seven different elementary districts fed the targeted high school, causing a "melting pot" effect in the freshman year. Students could change or add friendships. They could also change their identities. If a student had been a class clown or displayed any negative personality, that student is given a chance to start fresh in this new environment. Unfortunately, students could also choose to take on negative qualities of their new friends. With this problem, the school had a co-coordinated effort between the deans of students and the counselors to help keep the students on task and in school.

National Context

From the time man first attached a rock to a heavy stick and started mashing his food or building his shelter, there was the need to understand that the mashing device could also bring severe pain to, or elimination of, the hand not holding this new tool. It became apparent that the new members of the workforce should not come to this same conclusion by personal experience. Glazener and Comstock (1978) stressed the need for safety education in technical education programs to prepare future employees for industrial safety requirements. As technology advances, safety is built into the new equipment, but the proper and safe utilization of these machines must still be learned.

A study indicated this same concern requires educating the educators (Petty & Pierce, 1988). The Safety Training Needs Survey, developed at the University of Tennessee, was sent to 145 industrial arts teachers and their administrators. The response revealed no difference between the two groups in the perceived high need for safety training. The study claimed this safety training should be emphasized in both undergraduate college courses and inservice training for industrial arts teachers.

Any observer of American legal activity would see that lawsuits are prevalent. One must recognize that vocational 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 history (Gathercoal & Stern, 1987). Any business or educational institution would find it obvious that an aggressive policy to teach, practice, and pursue the safest environment for its staff, students, or workers would be the best plan of action for all concerned, and the best place to start is in the first years of industrial education. An understanding of teacher liability is therefore crucial. In 1999, Zirkle spoke of the courtroom topics involving teacher responsibility to protect his students. Teacher and school liability concerns tort law. There are two types of torts, negligence torts and intentional torts.

Negligence is a breach of duty to keep others safe from harm. This harm can arise either from doing something the teacher was not supposed to do, or from not doing what the teacher was supposed to have done. Negligence has four elements that determine the extent of the liability. The first element is duty. Teachers are legally obligated to protect their students from harm. The second element is the standard of care. Teachers must demonstrate a reasonable

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standard of care such as not leaving the classroom unattended or failure to show up for assigned hall duty. There is an allowable variance as to the level of care provided that is determined by the situation. Younger students and students working in areas such as vocational and technical labs require closer supervision. The third element of negligence is proximate cause. Is there a direct link between the teacher's lack of care and the student's injury? The fourth element is the actual injury. The severity of the injury should not bear on the level of negligence by the teacher but it most definitely will determine the extent of reparations due the student if negligence is indeed found.

Intentional tort is when a person desires to bring about an intended consequence. Under this category of tort law the teacher or student may be found guilty. There are four types of intentional tort. Assault is a verbal threat to do harm. Battery is the physical act threatened in the assault. This physical act can range from punching or hitting to touching. Any physical touch can be taken as assault. The friendly pat on the back is now put in question as battery. False imprisonment is the detaining of someone against his or her will. Locking a misbehaving student in a closet is obviously a violation but sending the student to the hallway may be considered negligent for failure to provide standard care of supervision. Defamation is the verbal or written statements that damages a person's reputation. In this area a teacher should never share information of a student's behavior or performance with another student. Understanding of these two types of tort law will help not only industrial and vocational instructors but also staff members of any educational institution.

CHAPTER 2

PROBLEM DOCUMENTATION

Problem Evidence

To help the researcher document the lack of concern for safety, the targeted production technology students were administered safety tests before lab work on power machines could begin. A chart was used to monitor the student progress to complete these tests. In addition, a repeat of the General Shop Safety Rules test was given near the end of lab work activities. This was to determine retention of basic safety rules. Observations of numerous minor safety violations during this previous semester were not recorded, as there were no established methods for documentation. These violations varied from a constant reminder to put safety glasses back on to improper use of a machine. The violators were given verbal admonitions and warnings to avoid future repeat actions. Safety violations of a flagrant nature such as intentional damage to a machine were referred to a dean of students. Small lacerations were tended in the classroom with bandages, whereas more serious injuries were sent to the nurse for medical attention.

During the previous semester, the production technology safety test scores were analyzed. Direct instruction of the safety rules was given prior to the administering of all the safety tests. Table 1 shows the class percentage of the individual tests and as the combined class percentage. Table 2 shows the mean scores to help indicate that one class scored higher with a

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certain test than another. It was observed the length of the rule sentence or the greater number of rules per machine tended to lower the percentage of correct responses. The first period class scored higher than the seventh period class. This difference may be attributed to tracking due to scheduling of core curriculum classes.

Table 1

Scores on Tests Administered to Production Technology Students Spring 2001

PRODUCTION TECHOLOGY SPRING 2001 3rd QTR	Gen. Shop Rules	Gen. Mach. Rules	Band Saw	Jig Saw	Drill Press	Table Router	Disc Sander	Spindle Sander	Total Score
Total Rules	16	3	8	7	7	5	8	7	61
1st Pd. Pct.	83.1	98.3	81.9	70.0	76.4	87.0	74.4	81.4	80.4
7th Pd. Pct.	81.8	100.0	61.9	66.2	75.3	80.0	56.3	75.3	73.3
Combined Pct.	82.5%	99.2%	71.9%	68.1%	75.9%	83.5%	65.3%	78.4%	76.9%

Table 2

Mean Scores on Tests Administered to Production Technology Students Spring 2001

PRODUCTION TECHNOLOGY SPRING 2001 3rd QTR	Gen. shop rules	Gen. mach. rules	band saw	jig saw	drill press	table router	disc sander	spindle sander	total score
TOTAL SCORE	16	3	8	7	7	5	8	7	61
1ST PD MEAN	13.3	3.0	6.6	4.9	5.4	4.4	6.0	5.7	49.1
7TH PD MEAN	12.1	2.7	4.5	4.3	4.8	3.6	4.1	4.8	41.0
ALL PD MEAN	12.7	2.8	5.5	4.6	5.1	4.0	5.0	5.2	45.0

Analyses of these test scores reveal students' safety scores on two machines dropped into the 60% range. A humorous yet sobering observation was that at a 60% safety rate, a worker would leave the work zone with at least 6 of his fingers. Note that these recorded scores were from the first time the tests were administered. The students were retested until they passed each test at a 75% to 80% range.

The researcher noted that several times during a normal lab activity, one or more students would have to be reminded to put on safety glasses. Usually the violating student would respond with, "Well, I'm not doing anything dangerous," or "They are too dirty to see what I have to do." Safety glasses are sometimes worn in a variety of places, from sitting on top of their heads, to mounted backwards on their heads, or hanging from one ear. Somehow being in the close proximity of their eyes seemed to be enough to fend off whatever dangerous projectile may fly at them. Generally the more conscientious the student, the less likely that student will misuse his safety glasses. The attitudes toward safety glass usage mirrored the students' proper or improper use of the power machines.

No method had been developed by the researcher to document these minor infractions. Just the sheer numbers of safety violations occurring leads to the chance that an injury might happen. "Considered as a batch of potential at-risk exposure, the task-related behavior of 500 people is a very predictable thing – without an active incident prevention process, injuries are going to occur" (Spigener, 1995, p. 63).

Probable Cause

One cause for the targeted student population to be lax in their attention to safety concerns is that there is little coordinated effort among the Industrial Technology and Vocational staff to bring attention to safety during lab-work. There was no concerted active incident prevention process. Safety tests are sometimes shared among instructors having common machines or lab work environments. The final control of student adherence to safety standards appears to rest upon individual instructors to lay the foundation of acceptable safety norms.

Casual observations by the researcher saw varying degrees of safety glass usage by students in other classes of the department. If a student commits an intentionally unsafe act that injures another student or creates a near-miss incident, the administration was solid in its support of referrals submitted for these infractions.

The targeted population was composed of students from several feeder schools. Students working in the industrial technology laboratory may disregard stated safety rules to impress new friends that they are above any need to adhere to safety rules put forth by this new teacher. "My teacher last year never had me adjust the blade guide." A macho attitude may prevail that "values risk-taking and denigrates health and safety" (Simon, et al., 1991, p. 107). This occasion could lead to a repeat performance even without an audience.

On a few conversations after student injuries, the students conceded the fact they were in a hurry. As a grading deadline approaches there is a flurry of activity to complete projects. In their concentration of getting the project work done, the students tend to forget or ignore the safe procedure thinking it was too time consuming.

In a study by Knight, Junkins, Lightfoot, Cazier, Olson (2000), it was proclaimed that injuries in the school environment are a serious health problem. Of all injuries to school-aged children, 20% occur on school property. These injuries cost an estimated $3.2 billion in medical costs, but the real tragedy is the individual suffering that school shop accidents can cause. An account was related of an eleventh grade female in a woodworking class who had two fingers partially severed as her hand was pulled across the blade of a table saw while she was reaching for the wood scrap. What was her previous training with the machine? What was her attention to safety factors at the time of the incident?

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Knight, et al., (2000) also noted that federal policies carefully regulate the safety of minors in the workplace. Many policies restrict or prohibit children under 18 from operating power equipment such as woodworking tools, metal-forming machines, circular saws, or band saws. These are often the same tools used by students in shop classes with few restrictions. Knight stated, "This equipment is not only designed for adults but also has great potential for serious injury" (2000, p. 10).

As this concern for a safe, industrial work environment is being targeted, the causes of unsafe acts must also be explored. Gardner (1970) stated that misguided motivations might be used to determine the cure. The causes listed were: inadequate skill, display of manhood, distractions, and seeking the approval of fellow workers. Developing a one-shot solution to all these causes does not appear reasonable.

CHAPTER 3

THE SOLUTION STRATEGY

Literature Review

During a review of the literature, the researcher found that there are many aspects of the vocational/industrial laboratory work safety environment that extend beyond the concerns and attitudes of the students. The industrial staff and administration must strive to ensure the entire lab facility is in compliance with existing safety rules and regulations. A 1995 article by Kirk stated, "the major problem with respect to mandated legislation, both federal and state, is simply not knowing these policies and laws even exist!"(p. 44) The article listed several federal legislative policies that affect school lab work environments.

One initiative by the Occupational Safety and Health Administration, OSHA, from a request of the employer, will send a consultant to visit the workplace and review the existing procedures and facilities. A walk-through will identify safety concerns with the machines or laboratory structures. A list is developed for areas of immediate attention. If a violation level item is found, no citation is issued; however, a timeline is allowed for the employer to address the problem. OSHA will also provide funds to nonprofit organizations, through grants, to conduct workplace training and education in subjects where OSHA determines there is a need. Conners (2000) described how Korellis Roofing Inc. conducted a daylong safety orientation seminar for its roofing installer crews. Construction Advancement Foundation provided the

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training funded by an OSHA grant. Many educational institutions take advantage of this service to ensure their facilities and policies meet OSHA standards.

A textbook, Organizing Course Materials for Industrial Education, devoted only four pages out of 458 on the subject of safety. This college text was used in the 1960's to prepare Industrial Education teachers. Short, but to the point, it spoke of testing two areas of student safety. One is to test for the understanding of the general laboratory and specific machine procedures to be able to work safely in the shop or laboratory. In effect, this is the "nuts and bolts" of shop safety. The second area to test is based on attitudes. How the student "is developing a wholesome attitude toward the importance of observing the safety precautions that are so essential for the correct use of industrial tools and equipment" (p. 356). Simple factual tests are inadequate to evaluate this psychological factor. It was advisable for the teacher to maintain observational records of the student's safety performance. In a sample project-grading rubric, safety was given a twenty percent weight. The descriptor cited, "Exhibited safe attitude and practical safety precautions in all activities" (p.360). As a self-evaluator, this would allow the student to contemplate his current development of safety attitude. This rubric would also provide the student with an understanding of how the teacher views his progress of safety attitude.

In a study of more recent textbooks devoted to training vocational and industrial instructors, Gregson (1996) surveyed three prominent texts. Gregson was trying to determine if trade and industrial education students were getting information and training to prepare their future students for work in a constantly changing work environment where hazards must be controlled. The selected texts were: Managing the Occupational Education Laboratory (Storm,1993), Teacher Liability in School-Shop Accidents (Kigin, 1983), and Safety and Health for Industrial/Vocational Education: For Supervisors and Instructors (Firenze & Walters,1981). Four categories were identified and as the texts were read, the data was collected per these categories: (a) the definition of a health and safety problem, (b) the allocation of responsibility for solving the problem, (c) the social context of work, and (d) collective responsibility for health and safety. The texts varied from one another in their coverage of these categories, but Gregson was able to make some valid discoveries. All the texts gave information that, if properly implemented, would protect trade and industrial educators from being found negligent and therefore liable for litigation. The texts emphasized personal solutions, for example personal protective apparel, instead of technical or administrative solutions.

There is yet a need to prepare workers to act collectively with their employers to improve the quality of their working environment (Hershbach, 1994). As the texts reviewed by Gregson (2000) emphasized the functions of current industrial workplaces, a need is yet to develop the ability of a worker to see contradictions or to question the taken-for-granted assumptions of how work is done. A worker must develop the ability to see how work can be done differently for the benefit of all concerned parties. The more participatory and democratic a workplace becomes, the more it becomes productive, profitable, and safe (McDermott, 1990). Projects are needed that study the workplace to compare the safety control factors of large and small industrial workshops. Problem solving of real or simulated situations will help future workers contribute in a positive manner to the safety of their work environment.

Many researchers identified safety procedures and precautions that dealt with specific lab environments. Brown (1999) gave tips and techniques that are critical to ensure that a welding work area would be free of health hazards. Details were given to provide adequate ventilation, spark and arc protection, shock prevention and other welding lab dangers. A checklist was developed with visuals of potential hazards, factors to consider with these hazards, and a summary of precautions to reduce the risk of these hazards. Pankratz (1999) described more specifically the personal protective clothing that a student in a welding lab should wear. Articles such as these are invaluable sources of information to bring instructors up to date on how to inventory their labs for specific hazards.

To help a vocational or industrial technology instructor survey his lab for dangerous conditions, Foster (2002) identified six general areas of safety. They are – Illumination and Color, Health Hazards, Fire Protection, Personal Protective Equipment, Machine Guarding, and Electrical Safety. These areas were briefly described as primary hazard concerns. A statement then followed each area with what the instructor could do to minimize the dangers or where to find the information to help minimize the danger. The items that should be posted at the danger zone and information that needs to be kept at close hand for reference were also discussed.

The placement and upkeep of stationary tools in the industrial work laboratory are of one concern for the industrial technology instructor, but hand-held portable power tools present another category of safety concern. Spry (2000) wrote of the need to read the manufacturer's specific instructions on the safe operation of a power tool. The article gave a list of general guidelines for all power tools. One rule of specific note is to secure the work-piece. This then frees both hands of the operator to hold the power tool. This reduces both dangers of kickback and injury to the hand holding the work-piece. More specific information was given for power tools, such as portable circular saws. The author made special note that the operator's manual must be read for the safety guidelines for that tool. Warning labels on the tool may have specific information that is not in the manual.

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Circular saws, both table and portable, have a primary danger of kickback. This happens when the blade binds against the wood and "kicks" the wood "back" at the operator. The force of this can bury a two by four stud into a wall behind the table saw. When the blade of a portable circular saw binds, the saw itself is kicked back at the operator. Domeny and Uzumcu described the features and accessories provided that would help reduce the dangers of kickback. No matter how well designed the safety feature the most common fault is with the operator. "Personal responsibility is crucial, starting with paying attention to the work" (2001, Oct., p. 22).

Physical injury can come from the hazardous chemicals that are utilized in the industrial education lab. In 1996, Humphrey wrote of the history, development, and necessity of Material Safety Data Sheets, MSDS. "When we understand the dangers inherent in ignorance, and the value of the information contained in these reports, we will be motivated and equipped to provide a safe, knowledgeable learning environment" (p. 35). The inclusion of MSDS into the safety curriculum will not only help students learn of the current hazardous materials in their lab but will develop their use of MSDS in their future work-related careers. The author wrote of how he had been using a popular brand of aircraft fabric coating on student projects for years. He came across the MSDS for this product. It became clear why he had developed chronic headaches, lightheadedness, and a ringing in his ears. He had not only threatened his own health, but that of his students as well. He pointed out that over 2,000 new chemical substances and compounds are developed each year. The knowledgeable use of MSDS is the one way instructors can protect their students and themselves from the hazardous misuse of chemicals.

The increasing popularity of cordless power tools is evident by the estimated 107.5 million in use by Americans in the year 2000. Cordless tools have an obvious safety advantage in that there is no cord to be accidentally cut and therefore create a shock hazard. That which replaces the power cord has created a new hazard.

The misuse of cordless tool batteries is now a concern for industrial technology instructors. Under normal use these batteries are not dangerous. Students need to be shown the proper methods of battery storage and recharge. Domeny and Uzumcu (2001, Nov.) described the dangers of battery misuse. A fire hazard is possible if metal objects tossed into the toolbox accidentally short across the terminals. Battery liquid leakage can cause tissue burns. This topic is evidence that as new technology is brought into the world of industrial technology the new hazards they present need to be explained to the students that will be working with them.

Advances in technology can also improve the safety in the vocational and industrial technology lab. Roudebush (1998) described the revisions made to the American National Standards Institute (ANSI) Z-87.1 Standard for eye and face protection. The previous Standard eye protection design specifications only required the frame and lens to withstand a high mass, low velocity impact test. In 1989 the ANSI Z-87.1 Standard was revised to include a low mass, high velocity impact test. This would be comparable to being struck by a flying broken drill bit. The 1989 revisions also made the eye safety glasses more performance oriented than specifications related to size and shape. In recent years the manufacturers of safety spectacles have been able to utilize lighter materials to make the glasses more comfortable. The shape of the glasses have become more stylish helping reduce the student wearer from feeling less than attractive as the old style of glasses appeared.

The introduction of polycarbonate as the lens material has not only lightened the safety glasses, but also considered the most impact-resistant clear optical material known. Polycarbonate as a plastic has allowed manufacturers to design the spectacles into wrap-a-rounds

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that are not only more stylish but provide a field of vision up to 200 degrees. The ease of scratching polycarbonate has been countered by a silicon polymer coating to improve the spectacle's abrasion resistance (Roudebush, 1998). The technological advancements of safety glasses have improved the safety of the wearer and the acceptance of the wearer to put on the glasses and keep them on.

In 1997, Yeager gave an analysis that indicated one area of industrial education laboratory safety that yet needs more attention. He contended that most objectives have been met that safeguards students from hazards and avoids litigation for the faculty and institutions. These have been preventative and predictive measures that are in the technical lab instructor's control. Instructors must now recognize and try to manage the inherent hazardous conditions that basically describe student attitude. He lists the top areas of dangerous student behaviors.

- Compromising safety because safe acts require more time.
- Forfeiting safe conduct in favor of unsafe acts that require less work.
- Allowing personal comfort to over-ride safety concerns.
- Ignoring safe practices in order to gain attention.
- Compromising safety performance when authoritative control is perceived.
- Sacrificing safe acts for peer approval.
- Forsaking.safety for risks and thrill seeking.
- Opting for recognition rather than safety.
- Compromising safety for vanity. (p 44)

After listing these hazardous behaviors, all that is suggested by Yeager is to use "managerial efforts to control or eliminate them"(p. 44). That must mean the student with uncontrollable hazardous behavior may need to be removed from the class. The instructor then needs to document the attitude and behavior of the student in question. After referrals and parental contact has failed to produce a change, the final step must be removal. The extra attention given to the one student while working on hazardous equipment jeopardizes the instructor's ability to help or attend to the other students in the class.

From a study of the literature, the researcher has drawn a conclusion that the vocational/industrial educator has three categories of the safety environment in his laboratory.

a. facility: adequate lighting, proper ventilation, placement and maintenance of equipment, storage of hazardous materials, and other physical controls of the environment.

b. information: knowledge of existing laws or policy changes that are enacted to effect his laboratory environment and students, adequate instruction to and evaluation of the students before they operate equipment, posting of information in appropriate areas.

c. attitude: of the instructor as he is the model of how to work with safety as a prime concern; of the students and how they view their role in protecting themselves and others from hazards in the lab work zone.

It appears to the researcher that the attitude of the student is the most difficult to control. What an instructor can do is provide motivators to help the student see there are advantages to increasing their conscious efforts to include safety. "Beyond traditional safety measures, teachers must learn to deal with hazardous conditions that are part of students' attitudes and behavior"(Yeager, p.43).

Project Objectives and Processes

As a result of implementing cooperative learning groups, during the instructional period from September 2001 to December 2001, the targeted production technology students will improve their safety attitude, as measured by teacher-constructed safety tests, teacher checklists, student assessment sheets, and the number of discipline referrals for flagrant safety violations.

In order to accomplish this objective, the following processes will be necessary:

1. Utilize cooperative learning groups to share the responsibility of learning the safety rules.
2. Assign safety supervisors within each group to help monitor the members as they work in the lab.
3. Develop an assessment sheet for a group to analyze the cause of a safety violation and determine what remedies will be used to prevent a repeat of the observed violation.

Action Plan

Cooperative learning groups will be utilized to share the responsibility of learning the safety rules. The groups will total four students per team. Each team is formed from a ranking of the students' grade percentages and assigned a number based on how many teams are needed to achieve four per team. This sorting procedure will blend students from across the spectrum of the class. If two students that gravitate towards each other for mischief would be placed in the same team, they will be separated. The instructor will initially demonstrate to each team the machine safety rules. Thereafter the teams may go to the machine for review. Team building will help the students identify that they are a vital part of the group's progress through the safety rule tests that precedes working in the lab on their projects.

Safety supervisors will be assigned within each group to help monitor the members as they progress through the safety rule tests. The random selection of displaying an open palm, a

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clenched fist, and the first and second digits of the hand, (Rock, paper, scissors) will be used if two or more students wish to be selected for the position of safety supervisor. The safety supervisor will be given the list of what rules each team member yet needs to pass. The group can then target which rule they wish to review for the next retake. The safety supervisor will also help monitor the group as they begin working in the lab on their individual projects.

An assessment sheet will be developed for the group members to analyze the cause of a safety violation by one of its members. The group must then determine what remedy will be used to prevent a repeat of the observed violation. The members of the violating group must complete, sign, and submit the assessment sheet for approval before the group returns to work. The assessment sheets will be collected by the researcher and used to track the students' progress hopefully toward fewer occurrences through the semester. The assessment sheets will also give the researcher insight as to possible improvements of the initial instruction of an individual machine or a need to review a machine's set of safety rules.

Timeline of the Action Plan

- First two weeks: General course startup activities;

  * Study first two chapters of textbook

  * Study flow chart and production chart information

  * Tests given over the above material

The worksheet and quiz scores will be used to develop heterogeneous groups for the intervention.

- Third week:

  * Assign cooperative learning groups, select safety supervisors

  * Study general shop safety rules via direct instruction with group time to review

* Test general shop safety rules

* Begin machine safety rules study with groups

- Fourth week:

* Begin testing machine rules, 2 machines per day

* Groups review rules missed for retakes to achieve proficiency level, 80%

* Retake machine safety rules until all members of each group have passed

- Fifth week onward:

* Students begin work on individual then group projects

* If a safety violation is observed, an assessment sheet is issued

- Seventeenth week:

* Issue retest of the General Shop Safety rules

Assessment Plan

One measure of the students having retained the safety rules is to retake the General Shop Rules test. This will be taken prior to semester end just before the students end their lab work on their projects. This similar before and after testing was given to the students enrolled in the previous semester yet without the intervention strategy. A comparison will be able to ascertain if the intervention has provided an improvement of the students' retention of the safety rules.

The number of referrals to the student services will be reviewed if any flagrant safety violations were issued. No adequate table or chart may be able to show progress here but it may give incite to the students' performance. These referrals will be used to evaluate the number of occurrences and track if one individual student is a recurring menace. A call to the parent or guardian may be necessary to improve the student's performance or the student may need to be removed from the class.

A good measure of the evolution of the students' attitude toward safety should come from a study of a checklist made from the assessment sheets. The assessment sheets spanning ten days of laboratory work will be placed onto a checklist. This checklist will be charted to determine if the number of safety violations change through the semester. From day to day the intensity of laboratory activity may change. If a class day is spent in classroom study, that day will not be counted toward the checklist.

CHAPTER 4

RESULTS AND CONCLUSIONS

Historical Description of the Intervention

The semester of the targeted intervention started with a study of the importance of manufacturing in society. The concept of manufacturing as an input-process-output system was then covered. A production run of a small project was used to show how industry utilizes mass production techniques to speed up the making of consumer goods. This production run helped study the principles of flow chart and production chart usage. The study of these topics produced homework and test scores used to rank the members of each class and form the safety teams utilized in the intervention. The current grade percentage of the students was sorted from high to low. The students were numbered one through six or seven depending on how many groups of four students were needed. This numbered column was then sorted thus grouping students from the top, middle and lower achieving strata of the class.

The first introduction of the targeted students to industrial education laboratory safety rules was with a whole class, teacher directed lecture of the 16 general safety rules. As each rule was displayed on the projection screen from an overhead projector, the instructor gave supporting relevance of the rule and its necessity for a safe environment in the work lab. Each student would write the rule verbatim from the screen onto his or her own paper for future

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reference and study. Three methods of sensory input were covered as the students saw the rule, heard the rule, and then wrote the rule.

The next day the students were tested on the 16 general safety rules following a whole class review of the rules. The test was to write as many of the rules as the students could remember. Many students wrote all 16, verbatim, and in the given order. Several got the minimum number to pass (12) and did not have to retake the test. Verbatim responses were not required but the basic understanding of the rule must be exhibited. The instructor, to ensure uniform acceptance of the written rules, scored the tests. The scores were placed on the Safety Rule Progress Chart, Appendix A. This Chart helped the instructor quickly ascertain who had passed and who yet needed to retake a test.

At the next class meeting the students were introduced to the members of their safety group. The value and benefit of the students working together as a unit is explained to the class. Peer coaching and team support techniques were discussed. The role of a safety supervisor was discussed and the students gathered into their groups to determine who got to be the safety supervisor. Some students jumped at the chance for a leadership role, while others accepted the role reluctantly.

The next day, two sets of specific machine safety rules were distributed to the groups. Similar machines (band saw and jig saw) were paired to help show similarities and differences. As with the 16 general rules the students wrote their own copy and began discussing the rules in their group. The first group to complete their writing was taken to the machines in study. The instructor explained the rules and how they applied to the machine. The intention was to have a nice concentrated study with a nearly one-on-one discourse of the rules to the members of the group.

This was the first change of the original plans. While the instructor was focused on 4 students, the other 20 were not always sitting and discussing the value of safety rules. The instructor also realized he would be reciting the safety rule demonstrations six or seven times per each of the three classes of the day. Two groups instead of one were given the machine safety rule demonstrations with students taking turns reading the next rule and the instructor giving the explanation. The safety supervisors were given the name of which member of their group needed to retake the test. Test reviews were the standing order for the groups not receiving the machine demonstrations. When all the safety groups had received the demonstrations for the two machines in study, the next day the test was administered over those two machines. This process of live demonstration, review and test, was continued until all six machines had been covered and initial testing administered.

Next, the final phase of the safety testing began with each group working on the review of safety rules for the first half of the class period and then test retakes were given to those in need. The groups were told that as soon as all the members of their group had passed their tests that group would be able to start on the first individual project of the class. Unbelievable peer pressure began to take effect and much energy was put into each group's effort to finish their testing.

It was determined by the instructor that several students had difficulty transferring the known rules onto paper. The struggle of writing was the barrier. It was then offered for a student to be at the machine for the test and verbally recite the rules to the instructor. This did not change the student's initial written test score but it did allow them to pass the test and be able to proceed with the laboratory work. Many of the students reviewed for this test with their group's safety

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supervisor. An aide, familiar with the safety rule tests, was summoned to help administer the verbal tests.

The next part of the intervention strategy to bring personal responsibility for the safety performance of each group was now introduced. The Safety Violation Assessment Sheet, as shown in Appendix B, was explained to the class. If any member of a group was seen violating any of the previously studied safety rules, the entire safety group had to stop work. They then had to sit with the violator of their group and process the Assessment Sheet. The Sheet had the group determine what rule was violated, why it was violated, and what would be done to prevent this from happening again. All this had to be completed before the group went back to work. After each violation assessment discussion, the sheet was signed by each group member in attendance and submitted to the instructor for approval. If a student did injure them self, no assessment sheet was issued. The researcher did not want any student to not report their injury to the instructor just to avoid the assessment sheet. The injury usually was enough of a penalty.

The Safety Violation Assessment Sheet now became a tracking tool for the intervention. After 10 days of laboratory work the SVA Sheets were placed onto the Safety Rule Violation Checklist, Appendix C. This Checklist helped to determine if the number of incidents of safety violations were increasing or decreasing due to the intervention strategy. It was observed by the researcher that the checklist could also be used to establish what rule if any had a larger than normal occurrence. In the future, this rule could be targeted by the instructor for increased coverage at the beginning of next semester's safety rule training.

During the laboratory work session of the targeted production technology classes, if any intentional acts were committed that caused damage to the machinery or injury to another student, a disciplinary referral was issued to remove the student to the associate principals. The

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associate principal covering the incident then assigned in-school or out-of-school suspensions depending on the severity of the incident.

The final evaluation of the targeted students safety concerns was the retaking of the 16 General Shop Rules test. This was administered unannounced to the class. The rationale for this "surprise" test was that it would be a true measure of their retention of these safety rules. To alleviate their fear of failure, the students were informed that the score would be placed in their homework grade category and lessen the impact on their semester grade. Homework bears a 20% weight, whereas tests and quizzes were at 30%.

Presentation and Analysis of Results

Comparing the beginning safety test scores of the spring 2001 production technology students, Tables 1 and 2, with the fall 2001 production technology students, Tables 3 and 4, there was no remarkable increase of test scores. No measure is recorded here of the increase of the teamwork and leadership skills by the targeted students of the intervention study. The students who took charge and helped their teammates finish their testing impressed the researcher. It was not always the safety supervisor that met this challenge.

Many variables beyond the control of this study could be in effect. One variable was the age of the students. The spring 2001 production technology students, although still freshman, were a semester older at the time they tested. The fall 2001 production technology students were just beginning to adapt to the high school environment. The overall freshman class of 2001 had a major increase of special education students, prompting the high school to reinforce their special education staff just to handle this increase. The average number of special education students being higher may have affected the test score results.

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Table 3

Scores on Tests Administered to Production Technology Students Fall 2001

PRODUCTION TECHNOLOGY FALL 2001 1ST QTR TOTAL POSSIBLE	Gen. shop rules 16	Gen. mach. rules 3	band saw 8	jig saw 7	drill press 7	table router 5	disc sander 8	spindle sander 7	total score 61
1ST PD AVE. PCT	87.8%	91.7%	67.7%	67.9%	69.0%	70.8%	70.8%	76.8%	76.0%
4TH PD AVE. PCT	86.2%	100.0%	65.1%	69.6%	60.7%	70.8%	74.5%	70.2%	74.7%
7TH PD AVE. PCT	84.1%	93.9%	64.2%	50.0%	57.8%	67.3%	60.2%	60.4%	67.8%
ALL CLASS AVE. PCT.	86.0%	95.2%	65.7%	62.5%	62.5%	69.6%	68.5%	69.1%	72.8%

Table 4

Mean Scores on Tests Administered to Production Technology Students Fall 2001

PRODUCTION TECHNOLOGY FALL 2001 1ST QTR TOTAL POSSIBLE	Gen. shop rules 16	Gen. mach. rules 3	band saw 8	jig saw 7	drill press 7	table router 5	disc sander 8	spindle sander 7	total score 61	total RULE PCT
1ST PD MEAN	14.0	2.8	5.4	4.8	4.8	3.5	5.7	5.4	46.4	76.0
4TH PD MEAN	13.8	3.0	5.2	4.9	4.3	3.5	6.0	4.9	45.5	74.7
7TH PD MEAN	14.1	3.0	5.4	3.7	4.2	3.5	5.0	4.4	43.3	71.0
ALL PD MEAN	14.0	2.9	5.3	4.4	4.4	3.5	5.6	4.9	45.1	73.9

It should be noted that the tragedy of September 11, 2001 occurred during this testing. It was difficult for the students and instructor to return to concentrating on the classroom matters at hand. The safety procedures enacted by the firemen and police that saved so many lives before the collapse of the World Trade Center Towers were brought into discussion. It was a reality check for us all. It made the students and staff realize how precious is our life and liberty.

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As the discipline referrals were tabulated, a few classroom level referrals were issued, but there were no intentional safety violations during lab work. One major factor to deter a student from coming up with a negative activity such as an intentional safety violation was to keep the student busy with required activities. Idle time around power tools is a magnet for dangerous activity.

As was expected, the test scores of the 16 General Safety Rules from the beginning of the semester to the end of the semester did show a drop. The encouraging aspect was that the spring 2001 classes dropped more than the targeted fall 2001 classes as shown in Tables 5 and 6. The targeted classes had to look up the rules for the Safety Violation Assessment Sheets to be filled out properly. This was an extra chance for these students to review the safety rules. The student having the most problem remembering his safety rules was therefore seeing more SVA Sheets and had him doing more safety rule review than the rest of the class.

Table 5

Safety Tests Re-administered to Production Technology Students Fall / Spring 2001

PRODUCTION TECHOLOGY SPRING 2001 3rd QTR	Gen. shop rules	PRODUCTION TECHOLOGY FALL 2001 1ST QTR	Gen. shop rules
Combined Pct.	82.5%	Combined Pct.	87.4%
End Semester	71.3%	End Semester	78.6%
Pct. Drop	11.2%		8.8%

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Table 6

Safety Tests Re-administered to Production Technology Students Fall / Spring 2001

PRODUCTION TECHOLOGY SPRING 2001 3rd QTR	Gen. shop rules	PRODUCTION TECHOLOGY FALL 2001 1ST QTR	Gen. shop rules
Combined Pct.	12.7	Combined Pct.	14.0
End Semester	11.4	End Semester	12.6
Pct. Drop	1.42		1.23

The tracking of the Safety Violation Assessment Sheets was the greatest indicator that the students had an increased attitude toward safety. Figure 1 shows a dramatic decline of the number of safety violations.

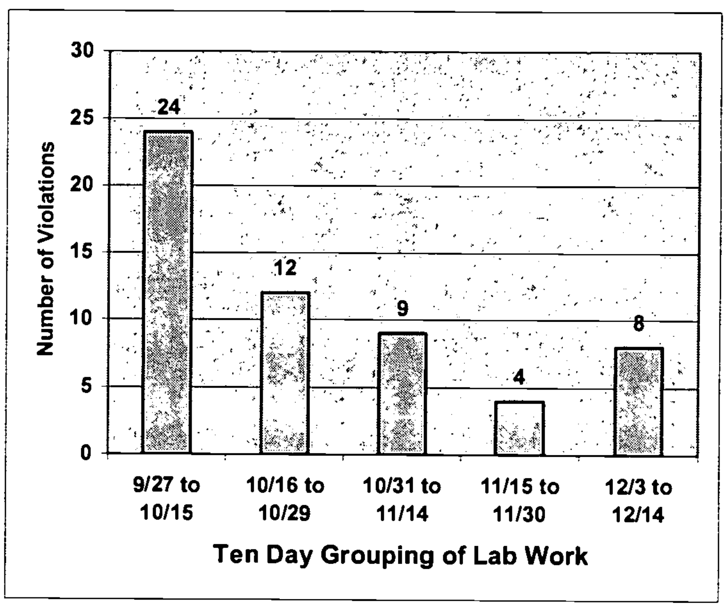

Figure 1. Safety violation assessment chart.

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After the first 10 days the violation count dropped in half. The only flaw in the continual reduction in violations was that the last 10 lab days of the semester showed a doubling from the previous 10 days. The best estimate of what happened was that the student projects were to be completed for the end of the semester and the students lost their attention to safety.

There was no data recorded of the number of times the researcher in previous production technology classes had to remind students to put their safety glasses on or to position the glasses properly over the eyes. During the intervention study with the production technology classes, that problem almost disappeared. It must have become apparent to the students that there was a negative consequence to any safety violation. Even as simple as keeping the safety glasses on.

Conclusions and Recommendations

An analysis of the assessment criteria gives a valid acceptance of a claim that the targeted production technology students did indeed increase their concern for safety as they worked in the laboratory. This concern is for the current safety rules that have been identified by the production technology curriculum and instructor. If other areas of safety were to be incorporated, such as a study of the OSHA hazardous material sheets, they would have to be placed in the semester timeline somewhere other than with the machine safety rules. That much safety rule study at one time would overload the students and the instructor as well.

The decrease of safety rule violations through the semester provided solid evidence that students began to internalize safety as a part of the work routine. The option to do any work without safety was eliminated. The researcher had students from the intervention study in his later classes and they showed evidence of this intrinsic safety consciousness. They were the first ones to put on their safety glasses and were the quickest to accept safety rules for new machines in these courses.

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The Safety Violation Assessment Sheets that were developed as an assessment tool became a motivational tool that decreased the incidents of safety violations. The students dreaded the work time lost by having to stop work and fill out the Assessment Sheet. The negative effect then of a safety violation was a loss of work. The positive effect was the evaluation of the cause of the safety violation and avoidance of that causal effect.

The reduction of the constant safety glass struggle that was noted by the researcher became the most visible sign that the students had accepted a concern for safety. Putting the safety glasses on at the beginning of the work session instead of setting them on the workbench indicated the proper mind set that safety is job one.

The researcher recommends that the student in a vocational or industrial technology lab work environment must know their role in promoting safe working conditions. It must be made perfectly clear that the student has a responsibility to not only them self, but to all persons in the work zone.

Safety rules must be precise and to the point. These rules should not be covered at the beginning of the course and then forgotten. The rules must be posted in critical need zones. The rules need to be reincorporated into every new project or machine that is studied.

Adherence to the established set of safety rules must be constantly monitored. The students need to know the negative consequences of a safety violation. Equally important are the positive consequences for striving for a safety violation free work ethic that will stay with them for the rest of their lives.

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Appendix A

SCORES TO PASS -->	12	3	6	5	5	4	6	5			
PRODUCTION TECH	Gen.	Gen.							student		
SPRING 2001	shop	mach.	band	jig	drill	table	disc	spindle	total	total	tests
3rd QTR	rules	rules	saw	saw	press	router	sander	sander	score	RULE	done
RULES PER TEST -->	16	3	8	7	7	5	8	7	61	PCT	
STUDENT 1									0	0.0	
STUDENT 2									0	0.0	
STUDENT 3									0	0.0	
STUDENT 4									0	0.0	
STUDENT 5									0	0.0	
STUDENT 6									0	0.0	
STUDENT 7									0	0.0	
STUDENT 8									0	0.0	
STUDENT 9									0	0.0	
STUDENT 10									0	0.0	
STUDENT 11									0	0.0	
STUDENT 12									0	0.0	
STUDENT 13									0	0.0	
STUDENT 14									0	0.0	
STUDENT 15									0	0.0	
STUDENT 16									0	0.0	
STUDENT 17									0	0.0	
STUDENT 18									0	0.0	
STUDENT 19									0	0.0	
STUDENT 20									0	0.0	
class average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

Appendix B

SAFETY RULE VIOLATION ASSESSMENT SHEET

DATE OF GROUP MEETING ____/____

DATE OF VIOLATION ____/____

CLASS PERIOD _______

GROUP NAME ____________________

GROUP NUMBER ________

GROUP MEMBER SITED FOR VIOLATION: ____________________

MEMBER SIGNATURES:

SAFETY CHAIR: ____________________

____

____

____

____

<u>VIOLATION OBSERVED</u> SAFETY TOPIC:	RULE NUMBER:	RULE - WRITTEN OUT BY VIOLATOR
GENERAL SAFETY		
BAND SAW		
JIG SAW		
DRILL PRESS		
TABLE ROUTER		
DISC/BELT SANDER		
SPINDLE SANDER		

CAUSE OF VIOLATION:

____

____

WHAT WILL BE DONE TO PREVENT A REPEAT OF THIS ACTION:

____

____

Appendix C

SAFETY RULE VIOLATION CHECKLIST

DATES OF LAB WORK

____/____, ____/____, ____/____, ____/____, ____/____,
____/____, ____/____, ____/____, ____/____, ____/____

CLASS PERIOD _______

VIOLATION OBSERVED:

SAFETY TOPIC:	RULE NUMBER
GENERAL SAFETY	
BAND SAW	
JIG SAW	
DRILL PRESS	
TABLE ROUTER	
DISC/BELT SANDER	
SPINDLE SANDER	
TOTAL VIOLATIONS	

CLASS PERIOD _______

VIOLATION OBSERVED:

SAFETY TOPIC:	RULE NUMBER:
GENERAL SAFETY	
BAND SAW	
JIG SAW	
DRILL PRESS	
TABLE ROUTER	
DISC/BELT SANDER	
SPINDLE SANDER	
TOTAL VIOLATIONS	

CLASS PERIOD _______

VIOLATION OBSERVED:

SAFETY TOPIC:	RULE NUMBER:
GENERAL SAFETY	
BAND SAW	
JIG SAW	
DRILL PRESS	
TABLE ROUTER	
DISC/BELT SANDER	
SPINDLE SANDER	
TOTAL VIOLATIONS	
COURSE TOTAL	

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