

379
N81
No. 1288

A STUDY OF ACCIDENTS AND THEIR CAUSES OCCURRING
IN INDUSTRIAL SHOPS IN THE PUBLIC SCHOOLS OF
TEXAS, AND THE METHODS USED TO TEACH
SAFETY EDUCATION IN INDUSTRIAL
ARTS PROGRAM

THESIS

Presented to the Graduate Council of the North
Texas State Teachers College in Partial
Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

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August, 1948

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CHAPTER I

INTRODUCTION

Industry has proven that the most effective way to have safe workers is through the development of safety consciousness, and this can best be developed through safety education. It follows logically then that if industry and society as a whole are demanding a safety-conscious citizenry, it is the duty of the American public schools to meet this demand.

Safety guards on machines are fairly well provided by manufacturers, but this is no assurance against accidents to the operator who is careless in manipulating the machine. The operator must be taught to observe certain specific rules and practices that have been found to be necessary for the safe use of hand tools and machines. An operator who has acquired a safety-consciousness will be more likely to observe personal caution at all times and will accept safety rules that the experiences of others have proved to be important in preventing accidents.

The problem of this study is to determine sound practices and teaching in connection with Industrial Arts shop safety program in Texas public schools, and the methods, policies, and programs used to prevent accidents. The

study reviews the Texas State Laws for safety precaution, and the devices and programs recommended by the Industrial Arts teachers who answered the questionnaire used in this study. The state safety laws of other states are studied for comparison with the Texas Safety Laws.

Limitations

This problem is limited to a consideration of certain industrial arts school shops located in the State of Texas. One hundred senior high school with a scholastic population of three hundred fifty and up, and one hundred junior high schools were selected as a basis for the study. Since only sixty-three of the one hundred senior high schools chosen originally, and forty-nine of the one hundred junior high schools replied to the questionnaire this study is further restricted. The scholastic population was determined by Bulletin 459, Regulations, Standards and Activities of the Division of Supervision.¹ This survey covers the accidents occurring in the shop during the school year 1947-1948.

Source of Data

The data necessary for this study were secured from several sources. Questionnaires were sent to senior high schools

¹
Bulletin 459, Regulations, Standards and Activities of the Division of Supervision of the State of Texas, pp.23-25.

and to junior high schools selected for the study. A copy of the questionnaire is included in the appendix. Professional magazines, books, and journals also were used. Five theses from schools in neighboring states were studied. Additional data were obtained from the State Department of Education.

Definitions

"Accidents" are injuries which necessitate medical aid or first-aid.

"Safety education" is a training program for students to help prevent accidents to themselves and to others.

"Shop liability insurance" is a form of insurance similar to workmen's compensation insurance, whereby the cost of an accident to the student is paid by an insurance company.

A "machine" or "shop" permission slip is a card or slip signed by the pupil's parents or guardian giving permission for the pupil to take shop and to operate shop machinery.

"Attending nurse" is a trained nurse employed by the school system and whose duties are to take care of and treat accidents which occur in the school.

"Shop safety record" is a record kept to show the number of injuries per year in a shop program.

"Evidence of accidents" is a detailed report describing the tool or machine and all other factors involved in an accident occurring in an industrial arts shop.

Recent Studies

A study of accidents occurring in school shops was made by Wayne M. Judy, Iowa State College, and the results of this study are as follows. From 250 questionnaires, the total number of accidents requiring medical treatment for two years was 726. There were 552 accidents occurring with hand tools. One hundred fifty-six accidents were caused by power-driven machinery. The physician treated 113 accidents. The number of accidents that resulted in the loss of any part of the body was eighteen. Twelve accidents resulted in the loss of one or both eyes. There were six accidents resulting in the loss of some bodily member.²

In a recent study by C. C. Davis, North Texas State Teachers College, who appraised safety needs in the light of different intelligence levels, the following results were found:

First, the men of the low intelligence were less capable of doing the same jobs, or even less hazardous jobs than those of higher intelligence. Second, those of low intelligence did not grasp the instructions given concerning safe practice so readily as the others. If they do not grasp the significance of safety instruction readily, it must be specifically adapted to the individual; the lower the level of his intelligence, the more it becomes necessary that safety instruction be specifically adapted to the individual.³

²Wayne M. Judy, "Accidents and Safety Education in the Industrial Arts Shops of Iowa," Unpublished Master's Thesis, Iowa State College, 1932, p. 20.

³C.C. Davis, "An Analysis of General Safety Education for Industry and Vocation Schools with Specific Recommendations for Wood Shops and Machine Shops," Unpublished Master's Thesis, North Texas State Teachers College, 1943, pp.35-36.

A study made by Schaefer in Safety Supervision shows the number of accidents per year per one hundred employees on the basis of intelligence. Schaefer grouped the people into different categories according to their intellectual level and designated them as Groups A, B, C, D, and E. Group A, with a higher intelligence rating, had a lower per cent of accidents. Table 1 gives the results of Schaefer's study.

TABLE 1
NUMBER OF ACCIDENTS PER YEAR PER 100 EMPLOYEES
ON THE BASIS OF INTELLIGENCE*

Intelligence Group	Number of Employees	Number of Accidents per Year per 100 Employees
A	1,373	0.66
B	1,606	1.12
C	2,095	1.53
D	1,393	2.08
E	362	2.76

*Adapted from Schaefer, Safety Supervision, p. 192. ⁴

Alvin Earl Covey found, through a survey of Texas high school woodworking shops in 1938, that there are square-head jointers in use in the public schools of Texas, and a number

⁴ Schaefer, Safety Supervision, p. 192.

of other old-time machines. He discovered that fifteen per cent of the woodworking shops are inadequately lighted and hazardous to operate, and that sixty-five per cent of these inadequately lighted shops had accidents occurring in them. He also found that there are many open, uncovered, unguarded and "non-safety" switch boxes in use over the state. One third of the balconies found in shops do not have a rail or banister around them of sufficient height and strength to prevent persons or materials from falling. Only one third of the shops require the use of goggles by the students when using the grinders, and one fourth of the shops have non-hooded and non-guarded grinders. One third of the lumber racks will allow lumber to fall, and thirty-six per cent of the shops have universal saws without a guard that will completely cover the part of the saw not in use. Covey found that only seventeen per cent of the universal saws have a "kick-back" guard. Ninety-six per cent of the shops studied reported having had one or more accidents the last year. Thirty-nine of the schools reported safety meetings held sometime during the year; fifty-seven of the schools did not hold any safety meetings.⁵

Lewis E. Beck, Ohio State University, in a survey

⁵ Alvin Earl Covey, "A Study of Safety in the Industrial Arts Woodworking Department of the Public Schools of Texas," Unpublished Master's Thesis, Texas A. and M. College, 1938, p. 28.

designed to indicate students' reasons for seven hundred and two shop accidents, over a period of years including 1929, 1930, 1931, 1932, and 1933, arrived at the following figures:⁶

TABLE 2
STUDENTS' REASONS WHY THE ACCIDENT OCCURRED

Reason	Number
Failure to understand safe practices	5
Bothered by classmate	4
Didn't know how accident occurred	4
Lapse of attention	4
Looked up from work	4
Wanted to save time	4
Thought he could get away with it	3
Hand slipped	3
Became too familiar with tool	2
No report	669
Total	702

The above is certainly evidence of the carelessness in failure to report and emphasize the reason for accidents occurring in the survey.

S. F. Hall made a study of Safety in School Shops and the results of his study are as follows:

Accidents to pupils in the public schools caused a total absence of 2,160,000 pupil days during one year.

Accidents in the shop occur at various times. In one state, one accident to every three students took place in one year. The National Safety Council says, "The influence of the vocational shop and the gymnasium on the accident rate is indicated by the sudden jump in the rate from the sixth to the seventh grade, which rose from 1.5 per cent to 3.5 per cent. Further advance to 4.17 per cent in the tenth grade, and 5.4

⁶ Lewis E. Beck, "School-Shop Accidents and Their Prevention," Unpublished Master's Thesis, Ohio State University, 1933, p. 27.

per cent in the seventh grades indicates an increase in exposure to accidents.'

It has been found in various shops that October is the month of accidents, and, of course, various times of the day are hazardous.

Some of the places and the per cent of accidents that happen are school buildings and ground, 4.75 per cent; going to school, 175 per cent; home, 3.5 per cent; other places, 3.25 per cent; in gymnasiums, 35 per cent; and other locations in the school, 18 per cent.

Accidents affected parts of the body as such; head, 14.89 per cent; neck, .63 per cent; shoulders, 50 per cent; arms, 8.21 per cent; hands, 5.12 per cent; fingers, 3.32 per cent; body, 2.47 per cent; legs, 14.26 per cent; ankles, 36.25 per cent; and feet, 2.33 per cent.⁷

H. W. Schmidt, in his study of School Shop Safety, expressed himself in the following manner:

The matter of shop safety education is at last receiving deserved attention at the hands of school authorities in an increasing ratio. As a rule, both educator and laymen consider the schools as perfectly safe areas, and that pupils are subject to accidents only on the playground, the football field, or on the basketball floor. But recent studies and statistics show the fallacy of this thought. A study of a few years ago showed that of all reported accidents to the school children, nearly thirty-six per cent occurred in the school plants, and about nineteen per cent within the buildings themselves. Of the latter, gymnasiums, corridors, and the stairs carry off the dubious honors of having the greatest numbers. Classrooms and shops just about split even, with about fourteen or fifteen per cent each.⁸

Indicated below are pertinent statements made by John

⁷ S. F. Hall, "Safety in School Shops," Industrial Arts and Vocational Education, Vol. XXIII (March, 1944), pp.125-126.

⁸ H. W. Schmidt, "School-Shop Safety," Industrial Arts and Vocational Education, Vol. XXX (September, 1941), pp.267-270.

J. Metz in his study of safety in school shops:

The shop student will not acquire safe habits by himself. He must be taught safety as a part of everything he does in connection with the work for which he is being trained. He must be made to recognize that his observance of the safety rules is as necessary as is the vigilance of the soldier who stands guard in the front line trenches. He must be taught that skill alone is of little avail if safe habits of work do not accompany that skill.⁹

In a study made by Roy R. Van Duzie, with the principal emphasis on methods and devices, some of the more important suggestions are indicated below.

Some teachers use one method to present safety, and some another. The same applies to the methods and devices. The sure thing that is known is that putting signs up in the shop and attaching them to machines will not be adequate safety instruction.

Shop safety is dependent to a great extent on two factors. One is shop condition, and the other is the effectiveness of instruction. Another important part of safety work is teaching what should be done if an accident does occur.

Here are some sound shop practices:

Machine tools should be guarded so as to pass any authority which passes on the proper guarding of machines for safe use. Old machines which are being altered should not be used until properly guarded. All machines should be controlled by a master switch, and each motor should be independently fused and operated by an overload and under voltage control.

Hand tools should be in good condition at all times. That is, tools should be well sharpened, handles secure in the tools, and no mushroomed tools should be used.

⁹ John J. Metz, Shop Safety, Vol. XXX (September, 1941), p. 281.

Inflammable materials should be stored in fire-proof cabinets. Recommendation of the fire underwriters and the fire department, relative to the use of self-closing cans and storage of inflammable materials, should be scrupulously followed.

Shops should be clean and in order. Stock and machine parts should be arranged in orderly piles, or kept on racks or in bins. The floors should be kept clean and no refuse should be permitted to lie about. Tools should be properly stored, and the toolrooms and supply rooms and storage rooms should always be kept in order.

Attitude toward safety is a most important factor in reducing accidents in any work situation. Another factor is knowing the right way and the safe way to handle the equipment.

The instruction of safety should consist of three phases. The demonstration and giving of information. The test for knowing and for the ability to do the operation safely. The securing of a record of signatures.¹⁰

These and other similar studies are of importance because of two main reasons: (1) society is demanding safe workers as never before, and (2) these studies are concerned with the ways and means of accomplishing more effective safety programs. This demand is made necessary by our present-day machine age, which makes in many instances working conditions very hazardous. Industry has proven that the most effective way to have safe workers is through the development of safety consciousness.¹¹ In the opinion of the

¹⁰ Roy R. Van Duzie, Industrial Arts and Vocational Education, Vol. XXX (September, 1941), pp. 267-270.

¹¹ Wayne M. Judy, op. cit., p. 6.

writer this development of safety consciousness may be best achieved through educational devices and procedures, i. e. Safety Education. It follows logically then that if industry and society as a whole are demanding a safety-conscious citizenry, it is the duty of the Texas public schools to help meet this demand.

CHAPTER II

SAFETY LAWS AND PROGRAMS ENACTED AND PROPOSED BY TEXAS, IOWA, AND OKLAHOMA

A survey of the safety laws of the State of Texas which pertain to the school and its environs shows that this state has enacted laws covering fire escapes, school houses and grounds, operation of school buses, steam boilers, and a State Board of School Safety Supervision.

Article 3959, Public School Laws of Texas, contains the regulations for fire escapes for school buildings, and states that each school building of two or more stories in height shall be provided and equipped with at least one adequate fire escape. If the lot area of the building exceeds five thousand square feet, then one additional fire escape must be added.¹

As indicated above, the State of Texas has enacted laws covering school houses and grounds. Every school building should be located on grounds that are well drained and maintained in a sanitary condition. Every school building must be properly ventilated and provided with drinking water,

¹
L. A. Woods, Public School Laws of the State of Texas, 1945, p. 238.

approved sewage disposal system, hand washing facilities, heating system, and lighting facilities.²

Operation of School Buses, under Article 301-b, states that all vehicles used for transportation of pupils must have a sign in front and rear and on each side showing words "School Bus." These words shall be plainly readable and not less than six inches in height. When the school bus stops, every operator of a motor car or motorcycle approaching in the same direction must bring his vehicle to a stop. The vehicle must not start up in any direction until the school bus has finished receiving or discharging its passengers. Any person who violates this law, upon conviction, shall be fined not less than ten dollars and not more than five hundred dollars, or confined in the county jail not more than ninety days.³

No steam boiler, unless specifically exempted from Article 5221, Section 2, can be operated in the State of Texas without registration with the Bureau of Labor Statistics and issued a certificate of operation.⁴

It is the public policy of the State Board of School Safety supervision (Article 2898-1) to prevent the unnecessary

² Ibid., p. 238.

³ Woods, op. cit., p. 254.

⁴ Ibid., p. 240.

loss of lives and destruction of property due to failure to observe safety protection. Section 5 of Article 2898-1 says that the school buildings of Texas schools shall conform with the following minimum standards:

No window shall be placed in the study hall or classroom where the pupil will have to face the light. The window openings shall not come lower than a point three and one-half feet from the floor and extend to a point within six inches of the ceiling. The area of clear window surface shall not be less than one sixth of the area of the floor space in the classroom or study hall. No part of the classroom or study hall shall be at a greater distance from the window than twice the height of the top of the window above the floor, except when adequate skylights are provided. The light shall come from the left, as the pupils sit at their desks.

All school houses shall be well heated. All stoves, radiators or other causes of direct heat shall be jacketed. All rooms and stoves shall be equipped with an automatic temperature regulator that will regulate the temperature of classrooms or study halls to within two degrees of any set standard. Every classroom or study hall shall be provided with an apparatus whereby in cold weather a supply of thirty cubic feet per minute of fresh, warm air shall be supplied to each child in such a manner as not to place any pupil in a disagreeable draft.

All interior wood shall be without unnecessary fluting, turning or coverings which will catch dust and microbes. All floors shall have their surfaces coated with boiling paraffin, oil, or other floor dressing having a similar effect. This shall be done immediately after the floor is laid and at periodical intervals after construction.

All school buildings of two or more stories must be provided with not less than two widely separated flights of stairs. No stairs may be constructed with winding treads, and turns must have flat landings not less than four feet wide. One of them shall be between floors. All stairs shall have a hand rail on each side and placed so it can be held easily by the pupils. All outside doors and doors leading from classrooms must be hung to open outward.⁵

In addition to the Texas laws covering safety in the public schools, a safety program is proposed for industrial arts in the Guide to Safe Living for Secondary Schools. This brief program is as follows:

By achievement standards, we are to demonstrate proper use and care of band saws. Care and use of hand tools should be illustrated. Operation and care of wood lathes should be correct. Illustrate proper use and care of the tool grinder. Correct use of the jointer should be shown. Demonstrate

⁵ Woods, op. cit., 1945, pp. 197-199.

proper method of care and use of surfacer.

Safety should be taught by use of printed instructions and demonstration. All students should participate in shop activities after proper instructions have been given. Keep a list of all hazards that occur in the shop. A visit should be made to factories and other school shops.

Under observation of instruction, through learning activities, inspections should be made of the machines for adjustments, guards, scraps, and other details of the machines. An instructor may use as an illustration dull tools, damaged tools, and dirty, oily tools, and show how they lead to accidents.⁶

The State of Oklahoma has no state safety laws pertaining to shop safety, but a bulletin prepared by the Safety Committee of the Industrial Education Division of the Oklahoma Education Association, Bulletin No. 47-C-10, lists some fundamental practices in safety instruction as indicated below.

Dangerous machines should not be operated without proper guards. Substantial metal guards must enclose all belts and gears, and universal, circular and variety saws must be equipped with splitters and cover guards. Machines, such as mortisers, metal lathes, drill presses, power back saws,

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L. A. Woods, Guide to Safe Living for Secondary Schools, Bulletin, 1945, p. 63.

jointers and other small machines are likely to be left unguarded. They should have belts and all gears enclosed and properly guarded. Non-skid floor surfaces, such as rubber hall runners or matting cemented to the floor, bound with metal edging strips, should be on all areas immediately in front of certain machines.

A first-aid certificate should be held by every shop teacher, and should not be more than five years old. Every school shop should have a first-aid cabinet, and such cabinet should be located in an easily accessible place. It should be painted with a red or green cross to attract the student's attention. The first-aid cabinet should contain the following:

Equipment and Supplies in First-Aid Cabinet

American Red Cross First Aid Manual.	\$.60
Individual first-aid bandages, procurable from First-Aid supply companies, cost per 100. . . . .	.60
Plain sterile gauze, folded to 3" by 3" pads in individual cellophane or glassine envelopes, cost per dozen . . . . .	.25
Gauze roller bandage, 1 inch by 10 yards, cost per roll . . . . .	.10
Gauze roller bandage, 1½ inch by 10 yards, cost per roll . . . . .	.15
Two triangular bandages, 36 inches, may be unsterilized, buy from local dry goods store. . . . .	.20
Picric acid gauze (for burns) 1 square yard to carton . . . . .	.30
3½ per cent Iodine, Mercurochrome, or Merthiolate, in small bottle, secure locally . . . . .	.20
Aromatic spirits of ammonia, secure locally, 2 oz. . . . .	.40
Eye cup . . . . .	.10
Burn jelly. . . . .	.20
Tourniquet, inelastic	
Scissors	
Tweezers	

Splints, prepare in shop	Or all in package secured from American National Red Cross.	85 ⁷
Total cost		4.00 ⁷

The State of Iowa has enacted shop safety laws. The Commissioner of Labor of the state, the mayor and chief of police are charged with the responsibility of enforcing these laws.

Article 1487, in connection with safety appliances, states that the owner, agent, superintendent, or person in charge shall see to it that belt shifters or safe mechanical means for throwing belts on and off pulleys are installed. Install loose pulleys and protect by guards or housing, all gearing, cogs, belting, shafting, tumbling rods, universal or knuckle joints, set screws, saws, planes, and other machinery so that employees may not receive injuries. When a guard or safety appliance is removed from a machine for repairs, it is the duty of the employee or employer to immediately replace it, which is provided for under Article 1486. Any machinery which throws off particles of dust which will be harmful to the operator shall be provided with a blower to carry the dust to the outside.⁸

⁷ Safety Education in the School Shops of Oklahome, Bulletin No. 47-C-10, p. 2-6.

⁸ Wayne M. Judy, op. cit., p. 20.

Article 1491 specifies that when the commissioner or inspector discovers or believes that any provisions of Section 1483 to 1490, inclusive, have been violated, he shall give to the person in charge a notice that such shall be fixed within thirty days. A record shall be kept of all accidents resulting in death or bodily injury, as required by Article 1492, and the record shall be open to inspection at all times. For a record of evidence of accidents, Article 1493 states that within forty-eight hours after the accident occurred, a written record is to be sent to the Commissioner of Labor, and he may require further and additional report to be furnished.

The State of Iowa has enacted penalties as follows under Article 1494:

For a violation of any one of the provisions of Sections 1483, 1484, and 1485, by a fine not exceeding ten (\$10) dollars for each offense.

For a violation of Section 1486, by a fine of not less than fifty (\$50) dollars nor more than five hundred (\$500) dollars for each offense.

For a violation of any of the provisions of Sections 1487, 1488, 1489, 1490, 1492, and 1493, by a fine not exceeding one hundred (\$100) dollars.⁹

Assumption of risks as provided for under Article 1495, states that where the employer is responsible for defective machinery or working conditions, the employee does not assume responsibility, unless it is the duty of the employee to make

⁹ Ibid., p. 20.

needed repairs in the usual or ordinary course of employment, and he has knowledge of such defects. If an employee has knowledge of such conditions and continues to work under such, then this provision is not binding or legal.

There are many industrial arts shops in the public schools of Texas which use hand tools and power equipment and as a consequence accidents do occur. Yet, the State of Texas has done very little toward a universal program for the teaching and enforcement of sound safety practices. However, this survey indicates that the shop teachers are coming to recognize the need for safety training, and are using various methods of teaching safety in connection with the industrial arts program. These methods are presented in the following table.

Table 3 shows the methods used to teach safety by the 112 teachers who replied to the questionnaire used as a basis for this study.

TABLE 3

METHODS USED TO TEACH SAFETY IN 112
INDUSTRIAL ARTS SHOPS IN TEXAS

Methods Used	Number
Safety talks	94
Safety rules posted in shop	51
Accident posters	45
Tests on safety	39
Painted danger zones	35
Visual aids	32
Safety assignments	31
Safety slogans	19
Safety bulletin boards	18

TABLE 3--Continued

Methods Used	Number
Student safety council	6
Safety contests	2
Demonstration of proper and improper procedure	2
Instructions relating to each phase of work	2
Safety engineer	2
Set of safety rules given each pupil at beginning of each semester	1
Student safety congress	1
Foreman checking wrong use of any tool or machine and reports immediately to shop instructor	1
Constant watchfulness for hazardous conditions	1
Use of jigs to avoid accidents	1
Safety notebook	1
Safety foreman	1
Staying in shop during working time, very seldom leave class	1
Daily reminders of safety precautions	1
Individual attention	1
Careful instruction in regard to machine	1
Safety shop manual	1

It will be noted in Table 3 that ninety-four industrial arts shops used "safety talks" as one method of teaching safety. Fifty-one teachers used "safety rules" which were posted in the shop and "accident posters" were used by forty-five of the schools in this survey. From indications of this survey, "tests on safety" is another important method of teaching safety, as thirty-nine schools used this technique. Thirty-five school shops used the "painted danger zone" method, and thirty-two used "visual aids." The methods of teaching shop safety by using a safety foreman, safety notebooks, jigs, individual attention, and shop safety manuals were the least used of all methods, and are undoubtedly the

the least productive. Only one teacher in the survey indicated that he used one or more of the above methods of doubtful value indicated above.

CHAPTER III

A SURVEY OF THE CAUSES, TYPES, AND NUMBER OF
ACCIDENTS REPORTED IN 112 INDUSTRIAL
ARTS SHOPS OF TEXAS

A study of the data received from the sixty-three senior high schools included in this study reveals that a large number of accidents did occur in these schools during the school year 1947-1948. Table 4 shows the number and classification of the accidents reported in the sixty-three senior high school shops studied.

TABLE 4

ACCIDENTS REPORTED IN SIXTY-THREE
SENIOR HIGH SCHOOL SHOPS

Report of Major and Minor Accidents	Number of Accidents
Accidents requiring services of physician.	36
Accidents requiring services of physician that resulted in loss or impairment of part of body	2
Accidents that were minor	186
Total number of accidents occurring in the senior high school shops	226

Two hundred twenty-six students were reported to have received injuries while working in the industrial arts shops of these sixty-three senior high schools. Of the 226 injuries reported, 188 of the injuries were classified as

minor accidents. Thirty-six of the accidents were reported as being serious enough to require the services of the physician, and two of the accidents reported resulted in the loss or impairment of some part of the body.

If the data in Table 4 present in any manner a typical sample of the accident situation which now exists in the public schools of Texas it is plain to see that there is a definite need for effective safety education.

The data in Table 5 indicate the common hand tools which were involved in the accidents reported by the sixty-three senior high schools for the school year of 1947-1948.

TABLE 5

COMMON HAND TOOLS WHICH WERE INVOLVED IN ACCIDENTS
REPORTED IN SIXTY-THREE HIGH SCHOOLS

Hand tools	Number of Accidents
Wood chisel	61
Hand saw	19
Plane iron	12
Coping saw	11
Screw driver	7
Hammer	8
Back saw	7
Knife	4
Wood carving chisel	2
Scratch awl	1
Scraper	1
Cold chisel	1
Total	134

In all probability, the average individual would consider the hand tools as being the least hazardous of all the tools used in an industrial arts shop. However, as the data in

Table 5 reveal, 134 accidents were reported wherein hand tools were involved. Table 5 also reveals that sixty-one students were injured while using the wood chisel. The hand saw was another common hand tool which obviously was dangerous when not properly used because nineteen students were injured during the school year of 1947-1948 while using this device. Among the other top ranking hand tools, in so far as accident potentiality was concerned, was the plane iron which was involved in twelve accidents. Eleven students were injured while using the common coping saw. The screw driver was involved in seven accidents, and eight accidents were reported which involved the common hammer. Four accidents were reported as being connected with an ordinary knife, and two accidents were reported in which the wood carving chisel was involved. The scratch awl, cold chisel, and scraper were involved in one accident each. This datum concerning the accidents in which common hand tools were involved reveals that accidents do occur where these tools are used. It also places special emphasis upon the need of safety education in the use of the more common hand tools found in the average high school shop.

The accidents occurring in the industrial arts shops of the public schools of Texas are not all connected with the common hand tools. Table 6 indicates the fourteen power-driven machines which were involved in the ninety-two accidents reported as occurring while power machinery was

being used by the sixty-three high schools surveyed during the school year of 1947-1948. This Table also shows the number of accidents connected with each of the machines.

TABLE 6

POWER-DRIVEN MACHINERY UPON WHICH ACCIDENTS
OCCURRED IN SIXTY-THREE HIGH SCHOOL SHOPS

Power tools	Number of Accidents
Band saws	17
Jointers	12
Table saws	9
Lathes	9
Power drills	8
Grinders	6
Welding	6
Sanders	4
Jig saws	3
Shapers	1
Cut off saws	0
Forge	0
Squaring shears	0
Milling machine	0
Total	75
Accidents reported but machine not specified. . .	17

As revealed in Table 6, the band saw was involved in more accidents than any of the other machines reported in the study. Seventeen accidents were reported in which the band saw was involved. The jointer was involved in twelve accidents. The common power-driven table saw and wood lathe can become a dangerous machine when improperly used, as evidenced by the fact that nine accidents were reported involving each of these machines. Eight of the accidents reported occurred while students were using the electric grinders. No accidents were reported involving the cut-off saw, forge,

squaring shears and milling machines. However, seventeen accidents were reported as having occurred which involved some type of power-driven machinery not specifically named.

The data in this study show that very few accidents did occur which involved power-driven machinery used in metal work. However, a study by H. M. Vernon reveals a high rate of accidents in industry which were connected with power-driven metal working machines.

Machine tools for metal working are responsible for over six thousand accidents a year. Nearly half of them are due to lathes and a sixth to milling machines or power presses, while the remainder are due to machinery of a miscellaneous character. Wood-working machinery is responsible for nearly three thousand accidents a year, about half of which are due to circular saws, and a fifty to planing machines.¹ Fortunately, very few of the accidents are fatal.

Included in the questionnaire was a group of factors which are frequently connected with accidents which occur in the school shops. The teachers were asked to check the factors which they considered most responsible for the accidents which had occurred in their shop. Table 7 presents these factors. Fifty-seven of the teachers indicated that they believed pupil carelessness was one of the causes of accidents which occurred in the high school shops.

¹
H. M. Vernon, Accidents and Their Prevention, 1936, Vol. 598, pp. 280 and 284.

TABLE 7

FACTORS CONSIDERED RESPONSIBLE FOR ACCIDENTS
OCCURRING IN SIXTY-THREE HIGH SCHOOL SHOPS

Causes of Accidents	Number
Pupil carelessness	57
Hasty work	25
Crowded conditions	24
Horse play	24
Dull tools	20
Improperly guarded machines	13
Poor housekeeping	9
Improper lighting	8
Working before class time	4
Falling objects	4
Jigs and fixtures	3
Working after school hours	2
Home made equipment	1
Unnecessary talking	1
Lack of class organization	1
Improper use of machines	1
Improper teaching	1

Twenty-five teachers selected hasty work as being a factor usually involved in accidents. Twenty-four teachers reported that "horse play" was a common cause of accidents, and twenty-four considered crowded conditions in the shop as being a definite cause of accidents. Dull and improperly sharpened tools were considered the cause of accidents by twenty of the teachers, and thirteen teachers reported that improperly guarded machines constituted a factor involving accidents. Poor housekeeping was reported by nine teachers to be an important factor here. Other factors which were considered as being responsible for accidents which occurred in the industrial arts shops considered in this survey are :

(1) improper lighting, (2) working before class time, (3) falling objects, (4) faulty jigs and fixtures, and (5) improper instructions on the use of machines.

The accidents which have been discussed in the preceding paragraphs were accidents reported as having occurred in the sixty-three senior high school shops included in this study. A survey was also made of accidents which occurred in the forty-nine junior high school shops included in the survey. Information derived from questionnaires returned has been segregated and organized for presentation into two groups for the following reasons: first, to determine, if possible, if there is any relation between the number of accidents resulting from the same tools and equipment used in the junior and the senior high school shops, and second, to determine, if possible, if the causes or factors involved in accidents are the same or similar in the junior high school shops and in the senior high school shops.

Accidents reported from the survey of the forty-nine junior high school shops reveal that there were twenty-four accidents which required the service of the physician. Of the 152 reported accidents, 129 were classified as minor accidents.

Table 8 reveals that there is also a high rate of accidents which occur in the junior high school shops in the public schools of Texas.

TABLE 8

ACCIDENTS REPORTED IN FORTY-NINE
JUNIOR HIGH SCHOOL SHOPS

Report of Major and Minor Accidents	Number of Accidents
Total number of accidents in junior high schools	150
Accidents that were minor	122
Accidents requiring service of physician	26
Accidents that resulted in the loss or im- pairment of any part of the body	2

Two accidents were reported which resulted in the loss or impairment of some part of the body. Table 4 reveals that the same number of accidents was reported in the senior high school shops study which resulted in the loss of some member of the body.² However, the total number of accidents reported in the forty-nine junior high school shops is less than that reported in the sixty-three senior high school shops as might be expected. The ratio of accidents occurring in the two shops, however, is very similar.

Table 9 gives the list of hand tools which were involved in the 107 accidents reported involving the use of hand tools.

The wood chisel was found to be a dangerous tool when improperly used in the junior high school shops because thirty-one accidents were reported which involved the wood chisel.

²See page 23 of this study.

TABLE 9

COMMON HAND TOOLS WHICH WERE INVOLVED IN FORTY-NINE
JUNIOR HIGH SCHOOL SHOP ACCIDENTS

Tools	Number of ac- cidents
Wood chisel	31
Files	17
Hand saw	18
Plane iron	11
Hammer	10
Tinner snips	9
Screw driver	3
Soldering iron	2
Carving chisel	2
Knife	2
Cold chisel	1
Draw knife.	1
Back saw.	1
Total	107

Seventeen accidents were reported in which the common file was involved. Obviously the lack of proper instruction is partly responsible for this number of accidents reported involving the file. Eleven students were injured while using the plane iron, and ten students were injured with the hammer. The screw driver was also found to be dangerous when improperly used because three accidents were reported to have occurred while this tool was being used. Other common hand tools involved in reported accidents are: (1) soldering iron, (2) carving chisel, (3) knife, (4) cold chisel, (5) draw knife, and (6) back saw.

Of the forty-nine junior high schools included in this survey, eight reported that they did not have power-driven

machinery. Those schools that did have power-driven machinery gave the number of the accidents which occurred on each machine involved. Nine students were injured while using the jointers and seven were injured while using the band saw. Seven students were reported to have been injured on the power drill, and eight on the lathe. The grinders were involved in six injuries, and three students were injured on the cut-off saw.

Table 10 gives the number and type of machines involved in the forty-three accidents reported and the number of accidents which occurred on each machine.

TABLE 10
ACCIDENTS OCCURRING ON POWER DRIVEN MACHINERY IN
JUNIOR HIGH SCHOOL SHOPS

Machinery	Number of Accidents
Jointers	9
Band saw	7
Power drill	7
Lathe	6
Grinders	6
Cut-off saws	3
Table saw	3
Sanders	1
Forge	1
Shapers	0
Welding	0
Milling machine	0
Squaring shears.	0
Jig saws	0
Total	43

The above table reveals that the same machines which were involved in the accidents reported by the sixty-three senior high schools were also involved in the accidents

reported in the forty-nine junior high schools. (See Table 6 of this study.) No accidents were reported involving the use of the welding equipment, squaring shears, milling machines, jig saws, and the shapers.

The teachers in the forty-nine junior high school shops were asked to check the list of factors which they considered as being responsible for accidents which occurred in their shops. Thirteen factors were selected and included in the questionnaire. These factors and the number of accidents which were reported as being connected with each factor are presented in Table 11.

TABLE 11

MOST COMMON FACTORS RESPONSIBLE FOR ACCIDENTS IN
FORTY-NINE JUNIOR HIGH SCHOOL
INDUSTRIAL ARTS SHOPS

Factors	Number of Accidents
Pupil carelessness	39
Crowded conditions	19
Horse play	19
Hasty work	15
Improperly guarded machines	9
Dull tools	8
Improper lighting	8
Poor housekeeping	2
Working before class time	1
Falling objects	1
Jigs and fixtures	0
Working after school hours	0
Home made equipment	0

Pupil carelessness appeared to be a common cause of accidents because thirty-nine teachers indicated it was a factor in causing the accidents which occurred in their

shops. Nineteen teachers reported crowded conditions as a factor contributing to the causes of accidents in their shop, and nineteen reported "horse play" as a factor. Hasty work was reported by fifteen teachers as being responsible for accidents. Improperly guarded machines were considered the cause of nine accidents by the teachers reporting. Eight teachers gave dull tools as a cause of accidents, and eight indicated that improper lighting was a factor. Two teachers gave poor house-keeping as a cause of accidents. One teacher said that the two accidents which occurred in his shop were caused by working before class time, and one indicated that falling objects were the cause of accidents. No one in the survey of the junior high schools gave reasons such as faulty jigs and fixtures, working after school hours, and the use of home made equipment as causes for accidents.

The following question was asked in this survey: What is the policy in your school system for defraying the expenses of accidents which occur in your school shop? From the 112 questionnaires returned, the following answers were received. Eighty-eight teachers reported that the parents were expected to pay the expenses of accidents; ten teachers reported that the school board did pay the expenses; and four teachers said that if the accident was minor, the school board was responsible for the expense, but if the accident was major, the parents were responsible for the expense. Ten did not answer this question.

Another question was, Are you in favor of shop liability insurance for your students? Sixty of the teacher indicated that they were in favor of the shop liability insurance, and twenty-nine teachers said they were not in favor of such a plan. Of the 112 questionnaires returned, twenty-three teachers did not answer this question.

Another question which was asked included in the survey was, Do you have a first-aid kit in your shop? Eighty-three teachers indicated that there was a first-aid kit located in their shop. Nineteen teachers answered "no" which indicated that these schools did not have a first-aid kit in their shop, and ten did not answer the question.

Another question which was included in the questionnaire was, Do you have an attending nurse in your school? Forty-four teachers answered that an attending nurse was employed by the school system for which they were working. Forty-seven of the 112 schools did not employ a school nurse. Eleven of the teachers did not answer the question.

A number of schools require a statement from the parents giving their permission for a student to take shop. This question was asked in the study, Does the policy of your school require that the student file a written statement from the parents permitting them to take shop? Only eight teachers reported that the students were required to bring a written statement, and ninety-one teachers replied that they did not

use the policy. Thirteen teachers did not answer this question.

A study of the data in this chapter reveals that many accidents are occurring in the junior high school shops and in the senior high school shops of the State of Texas. The data reveal that the ratio of accidents occurring in the junior high school shops and senior high school shops is about the same because the number of accidents reported by each group is comparable.

This study further reveals that the hand tools and the power-driven machinery involved in accidents reported by the junior high schools and the senior high schools are pretty much the same. The ratio of accidents reported by the junior high schools and the senior high schools is comparable because of the more limited use of the power-driven machinery in the junior high school shops.

The factors as probable causes of accidents in the junior high schools and in the senior high school shops are very much the same in the junior high school shops and in the senior high school shops as shown in Tables 7 and 11 of this study. The same factors are high ranking in both the junior high schools and the senior high schools as shown in this study.

CHAPTER IV

SUMMARY AND RECOMMENDATIONS

Investigations completed in the course of this study showed that Texas has not enacted any specific law to promote and govern a safety program to be used in the industrial arts shops of the public schools. However, the State Board of School Safety Supervision, has, as part of its duties, the prevention of unnecessary loss of lives and destruction of property due to failure to observe safety protection.¹ These standards, upheld in the authority of the State Board of School Safety Supervision, regulates the placement of the windows, the heating facilities, ventilation, fluting of the interior wood, specifications for flights of stairs, and hanging of the doors in the school buildings of the State of Texas. In addition to these standards, a safety program has been proposed in Guide to Safe Living for Secondary Schools, a bulletin published by the State Department of Education. Here suggestions are made relative to safety through achievement standards, teaching methods, and learning activities. However, no definite program has been provided for or recommended for the industrial arts shops in the State of Texas.

¹L. A. Woods, Public School Laws of the State of Texas, 1945.

A bulletin has been prepared by the Safety Committee of the Industrial Education Division of the Oklahoma Education Association proposing certain fundamental practices in safety instruction for industrial arts.² Several of these practices are worthy of attention here. Some of the suggested procedures are as follows: (1) poster boards are to be placed in some conspicuous part of the shop; (2) a machine should not be operated without proper guards; (3) metal guards must enclose all exposed belts and gears; (4) all universal, circular, and variety saws must be equipped with splitter and cover guards; (5) rubber runners or matting should be on the floors in front of certain machines, and a fully equipped first-aid cabinet should be in all shops.

Further study shows that the State of Iowa has enacted laws to govern safety in the industrial and school shops.³ These laws state that the Commissioner of Labor of the State, the mayor and chief of police of every city must enforce the safety laws. The owner, agent, superintendent or person in charge of these industrial and school shops must see that belt shifters, or some safe mechanical means for throwing belts on and off pulleys are installed, and that guards are installed to cover open belts, pulleys, and gears. It is

² Bulletin, Safety Education in the School Shops of Oklahoma, No. 47-C-10, p. 2-6.

³ Wayne M. Judy, op. cit., p. 20.

the duty of the employee or employer to immediately replace all guards which may become defective. Machinery that throws off dust must be provided with a blower which carries the dust to the outside. When the Commissioner discovers a violation, he must give a notice to the person in charge to correct such procedure within sixty days. When an accident occurs in an industrial plant or school shop, the person in charge is required to file a written report with the Commissioner. The Commissioner may require any additional information needed. For violation of these provisions, fines will be assessed accordingly.

Information received from the 112 schools included in this study reveals that many methods are currently being used to teach safety education in the industrial arts shops of Texas. Ninety-four teachers reported they were using safety talks, and fifty-one teachers indicated that they were using safety rules posted in the shop to teach safety. Accident posters were used by forty-five teachers, and thirty-nine teachers used tests on safety as a method of teaching safety. Painted danger zones were used by thirty-five teachers; thirty-two teachers reported that they used visual aids; and thirty-one teachers taught safety by the safety assignment method. Safety slogans were used by nineteen teachers. Eighteen teachers reported the use of safety bulletin boards, and six teachers indicated that they used the safety council as a method for teaching safety.

This study reveals that accidents are occurring in the school shops of Texas even though the teachers of industrial arts are using many methods to teach safety and to prevent accidents. Two hundred twenty-six accidents were reported in the sixty-three high school shops included in the study during the school year 1947-1948. One hundred eighty-eight of these accidents were minor, and thirty-six accidents were major. Two of the accidents resulted in the loss or impairment of some part of the body. Teachers from the forty-nine junior high schools reported one hundred fifty accidents occurred in their shops during the school year 1947-1948. One hundred twenty-two of the accidents were minor, and twenty-six were major. Two of the accidents resulted in the loss or impairment of some part of the body.

Data in the study reveal that hand tools take their toll in accidents. Hand tools were involved in one hundred thirty-four accidents which were reported by the sixty-three senior high school shops. One hundred seven accidents occurred while using hand tools and were reported by the teachers of forty-nine junior high schools. The most common hand tool involved in accidents was the wood chisel. The teachers of the senior high schools reported that sixty-one students were injured, and the junior high school teachers reported they had thirty-one injuries which occurred while using the wood chisel. Hand saws were involved in accidents which occurred in both the junior high schools and senior high schools.

Nineteen students were reported injured while using the hand saws. The number of accidents which occurred in the junior high schools while using the hand saw was seventeen. The total number of accidents with the use of the hand saw in both junior and senior high school shops was thirty-six. Twelve students were injured while using the plane iron, and eleven students received injuries when using the coping saw in the senior high schools. Eleven students were injured while using the plane iron in junior high school shops. The common hand file was involved in seventeen injuries reported occurring in the senior high schools.

The study reveals that students were also injured while using power-driven machinery. In the senior high school shops, ninety students were injured during the school year 1947-1948, and forty-three were reported injured in the junior high school shops while using the power-driven machinery. One hundred thirty-three were injured in both junior and senior high school shops with power-driven equipment. Band saws used in the senior high school shops were involved in seventeen injuries reported in the study. Twelve students were injured while operating the jointer, and nine each were injured while operating table saws and lathes. Eight accidents were reported which involved the use of the power drill. As power-driven machinery is not used so extensively in the junior high school shops, the number of accidents was smaller. Nine teachers reported that accidents occurred in

their shops while the students were operating the jointer machine. Seven students were injured while using the band saw, and seven were injured while using the power drill. Six accidents were involved with the use of the lathe and six with the grinder. Cut-off saws and table saws were involved in six accidents which occurred in the junior high school shops. There was a total of eighty-seven accidents in both the junior and senior high school shops as the result of using power-driven machinery.

The industrial arts teachers teaching in the 112 schools included in the survey gave some of the factors which they considered partially responsible for accidents. Fifty-seven teachers in the sixty-three senior high schools stated that pupil carelessness was responsible for some of their accidents. Twenty-five teachers reported hasty work was a factor involved in accidents. Twenty-four teachers considered crowded conditions as a factor contributing to shop accidents. Twenty-four teachers reported that "horse play" was responsible for some accidents. Dull tools were considered the cause of accidents by twenty teachers. Thirteen teachers stated that improperly guarded machines were responsible for some accidents. Pupil carelessness was also found to be a factor involved in accidents occurring in the junior high schools. Thirty-nine junior high school teachers reported pupil carelessness as the most common factor involved in accidents. Nineteen teachers

reported that they believed crowded conditions were responsible for the accidents occurring in their shops. Nineteen teachers reported "horse play" as being responsible for accidents. Fifteen teachers reported hasty work as being a factor responsible for accidents. Nine teachers reported that improperly guarded machines were the cause of accidents occurring in their shops. Dull tools were considered the cause of accidents by eight teachers. Eight teachers indicated that improper lighting was a common factor responsible for some accidents occurring in the junior high school shops.

In order to further reduce the number of accidents occurring in the school shops, it is suggested that each shop teacher use the following suggested recommendations. Using this approach as a beginning, from the results of this study, it is recommended that a similar study be made on a state-wide basis to determine the number of accidents, and if possible, the causes of the accidents occurring in the industrial arts shops in the public schools of Texas. Should the finding of such a study show that there is a high rate of accidents occurring in the industrial arts shops, and it should if this sample is typical, it is recommended that the State Department of Education give serious thought to the problem, and if possible, provide a universal safety program for the industrial arts shops. It is further recommended that the State Department of Education provide safety supervision in order to stress safety education and help improve the

physical conditions of the industrial arts shops in the public schools of Texas.

It is recommended that all teachers of industrial arts should place special emphasis on the proper and safe use of the following hand tools: wood chisel, plane iron, file, hand saw, and coping saw.

In view of the fact that 135 accidents were reported in the 112 schools which occurred while students were using power driven equipment, it is recommended that each teacher of industrial arts should place more emphasis upon the safe use of all power-driven machinery.

It is recommended that each teacher of industrial arts check the physical condition of his shop and remove all hazards in so far as possible.

It is recommended that each teacher of industrial arts in the public schools of Texas endeavor to perfect his shop organization in order to prevent pupil carelessness, "horse play," hasty work, and other factors commonly involved in accidents.

APPENDIX

May 5, 1948

Dear Sir:

The State Department of Education has set some very specific rules and requirements for teaching and providing safety education in our public schools of Texas. The regulations are specific in regards to building requirements, transportation of students, and fire control. However, little has been done with safety education in our industrial arts shops.

I am making a survey to determine to what extent safety education is taught and provided for in our industrial arts shops. I am endeavoring to discuss the most common accidents, their causes and prevention.

I am asking a number of the more progressive shop teachers in the state to cooperate in this survey, and I shall appreciate it if you will fill out the enclosed questionnaire and return it to me as soon as possible.

Sincerely yours,

Finis Turner

FT:bt

Questionnaire

Confine all accident data to the school shop and to the school year 1947-48. Consider in this report all accidents where medical aid or first-aid was needed.

- I. The total number of accidents in the one year period. ()
 The number of accidents treated by a physician ()
 The number that resulted in the loss or impairment of any part of the body. ()
- II. Do you teach Safety Education as you take up new types of work? Yes () No ()
- III. Do you teach Safety Education as a separate course prerequisite to the shop course being taught? Yes () No ()
- IV. List the hand tools used in your shop with which accidents are most common, and give the number resulting from the use of each in your shop this year:
 () () ()
 () () ()
- V. Have your students had any accidents while using power driven equipment? Yes () No ()
 Check the machine upon which the accidents occurred, and the number of accidents in the parenthesis to the right:
 jointers. () band saws () lathes ()
 squaring () cut off saw () shapers ()
 sanders () shears () table saw ()
 grinders () forge () milling ()
 power drill () jig saws () welding ()
 machines ()
- VI. Check the factors which you consider most responsible for accidents which occur in the school shop:
 improperly guarded machines ()
 crowded conditions ()
 pupil carelessness ()
 working before class time ()
 horse play ()
 working after school hours ()
 dull tools ()
 hasty work ()
 jigs and fixtures ()
 poor house keeping ()
 Home made equipment ()

- falling objects ()
- improper lighting ()

- VII. Check safety methods used and add any which you use that are not listed:
- accident posters ()
 - safety rules posted in shop ()
 - safety bulletin boards ()
 - safety talks ()
 - tests on safety ()
 - visual aids ()
 - painted danger zones ()
 - student safety council ()
 - safety contests ()
 - safety slogans ()
 - safety assignments ()

- VIII. What is the policy in your school system for defraying the expenses of accidents which occur:
 Parent () School Board () Teacher ()

- IX. Are you in favor of shop liability insurance for your students? Yes () No ()

- X. Do you have a first-aid kit in your shop? Yes () No ()

- XI. Do you have an attending nurse in your school? Yes ()
 No ()

- XII. Have you noticed or found whether or not the majority of your major or minor accidents happen at the beginning or end of period? Beginning () End ()

- XIII. Does the policy of your school require that the students file a written statement from the parents permitting them to take shop? Yes () No ()

- XIV. Give the approximate time of day when most accidents occur.

- XV. Does the policy of your school require you to keep a record of all accidents that happen in your shop? Yes () No ()

- XVI. Is it a policy of yours to keep evidence of the accident? Yes () No ()

- XVII. Do you have other teachers to examine accidents with you? Yes () No ()

- XVIII. Is it the policy of your school, in case of accident,

to send the pupil to his family physician or to a
doctor designated by the school? Yes () No ()

XIX. Any comment you choose to make in addition to the
above questions will be appreciated.

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