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Scope of Study: The purpose of this report is to present information on safety in the drawing room. Included in the report is a history of drawing, and a synopsis covering safety in the drawing room and how to maintain it. Also included in this report are some selected definitions.

Findings and Conclusions: Safety is essential in the drawing room just as it is in industry today. The importance of safety cannot be overemphasized, since it is needed for the welfare of young people and future industrial workers of America. It is the writer's hope that more teachers will express the need for safety in their classrooms and that surveys be taken to show where safety should be considered and used extensively.

ADVISOR'S APPROVAL C. R. Hill

SAFETY IN THE DRAWING ROOM

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By

CLETIS D. HAWKINS

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REPORT APPROVED:

C. L. Hill

Associate Professor and Head, Department of
Industrial Arts Education

L. H. Bengtson

Report Advisor and Assistant Professor,
Department of Industrial Arts Education

Dean of the Graduate School
Oklahoma State University

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CHAPTER I.

INTRODUCTION

This report covers the historical background of drawing and art throughout the primitive ages, when drawing was a means of communication, up until the present time, when drawing is an essential need, as a picture for designers, industries and etc. for means of relating information. It includes the early beginning and the development in drawing methods and education.

This report also includes a synopsis of safety in the drawing room. It covers the history of shop safety, the setting up of a safety program and information on how to administer it.

The Purpose of the Study. This study was chosen because of the author's interest in this type of industrial program.

This study may give evidence and proof that industrial drawing is essential in Industrial Arts Education. Also this evidence may be of value to Industrial Art Teachers attempting to introduce Industrial Drawing Safety into their program.

Research Technique. The information shown in this report was obtained principally from books found in the Oklahoma State University Library and from instructors in the field of Industrial Arts Education. The books were written by well known authors and educators of Industrial Arts and Mechanical Drawing.

Similiar Studies. The following studies are not concerned with the same problem with which this study deals, but in these studies it is assumed that the history and safety are important and stresses the meaning of each.

Nawaby, Ahmad Shira, History of Mechanical Drawing in the United States. Master of Science Report, 1960, Oklahoma State University. This report gives evidence of great effort toward the findings of the history of mechanical drawing in the United States.

Schilling, Clifford Wayne, The History and Modern Developments of Drafting in Industrial Arts Education. Master of Science Report, 1960, Oklahoma State University. This report gives evidence of the need of modern developments of drafting in the Industrial Arts Education classes.

Predicted Views and Results. The writer predicts that he will gain more knowledge from the study of this report, than he would otherwise receive. He will be able to use the information from this report in his future work and studies in Industrial Arts.

It is hoped that the results of this study will give teachers in the Industrial Arts a broader view of safety education and safe practices in their classrooms.

Definition of Terms. In order that the reader may have a clear knowledge of the vocabulary used in this report, the following list is prepared.

Reed: Any of the various tall bamboolike grasses, one species (Phragmites communis) or their slender, often jointed, stems.

Hieroglyphic: A sacred character; a character in the picture writing of the ancient Egyptians, or the mode of writing in such characters.

Geometric: Designating, or pertaining to, a style of Greek pottery marked by simple geometric designs, usually rectilinear, such as bands, zigzags, triangles, etc.

Quill: One of the large stiff feathers of a bird's wing or tail especially one of those of the wing; also, the hollow barrel or calamus of a feather.

Renaissance: A new birth or revival. Any period similarly characterized by vigorous activity along literary, artistic, and other lines.

Graphite: Soft, black native carbon of metallic luster, used for lead pencils.

Papyrus: A tall sedge, native to the Nile region; the pith of this plant is sliced and pressed into a writing material by the ancient Egyptians, Greeks, and Romans.

A brief history of drawing, covering the primitive age up until the present time, showing the developments of drawing, drawing methods and the beginning of drafting will be covered in the next chapter.

CHAPTER II.

THE HISTORY OF DRAWING

The highest level of art was reached when man was living in the Palaeolithic stage of the Old Stone Age, at a time when conditions had been made arctic or subarctic by the advance of the glaciers. From the Neolithic period onward, civilization tended to become almost entirely materialistic in its outlook. There was a gap of several thousands of years between the cave art of the Magdalenian era (the final era of the Old Stone Age) and the first great civilizations of the southwestern Asia and the Nile Valley. Bazin in his book, A History of Art, states:

> We know that our ancestor of the Old Stone Age painted or carved natural forms with no intention of making a "work of art"; he intended, rather, to ensure the fertility of his prey, to entice it into his traps, or to acquire its strength for his own purposes. The primitive artist was a magician whose drawing had all the virtue of a magic spell, an incantation. (2, Page 2)

Some fifty thousand years ago a group of artists were decorating the walls and roofs of their caves, near Altamia, in Spain. Because they had simply seized the first bits of sharpened flint or burnt wood near their hands and had added some color, they were entirely unaware that they were to be considered artists. It is impossible to attach definite dates to many examples of primitive and prehistoric arts, but it is said that from the European cavemen is found authentic evidence of the finest natural artistic talent of prehistoric days.

Ancient Egypt. Egyptian art began with hieroglyphic or pictorial symbols, which were employed in inscription on temples, tombs, coffins, statues, wall decorations and on the sheets of papyrus which formed their writing material. These hieroglyphics proved that the Egyptian scribes were remarkable artists, for their pictorial symbols called for the most incisive and accurate drawing.

The Egyptians drew plans for their cities and buildings by laying their circles out on stone, wood, or papyrus with the aid of a piece of string. A bronze point, passed through a loop in the string, was manipulated with one hand to scribe the circle while the other hand held the string at the center. After a circle had been laid out by one of these methods it was drawn over with the same pen used for writing. This was usually a slender piece of reed, or other fiberous woody material frayed out at one end and tapered to form a pointed brush.

In Egypt's Third Dynasty (about 3000 B.C.) their architects built mighty temples, and the Great Pyramids, built a century or so later, remains today one of the enduring wonders of the world.

Line was the basis of Egypt's drawings on papyrus, their wall paintings, and their designs on pottery. Line was the medium by which they recorded their daily lives, their trials, and their triumphs. (4, Pages 20-24)

<u>Ancient Greece</u>. Egypt had already become a highly civilized nation and had given proofs of her many-sided artistic genius more than two thousand years before the golden age of Greece. Although her intellectual development was of slow growth,

Greece was destined to leave to mankind an incomparable legacy of every form of beauty, art, and culture. It was obvious that the artists of Greece were already exploring the third dimensional possibilities of line drawing.

The first crude beginnings of drawing in Greece were in the so-called geometric style of the eighth century, B.C. Around the beginning of the sixth century, there was a growing ability to draw figures and animals. The Black-figure technique had arrived, with its mastery of drawing, decorative quality of its line technique, and the general beauty of its craftsmanship. Red-figure pottery was of a later growth, in which the figures were drawn in red with a background in black.

In the year 410, craft was beginning to replace art, and in the first century B.C., the manufacture of painted pottery had altogether ceased. (4, Pages 25)

The Roman World. Caesar began the great transformation of Rome into the imperial capital. He did this by building great monuments: a forum, a theater, the Aemilia and Julia basilicas, the Curia Julia.

The burning of Rome in A.D. 64 enabled Nero to make the city more healthy and to build himself an immense palace called the Golden House.

The whole of the Roman world was covered with monuments during the time A.D. 310-312. It was in the domain of architecture that the genius of the Romans found their most powerful expression.

Their rulers were made of wood, but some were made out of ivory pieces joined together with bronze, and their compasses were made of bronze. Drawings were made upon tablets of wood coated with wax, or upon the skins of animals (usually sheep or goats), and later upon a smooth product known now as parchment or vellum. Their pens were usually made from a hollow reed, which was cut at one end to a flat point and slit like the modern pen.

They specialized in civil engineering and making buildings which were functionally perfect. Abandoning the Greek manner of building with blocks of dressed but uncemented stone, they adopted a system of building in brick or rubble, having invented a cement of exceptional firmness. The Romans had a splendid sense of monumental grandeur. (2, Pages 94-95)

<u>China and Japan</u>. Line is the fundamental basis of Eastern technique. The brush is invariably used for their line drawing, and control of the brush is the first stage in the education of Chinese and Japanese artists. With the brush-stroke they aim to suggest, in outline, the very essence of the subject. Oriental artists never draw from life or nature; they observe and memorize their subject and then endeavor to suggest its spirit and essence. They aim at decoration and pattern, not at realistic representation.

The achievements in decorative line drawing can be traced to their origin in China as long ago as 2700 B.C., when writing was also originated. There was a mention of portraiture in China in 1326 B.C., and it was from China that for many centuries Japan derived her artistic inspiration.

In the seventeenth century, Oriental art was being especially notable for new movements in pictorial art, decoration and design, which was followed by the discovery of the woodcut and the production of books and color prints. (4, Pages 32-36)

<u>The Middle Ages</u>. The most characteristic art of the middle ages is to be found in the psalters, manuscripts, and books, which monkish scribes and artists, so lovingly, produced.

The introduction of paper from Asia during this time was very important. The first paper making plant in Europe was established in Spain by the Moors about the middle of the twelfth century.

In the second half of the tenth century a rich variety of work was received, some of it realistic in its treatment of the figure, others containing beautifully painted miniatures and borders, pen drawings, and script. The goose quill seemed to have been commonly used, with the swan quill as a substitute.

Printing from metal type began in Italy in 1465, in Paris in 1470, and spread throughout Europe a few years later. By the end of the fifteenth century books were being printed in great quantities. (4, Pages 38-41)

<u>Renaissance</u>. Artists, architects, sculptors, historians, scholars, poets, statesmen, and scientists worked with inspired ardor, and shared their discoveries. Other Italian cities developed their own schools of painting; Venice the most notable for its art was distinguished.

The metal points were widely used by artists of the late middle ages and the Renaissance. A silver point attached to the leg of a compass was used for drawing circles. This method was widely used by artists and was found to be of high favor among the architects and engineers. Despite the numerous advantages of silver point, it never fully replaced the old Roman method of first marking with a plain point and then drawing with pen and ink. (4, Pages 42-43)

The Development of the Lead Pencil. The inventor of the lead pencil is not known, but the pencil was written about in the year 1565 and it was stated that the core was of graphite from England. Pencils were gradually adopted by artists, architects, and engineers, but because of their softness they smudged the paper and offered some disadvantages.

Numerous experiments were made in Nurenberg, Germany where the firm of Faber was established in 1760. Here they found the answer to control the hardness of lead.

Developments in Method. The preliminary drawing had advanced from simple scratching on stone, wood, or papyrus to drawing on specially prepared paper with a silver point, and finally drawing on almost any kind of paper with a graphite pencil. The process of inking had advanced from painting with a pointed brush to drawing free-hand with a writing pen, and finally to use a pen guided by a compass, straight edge or some curved edge. The draftsman also learned to handle his pen lightly so as not to cut the paper and to insure the breadth of line.

Period of the Industrial Revolution. Bow pens, pencils, dividers, and beam compasses were the start of much progress in the making of drawing instruments during the period of 1750 to 1870. There was a definite trend toward light, even fragile, construction. The most common material used in instruments was brass and when better grades were being made they used an alloy of nickel, zinc, and copper.

Since the demand for more machines was becoming complex, the old method of written description and a simple pictorial view led to confusion as well as waste and increased costs. Modern drafting really came into being about 1880, at which time the blueprint process was perfected to a point where the reproduction became practical.

During 1880 to 1940, only thirty per cent of the schools teaching manual training were teaching drawing. Manual training was making greater gains in the public schools than drawing. In 1903 the public schools of New York offered drawing as a school subject because of its value in imparting habits of accuracy and neatness and for cultivation of the imagination and reasoning powers. (6, Page 70)

By 1927, drawing had become a part of the industrial arts program and was recognized as such among the leaders.

Developments in Recent Drafting Practice. Surveyors ceased to ink in their plans-table sheets and simply traced them on tracing cloth, or paper, from which reproductions were made.

Then mechanical draftsmen discontinued the practice of inking their originals before making tracings.

In 1910, some draftsmen were laying out their work directly on tracing cloth or paper, this procedure became widespread.

In 1925, a few draftsmen were making many of their drawings with heavy pencil directly on tracing cloth or paper.

World War II. Since it seemed that there would be an insufficient supply of drawing instruments during this time, many companies that were in the drafting machine business undertook the manufacturing of drawing instruments. These new drawing instruments met with immediate success and were used in very large quantities throughout the war industries. Not only has the new practice in drafting brought about changes in instruments, but also in the composition of drawing sets. Fewer instruments were required, but they must possess greater rigidity and durability.

The first type of blueprinting was photographic type operation by exposing a sensitive paper to light. The general methods of making such prints was discovered by Sir John Frederick William Herschel in the 1840's. Paper, which has been made sensitive by being treated with a mixture of ammonium ferric citrate and pottassium ferricyanide, was exposed to light under transparent paper on which was drawn the materials to be transferred. Light passes through the drawing and causes the ferric salt not covered by lines to react with the ferricyanide and form Turnbull's blue as a background. There is no chemical reaction in the area under the lines, which thus appear white on the blueprint; the furic acid under the lines is then washed away after exposure. The exposure and washing were usually done in a continuous machine process. This was the first way of reproducing copies of sketches, line work, etc. Since this time there has been a tremendous advancement in reproduction (copying). Various techniques employed to reproduce copies of an original subject. Among the methods used are: Photocopying, the whiteprint, the blueprint, the brownprint, and the phototracing.

Photocopying is a form of photography used for copying drawings, tracings, charts, printing, and typing. Copies may be made larger or smaller than the original but no intermediary step is required to produce readable prints.

The whiteprint copy is a true positive of the original; i.e., the black lines and white areas of the original are faithfully produced without any intermediary step or negative being necessary. However, no enlarging or decreasing of size is possible.

In the ammonia process both the compound and the coupling component are coated on the whiteprint paper, blue premature interaction of the two is prevented by an acid, which forms part of the coating. After exposure to ultraviolet light, the coated paper is brought into contact with ammonia vapors which neutralize the acid stabilizer and permit the reaction of the Diazo compound and the coupling component on areas not affected by the ultraviolet light. The entire process is done in one machine.

In blueprinting, the drawings, tracings, charts, and similar linework to be copied, must be on translucent stock to permit passage of light rays, and the copy will reproduce the opaque lines on the original will appear on the copy in a blue color.

A blue line print is made with the blueprint process by using a translucent negative as the original. In this way the white lines on the negative will be reproduced by blue lines on the copy, and the opaque areas on the copy. Thus, in blue lines and white areas, the blue line print will reproduce the black lines and white areas of the original from which the negative is made.

The brown print, also sometimes termed the "Vandyke", is made on paper coated with both ferric iron and silver salts, the former being the light sensitive ingredient. Exposure reduces the ferric iron salt to a ferrous iron salt and, on the application of water, the ferrous salt reduces the silver salt to metallic silver, as in a photographic print.

Brown line prints are also known as silver prints or Vandyke positives, and are made from negatives. As in the case of the blue line print, they reverse the light and dark areas of a negative so that it presents the same appearance as the original except that the lines are brown on a white background.

Phototracings, also known as CB tracings, utilize a "wash-off" silver emulsion. The reproduction is usually made on a gelatin emulsion containing silver chloride and a soluble bichloromatic salt, coated on a water-repellent base, such as a lacquered cloth. Exposure is made through a negative, usually a Vandyke or brownprint, in a vacuum frame, using the principle that exposure to light "hardens" the gelatin because of the bichloromate. (8, Page 356)

History of Drawing in American Schools. In 1697, John Locke organized a working school for young children where they could learn a trade. He recognized the value of drawing because it was helpful in fixing the image of objects in the mind.

In 1820, the manual labor movement began in the United States. This introduced manual arts instruction into the schools on the basis that pupils would work a half day and receive instruction the other half.

During the last half of the 19th century came industrial improvement which brought with it increased demand for draftsmen and the necessity for classroom operations. Modern drafting really came into being about 1880, at which time the blueprint process was perfected to a point where reproduction of drawing became practical.

In 1862, the Morrill Acts provided the endowment of higher education in the agricultural and mechanical arts. This grant enabled Land Grant Colleges to train more industrial arts people such as engineers, designers, draftsmen, and factory managers.

In 1896, Charles A. Bennett, set up the first graduate course in teaching manual training in an American college and wrote many books, four of which were used for a foundation and guide for drawing.

The public schools of New York in 1903 offered drawing as a school subject because of its value in imparting habits of accuracy and neatness and for cultivation of the imagination and reasoning powers. Freehand work was given at intervals and lettering was carefully taught. House planning was given as a unit of drawing and means of freedom of expression. It appealed to the inventive minds and furnished additional skill in drawing.

In large city school systems, such as New York, the student may be introduced to drawing as early as the seventh grade. Needs of the individual at this grade level call for a wide variety of experience in exploration, guidance and knowledge. When the individual enters high school the exploratory and guidance activities need to be continued as his interests center upon a chosen goal.

The high school will be the last formal education for many individuals, therefore, it must have prepared them for a means of earning a livelihood. Two other groups of people must be considered; (1) those preparing for college and (2) those who do not expect to make practical use of it. Mechanical drawing courses should be planned to give the greatest practical value to individuals represented by each of these groups.

Many schools are small and offer mechanical drawing only in the high school if at all. The possibility of offering it at the junior high school level in these schools is very remote. With this in mind it may necessitate the offering of mechanical drawing in the curriculum only at the high school level.

Mechanical drawing was designed for the beginning classes; then, later, the emphasis was placed on the more advanced phases of drawing; such as sheet metal drawing and finally the students are introduced to machine drawing and architectural drawing.

In the following chapter the author will attempt to give a synopsis on safety in the drafting room. This synopsis will include such information as the history, setting up a safety program and how to maintain it.

CHAPTER III.

SAFETY IN THE DRAWING ROOM

During the current decade, a national consciousness for the need of safety in education is forming an influence on the school shop program. Teachers, especially in Industrial Arts and Vocational shops, are being advised to develop the consciousness of safety in the student. The student who has acquired safety consciousness will observe personal caution at all times from the experience of others who have practiced safety rules in preventing accidents. This consists of important rules that are recommended for use in an educational program for the prevention of accidents in the drawing room.

Accident Prevention Psychology. To do what is basically correct and get the greatest amount of work accomplished over a long period of time is considered the sound psychology of accident prevention. Not all sound principles of accident prevention are written in rules governing a particular machine or tool.

When exposed to risks, a person should acquire the habit of increased alertness. The worker should automatically take the correct steps, if the safety habit is both subconscious and instinctive to some extent. The child who is overinstructed may be timid and lose his spirit for adventure.

Some students may refuse to take the necessary precautions while in the drawing room. For an example, a group of boys were not keeping the drawing room clean from fire hazards. One boy seemed to be the leader and he was persuaded to keep his part of the room clean, therefore, the other boys in the group followed in his steps. In the drawing room this means of psychological control may have to be used at times.

Industrial Drawing Objectives. Objectives may be thought of as aims or goals. These are to be achieved by bringing about desired changes in student behavior as a result of his experiences under the direction of the teacher. These experiences provided by the school are the facts, skill, and tools which the individual will need if he is to become a happy, useful, and successful citizen.

To make any instructional unit of work purposeful, there must be guiding objectives. Every teacher needs to develop his own objectives designed to fit the needs of the students in the drawing room.

The specific objectives for Industrial Drawing should be to:

1. Develop the power of visualization and strengthen the constructive imagination.
2. Form habits of careful observation and perception.
3. Form habits of accuracy and exactness.
4. Develop a degree of skill.
5. Develop an understanding and appreciation of the language of industry.
6. Develop correct techniques of drawing.
7. Develop the ability to convey ideas to others through drawing.
8. Develop the ability to read blueprints and working drawings.

9. Develop a safety consciousness.

10. Present occupational information of the drafting industry.

It was the author's aim to introduce the reader to the subject of Safety in the Drawing Room. In Part A the author will give a brief synopsis of the history of shop safety, which covers dates as early as 1800 until 1943.

PART A

History of Shop Safety

Before the year 1800, there was no industrial system in America and there were no large cities as we know them today. Most families lived on small farms where they grew their own food and made their own clothing.

Soon after 1800, however, the effects of the Industrial Revolution that had started in England about 100 years earlier, began to come into America. Steam engines were imported into Massachusetts and mills were constructed to manufacture cotton goods. The workers consisted of both women and children and many of the children ranged in ages from 6 to 10 years.

For many years, working conditions in industry were deplorable. No attention was paid to the safety, health, and welfare of the workers. Each person worked twelve to fourteen hours a day for six days a week.

The Ashley Great Factory Act was passed in England in 1835, which was for all the employers to put safety guards on all moving machinery.

In 1867, Massachusetts passed a law providing for the services of factory inspectors. The same year they established the ten-hour maximum working day for women.

In 1877, the Massachusetts legislature voted to compel employers to put safeguards on hazardous machinery.

In 1885, Alabama passed an Employers' Liability Law, and Massachusetts did likewise in 1887. Although these laws were passed, they contained many loop-holes. The main ones were the three so-called common law defenses: contributing negligence, assumption of risk, and negligence of a fellow worker. Also in 1887, England had the first Compensation Act.

In 1892, a safety department was organized in the Joilet Works of Illinois Steel Company to promote and maintain safety in their plant. This company has been referred to as the birthplace of the American industrial accident-prevention movement.

The first compensation law was enacted by Congress in 1908, but the benefits were very meager, and they were limited to certain special classes of Federal workers. The oldest law of its kind still in effect in the U.S. was passed by New Jersey in 1911.

In 1912, a number of industries assembled to work up or exchange ideas on accident prevention in the shops. Robert J. Young was known as the safety crusader at this time.

In 1913, there was the organization of the National Council for Industrial Safety which for two years confined its activities to the industrial accident problem. Then in 1915, this name was changed to the National Safety Council. This council published six monthly magazines; National Safety News (for industrialists), Public Safety, The Industrial Supervisor, The Safe Worker, The Safe Driver, and Safety Education (for school teachers).

In 1917, the first paid manager of a community safety council was installed in the city of Pittsburg to secure the active support and cooperation of city officials, school authorities, industrialists, parent-teacher associations, etc.

In 1920, the first article on school safety was published.

In 1940, the Engineers Service Management Development Training Program was organized.

By 1943, a safety degree was being offered by several colleges.

In the following Part, the author aims to explain the administrator's, the teacher's, and the student's responsibilities in setting up a safety program. This section also includes the techniques that could be used in the classroom and in the mechanical drawing classes in setting up a safety program.

PART B

Setting Up A Safety Program

An effective safety program should be backed by the school administrator, the instructor or teacher, and the students. In schools with safety coordinators, guidance counselors, and nurses, they too should play key roles in the safety program. Often parents and community leaders, especially safety engineers, may also fit into the picture. With so many people having partial responsibility, someone must take charge.

The Administrator. The overall responsibility of a safety program in schools rests upon the school administrator. His leadership and support are essential and he must make them felt. Among the ways he can do so are:

Helping to plan the school's safety program

Requiring and analyzing safety surveys
Organizing safety instruction
Enforcing safety rules
Correcting hazards that arise
Promoting desirable attitudes toward accident prevention
Developing procedures for handling emergencies

Obtaining professional assistance when necessary

Accepting responsibility for injuries

Appointing a competent coordinator of safety

Providing adequate and safe facilities

Maintaining teacher interest in safety efforts (11, Page 17)

The Teacher. The teacher, like the administrator, must demonstrate that he cares for the safety of the student. Students will learn both from his examples and from his direct teaching. Many instructors carry on far more safety education than they realize, for safety is sometimes best taught by example without mentioning the word itself. But organized, explicit safety education is also necessary to help students accept their own responsibility for accident prevention.

One of the greatest needs in accident prevention today is more effective teacher education. He should study the subject he will teach. Such study promotes the excellence in a particular field which yields both good workmanship and safety. He can then articulate this knowledge and skill in accident prevention throughout the instructional program, be it in a prescribed curriculum or in lesson plans he develops himself.

The teacher needs to study child growth of development, psychology of learning, and adolescent psychology. These subjects help him to become a more sensitive observer of human behavior. He can effectively relate safety education to student needs, interests, and goals; he can see the relationship between stress or emotional disturbance; he can recognize which students need what kind of help and when they need it; and he can guide them to understand and work within their capabilities and limitations, and he can help them extend their capabilities safely.

By studying such courses of organization and management of shops, teachers see more clearly what factors in planning and in organizing the classroom add up to good management which, in turn, yields high morale, good discipline, and safety.

The teacher should study general safety and safety education, shop safety, and occupational health. Such courses include specific units on accidents and accident prevention, outlining safety programs with full understanding of psychology, planning shops and laboratory layouts, good housekeeping and upkeep of tools, equipment, and materials, fire hazards and fire-fighting techniques, personal protective devices, organization and management, interpreting and preparing guides of safe practices for particular situations, analyzing shop, laboratories, and jobs for hazards, organizing safety lessons, accident prevention with problem students, and evaluating teaching-learning for safety.

Teachers should also be familiar with the National Safety Council, local safety councils and other professional safety organizations such as the American Society of Safety Engineers. These groups offer many resources including assistance in program planning and execution, safety conferences, data sheets, check lists, journals, and audio-visual aids. (11, page 18)

The Student. Since first experiences make the greatest impact, it is essential that students learn safe practices at the same time that they learn other shop and laboratory skills. This means they should learn habitually to exercise added caution when under emotional strain. Such habits of safe living are the product of countless learning experiences from early childhood on through life. Yet they must also be constantly reinforced and relearned.

As students learn craftsmanship, they are actually learning safety, whether they think of it as such or not. On a more conscious level, in addition to perfecting manual skills, students can also learn specific skills of accident prevention. As they learn to analyze a job before them, they can learn to recognize and control hazards. They can also learn such fundamentals of accident prevention as good housekeeping and following directions of container labels. (11, Page 22)

Techniques Used In Setting Up A Safety Program. Shop instructors are justified in assuming that their pupils have received, in the elementary schools, an understanding of the meaning of the term "accident prevention" but have not had an opportunity to learn the hazards incident to the various trades.

It is obvious that the teaching of accident prevention in the shops must find its place in the actual work in classes and the subject matter of safety education must come from real needs as seen by pupils on the job, rather than from the material that may not in every case be pertinent.

In classroom work the class may:

1. Work out a safety code that applies to the trade being learned.
2. Study the compensation laws with respect to the responsibility of the employer and the workman.
3. Discuss advantages that occur to the employer through the organization of shop safety committees.
4. Study safety orders and safe practice pamphlets affecting the trade being learned.
5. Discuss need for immediate attention to small cuts and abrasions so as to preclude the danger of infection.
6. Discuss need for keeping aisles clear and floors clear so as to eliminate the tripping hazard.
7. Discuss lost-time cost to the worker, his family, and his employer. (7, Page 85)

In the mechanical drawing classes, pupils may:

1. Design safety devices for the different machines used in the school shops.
2. Discuss the strength of materials, such as those used in bridges, buidlings, etc.

A survey of the bleachers on the school grounds

> may be used as a practical demonstration of the need for considering strength of materials. (7, Page 86)

In the following section, accident prevention and occupational hygiene will be covered. It includes the contributing causes of accidents in a drawing room and briefly describes the safety program of a teacher in the drawing room.

PART C

Accident Prevention & Occupational Hygiene

Ignorance, carelessness, and fatigue are known as the human causes of accidents. Ignorance may be due to lack of knowledge about the operating of certain kinds of machinery such as the blueprinting machine. Carelessness may be due to over-confidence or loss of interest within the student. Fatigue may be caused by monotony, unnecessary motions, continuous work without rest, etc.

Every teacher needs the assistance of each one of his students in order to help remove some of the human causes of accidents. The teacher can help by showing the students the importance of working safely and by discussing the causes of accidents and how they may be avoided. This will help them develop correct work habits. The shop teacher must give his personal supervision to enforcing safe working habits by setting an example, never permitting students to get by with unsafe practices, and by arranging for periodic fire drills.

Contributing Causes of Accidents. There are also contributing causes to accidents in the drawing room. The dangerous conditions in contributing causes could be any one of the following: exposed conductors of electricity, holes in the floor, projecting objects, broken or defective ladders, slippery floors, horseplay, and improperly piled materials.

The shop teacher should remove as many of the contributing causes to accidents as possible. He should supervise storage by insisting upon proper piling or placing of materials and he should provide proper storage by placing inflammable and poisonous materials in proper containers. Smoking should be prohibited and congested floor areas should be cleared. Both of these are fire hazards if not kept under control. A fire extinguisher should be kept close by. A report of all possible hazards and needed repairs should be made to the principal. Proper lighting, proper insulating of electrical conductors, and proper ventilation are all for the students benefit. A good shop teacher will see to it that these are provided.

A Teacher's Safety Program In The Drawing Room. The shop teacher's major responsibility lies in developing good work habits. He must practice the best accepted procedures and methods. A competent teacher concentrates his efforts on the elimination of hazards and teaches prevention of accidents at the time the student is introduced to the use of each piece of equipment.

School accidents are a serious reflection on the teacher's effectiveness, in addition to incurring a loss of time and money, pain, possible permanent injuries and destruction of property. These accidents also lower the reputation of the school in the eyes of the community.

A safety program for every drawing teacher should include instructions for safe practices, a planned series of motion pictures and films on safety and first aid, a safety poster board with current posters installed each week, and statistics of accidents. Every school shop instructor should have a First Aid Certificate and it should be renewed at least every three years.

The following section briefly explains the importance of the correctiveness and effects of light, the water supply, and good housekeeping. The author aims to show this information under the title of physical conditions in the drawing room.

PART D

Physical Conditions In The Drawing Room

Learning takes place most effectively when organized instruction is given under favorable physical conditions. Just what these conditions are, how they affect the students and what particular steps must be taken to maintain them is of major concern to the teacher.

To control the physical conditions of the department, the teacher should know something about the factors involved in heating, ventilating, lighting, water for washing and drinking, and good housekeeping.

How to adjust and maintain the available equipment within limits and how to recognize the effect of good, as well as of unfavorable shop conditions upon the student.

Some of the important points regarding ventilation are the quality and quantity of air for the conditioning of the student. It must provide for a continuous supply of fresh oxygen for any room where people are at work. It also must be free from irritating odors and poisons which may affect the lungs, blood, mucous membranes, skin, and eyes.

The effective temperature is a measure of comfort produced by the combination of temperature, and amount of humidity, and the rate at which the air is moving. The feeling that a room is too hot or too cold may be modified by changing one or more of these factors. A room at 68 degrees Fahrenheit will feel comfortable if the air has plenty of moisture and is not moving too fast. On the contrary, it will feel cold if the air is too dry or moving too rapidly. A temperature of 80 degrees Fahrenheit does not become uncomfortably hot unless the humidity is very high and the air is comparatively still. Since comfort depends on the effective temperature rather than on the absolute temperature, the teacher must also consider that active work requires a much lower effective temperature than sedentary work. Under any condition where the temperature is not correctly adjusted, it can cause mental drowsiness and an accident may happen very easily.

Importance and Effects of Light. Special attention should be given to provide adequate illumination in school drawing rooms. Better than 80 per cent of the student's impressions are visual. Illumination, therefore, is of primary importance to his learning, his safety, the quality of his work, the care of his equipment, and the continuation of concentrated attention over a period of time. Light conditions may be unsatisfactory due to unsteady or flickering light, requiring constant readjustment of the eye muscles which is very tiring. Poor direction of light causing shadows on the work have the same effect as unsteady light. Facing the light also causes eye strain.

Water Supply. The effectiveness of the water supply depends on its location in the department and the maintenance of the equipment. Unsatisfactory water supply will result in insufficient cleanliness by students. Loss of time in reaching drinking water is also a result of unsatisfactory water supply and causes loitering of students. In controlling the water, the teacher should insist that the students use the facilities in an orderly manner. Special supervision must be exercised at all times in order to keep it more healthy for the students.

Good Housekeeping. The school shop should set an example for cleanliness and orderliness. Because of the multiplicity of equipment, the teachers have a fine opportunity to teach good housekeeping and supplement the paid janitor service provided by the school administration. Student participation in this activity is of mutual advantage to the student and to the school through higher shop standards of cleanliness, less damage to finished and semi-finished work, more efficient janitorial service, etc. The wise teacher will give personal attention to all the physical conditions outlined in this chapter because of the specific influence they have on the final results of his efforts.

In the following section the author aims to briefly explain the common hazards and their preventions in the drawing room. Fire, lighting, blueprinting, scissors and trimming boards, and water are included. Also information on low voltage electrical hazards is included in this part.

PART E

Hazards & Their Preventions

The most common hazards in the drawing room include burns from fire, danger of injury to eyes due to improper lighting, in using the blueprint machine, cuts from paper, knives, scissors, etc., and other customary hazards of the school classroom.

Fire. Fire can be avoided by picking up accumulated paper trimmings, stacks of drawings, cleaning solvents or benzine in glass bottles, open boxes of blueprints in rolls. Discontinue the practice of holding pen points in a match flame to remove oil from new pens, instead moisten the pen with a safety solvent and wipe on a pen wiper.

Keep the room orderly so that exit from the room is made easy when there is a fire drill. Fire drill practices make it easier in learning how to leave a room quickly and quietly.

Lighting. Eyesight is valuable and sufficient lighting should be used in the drawing room. The recommended National Lighting Code provides for from 30 to 50 foot candles with filament lamps over all the drawing boards. By means of a general lighting system, this may be accomplished. All reflectors should be cleaned; dirty lamps and reflectors may absorb 50 per cent of the available light. Overhead lights should not be used without reflectors; bare lamps waste useful light and cause glare. Lights on machines or at benches should be shielded. Unshielded lights at or near eye level cause glare and seeing fatigue. Recommendations from a lighting company should be posted, for sometimes the janitor, by mistake, uses a smaller lamp where a larger one should be used.

Blueprinting. See that shields are on all printing lamps and that sun glasses are provided for students operating electric blueprinting equipment. There should be a poison sign marked on Potassium bicromate that is often used in blueprinting. The instructor should take the entire responsibility of turning on and off the dryer when students are using the blueprinting equipment. A fire extinguisher should be kept close by.

Scissors & Trimming Boards. Paper trimming knives should be permitted to only one person at a time. Scissors should not have sharp points.

Water. Drawing files and drafting tables should never be located under water supply pipes that sweat. Water may ruin an abundant amount of drawings. The most desirable location for a drawing room is on the top floors of buildings where water pipes are not overhead, where lighting is good and where sand and dust are not so heavy.

Low Voltage Electrical Hazards. There are two ways of electric current injury--burns and shock. Burns are caused by coming in contact with electrical heating devices, overheated electric motors, electric arc, and current passing through the body. Shock is caused by coming in contact with an electric voltage so that the body becomes a part of the electric circuit. The amount of current through the body depends upon ohms law, Volts = amperes x ohms or Amperes = volts ÷ ohms. The amount of resistance of the body depends on the condition of the skin, the type of shoes, the type of floor and where contact is made.

The higher the resistance of the body, the less current goes through it when contact is made. If the resistance of the body is 1,000 ohms and the voltage is 110 volts, current = $\frac{110}{1000}$ = .1+ amperes. This amount is usually more than enough to kill. Any voltage greater than this will give greater current. Fifty volts could be deadly if the resistance of the body were low enough.

Electric shock produces involuntary muscular contraction. If something "hot" is grasped, the hand closes and will not let go. The back of the hand is more sensitive and any contraction will pull the hand away. Consider all electric equipment "hot" until proven otherwise. Give manual resuscitation for electric shock as soon as possible.

In making a school shop safe in regards to the electric power, one may overlook a small item. This may be deadly. One should keep all electric outlets and water away from each other. Water makes the resistance of the body low enough to be dangerous, if contact with electric voltage is made.

If at any time, an electric device "bites", it should be fixed then and not wait, as its next "bite" may be deadly. (5, Page 31-1)

It was the author's aim to give information toward setting up a safety program and help on how to maintain this safety in the drawing room. Chapter IV will contain a summary of this report and recommendations.

CHAPTER IV.

CONCLUSIONS AND RECOMMENDATIONS

This report includes the progress of drawing from the early prehistoric days up to the time when drawing had a definite place in the educational program. It also includes shop safety; its history, how to set it up, accident prevention, physical conditions in the drawing room, and hazards and their preventions.

Summary. In the primitive age, drawing was a way of commuting through the use of pictures; in the Roman World, drawing was needed for their constructions; and now in the present times, drawing is needed for the development of our machinery, roads, buildings, etc. All these stages of development in drawing have a great bearing on the success of today's industries.

The known tested satisfactory methods of dealing with safety should be employed until better methods have been discovered. Despite all of our progress only a fifth of our young people can be promised an accident-free working life and this is assuming our present levels of accomplishments can be maintained. Teachers and students should be informed and trained in what to do in case of an accident and directors of industrial education will need to lead in setting up and administering an effecting safety program.

Recommendations. The author believes that in order for the world's development to continue, drawing will always be essential and therefore an educational program in drawing even more essential. It is suggested that there be a wider program given to both girls and boys in the drafting field. More current material and literature should be made available to teachers and instructors for the development and growth in the classrooms.

In drafting classrooms today it is found that there are many courses in Drawing that are not adequately studied or standardized. It is found that more time is spent on the making of a drawing than learning how to read drawings or blueprints. Most likely a larger per cent of students will face the needs of reading drawings and blueprints, before they will become skilled draftsmen.

The author also believes that experimentation to determine the most effective educational methods are needed. More reliable statistical surveys, including the number of student accidents in various school activities, accident rates per time spent in each activity and statewide summaries based on sound local reportings are needed. To interpret such experimentation and statistical surveys, comparisons from course to course, school to school, and state to state are also needed.

Benefits are sure to arise from research in accident prevention. Motivation for safety is likely to increase when studies are being made. Student participants will gain mathematical, fact-finding, and analytical skills, and they will grow in safety consciousness. Projects may also yield new knowledge and improved accident prevention techniques to be shared with other educators.

A SELECTED BIBLIOGRAPHY

Books

1. Ade, Lester K., Safety Education in Industrial School Shops, Department of Public Instruction, Harrisburg, Pennsylvania, 1938.

2. Bazin, Germain A., A History of Art, Houghton Mifflin Company, Boston, Massachusetts, 1959.

3. Bennett, Charles A., A History of Manual and Industrial Education Up To 1917, The Manual Arts Press, 1937.

4. Bradshaw, Percy V., The Magic Line, The Studio Publications, London and New York, 1949.

5. National Safety Council, Handbook of Accident Prevention for Business and Industry, Chicago, Illinois, 1958.

6. Stombaugh, Roy M., A Survey of Movements In Culminating Industrial Arts Education in Secondary Schools, Columbia University, New York, 1936.

7. Public Safety Department, Automobile Club of Southern California, Manual of Safety for Secondary Schools, 1931.

Encyclopedia

8. Americana Corporation, "Safety", The Encyclopedia Americana, Volume 17, New York, American Corporation, 1955.

Dictionary

9. Webster's New Collegiate Dictionary, G. & C. Merriam Company, Springfield, Massachusetts, 1951.

Magazines

10. Report of Committee on Handicrafts, "Western Drawing and Manual Training Association", Manual Training Magazine, July, 1906.

Bulletins

11. School Health Bureau, Health and Welfare Division, Accident Prevention Can Be Learned, Metropolitan Life Insurance Company, New York, 1962.

VITA

Cletis D. Hawkins

Candidate for the Degree of

Master of Science

Report: SAFETY IN THE DRAWING ROOM

Major: Industrial Arts Education

Biographical:

Personal data: Born at Mountain View, Oklahoma, November 1, 1935, the son of Mr. and Mrs. Henry Hawkins. Married May 27, 1960, to Barbara Jean Hawkins (Fogle) and have a daughter, Ginger Kay, born April 2, 1962 at Stillwater, Oklahoma.

Education: Grade School and High School, Mt. View, Oklahoma, 1942-1954; Received Bachelor of Science, Oklahoma State University, Stillwater, Oklahoma, May, 1961.

Professional Experience: Entered the United States Army on August 25, 1958, spent 8 weeks at Fort Carson, Colorado, and 19 months at Fort Lewis, Washington as a clerk typist with the S-3 office (training) of the 47th Infantry Division. Did my practice teaching for my Bachelor of Science Degree at Stillwater Junior High School, Stillwater, Oklahoma.

Organizations: Member of Iota Lamba Sigma (Zeta Chapter), American Industrial Arts Association, Oklahoma Industrial Arts Association, Student Industrial Arts Association, and member of the Red Red Rose (Social Fraternity for men in the field of teacher education).

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AUTHOR: Cletis D. Hawkins

REPORT ADVISOR: Professor Cary L. Hill

Typist: Barbara Hawkins