CORRELATION OF MECHANICAL DRAWING AND INDUSTRIAL ARTS SHOP COURSES IN THE HIGH SCHOOLS OF NEW MEXICO

by

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Bachelor of Science

University of New Mexico

1955

Submitted to the Faculty of the Graduate School of the Oklahoma Agricultural and Mechanical College in Partial Fulfillment of the Requirements for the degree of

MASTER OF SCIENCE

MAY 1956

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ACKNOWLEDGMENT

I give my thanks to these persons - to each of whom I am indebted.

To my adviser, Professor Earl R. Hesch, Acting Head, Department of Industrial Education and Engineering Technology, for his guidance and advice.

To my wife, Anne, for her patience, understanding and inspiration and typing assistance during the completion of this thesis.

To the other members of my committee, Professor [illegible] and to the faculty members and friends who have provided valuable help throughout this graduate study.

Earl Raymond Hesch
May 1956

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CHAPTER I

INTRODUCTION TO THE SURVEY

Of the several criteria which are generally accepted as the motivating elements of a research problem, the writer considers four of these as having the most significance to this particular thesis. These may be stated as; one, a felt need for the investigation of the factor of correlation between the teaching of Mechanical Drawing and the Shopwork courses in the field of Industrial Arts; two, a personal interest in the application of this research problem to the secondary schools of New Mexico; three, a close association to and some degree of familiarity with both phases of the problem; four, anticipation of the approaching opportunity to apply the results of the survey to an authentic teaching situation. If a fifth element were to be added to this list, it would be that of a desire to make a professional contribution of some value to the field of teaching.

With these criteria in mind, the problem has been approached and the thesis carried to completion, to the best of the writers ability.

It should be noted here that in addition to this human element of ability, one of the primary limiting factors in completing this paper has been that of time - but time is always the insurmountable obstacle - the Sword of Damocles under which all writers of theses labor.

Origin of the Study. A problem in research seldom comes into being overnight. An invention, a scientific theory, a new antibiotic; none of these are born as the result of a single effort or moment in time. Each of these owes a debt, an obligation, to previous thoughts and efforts which have contributed to their final form and existence.

So it is with this thesis. Its origin did not begin with the thoughts of this writer, nor perhaps with those who just preceded him. It will be seen, in a later chapter, that at least one phase of this study, that of drawing, may be traced far back into the dim recesses of time, and that its practical application to man's problems was known over seven thousand years ago. Its development will be followed up to the present day, where it is both a firmly established part of our secondary school curricula, and an indispensable tool of industry.

This writer has had the dual opportunity to personally observe the important place of drawing in industry, and to formally study its several applications in the field of Industrial Arts Education and Engineering Shopwork. With this background of practical experience and formal study, the problem of correlation has evolved. This problem evolved from the repeated observation that, neither in the practical applications of industry, nor in the teaching of drawing in the secondary school programs, is complete correlation attained between the study of drawing and many of the basic industrial processes. It may be reasonable to assume that

complete and perfect correlation is neither possible, nor perhaps desirable. However, it also seems that there exist at the present time a great many opportunities for the application of the principle of correlation which are not fully exploited in the drawings of our schools.

It will not be the purpose of this study to concern itself with the position of correlation in industry. Rather, the principal aim of the writer will be to study the existing conditions in a selected number of secondary school drawing rooms, with regard to the thesis problem. The opinions of teachers will be sought concerning the value of correlation as it now exists, and its potential value to more extensive applications. Suggested methods of extending the principle of correlation will be requested. These will be compiled and presented in a later chapter.

Need for the Study. The need for this study is premised upon the assumption that where there is a problem, there is a need for its solution. That the problem exists has already been determined. Referring back to the first of the motivating criteria of this thesis, the writer believes that there is a definite need for a survey of the existing teaching situation in the state of New Mexico, with reference to the correlation of Mechanical Drawing and Industrial Arts Shopwork.

Further needs, perhaps of even more importance than the survey itself, are one, bringing the problem to the attention of the teachers directly concerned, and two, furnishing them

with the findings of this investigation, with a view toward the improvement of teaching methods, and a resulting positive value to the Community, the School, the Teacher, the Pupil, and finally, to Industry.

Still a further need may be that of the singular nature of this study. As indicated in another section of this chapter, a fairly thorough search of available records fails to disclose the existence of a duplicate study, at least within the last five year period, and no record was found of a similar study as applied to the same geographical location (the State of New Mexico).

Methods of Research and Investigation. In the writing of this thesis, the Historical Method of Research was used in obtaining the material for Chapter II, The History of Drawing. References found in the outstanding library at Oklahoma A & M College were used as primary sources, and these are listed in the bibliography to this study.

The Normative Survey Method was used in acquiring the material for Chapter III. A questionnaire was prepared and sent to Industrial Arts teachers in twenty-eight high schools (selected from a total of one-hundred and thirty-eight) in the State of New Mexico. The selection was based upon curricula, geographic location and other information which was furnished by the State Department of Education of New Mexico. Much thought was given to the preparation of the questionnaire, with respect to Objectivity, Validity, Comprehensiveness and Reliability of each item thereon. The questionnaire

was also designed for ease of completion, a factor to be considered when a representative percentage of response is sought.

The remaining chapters of the thesis, are the result of further library research, personal observation, and investigation of related material, as well as a personal philosophy of the research problem.

Definitions of Significant Terms. To clarify the meanings of terms that are used frequently in this study, the following list of definitions is offered. References are listed in the Bibliography.

> Correlation. To put or be in relation, especially in reciprocal relation;....to have reciprocal relations; ....to connect systematically.... (34, page 598)

> Mechanical Drawing. Drawing accomplished with the use of instruments. Technically, the term includes orthographic projection, architectural and engineering drawing, various kinds of perspectives, and projections. (11, page 248)

> Industrial Arts. Those phases of general education which deal with industry - its organization, materials, occupations, processes, and products - and with the problems resulting from the industrial and technological nature of society. (35, page 2)

> Engineering shopwork. All practical shopwork courses required by the various schools in the Oklahoma Institute of Technology. (43, page 2)

The following definitions are given in terms of Learning experiences and Informational topics, as suggested by the Editorial Committee (of the American Vocational Association) for A Guide to Improving Instruction in Industrial Arts.

These terms are listed in the same order in which they are found in the Survey Questionnaire (see Appendix B), that is, by groups or areas of instructional material.

GENERAL WOOD

Woodwork. Learning experiences; Designing, Planning, Layout, Checking workmanship, Using and adjusting cutting tools, Fastening, Assembling, Applying hardware, Preparing for finish and finishing, Care and maintenance of tools, Surface decoration, Upholstery. Informational topics; Occupational information, Consumer knowledge, Planned industrial tours - local resources, Health and safety, Human relations, Industrial design, Understanding industry, Habitat and uses of native woods, Purchasing and measuring of lumber, Production of lumber, Uses of forest products, Period design in furniture, Glues and their uses, Composition and types of finishes, Role of woodworking in the industrial environment. (38, page 51)

Woodturning. Learning experiences; Drawing and planning, Laying out the stock, Mounting stock in lathe, Spindle turning, Offset turning, Faceplate turning, Grinding and sharpening the tools, Sanding in the lathe, Finishing turned work. Informational topics; Care of the lathe, Grinding and sharpening tools, Woodturning in industry, Turning as a hobby, Safety rules, Turning speeds. (22, pages 11-54)

Patternmaking. Learning experiences; Layout of pattern, using shrink rule and other layout tools, Use of woodworking (hand & power) tools to form pattern, Giving draft to pattern surfaces, Forming fillets and rounds, Assembly of pattern components, Finishing. Informational topics; History of patternmaking, Uses of patterns, cores and core boxes, Types of pattern woods, Tools used in patternmaking, Theory of molding, Methods of pattern construction, Methods of finishing. (24, pages 1-366)

Carpentry. Learning experiences; Use of hand woodworking tools, Use of power woodworking tools, Use of framing square. Informational topics; Carpentry as a trade, History of carpentry tools, Modern carpentry tools and equipment, The framing square tables, Principal woods, uses, grades and classifications, Insulation, Wood fastenings, Essential preparation for building a house, Blueprint reading. (12, pages 1-231)

GENERAL METAL

Machine Shop. Learning experiences; Using the scale, calipers, snap gauge, and micrometer in layout of a project, Centering, Facing, Turning, Chucking, Cutting tapers and angles, Cutting threads, Turning on faceplate, Milling, Planing, Grinding, Drilling, Using handtools in bench operations, Heat treating metals, Reading working drawings. Informational Topics; The function of the machine shop, Tools and machines used, Knowledge of metals and their characteristics, Classification of "bench work" and "floor work", Safety Practices in the Machine Shop, The place of the machinist in industry. (9, pages 1-420)

Sheet Metal. Learning experiences; Drawing and laying out a project, Use and care of tinners snips, Punching and drilling, Riveting, Filing edges, Making a hem by hand, Forming, turning and wiring, Forming on the stakes, Cutting with the squaring shear, Cutting with the circle cutter, Forming edges with burring machine, Folding on bar fold, Use and care of soldering copper, Preparing flux and acid, Soldering joints, Cleaning and finishing sheet metal. Informational topics; General properties of sheet metals, Uses of sheet metal, Design, layout and preparation of blanks, Principles of forming and drawing, Principles of annealing, Soldering techniques, Vocational and avocational information. (30, pages 1-526)

Foundry. Learning experiences; Construction of the cope and drag, Preparation of sand, Ramming up a sand mold, Operation of the furnace or cupola, Pouring molten metal, Cleaning and finishing a casting, analysis of a casting. Informational topics; Types of molding equipment and tools, Molding processes and problems, Foundry metals and alloys, Safety practices in handling molten metal, Types of cores and patterns, Types of sand and refractories. (31, pages 1-214)

Forging. Learning experiences; Operation of the forge furnace, Cutting stock, Heating stock to working temperature, Swaging, Upsetting, Annealing, Forge welding, Tempering, Drawing. Informational topics; Structure of Iron and Steel, Theory of hot and cold working of metals, Identification of steel, Methods of testing for defects, Production forging methods. (19, pages 1-131)

Welding. (Arc & Gas) Learning experiences; Setting up equipment for operation, Attaching welding

and cutting heads to torch (Gas), Striking an arc (Arc), Practise welding different types of beads, Welding different types of metals, Welding in various positions, Straight line and bevel cutting, Laying out and cutting odd shapes, Testing welds. Informational topics; Industrial uses of welding, Types of welding equipment, Types of torch heads (Gas), Types of electrodes (Arc), The fundamental welded joints and their characteristics, Testing and inspection of welded joints, Safety precautions, Fundamentals of blueprint reading, Welding symbols. (29, pages 1-343)

CRAFTS (GENERAL SHOP)

Plastics. Learning experiences; Designing, Planning, Layout and measuring, Cutting, Shaping, Casting, Smoothing, Assembling, Finishing, Decorating. Informational topics; Types of plastic materials, Manufacture of plastic materials, Characteristics of plastics, Use of plastics, Occupational information, Home workshop information. (38, page 79)

Leathercraft. Learning experiences; Planning and designing, Transferring patterns, Carving, Tooling, Embossing, Stamping, Stippling, Raising, Edging, Lacing, Cementing, Sewing, Riveting, Applying accessories, Braiding, Applying finishes. Informational topics; Historical development of leathercraft, Characteristics and kinds of leathers, Tools and equipment, Preparation of drawings and templates, Stains, dyes and finishes, Consumer knowledge (selection, use and care of leather goods), Occupational opportunities, Avocational information. (38, page 83)

Electricity. Learning experiences; Preliminary experimentation, Planning, Safe practices, Use of tools and equipment, Insulating techniques, Coil winding, Wiring techniques, Circuit analysis, Repair and upkeep of electrical equipment, Fabrication of an electrical device, Power installations. Informational topics; Nature of electrical phenomena (general and electronic), Types of circuits, Measuring devices (theory), Manufacture and procurement of materials, Industrial application of basic electrical principles, Occupational information, Consumer knowledge, Safety and First Aid, Understanding industry. (38, page 63)

Metal Spinning. Learning experiences; Drawing design, Laying out design on metal, Turning contour blocks, Mounting and centering metal disc, Spinning, Annealing,

Finishing, Polishing, Soldering, Mounting handles, spouts, bases, etc. Informational topics; Use of lathe, tools and equipment, Avocational information, Safety practices. (15, page 316)

Art Metal. Learning experiences; Designing a project, Planning and production control, Measuring, Layout, Cutting, Drilling, boring, reaming and punching holes, Bending and twisting metal, Shaping and forming metal, Heat treating metal, Smoothing metal, Cutting threads, Assembling metal parts, Decorating the surface, Finishing the surface, Use and care of tools and machines. Informational topics; Sources of raw materials, Refining of metals, Characteristics of metals, Consumer uses of metals, Types of tools and machines used, Safety rules and practices, Occupational information, Home repair and hobby activities. (38, page 57)

Ceramics. Learning experiences; Preparation of clay bodies, Care and conditioning of clay and clay slip, Designing, Making plaster of paris molds, Making pottery, Decorating processes, Preparation and application of glazes, Firing and kiln management, Enameling on metal, Informational topics; Study of glass production, Study of cement and plaster production, Types and properties of clay, Nature and types of glazes, Types of ceramic kilns, Industrial ceramic equipment, Testing of ceramic products, Porcelain enameling on metal, Ceramic design, Occupational information, Consumer knowledge, Health and Safety, Industrial design, Understanding industry, Use and care of ceramic products. (38, page 87)

Jewelry. Learning experiences; Planning and designing, Transferring designs to metal, Cutting, bending, forming, filing and annealing, Soldering (hard and soft), Buffing, Polishing, Lacquering, Gilding and plating, Chasing and repousse, Planishing, Casting, Making bezels, Making findings (fasteners), Wire working, Selecting, cutting, polishing and setting stones, Enameling. Informational topics; Methods of jewelry construction, Use of jewelers tools, Types of abrasives, Soldering methods, Methods of filing, annealing, buffing, polishing, lacquering and enameling, Methods of chasing and repousse, Miscellaneous types of construction, sources of supplies, History of jewelry, Occupational and avocational information. (16, pages 408-576)

Wood carving. Learning experiences; Drawing and layout of project, Incising or chase carving, Chip carving, Carving in low relief, Bas-relief or high-relief

carving, Inlaying, Gluing, Sanding, Finishing. Informational topics; Types of woods used, Tools - their use and care, Kinds of glues, Sanding materials and methods, Methods of finishing. (16, pages 241-267)

GRAPHIC ARTS

Printing. Learning experiences; Making a layout, Composing type, Plate making, Taking and reading proofs, Correcting galley material, Imposing, Making ready the press, Operating the press. Informational topics; The development of printing, Kinds and styles of type, Type case layouts, Kinds and uses of spacing materials, Techniques of imposition, Types of presses, Techniques of photoengraving, Safety in the printing shop, Wire-photo transmission, Color process printing, Careers in printing. (38, page 70)

Photography. Learning experiences; Operation of various types of cameras, Handling and cutting film, Loading the camera or film pack, Arranging the subject and background, Arranging the lights, Setting the camera, Taking the photograph, Preparation of developing solutions, Developing the film, Making prints. Informational topics; Development of photography, Types of cameras, Iris openings and Shutter Speeds, Types of film, Exposure meters and their use, Photographic papers, Development of a negatives and prints, Use of the enlarger, Occupational information, Photography as a hobby. (18, pages 31-47)

Linoleum Block. Learning experiences; Cutting linoleum, Mounting linoleum type-high, Drawing the subject, Tracing, Transferring pattern to block, Inking in the block, Carving the outline, Routing the block, Testing work in progress, Cleaning the block, Printing (by hand or press), Printing in color. Informational topics; Historical development of block printing, Design (importance, methods and limitations of), Types of tools and equipment used, Hobby possibilities of linoleum block printing. (16, pages 583-618)

Silk Screen. Learning experiences; Raising the screen, Setting register guides, Fastening stencil paper over original copy, Tracing-cutting the design, Marking areas to be stripped, Replacing screen in hinges, Removing tape from stencil paper, Lowering screen onto the stencil, Stripping the cut-away portions of the stencil, Removing original copy from base, Applying ink, Removing Stencil, Cleaning the screen. Informational topics;

Development of silk screen process, Commercial applications of silk screen printing, Equipment and materials used, Basic principles and methods. (2, page 46)

Bookbinding. Learning experiences; Planning the project or problem, Preparing the book and materials, Sewing the book, Making the case, Lettering or decorating, Assembling the book in the case. Informational topics; Kinds of essential tools and equipment, Kinds of materials used, Methods of sewing, Types of bindings, Suitable glues and pastes, Proper binding techniques, Care and use of books, Book crafts projects. (38, page 71)

OTHER

Auto Mechanics. Teaching units; Introduction to the automotive shop, Uses of tools, gauges, meters, The automobile engine, Engine diagnosis and tune-up, Transmissions, clutches, torque converters, Drive shafts, universal joints, differentials, Frames, springs, suspension systems, Steering, front-end geometry, The brake system, tires and wheels, The fuel system, Lubrication system, The cooling system, The electrical system, The automobile body, minor body repairs and finishing. Informational topics; The automotive industry in the American economy, Related industries, Occupational information, Operation of the automobile and safety rules. (8, U.N.M. Course of Study, not paginated)

Shop Safety. Learning experiences; Application of safe practices in the use of hand tools, power tools, electricity, and inflammable liquids, Constructing and maintaining a safety poster board, Reporting hazardous conditions, Reporting accidents, Applying first aid. Informational topics; Recommended safe practices for the various shops, The psychology of accident prevention, Emergency first aid techniques, Methods of fire prevention and fire fighting, Use of the safety check list. (1, pages 1-58)

Home Mechanics. Learning experiences; Care and repair of plumbing fixtures, doors and windows, electric appliances, gas appliances, Basic metalworking, Basic woodworking and finishing, Floors and floor coverings, Painting and decorating, Care of tools, uses of rope and twine, Uses of concrete, mortar and plaster. Informational topics; Theory to correlate with the learning activities in Home Mechanics, Home economy (consumer knowledge). (3, pages 1-129)

Review of Similar Studies. In a previous paragraph, it was stated that one of the criteria which might establish the need for this study was that of its singular nature. The search for other theses as outlined herein failed to disclose the existence of a duplicate study. Other studies were found which treated with the topics of Drafting, Mechanical Drawing, Correlation, and Shopwork, but none of these were in the same relative combination as the subject thesis. In making this search two steps were followed.

First, the main index and sectional indices of the Oklahoma A & M College Library were consulted. Record was made of any similar theses or reports that were indicated to be on file. These studies were then consulted and evaluated for their reference value. Those selected are listed in Part A of the following list, together with a summary of each.

Second, an annual directory was consulted for its national listing of theses. (39, 40, 41 and 42) The volumes of this annual on file at the library were for the years 1951-1955 inclusive. In these volumes were found listed studies which appear to be related somewhat to the subject thesis in content, but none seem to bear close similarity or duplication of the approach to the problem. Nevertheless, those whose titles seem to indicate that they would be of value for further reference are included in Part B of the following list. These studies are located in various college libraries throughout the country, but can probably be obtained through an inter-library loan by any interested person.

A. The following listed Reports and Theses are on file in the Oklahoma A & M College Library, Stillwater, Oklahoma.

Earley, Robert Marvin, Instructional Aids in Pre-Vocational Mechanical Drawing, OAMC, 1938, 70 pages.

The author of this study draws from his own teaching experience to present an illustrated list of suggested aids to be used in the teaching of beginning Mechanical Drawing. Particular emphasis is given to Spelling, Lettering, Lines and Line Work, Reading Scales, Judging Angles, Finding of Errors, Dimensioning and Orthographic Projections.

Ekstrom, Kenneth G., Shopbuilt Equipment for use in Industrial Arts Installations, OAMC, 1952, 103 pages.

A comprehensive study which lists a number of devices and equipment that can be made in the average shop to promote safety, convenience and versatility of the equipment, and at the same time aid in the teaching of woodshop. This study is very well illustrated and offers many possibilities for achieving correlation between Drawing and Woodwork.

Foreman, George C., The Use of Still and Motion Pictures in Industrial Arts Classes, OAMC, 1941, 112 pages.

An annotated list of Filmstrips and Motion Pictures for use in the teaching of Industrial Arts classes, including Drawing. Sources of films are given and suggested techniques are described.

Lack, Rudolph L., A Suggested Course of Study for Industrial Drawing in Oklahoma Schools, OAMC, 1954, 57 pages.

One of a series of six courses of study issued by the Oklahoma State Department of Education. Includes Objectives, Methods, Learning Units, Equipment and Teaching Aids.

Ledbetter, James L., Visual Aids Furnished by Commercial Firms for use in Industrial Arts Classes, OAMC, 1941, 141 pages.

This study contains a comprehensive, detailed list of those visual aids that are available from commercial firms for the teaching of Industrial Arts subjects, including Mechanical Drawing. Each item is rated as to its potential value to the teacher, and most of these are available free of cost. The psychology of visual aids is discussed.

Martin, O. M., The Correlation of Grades Made in Shops Courses With Those Made in Academic Subjects of All Graduates of Six Selected Oklahoma High Schools, OAMC, 1932, 25 pages.

As stated in the title, this study reports a survey of six Oklahoma high schools, with reference to the grades attained by the graduates in Shop Courses and Academic Subjects. The findings of this survey indicate that the "Shop" student attains grades equal or superior to the "Academic" student in addition to developing mechanical skills and resourceful thinking.

McGlamery, Kenneth W., Industrial Drawing as an Indispensable in the Industrial Arts Program, OAMC, 1948, 54 pages.

The author traces the Historical Development of Industrial Drawing and the place of Drawing in Industry. The need for effective teaching of Drawing is discussed, and methods of presentation are illustrated. An evaluation of several Drawing books is well presented.

Miller, Oswell C., Analysis of Industrial Drawing Books Published Since 1940, OAMC, 1952, 49 pages.

An analysis of thirty-four Drawing books is made, using a detailed score card with which to objectively rate each book according to six major items. Each major item is further

subdivided to assure objectivity and provide for ease of scoring. The major items are; Local Adaptability, Subject Matter, Arrangement and Organization, Aids to Instruction and Study, Mechanical Features, and Special Features.

Niles, Rex A., Mechanical Aids To Assist In The Teaching Of Drafting, OAMC, 1949, 112 pages.

This study, itself reproduced entirely by the Ozalid Process, has three main divisions. The first section deals with Reproduction and Duplication, and describes the Mechanical and Photochemical Processes of reproducing drawings. The second section is devoted to Drafting Teaching Aids, and is illustrated by excellent drawings. The third section, also well illustrated, is given to Laboratory and Equipment Aids. As in the Ekstrom study, this study offers many possible drawing problems to aid in achieving Correlation between drawing and other Industrial Arts subjects.

Strunk, Granville B., The History And Status Of Industrial Arts In New Mexico Since Statehood, OAMC, 1941, 110 pages.

Through the use of a very detailed questionnaire, the author of this study has obtained a representative picture of the status of Industrial Arts in New Mexico, with particular reference to twenty-five Senior and Junior High Schools in the state. The study deals not only with the shop equipment, layout, etc., but also provides much background information about the Industrial Arts teachers and the methods used in presenting the course materials. Recommendations are made for improvement of the state-wide Industrial Arts program.

B. The following listed Theses are on file in the libraries of the Colleges and Universities given. For further information see the preceding section entitled Review of Similar Studies.

Allison, Arthur W., A Comparison Between the use of Projection Planes and Non-projection Planes in the Teaching of Mechanical Drawing in the High Schools, University of Richmond, Richmond, Virginia, 1953.

Bagaglia, Joseph A., A Survey of the Mechanical Drawing Curriculum in the Secondary Schools of Rhode Island and Several Secondary Schools throughout the Country, Rhode Island College of Education, Providence, Rhode Island, 1955.

Bankhead, Hugh L., A Survey of Drafting Instructors and Architects in order to Determine Subject Matter Changes in Architectural Drawing Courses at the High School Level, Arizona State College, Tempe, Arizona, 1954.

Beauchamp, Theodore J., Drafting as a Basic Tool in the Vocational Instructional Program, Tennessee Agricultural and Industrial State University, Nashville, Tennessee, 1952.

Grau, Russell, Teaching Design Through Industrial Arts Education, North Carolina State College of Agriculture and Engineering, Raleigh, North Carolina, 1953.

Griffith, Fuller O., Jr., Industrial Arts Drawing in High School as a Predictor of Grades in College Drawing, Colorado Agricultural and Mechanical College, Ft. Collins, Colorado, 1954.

King, Charles M., Contemporary Design as it May be Applied to Industrial Arts in the Secondary Field, University of Florida, Gainsville, Florida, 1952.

Klotz, Harry S., Industrial Arts Drawing in Selected High Schools in Northwestern Ohio and Products and Materials Used in the Building Trades, Bowling Green State University, Bowling Green, Ohio, 1954.

Lively, Roy J., Blueprint Reading as an Introductory Background for Mechanical Drawing in Junior High School, Oregon State College, Corvallis, Oregon, 1953.

McCaleb, Omer K., High School Drawing and Certain Other Factors Relating to Student Performance in Engineering Drawing, Oregon State College, Corvallis, Oregon, 1954.

be outstanding in content, arrangement, and choice of drawing problems for correlative purposes. This text is also listed in the Bibliography.

The references given here do not constitute the only literature available, but those listed above are considered by the writer to be of the greatest potential value to the teacher. Much other literature has been reviewed and is mentioned in other sections of this study. All material reviewed, with the exception of Similar Studies (theses and reports), will be found listed in appropriate division of the Bibliography.

Possible Uses of the Results of this Study. It is the intent of the writer to reciprocate the cooperation of those teachers who are participating in this survey by furnishing them with the findings of the study. By this means, these drawing teachers will gain some insight into the teaching problems and correlation techniques of other teachers throughout the State of New Mexico. Through the results of this investigation of a common problem, it is conceivable that a common solution to the problem of attaining better correlation may be discovered.

A second possible use of the results of this investigation is that of a reference - a partial survey of the status of the Industrial Arts in the New Mexico High Schools. A limiting factor in the selection of the schools for the study was that of population. This factor presumes the probability that a comprehensive Industrial Arts program would not be found in the schools of the smaller cities or towns,

and the findings of the study tend to verify this presumption. Most of the schools selected are located in cities of at least 5,000 Population, according to U. S. Census of 1950, and every New Mexico city of at least this size is represented in the survey, although a few of the smaller towns are also represented. In summarizing, therefore, the information acquired by this survey gives, within the limitations of the questionnaire, a picture of the Industrial Arts program in the larger cities of New Mexico.

Early Programs of Industrial Arts. The earliest programs of Industrial Arts in the New Mexico Public schools originated, according to other investigators, about 1913. It is interesting to note that these first programs were organized only a year after the state was admitted into the union.

> The New Mexico Educational Directory for 1913-1914 gives the first record of industrial arts in the state of New Mexico. The following public schools offered what was termed "manual training" for the first time during the school year of 1913-1914: Albuquerque, Raton, Roswell, East Las Vegas, New Mexico Normal School, Silver City, New Mexico Military Institute, Roswell. (32, page 35)

By 1924, there were about 15 schools throughout the state offering a program of "Manual Training".

In the light of this brief review, it would seem relevant at this point, and before discussing the report of the survey, to consider some of the other historical aspects of Mechanical Drawing and Industrial Arts. The following chapter, therefore, is devoted to the History of Drawing and its place in Industrial Arts Education.

CHAPTER II

THE HISTORY OF DRAWING
AND
ITS PLACE IN INDUSTRIAL ARTS EDUCATION

In tracing the history of drawing as a part of General Education, and specifically as a phase of the Industrial Arts, it has been necessary to delve far back into the earliest historical records of civilized man. In point of fact, it has been found that the art of drawing existed before man became civilized. Some of these early developments in drawing have been brought to light by Klenke and Hayes:

> "More than 7,000 years ago the Egyptians expressed their ideas by means of a picture language known as heiroglyphics. They used this graphic form of writing until about 100 B.C. or nearly to the end of the rule of the Greek Ptolemies.....
>
> The Mexicans used a picture language before the advent of the Europeans, and many North American Indians did likewise until long after their conquest by the White Men. The inscriptions on the totem poles of the Tsimshian Indians at Kitwankool, B.C., are specimens of the Indian picture language. Messages and treaties which have been handed down from Colonial times furnish excellent examples of the picture language used by the North American Indians.
>
> Such well known uses of pictures to convey ideas are merely a few of the many evidences that all written languages, all alphabets, back in the dim recesses of time, originated in pictures.
>
> But today a real and actual picture language is used throughout the civilized world. It is the language of industry, and it is commonly called "Mechanical Drawing." (21, page 122)

Giesecke, Mitchell and Spencer offer further evidence of the existence of drawing in Pre-Biblical times, citing as an

example the massive, complex, Temple of Solomon, which was erected about 1020 B.C.

> History indicates that drawing was used in ancient times to delineate the exact forms and sizes of structures. The Bible states that Solomon's Temple was "built of stone made ready before it was brought thither," indicating that drawings were used to describe the forms and sizes of the individual members of this historic structure. (13, page 1; and I Kings, 6:7)

One of the few remaining vestiges of the highly advanced state of civilization of ancient Greece, is the Parthenon of Acropolis, in Athens. Built entirely of Pentelic Marble, this structure crowned the power and glory attained by Athens during the Periclean Age (461-430 B.C.).

> .....the ancient Greek Temples, so complex in arrangement and refined in detail, as the Parthenon, for example, could not have been constructed without accurate drawings to guide the artisans in forming the structural elements and the builders in assembling them. (13, page 1; and 25, pages 93 & 109)

In a like manner, the history of the Roman architecture of a later date implies the extensive use of applied art or drawing in the design of the vast constructions which the Romans erected all over the then-known Western world:

> .....mere constructive ability was not enough. It might help to build those great aqueducts which furnished all the Roman cities with ample water, to bridge rivers, and to cover warehouses, but if it did no more than that the Roman was still unsatisfied. Out of this engineering necessity, he must, by careful design and beautiful proportion, produce beauty as well as use, and the secret of Roman organization is as much aesthetic as it is practical. (17, page 150)

The foregoing, and many other similar references that are to be found, may lead us to believe that the principal application of art, drawing and design at this point in history was in the field of architecture. For the most part, this assumption may be accepted. It must be remembered that

this was a pre-medieval period; that the development of printing, the practical application of power, and the industrial age were as yet a thousand years away, and of prime consideration is the fact that well-defined system of universal education did not yet exist.

It would seem pertinent, therefore, to pause at this point in the tracing of history, and review some of the educational aspects of the topic.

Part A

Some Early Developments of Education

I Ancient Education

The Ancient Period (which extended from about 3,000 B.C. to about 500 A.D.) may be considered in the light of three great geographical divisions of the world; The Ancient Monarchies of the East (China, Japan, Egypt, India and Persia); The Semitic Peoples (Babylonians, Assyrians, Phoenicians, and Hebrews); and The Ancient Empires of the West (Greeks and Romans). The more significant educational developments of each of these countries have been summarized in an excellent synopsis by McCormick and Cassidy. (25, page 3) Of these developments, probably the most important contributions to present-day knowledge were; the invention of the System of Weights and Measures by the Babylonians (who also arranged the names of the days of the week); the invention of symbols for numbers and the formation of the alphabet by the Phoenicians; and the organization of elementary, secondary and higher levels of education by the Romans.

II Christianity and Medieval Education

This period extends from the time of Christ to about the fourteenth century. Without question, the most significant events of this period was the birth of Jesus Christ and His subsequent teachings. No other single occurence in the history of man has influenced so greatly the course of history.

> With the Christian conception of life came distinctly new ideals in culture and education, and when we consider the subsequent influence of these ideals in shaping educational theory and practice for two thousand years, we realize how fittingly Jesus Christ is called the Great Teacher of Mankind.....(25, page 171)

Education and the Monasteries with the teaching of Jesus Christ began a new era in the history of education. As a direct result of His influence, there were established church schools for teaching religion to children and for training the clergy. Monasticism became a great educational force.

Among the earlier recorded references made after the establishment of the Gregorian calendar, are those of the Benedictine Monks. One of the most influential establishments in the period of Christian Education was the Monastery of Monte Cassino, founded in the year 529 A.D. by St. Benedict. Here the monks were required to read daily some portion of the sacred manuscripts. Since the art of printing was not developed until 1450, these handwritten documents were rare. As the population of the monastery grew and the old manuscripts wore out from constant use, it became necessary to reproduce others. This led to copying the existing manuscripts and the art of bookmaking. Cassiodorus (468-560 A.D.) an Italian statesman turned monk, became one of the leaders in this art. One of his contributions was the development of

the "Scriptorium", a sort of workshop devoted entirely to the production of books.

In time the monasteries became centers of civilization and learning. Agriculture, art literature and many trades were developed to a high degree.

> Besides bringing civilization and the light of faith, the monks were the veritable teachers of the nations. They taught agriculture and the industrial arts, kept schools for the young, and founded libraries in which the treasures of the ancient literatures were preserved for posterity. (25, page 315)

The Benedictines became a guiding influence, and the monasteries were the principal educational centers of these early centuries. It must be stated here, however, that the only subject matter offered outside of religious writings were the Seven Liberal Arts which were supposed to encompass all learning. These were The Trivium (Grammar, Rhetoric and Dialectic) and The Quadrivium. (Arithmetic, Geometry, Music and Astronomy).

Outside of monasteries, the principal means of education for the great majority of the people was participation in some form of skilled labor. Apprenticeship became the chief educational institution for middle class youth. During this 7-year period, the apprentice was taught all the mysteries of his craft, together with religious, moral and civic instruction, and any other information related to his craft.

Schools of the Later Middle Ages. The Later Middle Ages was quite replete with schools. Not only secondary but elementary education was provided in the fourteenth and fifteenth century. Although the monastic schools never recovered their

importance after the Renaissance of the thirteenth century, several new types of schools became prominent. One, the Chantry School, was supervised and taught by the church. Another type, more free from ecclesiastical control, was the Guild School, which was commonly supported by the merchants and craft guilds.

An interesting (and pertinent to our history of drawing) outgrowth of the old Guild System, was the Guild of Compass Makers, wherein specialists in the manufacture of drawing instruments were slowly developed in a crafts atmosphere, and where knowledge was handed down from father to son.

> It is known that the early Egyptians and Romans, and other contemporary civilizations, used a compass-like instrument. But, the basic form of the compass as it exists today, was known to be in existence in Germany since the year 1200. The Guild of Compass Makers is mentioned in the old books of the City of Nuernberg in the year 1442. These instruments were originally made of wood and later on of iron. The instruments were hand-forged and because of this the name of the Guild in German was actually the Guild of the Compass Forgers. (44, page 4)

The Dark Ages. The development of education in the Western world was greatly hindered at this time, first by the feudal system which came into existence after the collapse of the Roman Empire, and second by the advent of the "Dark Ages". During this time (from the sixth to the tenth century) Europe was overrun by successive waves of barbaric tribes. As a result of these events, the normal progress of practically all intellectual pursuits suffered for over four hundred years.

Intellectually, Christian Europe was one vast desolation. (25, page 53)

III The Renaissance and the Middle Ages

The Church of Rome launched the Crusades in 1095, with the objective of driving out the invaders from some of the conquered lands and of converting them to Christianity in others, but in lauching these expeditions during the next two centuries, the church loosed forces which were eventually to undermine her authority. The warriors returned intellectually aroused; a new world of learning had been opened up to them. Arabic numerals, decimals and algebra were introduced to Christendom, by Emperor Frederick II, and in the twelfth century centers of learning called universities began to spring up here and there at Paris, Oxford, Salerno and other important European cities.

A New Concept of Learning - The Relationship between Things and Thoughts. The invention and early development of the art of Printing, the revival of classical learning, especially in Italy during the fifteenth century, and the Protestant Reformation with its center in Germany, (in the sixteenth century), unfolded new educational possibilities and put new life into teaching methods. One of the most fundamental ideas developed at this time was that of "learning by doing", or the recognition of the value of working through a process, of making something with the hands, with tools, and of doing something skilfully, as a basis for rational thinking.

Mulcaster Makes Drawing One of the Fundamental Studies. Richard Mulcaster (1531-1611) a young English school teacher,

was one of those who broke with tradition. He organized an elementary school curriculum consisting of reading (English), writing, drawing and music. He has been given credit for being the first to make drawing one of the basic studies of the school. However, he in turn, credits Aristotle's POLITIKES for the origin of the idea:

> There he sayeth, that as writing and reading do minister much helpe to traffique, to householderie, to learning, and all publicke dealings; so drawing by penne or pencil is verie requisite to make a man able to judge, what that is which he byeth of artificers and craftesmen, for substannce, forme, and fashion, durable and handsome or no: and such other necessarie services, besides the delitefull and pleasant. (4, page 34)

In Twentieth Century English this could be translated as the latest argument for inclusion of drawing in the curriculum - that of consumer knowledge and appreciation.

Comenius Advocates Drawing in Education. John Amos Comenius (1592-1670), the most famous educational writer of the 17th century, in his system of education ".....would have the children exercised in drawing and writing...." (4, page 34)

Pestalozzi Makes Drawing a Fundamental Study. Johann Henrich Pestalozzi (1746-1827), the Swiss educator who has been called the "father of manual training", realized that in considering any object one must observe: (1) how many, (2) how they look - what is their form and outline, (3) what they are called - how one can recall each to mind. He concluded that education must proceed on this three-fold basis. Therefore, drawing, as a means of form study, became one of the

fundamental studies in Pestalozzi's schools. (4, page 120)

Technical Drawing in France. In the nineteenth century France led the world in engineering education, including the teaching of technical drawing. Some of the characteristics of this instruction were: (1) Early emphasis on Geometrical Drawing, (2) Projection Drawing, (3) Drawing to Scale, (4) Machine Drawing, (5) Machine Design, and (6) Visiting factories and dimensioning sketches of machines. The emphasis given drawing in the report of the French Commission of 1865 on Technical Education is explained in the following:

> Among all the branches of instruction, which..... can contribute to technical education of either sex, drawing.....has been almost unanimously regarded as the one most important..... (4, page 286)

Drawing in Germany. England was not the only country to profit by the revelations of the World's Fair in London in 1851. Germany also recognized the superiority of French manufactures. In the Kingdom of Wurttemburg, for example:

> ".....the Department of Commerce and Industry organized in nearly every town classes for drawing....." (4, page 291)

By way of a return compliment, the French Commission of 1865 said in it's report that the drawing school at Nuremberg was the best in Central Germany.

Establishment of Drawing in England. In 1830, the British House of Commons appointed a committee whose purpose was:

> "to inquire into the best means of extending a knowledge of the arts and the principles of design, among the people....." (4, page 383)

In the committee's report it was shown that whereas there were no means of obtaining adequate design instruction in England, there were in France about eighty schools of design and in Bavaria (Germany) there were thirty-three schools of design. As a result of this report the British government allowed the sum of L 1,500 to be used for the establishment of a Normal School of Design. The principal subjects to be taught were Drawing and Applied Design.

Part B

The Development of Education and Drawing in America

In tracing the Early History of drawing it was necessary to closely parallel the development of early education, since the two topics were so closely interwoven. Again, in tracing the development of drawing in America, it is necessary to delve through many ramifications in the evolution of industrial education.

The development of industrial education in the United States was influenced by the important changes that took place in Europe, but the evolutionary process was simpler here than, for example, in England, because of the well established democratic principle of free schooling for all.

The Manual Element in Education. One of the most significant motivating forces behind the establishment of the Manual Arts in America was the Russian Exhibition at the Centennial Exposition in Philadelphia in 1876. Dr. John D. Runkle (1822-1902), then president of the Massachussetts Institute of Technology, had observed at that time a positive relation-

ship between a knowledge of shopwork and the ability to readily enter professional work (in mechanical engineering).

> At Philadelphia, in 1876, almost the first thing I saw was a small case containing three series of models - one of chipping and filing, one of forging, and one of machine-tool work. I saw at once that they were not parts of machines, but simply graded models for teaching the manipulations in those arts. In an instant, the problem I had been seeking to solve was clear to my mind; a plain distinction between a mechanic art and its application in some special trade became apparent. (5, page 320)

Upon his return from the Centennial, Dr. Runkle recommended that "instruction shops" be established at that institution which all the mechanic arts needed by young engineers and others should be taught.

> .....such a shopwork department of the Institute was established.....This new school was named "School of Mechanic Arts".....Besides shopwork, the course of instruction, which was to cover two years, was to include arithmetic, algebra, geometry, English, physics and drawing. (5, page 320)

There was much discussion about the manual training system, both pro and con. The proof of its worth, however, lay in the fact that the manual-training movement grew and spread throughout the educational system of the country. Its proponents believed that this type of school was to help solve the problem of providing more skilled and better prepared graduates.

The manual or industrial arts, as taught in the early shop programs of this country, had the singular objective of preparing specialists for industry. Little thought was given at that time to the achievement of a well balanced curriculum, except by a few far-sighted educators. One of these visionaries was Professor Calvin M. Woodward (1837-1914), dean of

the Polytechnical School, Washington University. Under his guidance, the mechanic arts were taught under the same principles that were used in teaching the sciences, mathematics and languages. Professor Woodward believed that in shopwork were to be found specific educational values not only for those entering trades, but for all youth, as a part of General Education. That his vision was prophetic of the future will be seen in a later paragraph, wherein his principles are seen to have been established in the American school programs through the enactment of the Smith-Hughes Act.

There were other early leaders in education who believed that too much emphasis was placed upon the development of skills in the manual arts programs, to the detriment of the educational aspects. In 1904, Professor Charles R. Richards (1865-1936), then director of the Department of Manual Training at Teacher's College, Columbia University, suggested that the term "Industrial Arts" be substituted for the term manual training. He contended:

> We are rapidly leaving behind the purely disciplinary thought of manual training.....Now we are beginning to see that the scope of this work is nothing short of the elements of the industries fundamental to modern civilization. (5, page 453)

Recent Developments in Education. Among the many developments that have occurred in recent years, there has been much legislation, both on national and state level, aimed at the improvement of education in the United States. Two of these legislative acts are particularly worthy of note.

The Morrill Act of 1862 established the Land Grant Col-

leges. Each participating state received a donation of 30,000 acres of land to be used for the benefit of the colleges. This act also provided several major benefits, among which was the provision for the teaching of mechanic arts on the college level.

The Smith-Hughes Act of 1917 allocated funds for the teaching of Trade and Industrial Education and for the preparation of teachers and supervisors of this type of education. This act was a turning point in the recent history of education. For the first time, a tangible division was made between the teaching of manual arts as a part of general education or as preparation for a vocation. With some modifications, these two branches of education exist in the same form in today's schools. The aim or objective of Vocational Education is the development of skill and preparation for a vocation; the objective of Industrial Arts is Exploration in a number of Industrial Processes as a part of General Education.

Part C

The Present Day Status of Drawing in Education and Industry

Drawing in the Secondary Schools. In the Junior High and Senior Schools, drawing is generally offered as an elective subject, and often as a part of the shop training. The most commonly given course is Mechanical Drawing, which is related primarily to objects found in the machine shop or foundry. Some high schools also offer elementary Architectural Drawing, but this is the exception, and not generally

taught except in those high schools which have Trade and Industrial programs. The high school T. & I. programs offer a fairly intensive course in drawing, with the objective of preparing apprentice draftsmen for industry.

Drawing in the Colleges. Drawing is given, on the college level, in three broad fields; Engineering, Industrial Arts Education and Trade and Industrial Education.

In the division of Engineering, the typical drawing requirements are; Mechanical Drawing, Descriptive Geometry, Machine Drawing and Architectural Drawing. Design courses in the field or specialization may also be required.

In the Industrial Arts Education curriculum, the drawing requirements are much the same as those of Engineering. However, the objective sought is the acquisition of sufficient skill to teach various drawing courses, and not as specialized training or vocational training.

In a college Trade and Industrial education curriculum, a course in Technical Drawing and Blueprint Reading is usually required in each program. In addition, each specialized field may have its own requirement. An example would be the course of Building Construction where a course in Architectural Drawing would be essential. Where the specialized field is Drafting and Design, the drawing requirements are naturally intensified, and drawing course requirements are even more comprehensive than for engineering as would be expected where the objective is to prepare skilled draftsmen for industry.

Drawing in Industry and the Development of Production Illustration. In view of the many arguments that have already been presented in this paper defending the important place of drawing in history, in education, and in the industry of an earlier period, it seems almost unnecessary to mention the indispensability of drawing in this industrial age. As the "language of industry", a drawing executed by a skilled draftsman truly speaks a thousand words. In point of fact, it is a technical impossibility to convey many engineering concepts without this graphic language, and every major branch of science, engineering, and technology requires training in the execution and reading of technical drawings.

Out of two major World Wars and the vast growth of the aircraft industry that resulted therefrom, has come recognition of perspective drawing as a versatile and significant engineering method. In this type of drawing, a single view can clarify the assembly of a complex object - one which might require several views in the conventional method of drawing. In addition to bridging the gap between the untrained worker and the complications of his assigned task, the perspective view saves hours of drafting time.

> In 1939, in the preliminary design department of the Douglas Company, Mr. Tharratt and his associates had experimented with a more graphic way to present Army and Navy bid designs. Highly successful in visualizing these proposals were the cutaway perspective illustrations which pictured in three dimensions the completed airplane with the pilots and crew at their stations, the bomb bays, gun turrets, fuel tanks, equipment location, as well as distinctive features of the structure.....
>
> Favorable reactions from Washington encouraged establishment in the Engineering Department, under Mr. Tharratt, of the Production Illustration Group, a group of engineer-artists. The work was started on a compara-

> tively small scale on the earlier light attack bombers, and on succeeding models it became an accepted part of manufacturing practice.....
>
> Many automobile manufacturers, later engaged in war production of tanks, guns, and aircraft, applied perspective illustrations to their new fields, impelled more than ever by the difficulties due to inexperienced personnel and the conversion of established factories to entirely different products and methods. (35, pages 2 and 3)

NOT correct

Conclusion. The future of drawing in the schools and in industry is limited only by the imagination and energy of its proponents.

There are many new applications of drawing to be made in manufacturing, engineering, building, construction and numerous other fields - this is the challenge to industry.

In like manner, there are equally as many new applications of drawing to be made in the teaching of Industrial Arts and Engineering Shopwork - this is the challenge to the teacher.

CHAPTER III

REPORT OF THE SURVEY

In a previous chapter it was stated that the principal aim of this writer was to study the existing conditions in a selected number of New Mexico high schools, with respect to the Correlation of Mechanical Drawing and Industrial Arts Shopwork. The purpose of this chapter will be to present the results of this investigation in logical sequence and in detail. Through this presentation, it is hoped to have accomplished the purpose of the study, and to make available to those interested, a gathering of data which represents the co-operative efforts of twenty-seven Industrial Arts teachers in the New Mexico high schools.

Part A

Sources of Data

One of the first problems to be considered in making the survey was that of choosing the possible sources of data. The following main sources were decided upon; The New Mexico State Department of Education for listings of teachers and schools; a selected number of high schools in New Mexico for analytic purposes; the Oklahoma A & M Library with its excellent facilities for research work; and a questionnaire for the purpose of conducting a normative survey.

State Department of Education Data. A letter was sent to the Director, State Department of Education, Santa Fe, New Mexico, requesting a copy of the Annual High School Bulletin or other such publication which would have listed in it those Junior and Senior High Schools in that state which offered Mechanical Drawing in their curricula. The department cooperated promptly, sending the writer a Directory of Secondary Schools for 1955-1956 which listed the Name of the School, the Principal, the County, Post Office address and Accreditation status. An asterisk mark in red pencil had been placed beside the name of each school which offered Mechanical Drawing. A notation had been made to the effect that Mechanical Drawing was not offered in the Junior High Schools, thus eliminating these schools from the survey. Of the total list of one hundred and thirty-eight High Schools listed in the directory, only twenty-two were indicated as offering Mechanical Drawing.

Addition of Other Schools. It was originally intended to survey only the twenty-two schools designated by the State Department of Education. However, upon further analysis of these schools and the cities in which they were located, it was observed that several High Schools in the larger cities of New Mexico had not been indicated as offering Mechanical Drawing. Because of the population of these cities, (5,000 or more) it was felt that their school system curricula would be fairly comprehensive and would very likely include some form of Mechanical Drawing in their Industrial Arts

programs. Accordingly, the high schools in six of these larger cities were added to the original twenty-two, making a total of twenty-eight. Of the six additional schools, subsequent questionnaire responses established that five of these currently offer Mechanical Drawing or Drafting. Of the original list of twenty-two schools, as furnished by the State Department of Education, twenty of these responded as offering Mechanical Drawing or Drafting, one included Drawing in a two-year Basic Engineering course, and one did not respond. (These data are reflected in more detail in Tables - I through XXXII) With all due respect to the State Department of Education data, it seems reasonable to assume that the addition of the six schools to the original list of twenty-two tended to increase the validity of this survey.

The Questionnaire. As stated previously, the Normative Survey (Questionnaire) method was employed to acquire the data for this report.

In composing the questionnaire, the writer endeavored to satisfy as many of the accepted requirements as possible. The primary purpose of the questionnaire was that of acquiring an accurate picture of the existing status of Correlation between Mechanical Drawing and Industrial Arts Shop Courses in the New Mexico High Schools.

The questionnaire was reproduced and mailed, with a letter of transmittal, which explained the aims and purposes of the survey, to the Principals of the twenty-eight high schools. A self-addressed, stamped envelope was enclosed for the respondents convenience. Most of the

completed questionnaires were returned in a fairly short length of time. A follow up letter, sent out one month after the original mailing, resulted in the return of all but one of the original twenty-eight, or a total response of 96.4%.

Validity of the Data. The validity of the data acquired by the survey is dependent upon several things; the validity of the questionnaire technique itself, the validity of the specific questionnaire used, and the validity of the responses.

The first of these, the questionnaire technique itself, generally is accepted as of sufficient validity for the purposes of this type of study. In the case of this writer, the physical and economic barriers of time, distance and expense made a personal survey of the problem impossible (although it is the writers belief that this would have been the ideal method) therefore the questionnaire technique was employed.

The second of these, the validity of the questionnaire used, is limited by two diametrically opposed sets of factors. One, the questionnaire should not be too detailed, too long, or too difficult to answer, if there is to be a truly representative percentage of response. Two, the questionnaire should be Objective, Valid, Comprehensive, and Reliable, if the responses are to be of value. To strike the happy medium that lies between these two extremes is the goal of every research student who uses the questionnaire technique.

The third and last of these, the validity of the respondents, becomes a matter of accepting upon good faith the responses received. The problems of interpretation, of human nature, of individual differences and many other unpredictable factors must be realized, however, by those who may use the data.

In summation, therefore, the data should be accepted as valid within the limitations stated herein. The tables, lists and other statistical data given in this study reflect the contents of the completed questionnaires exactly as received. Where a statement, belief, or question reflects the opinion of the writer, it is so stated therein.

Part B

Survey Data

The data acquired by the survey represents statistical, and factual information which is supplemented by commentary of the respondents. To present this rather large amount of data in condensed form, and yet retain its meaning, value and logic is a primary objective of this section of the report.

Reporting the Data. The data is reported for the most part in tabular form. The more significant of these tables are included in this chapter. Other tables, however, have been placed in the Appendix in order to conserve text space. A summarization of these is included in this chapter, also in tabular form. By this means, the general information is presented in this chapter together with the text discussion,

and the detailed material is available in the Appendix for reference.

Identity of the Respondents and Schools. One of the principal aims of this chapter is to present the data in as objective a manner as possible. It is the authors belief that, in order to assure the objectivity of this survey, the identity or location of the school should not be associated with the responses. It is further believed, that in the best interests of all concerned, the identity of the respondents should be connected with the responses given, particularly where a personal opinion is voiced.

The method employed in presenting the data anonymously was to rearrange the original alphabetical order of the schools into a random numerical order. Each school is thereafter represented by a Key Number which bears no relationship to the original alphabetical list. The respondent from that school is also referred to by the same number.

The assumptions are; that each respondent will recognize his own data, that all respondents will benefit from the total gathering of data, and that the value of the information is not affected to any great extent by presenting it in this manner.

Data in Table I. This table lists, in Column I, the name of each high school to which the questionnaire was mailed, In only two instances were questionnaires sent to more than one school in any one town. These two exceptions

TABLE I

LIST OF NEW MEXICO HIGH SCHOOLS; CITIES, AND TOWNS INCLUDED IN THE SURVEY

Column I	Column II	Column III	Column IV
High Schools	City or Town	Enrollment	Population
Alamogordo	Alamogordo	662	6,783
Albuquerque	Albuquerque		96,815
Albuq. Indian	"	7,770	
Highland	"	incl.	
Valley High	"		
Artesia	Artesia	822	8,244
Carlsbad	Carlsbad	1,708	17,975
Clovis	Clovis	969	17,318
Deming	Deming	504	5,672
Gallup	Gallup	617	9,133
Hobbs	Hobbs	1,294	13,875
Hot Springs	Truth or Consequences	354	4,563
Las Cruces	Las Cruces	1,358	12,325
Las Vegas	Las Vegas	979	7,494
Lordsburg	Lordsburg	235	3,525
Los Alamos	Los Alamos	495	9,934
Los Lunas	Los Lunas	362	889
Lovington	Lovington	584	3,134
New Mexico Milit. Inst.	Roswell	379	25,738
Portales	Portales	669	8,112
Raton	Raton	576	8,241
Roswell	Roswell	1,419	25,738
Ruidoso	Ruidoso	142	806
Santa Fe	Santa Fe	1,554	27,998
Taos	Taos	550	1,815
Tucumcari	Tucumcari	587	8,419
Tularosa	Tularosa	204	1,642
Western	Silver City	553	7,022

NOTE: Enrollment figures (Column III) from New Mexico State Department of Education for School Year 1954-55.

Population figures (Column IV) from 1950 U. S. Census of Population, published by the U. S. Dept. of Commerce, Bureau of the Census.

were Albuquerque and Roswell. As indicated by State Department of Education data, there are four high schools in Albuquerque which offer Mechanical Drawing, and two such high schools in Roswell.

The name of each city in which each high school is located is given in Column II.

The enrollment figures in Column III were also furnished by the Department of Education.

Column IV gives the population of each city as reported by the U. S. Bureau of Census for 1950. In some cases there appears to be a notable disproportion between the high school enrollment and the population for the same city or town. This may possibly be accounted for by the consolidation of a school district, particularly where the population of the district is largely rural, with the resulting effect of greatly increasing the enrollment of the school.

Data in Table II. This table gives the responses to Questions Nos. 1 and 6 of the questionnaire. See bottom of Table II for listing of the questions.

The responses to these two questions have been combined so as to show the total Industrial Arts Load of each respondent. The significance of this information may be that of indicating the correlative potential available to each teacher - the drawing and other shop courses which may be correlated to the drawing course(s).

Data in Table III. The data in this table shows the origin of the drawing problems in each drawing course

TABLE II

RESPONSES TO QUESTIONS NO. 1 & 6
OF THE SURVEY

Col. I	Column II	Column III
School Key No.	Question No. 1 Drawing Courses	Question No. 6 Other I. A. Courses
1	Mechanical Drawing I " " II " " II	Metal Shop Transportation Shop
2	Woodworking project drawing	Woodwork Auto Mechanics Welding
3	Beginning Mechanical Drawing	Woodwork I Sheet & Art Metal Arts & Crafts
4	Basic Engineering Course	None
5	Beginning Mechanical Drawing	Woodwork (Seventh Grade) " Eighth " " Ninth " " High School I
6	Beginning Mechanical Drawing	Woodwork Woodturning Plastics
7	Mechanical Drawing I	Shop I (Freshman course) Shop II (to be offered 1956-57)
8	Mechanical Drawing I	Crafts (Jewelry, Leather, Plastics, Lapidary)
9	Drafting I Drafting II	Photography
10	Mechanical Drawing I Scale Drawing Freehand Drawing Design (Arts)	Carving Construction Finishing
11	Drafting I	General Shop (Metals)

TABLE II (continued)

Col. I	Column II	Column III
School Key No.	Question No. 1 Drawing Courses	Question No. 6 Other I. A. Courses
12	Mechanical Drawing (Gen) Machine Drawing Architectural Drawing	Leathercraft Jewelry Art Metal Work Woodworking
13	Mechanical Drawing I " " II	Wood Shop I " " II
14	General Drafting I " " II " " III " " IV	ON COLLEGE LEVEL: Woodworking Mechanical Drawing Shop Sketching Architectural Drawing
15	Mechanical Drawing	General Shop Machine Woodwork Plastics Auto Mechanics Bench Metals Lapidary Ceramics Leather
16	Mechanical Drafting I " " II Architectural Drafting I " " II	None
17	Elementary Drawing	Woodwork
18	Mechanical Drawing	Bench Woodwork Carpentry
19	Mechanical Drawing I " " II " " III	Not at present - taught shop 18 years
20	Beginning Drawing	Arts & Crafts
21	Mechanical Drawing I " " II " " III	Shop (General Woodwork) Cabinet Making Carpentry

TABLE II (continued)

Col. I	Column II	Column III
School Key No.	Question No. 1 Drawing Courses	Question No. 6 Other I. A. Courses
22	-	Mechanical Drawing not offered in this school
23	Mechanical Drawing	General Woodwork General Metalwork
24	Drafting I (Mechanical) Drafting II (Architect.) Drafting III (Mapping)	Woodshop Metalshop
25	1st Year Mechanical Drawing	Woodworking Metalwork Sheet Metal
26	Mechanical Drawing I " " II	Industrial Arts I " " II " " III
27	General Mechanical Drawing	General Shop Woodwork Advanced Woodwork
28	-	No response received from this school

Questions:

1. Please write in the following spaces the titles of the Mechanical Drawing courses offered in your school.

6. Do you teach other Industrial Arts courses in addition to Mechanical Drawing? If so, please list these.

TABLE III

RESPONSES TO QUESTIONS NO. 2, 3, 4 & 5 OF THE SURVEY

Col. 1	Column II				Column III				Column IV				Column V			
School Key No.	Drawing Course (a)				Drawing Course (b)				Drawing Course (c)				Drawing Course (d)			
	2	3	4	5	2	3	4	5	2	3	4	5	2	3	4	5
1	x	x	x		x	x	x		x	x			x	x	x	
2		x	x													
3	x	x		x												
4	x															
5	x	x	x	x												
6	x	x		x	x	x	x	x								
7	x	x														
8	x				x	x										
9	x	x	x		x	x	x									
10	x	x			x	x	x	x				x	x	x	x	x
11	x	x	x	x												
12	x	x			x	x	x		x							
13	x	x		x	x	x		x								
14	x				x			x	x	x	x			x	x	
15	x	x	x	x												
16	x	x		x	x	x	x		x	x	x			x	x	
17	x	x	x	x												
18	x															
19	x	x	x	x	x	x	x	x		x	x	x				
20	x															
21	x				x				x				x			
22	-															
23	x															
24	x	x		x			x		x	x	x					
25	x	x	x													
26	x	x			x	x		x								
27	x	x	x													
28	-															
Totals	25	19	10	10	12	10	8	6	6	5	4	2	3	4	4	1

Questions:

	(a)	(b)	(c)	(d)
2. Drawing Problems taken from Textbook....				
3. " " originated by Teacher..				
4. " " originated by Pupil....				
5. " " originated by Shop..... (problems or projects)				

NOTE: Drawing courses offered by each school are listed in Table II.
School No. 22 Drawing not offered in this school.
School No. 28 No response received from this school.

offered in each school. In Question No. 1, the teacher was asked to list the title of each drawing course taught. Four spaces were allowed for the responses (although few teachers listed as many as four drawing courses). Questions Nos. 2, 3, 4 & 5 refer to each of these courses by the prefix Drawing Course (a), (b), (c) and (d). See bottom of Table III for listing of the questions. The implications of the data in this table are several in number.

First, the time-honored, though not always desirable, method of choosing drawing problems from the textbook is dominant in most of the drawing classrooms. This is reflected by the numerous responses to Question No. 2 (shown in the first vertical space in each column).

Second, the next most frequently used method of choosing drawing problems is to have the teacher originate the problems. It is the writers belief that this represents a better technique than the textbook method. In originating these drawing problems, the teacher may eliminate the rote copying method, more interesting problems may be developed, and allowances may be made for the many possible variables found in the average classroom such as the influence of local environment and individual differences in the students.

Third, a small percentage of the drawing problems are originated by the pupils. However, this percentage increases from about 15% in the beginning drawing courses to about 33% in the more advanced classes. This appears to indicate that the drawing pupils are given more opportunity

to exercise independent thought in the advanced courses. This is a desirable situation.

Fourth, the least percentage of drawing problems appear to be originated by the shop problems or projects. It is the opinion of this writer that this indicates an unexploited source of innumerable drawing problems which could to a great extent promote the correlation between drawing and many industrial processes.

Data in Table IV. This table lists the responses to Question No. 7. This question asks the teachers opinion as to whether or not Mechanical Drawing can be correlated to all or most of the other Industrial Arts courses.

All the teachers but one responded in the affirmative, but according to the remarks which accompanied some of the responses, there still remains some division of opinion on the question. This division may be due in part to the deeply instilled traditional methods of teaching drawing, in part to the lack of administrative interest or support, and in part to the uncertainty as how to best approach the problem. Some suggested methods of attaining better correlation are presented in a subsequent section of this report.

Data in Table V. The responses given in this table indicate the teachers opinion as to the relative value of the proposed correlation to the Community, School, Teacher, Pupil and Industry, as listed in Question No. 8.

The proposed correlation is indicated to be of most

TABLE IV

RESPONSES TO QUESTION NO. 7
OF THE SURVEY

Col. I	Column II		Column III
School Key No.	Response YES	NO	Remarks Refer to School No. given
1	x		1. Indirectly with all.
2	x		
3	x		3. Is possible, yes, but not advisable.
4	x		
5	x		
6	x		11. (a) Drafting students are not enrolled in other Industrial Arts courses.
7	x		
8	x		
9	x		(b) Mechanical Drawing is not required as prerequisite to any I. A. subject.
10	x		
11		x	
12	x		
13	x		12. Mechanical Drawing should be correlated with all Shopwork to get the best results.
14	x		
15	x		
16	x		
17	x		16. Could be more closely correlated than it is now.
18	x		
19	x		
20	x		19. If administration would require it, it would be better for the students.
21	-		
22			
23	x		
24	x		22. Drawing not offered in this school.
25	x		
26	-		
27	x		28. No response received.
28	---	---	
Totals	23	1	(Of a Total of 27 Respondents)

Question:

7. In your opinion, is it possible to correlate Mechanical Drawing with all or most of the other Industrial Arts courses given in your school?

NOTE: Blank Space in Column II indicates course is not offered at this school.

TABLE V

RESPONSES TO QUESTION NO. 8
OF THE SURVEY

Col. I	Column II					Column III
School Key No.	See Note Below					Remarks Refer to School No. given
	a.	b.	c.	d.	e.	
1	x	x	x	x	x	
2		x	x	x	x	7. Gives the pupil more opportunity for creative expression.
3	-	-	-	-	x	
4			x	x	x	
5	x	x	x	x	x	
6	x	x	x	x	x	11. Correlation is of greatest value to the pupil.
7	x	x		x	x	
8	x	x	x	x	x	
9	x	x	x	x	x	
10				x	x	14. Indirectly of value to Community; directly to Pupil, Industry.
11	x	x	x	x	x	
12	x	x	x	x	x	
13	x	x	x	x	x	
14	x			x	x	16. (Referring to Teacher) Probably of value, but requires more groundwork.
15	x	x	x	x	x	
16	x	x	x	x	x	
17	x	x	x	x	x	
18	x	x	x	x	x	
19	x	x	x	x	x	19. Life is a Correlation of many things.
20				x	x	
21	x	x	x	x	x	
22						22. Drawing not offered in this school.
23	x	x		x	x	
24	x	x	x	x	x	
25	x	x	x	x		28. No response received.
26		x	x	x		
27			x	x	x	
28						
Totals	19* 1-	20* 1-	20* 1-	25* 1-	24*	(Of a Total of 27 Respondents)

Question:

8. Do you consider correlation (as proposed in this questionnaire) of value to:

a. The Community
b. The School
c. The Teacher
d. The Pupil
e. Industry

Key to Symbols: x Yes, - No

value to the Pupil. It is of next highest value to Industry, into which the student may presumably enter upon leaving school. The correlation is also believed by the respondents to be of considerable value to the Community, the School and to the Teacher.

Responses to Question No. 9. The question was:

> Can you suggest any special methods of attaining or improving this proposed correlation?

The responses received speak for themselves and are herewith presented in their entirety. The only comment this writer believes should be added here is that it would have been desirable to have had many more responses to this question. Of the ten questions, this was the one to which most of the teachers failed to respond. To those respondents who tood the time and effort to write in these comments, the writer is grateful.

Teacher No. 3

> The correlation might be improved if the Drawing phase is introduced into the other Industrial Arts courses as a first step to the course.
>
> The correlation would be of no significance if the Mechanical Drawing student never planned on going into woodshop or metalshop.
>
> In a vocational school or strictly vocational program where the course of study is made to include this correlation, this type of a program would be satisfactory and feasible.

Teacher No. 7

> By offering Mechanical Drawing before a student advances too far in Industrial Arts - will give him the ability to read working drawings and better acquaint him with dimension and perspective. This will instill in him a more defined interest and bring out his creative ability.

Teacher No. 9

More Drafting should be offered on the Junior High level. In my classes, those students exposed to the subject on this level are much better students in all shop work and in my opinion this training reflects in their work in other classes in terms of neatness, accuracy and planning.

It is my opinion that the Drafting program throughout the state of New Mexico leaves much to be desired. It need not be an expensive course and I feel that it should be a part of every General Shop course with specialization in the actual Drafting class. Admitted that we are not a highly industrialized state there are still many jobs available for those possessing the necessary skills.

Teacher No. 11

Preferred method of attaining correlation: Drafting required as a prerequisite or accompanying other I. A. courses. Not desired: Take time from other I. A. courses and teach Drawing.

Many drawing problems originate in shop courses.

Teacher No. 14

The Composite General Shop is presently one of the most efficient ways of correlating or integrating the various phases of industry. Here sketching and drafting are necessary in the formulation of shop projects. The student should be encouraged and helped in originating plans although these should be based upon accepted and appropriate operations and design patterns.

Teacher No. 16

Two methods suggested. a. Preparation of job sheets with appropriate drawings. b. Securing drawing problems from shop. Right now the Mechanical Drafting II class has a cut-away model (old) of a car; motor, transmission, differential, etc., from which we are taking such drawing problems as water pump, fuel pump, oil pump, valve assembly, gears, "U" joint. We have 12 such problems going on and the interest is high.

The pet question of the 2nd year boys to the uninitiated is "How is this oil pump lubricated?"

Teacher No. 19

> Generally you find that most administration officials have little or no background in the Industrial Arts or Industrial fields. Due to a lack of knowledge, little thought is given to correlation which could be carried on into Math., Physics, General Science, etc.
>
> Too many administrators have only the idea of Leisure time and hobbies when considering Industrial Arts.

Other Remarks. Listed here are other remarks for which no other space was allotted in the questionnaire, but which were volunteered by these teachers as having some bearing on the problem of correlation.

Teacher No. 11

> (In response to Question No. 5) Drafting students develop pattern layouts requested by shop students and learn through project work sheets that are used. Drafting students help solve design problems encountered by shop students planning original projects.
>
> Only three students enrolled in other I. A. shop courses have had or are taking Drafting.

Teacher No. 19

> (In further response to Remarks column, page 2 of the questionnaire) We also have time devoted to home floor plans, electrical plans, and plumbing plans. All students live or will live in some type of home. You would be surprised how original some of the home designs really can be.
>
> No controls are placed on these home plans, but the student has to justify his design and work out the cost and Bill of Materials.
>
> The above gives the students a chance to realize values, and dig in and study when they see that the things they want in life will be available only to the well trained individual.

Responses to Question No. 10. Of the twenty-seven teachers who returned the questionnaire, twenty-two replied

in the affirmative as desiring a copy of the summary of the thesis and the data acquired by the questionnaire. Three failed to reply the question, and two responded in the negative. Of the latter two, one teacher added some interesting comments to his response. This response follows verbatim:

> No. I seriously question the value of this survey. Any good shop teacher will correlate his various courses with each other. A teacher who does not do so is a poor teacher and should be replaced.

Data in Table VI. This table is a condensation of Tables VIII through XXXII. These tables were placed in the Appendix to conserve text space and facilitate reading of this report.

The individual tables (VIII through XXXII) give a detailed breakdown of the responses to each item in page two of the questionnaire, including the remarks of the respondents.

The percentage of correlation for each shop course is arrived at by dividing the total number of schools offering the course into the total number of schools which correlate the shop course with drawing, and multiplying by one hundred.

The data in Column I of Table VI is arranged in the same original order given in the questionnaire. Column II lists the percentage of correlation as taken from the tables in the Appendix. Column III shows the number of schools (of a total of twenty-seven) which offer the course.

The significance of the data in this table may be that

TABLE VI

TOTAL STATUS OF CORRELATION BETWEEN MECHANICAL DRAWING AND INDUSTRIAL ARTS SHOP COURSES
(In Questionnaire Order)

Column I	Column II	Column III
Industrial Arts Shop Courses	Percentage of Correlation	No. of Schools Offering this Course (of a total of 27)
GENERAL WOOD		
Woodwork.....	90.2 %	22
Woodturning....	80.9	20
Patternmaking..	100	9
Carpentry.....	100	15
GENERAL METAL		
Machine Shop...	87.5 %	9
Sheet Metal....	100	13
Foundry.....	66.6	7
Forging.....	50	7
Welding.....	88.8	10
CRAFTS (GEN.SHOP)		
Plastics.....	81.8 %	11
Leathercraft...	75	13
Electricity....	66.6	6
Metal Spinning.	60	5
Art Metal.....	76.9	13
Ceramics.....	75	9
Jewelry.....	72.7	12
Woodcarving....	62.5	9
GRAPHIC ARTS		
Printing.....	42.8 %	7
Photography....	0	5
Linoleum Block.	80	5
Silk Screen....	66.6	3
Bookbinding....	0	1
OTHER		
Auto Mechanics.	100 %	9
Shop Safety....	100	9
Home Mechanics.	85.7	7
MEAN	72.4 %	

NOTE: See Tables VIII through XXXII in Appendix for Correlation status of each School and Subject.

of indicating which courses are at present strongly correlated to the drawing courses and which are in need of further correlative development.

This chapter has presented, for the most part in tabular form, the data acquired by the survey of twenty-seven high schools in New Mexico. The survey was based upon a study of the existing correlation of Mechanical Drawing and twenty-five Industrial Arts Shop Courses. Much other information of related value was also gathered through use of the survey questionnaire. The data and related information have been presented in entirety in this chapter or in supplemental tables in the Appendix. The writer has attempted to interpret, to some extent, the data in this report for the purpose of clarification, especially where given in tabular form. The following chapter presents the conclusions of the survey together with recommendations for improving the methods of correlating Mechanical Drawing and Industrial Arts Shop Courses.

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

The purposes of this chapter are; to summarize the findings of the survey, and to offer recommendations, based upon the data, with view toward the improvement of drawing instruction in the New Mexico high schools. These recommendations are offered as suggested steps of action, which may be applied by the teachers of drawing according to the needs of their individual classes or schools.

Summary of the Survey. In summarizing the survey, the same order of presentation will be followed as was used in Chapter III. This order is patterned after the original survey questionnaire. By presenting the material in this order it is believed that the continuity of thought and the established relationship of the material is maintained to a better extent.

The survey established that Mechanical Drawing is offered in the high schools of at least twenty-six of the larger New Mexico cities or towns.

It was found that the origin of the drawing problems in most drawing courses is the traditional method of taking the problems from the textbook. The second most used method is that of the teacher originating the problems.

In more advanced classes, the pupil has a more personal choice of his drawing assignments.

Practically all of the drawing teachers are found to be in accord with the belief that correlation can be attained between Mechanical Drawing and all or most of the other Industrial Arts courses.

The proposed correlation is believed to be of most value to the pupil, according to the respondents. It is also of very high value to Industry, to the Community, to the School, and to the Teacher.

Several methods of attaining or improving correlation have been suggested by the drawing teachers. These have been listed in detail in Chapter III. These methods will also be discussed in the following section on recommendations.

Conclusions. The survey indicates that Mechanical Drawing is offered in a rather small percentage of the high schools in New Mexico. Of a total of one-hundred and thirty-eight high schools, only twenty-six (in the larger cities and towns) include drawing in their curricula.

The teachers of drawing are almost unanimous in their recognition of Mechanical Drawing, not only for its practical values, but as an outstanding correlative device. These teachers, in addition to drawing, teach from one to eight other Industrial Arts courses. This teaching load varies in content and amount from school to school. Considering the high schools from a statewide, overall

viewpoint, a wide selection of Industrial Arts shop courses is offered in the high schools. From the same point of view, it seems that this variety of shop courses presents numerous opportunities for correlative teaching.

Of the several origins of drawing problems (the textbook, the teacher, the pupil, and the shop problems or projects) the shop problems or projects are the least used sources. By the same token, they may be the richest sources of a great many drawing problems with which to promote correlation between drawing and many industrial processes.

The possible keys to the solution of attaining greater correlation may be; one, more administrative support and interest in the problem, and two, the dissemination of successful methods used by other teachers in their drawing classes.

These conclusions are offered by the writer in the light of a personal philosophy of the problem, but the conclusions were drawn after much study of the survey data and its possible implications. These conclusions are presented in the interest of furthering the growth and value of Mechanical Drawing in the high schools of New Mexico.

Recommendations. These recommendations are presented as suggestions, based upon the survey data and particularly upon the suggested teaching methods offered by the respondents to the survey. These methods are discussed in the following paragraphs.

A recommendation made by many of the teachers was that correlation might be improved if drawing was offered as a pre-requisite or as a co-requisite to the other courses. The reasons given for this suggestion are that the student will gain ability to read working drawings and will develop a knowledge of dimension and perspective. These abilities are important in any phase of shopwork, but are often lacking in students who have had little or no drawing experience. Along the same line of thought, one teacher suggested that more drafting should be offered on the junior high school level. His favorable experiences with students who had been exposed to this early training seem to bear out the point. It should be noted here that, according to New Mexico State Department of Education data, drawing is not offered in any of the junior high schools in the state.

Another recommendation proposed by several of the teachers was to the effect that the drawing should be presented in the General Shop (a shop in which two or more Industrial Arts courses are offered). The General Shop is recommended by these teachers as an effective source of correlative problems wherein the drawing and shopwork may directly related in both the theory and the practical applications. To be very effective, however, the General Shop would have to offer several courses. It would be preferable for these courses to represent several distinct areas of industry. In connection with these comments, there is presented herewith Table VII, which lists (in descending order of correlation) the total status of

TABLE VII

TOTAL STATUS OF CORRELATION BETWEEN MECHANICAL DRAWING AND INDUSTRIAL ARTS SHOP COURSES
(In Diminishing Order Of Correlation)

Column I	Column II	Column III
Industrial Arts Shop Courses	Diminishing order of Correlation	No. of Schools Offering this Course (of a total of 27)
Patternmaking..	100 %	99
Carpentry.....	100	15
Sheet Metal....	100	13
Auto Mechanics.	100	9
Shop Safety....	100	9
Woodwork.....	90.2	22
Welding.....	88.8	10
Machine Shop...	87.5	9
Home Mechanics.	87.5	7
Plastics.....	81.8	11
Woodturning....	80.9	20
Linoleum Block.	80	5
Art Metal.....	76.9	13
Leathercraft...	75	13
Ceramics.....	75	9
Jewelry.....	72.7	12
MEAN	72.4%	
Foundry.....	66.6	7
Electricity....	66.6	6
Silk Screen....	66.6	3
Woodcarving....	62.5	9
Metal Spinning.	60	5
Forging.....	50	7
Printing.....	42.8	7
Photography....	0	5
Bookbinding....	0	1

NOTE: See Tables VIII through XXXII in Appendix for Correlation status of each School and Subject.

correlation between Mechanical Drawing and Industrial Arts Shop Courses. It is suggested that those courses which are listed below the mean, are those which are neither offered in many schools, nor correlated sufficiently where they are offered.

A comment of several teachers had to do with the need for more administrative interest and cooperation. It is very possible that much of the unfavorable attitude of some administrators toward the Industrial Arts is due to the impressions made by the earlier programs which were not progressive or dynamic in nature. Possibly a form of public relations, or of re-education of not only the administrators, but of the other teachers, the parents, the local industries and any other interested agencies, would result in more active support and growth of the Industrial Arts programs. To accomplish this would require some effort on the part of each shop and drawing teacher, but the possible results may well be worth the effort. Any betterment of the Industrial Arts, on a local, state, or national scale, would directly benefit those who are now connected with it.

The Industrial Arts program in New Mexico is as yet comparatively young. Mechanical Drawing, as we have seen, is an old form of "art in industry", yet its full growth has not been reached - many of its possible applications have not yet been fully exploited. In combination, these two - Mechanical Drawing and the Industrial Arts Shop Courses - offer a challenge, and an opportunity, to the drawing teachers in the high schools of New Mexico.

APPENDICES

A. A Selected Bibliography

B. Letters and Forms Used in the Survey
   a. Letter to State Dept. of Education
   b. Letter of Transmittal
   c. Questionnaire
   d. Letter (follow-up)

C. Tables (See List of Tables)

A SELECTED BIBLIOGRAPHY

A. Books

1. Bailey, Wilson R., Safety Education in the School Shops of Oklahoma. Unpublished Master's Thesis, Oklahoma A & M College, Stillwater, Oklahoma, 1954, 54 pages.

2. Barber, Carl S., Silk Screen Printing as an Industrial Arts Subject in the High School General Shop. Unpublished Master's Thesis, Oklahoma A & M College, Stillwater, Oklahoma, 1948, 85 pages.

3. Bedell, Earl L. and Gardner, Ernes G., Household Mechanics, International Textbook Co., Scranton, Pennsylvania, 1937, 130 pages.

4. Bennett, Charles A., History of Manual and Industrial Education Up to 1870, Charles A. Bennett Co., Inc., Peoria, Illinois, 1926, 461 pages.

5. Bennett, Charles A., History of Manual and Industrial Education, 1870 to 1917, Charles A. Bennett Co., Inc., Peoria, Illinois, 1937, 566 pages.

6. The Holy Bible.

7. Bradley, Charles B., Design In the Industrial Arts, The Manual Arts Press, Peoria Illinois, 1946, 254 pages.

8. Brown, Chester R. and Committees, Suggested Courses of Study in Industrial Arts and Vocational Education for the Albuquerque Public Schools, University of New Mexico, Albuquerque, New Mexico, Spring 1955.

9. Burghardt, Henry D., Machine Tool Operation, McGraw-Hill Book Co., New York, 1941, 420 pages.

10. Coover, Shriver L., Drawing, Sketching, and Blueprint Reading, New York, 1954, 377 pages.

11. Crispin, Frederic Swing, Dictionary of Technical Terms, The Bruce Publishing Co., Milwaukee, Wisconsin, 1946, 427 pages.

12. Durbahn, Walter E., Fundamentals of Carpentry, Volume 1, American Technical Society, Chicago, Illinois, 1948, 890 pages.

13. Giesecke, Mitchell and Spencer, Technical Drawing, The MacMillan Co., New York, 1936, 564 pages.

14. Good, Carter V., The Methodology of Educational Research, Appleton-Century-Crofts, Inc., New York, 1941, 890 pages.

15. Griswold, Lester, Handicraft, Prentice Hall, Inc., New York, 1951, 480 pages.

16. Haines, Ray E., The Home Crafts Handbook, D. Van Nostrand Co., Inc., New York, 1948, 1,008 pages.

17. Hamlin, Talbot, Architecture Through the Ages, G. P. Putnam's Sons, New York, 1944, 680 pages.

18. Harris, Woodfin G., Jr., Photography as an Industrial Arts Activity. Unpublished Master's Thesis, Oklahoma A & M College, Stillwater, Oklahoma, 1954, 57 pages.

19. Johnson, Carl G., Forging Practise, American Technical Society, Chicago, Illinois, 1938, 131 pages.

20. Katz, Hyman H., Technical Sketching and Visualization for Engineers, The MacMillan Co., New York, 1949, 163 pages.

21. Klenke, William W., and Hayes, Charles J., Elementary Mechanical Drawing for High Schools, International Textbook Co., Scranton, Pa., 1940, 250 pages.

22. Klenke, William W., The Art of Woodturning, Charles A. Bennett Co., Inc., Peoria, Illinois, 1954, 186 pages.

23. Koos, Leonard V., The Questionnaire in Education, The MacMillan Co., New York, 1928, 178 pages.

24. McCaslin, Herbert J., Wood Patternmaking, McGraw-Hill Book Co., Inc., New York, 1946, 366 pages.

25. McCormick-Cassidy, History of Education, The Catholic Education Press, Washington, D. C., 1953, 688 pages.

26. Mawson, C. O. Sylvester, Roget's Thesaurus of the English Language, Garden City Publishing Co., Inc., New York, 1939, 600 pages.

27. National Council of Teachers of English, A Correlated Curriculum, D. Appleton-Century Co., Inc., New York, 1936, 326 pages.

28. Newkirk, Louis V., Organizing and Teaching the General Shop, The Manual Arts Press, Peoria, Illinois, 1947, 200 pages.

29. Rossi, Boniface E., Welding and Its Applications, McGraw-Hill Book Co., Inc., New York, 1941, 343 pages.

30. Sachs, George, Principles and Practises of Sheet Metal Fabricating, Reinhold Publishing Corp., New York, 1941, 526 pages.

31. Stimpson, William C., Foundry Work, American Technical Society, Chicago, Illinois, 1939, 216 pages.

32. Strunk, Granville B., The History and Status of Industrial Arts in New Mexico Since Statehood. Unpublished Master's Thesis, Oklahoma A & M College, Stillwater, Oklahoma, 1941, 110 pages.

33. Treacy, John, Production Illustration, John Wiley & Sons, Inc., New York, 1945, 202 pages.

34. Webster, New International Dictionary of the English Language, G. C. Merriam Co., Springfield, Massachussetts, 1953, 3,194 pages.

35. Wilber, Gordon O., Industrial Arts in General Education, International Textbook Co., Scranton, Pennsylvania, 1954, 401 pages.

B. Periodicals

36. The Bruce Publishing Co., Industrial Arts and Vocational Education, 400 North Broadway, Milwaukee Wisconsin, Vol. 44, 1955.

37. School Shop, School Shop, 330 South State St., Ann Arbor, Michigan, Vol. 13, 1953-1954.

C. Bulletins

38. American Vocational Association, A Guide to Improving Instruction in Industrial Arts, American Vocational Association, Washington 5, D. C., 1953, 119 pages.

39. Lamke, T. A., and Silvey, H. M., Masters Theses in Education, 1951-52, Research Publications, Cedar Falls, Iowa, 1952, 155 pages.

40. Lamke, T. A., and Silvey, H. M., Masters Theses in Education, 1952-53, Research Publications, Cedar Falls, Iowa, 1953, 174 pages.

41. Lamke, T. A., and Silvey, H. M., Masters Theses in Education, 1953-54, Research Publications, Cedar Falls, Iowa, 1954, 167 pages.

42. Lamke, T. A., and Silvey, H. M., Masters Theses in Education, 1954-55, Research Publications, Cedar Falls, Iowa, 1955, 169 pages.

43. Oklahoma A & M College, Bulletin of the Institute of Technology, Oklahoma A & M College, Stillwater, Oklahoma, 1955-56, 120 pages.

D. Pamphlets

44. Gramercy Guild Group, Operation Craftsmanship, Gramercy Import Co., Inc., New York, 1954, 27 pages.

February 20, 1956

Director
State Department of Education
Santa Fe, New Mexico

Dear Sir:

I will very much appreciate it if you will inform me as to the availability of an Annual High School Bulletin, or other such publication, which will have listed in it those Junior High Schools and High Schools in the State of New Mexico which offer Mechanical Drawing as a part of their curricula. This information is needed for the purpose of completing a Master's degree thesis.

Information will be obtained from these schools, compiled, and incorporated into the thesis. A summary of the information will be made available to the schools and/or instructors participating. It is thereby hoped that the efforts of all concerned will result in more effective teaching of Mechanical Drawing.

As a native of New Mexico, I am naturally interested in the status of my thesis topic as applied to that state, and hope eventually to teach in a New Mexico school.

Thanking you for any information which you may have available, I remain

Sincerely yours,

/s/ Earl R. Hesch

Earl R. Hesch

Approved:

/s/ C. L. Hill

C. L. Hill, Acting Head
Industrial Arts Education
and Engineering Shopwork

March 1, 1956

Dear Sir:

To fulfill the requirements for the Master's Degree and in an attempt to contribute in some measure to the betterment of teaching, I am writing a thesis on the topic "Correlation of Mechanical Drawing and Industrial Arts Shop Courses". As a native of New Mexico, I am especially interested in the application of my thesis topic to the schools of that state.

It is my sincere belief that many other teachers in New Mexico share my interest in improved methods of teaching, and with that belief in mind, I will very much appreciate your cooperation in furnishing me with some information about the Drawing and Shop courses offered in your school.

Your school is one of twenty-two (from a list of one hundred and thirty-eight) selected on the basis of enrollment, curriculum, geographic location and other essential factors. Inquiry forms, as attached hereto, are being sent to the principals of these schools with the request that they be filled out by the teachers of Drawing and/or Shop courses. The form has been designed for ease of completion. Most of the replies can be made by the insertion of a check mark.

From the information thereby acquired, it is hoped to obtain an accurate cross-section of the current situation in New Mexico, as regards the thesis topic. This information will be compiled and incorporated into the thesis. A summary of the thesis and questionnaire material will gladly be furnished to the participating teachers upon request.

May I thank you for an early reply to this inquiry?

Sincerely yours,

/s/ Earl R. Hesch

Approved:

/s/ C. L. Hill
C. L. Hill, Thesis Adviser

A survey of the current status of the Correlation between Mechanical Drawing and Industrial Arts Shop Courses

Spring 1956

School_____ City_____

Industrial Arts Teacher_____

1. Please write in the following spaces the titles of the Mechanical Drawing courses offered in your school.

(a)_____ (c)_____

(b)_____ (d)_____

Questions 2, 3, 4 & 5 refer to the above listed courses. Please check the appropriate blank spaces.

		(a)	(b)	(c)	(d)
2.	Drawing Problems taken from Textbook....				
3.	" " originated by Teacher..				
4.	" " originated by Pupil....				
5.	" " originated by Shop..... (problems or projects)				

6. Do you teach other Industrial Arts courses in addition to Mechanical Drawing? If so, please list these:

(a)_____ (c)_____

(b)_____ (d)_____

7. In your opinion, is it possible to correlate Mechanical Drawing with all or most of the other Industrial Arts courses given in your school?

		Yes	No	Remarks
8. Do you consider correlation (as proposed in this questionnaire) of value to:	The Community..			
	The School.....			
	The Teacher....			
	The Pupil.....			
	Industry.....			

9. Can you suggest any special methods of attaining or improving this proposed correlation? Please answer on the back of this sheet if more space is needed.

10. Would you like to have a copy of the summary of this thesis and the data acquired by this questionnaire?

Column I	Column II		Column III
INDUSTRIAL ARTS SHOP COURSES	Drawing Problems Correlated to Shop		Remarks (Optional)
	Yes	No	
GENERAL WOOD			
Woodwork.....			
Woodturning.....			
Patternmaking...			
Carpentry.....			
GENERAL METAL			
Machine Shop....			
Sheet Metal.....			
Foundry.....			
Forging.....			
Welding.....			
CRAFTS (GEN.SHOP)			
Plastics.....			
Leathercraft....			
Electricity.....			
Metal Spinning..			
Art Metal.....			
Ceramics.....			
Jewelry.....			
Woodcarving.....			
GRAPHIC ARTS			
Printing.....			
Photography.....			
Linoleum Block..			
Silk Screen.....			
Bookbinding.....			
OTHER			
Auto Mechanics..			
Shop Safety.....			
Home Mechanics..			

NOTE: Please answer by placing a checkmark in the appropriate space. Leave blank if course is not offered.

April 1, 1956

Dear Sir:

I will very much appreciate your assistance in helping me to complete a survey of the Industrial Arts program in the High Schools of New Mexico, with particular respect to the teaching of Mechanical Drawing.

Copies of the enclosed questionnaire were mailed to a selected number of New Mexico high schools early in March. The _____ high school is one of the schools that were selected for this survey. Since no response has been received from your school, this questionnaire may not have reached you at that time. I am enclosing herewith another copy of the questionnaire together with the original letter of transmittal which will explain the purpose of the survey.

The information from your school will be of great help in increasing the value and completeness of this survey, and since I have but a few weeks left in which to complete the thesis, may I thank you for your early cooperation?

Sincerely yours,

/s/ Earl R. Hesch

Earl R. Hesch

TABLE VIII

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND WOODWORK

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2		x	
3		x	
4			7. Develops ability to Read and Originate Working Drawings.
5	x		
6	x		
7	x		
8	x		9. Taught together with Woodturning, Pattern-making and Carpentry.
9	x		
10	x		
11			
12	x		16. Correlated to some extent.
13	x		
14	x		
15	x		19. Students draw plans of projects before actual construction.
16	x		
17	x		
18	x		
19	x		22. Drawing not offered at this school.
20			
21	x		
22	---	---	28. No response from this school.
23	x		
24	x		
25	x		
26	x		
27	x		
28	---	---	

No. of schools correlating Drawing & Woodwork 20
No. of schools which offer " " " 22

Correlation for Woodwork = $\frac{20}{22}$ = .902 x 100 = 90.2%.

NOTE: Blank space in Column II indicates Woodwork is not offered at this school.

TABLE IX

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND WOODTURNING

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2		x	
3		x	
4			7. Develops ability to Read and Originate working Drawings.
5	x		
6	x		
7	x		
8	x		9. Taught together with Woodturning, Pattern-making and Carpentry.
9	x		
10	x		
11			
12			10. Correlation in following plan - design and measurements.
13	x		
14		x	
15	x		
16	x		19. Students draw plans of projects before actual construction.
17	x		
18	x		
19	x		
20			22. Drawing not offered at this school.
21	x		
22	---	---	
23	x		28. No response from this school.
24		x	
25	x		
26	x		
27	x		
28	---	---	

No. of schools correlating Drawing & Woodturning 17
No. of schools which offer " " " 21

Correlation for Woodturning = $\frac{17}{21}$ = .809 x 100 = 80.9%.

NOTE: Blank space in Column II indicates Woodturning is not offered at this school.

TABLE X

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND PATTERNMAKING

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2			
3			
4			
5			
6			
7	x		7. Develops ability to Read and Originate Working Drawings.
8			
9	*		
10	x		10. Correlation in following plans.
11			
12			
13			19. Students draw plans of projects before actual construction.
14			
15	x		
16	x		
17			22. Drawing not offered at this school.
18	x		
19	x		
20			28. No response from this school
21	x		
22	---	---	
23	x		
24			
25			
26			
27			
28	---	---	

No. of schools correlating Drawing & Patternmaking 8
No. of schools which offer " " " 8

Correlation for Patternmaking = $\frac{8}{8}$ = 100%.

NOTE: Blank space in Column II indicates Patternmaking is not offered at this school.
Symbol * in Column II indicates teachers opinion if Patternmaking was offered at this school.

TABLE XI

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND CARPENTRY

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2			
3	x		
4			7. Develops ability to Read
5	x		and Originate Working
6			Drawings.
7	x		
8			9. Taught together with
9			Woodworking, Woodturning
10			and Patternmaking.
11			
12			10. Correlation in following
13			plans of construction.
14			
15	x		19. Students draw plans of
16	x		projects before actual
17	x		construction.
18	x		
19	x		22. Drawing not offered at
20			this school.
21	x		
22	---	---	28. No response from this
23			school.
24	x		
25	x		
26	x		
27			
28	---	---	

No. of schools correlating Drawing & Carpentry 16
No. of schools which offer " " " 16

Correlation for Carpentry $= \frac{16}{16} = \underline{100\%}$.

NOTE: Blank space in Column II indicates Carpentry is not offered at this school.

TABLE XII

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND MACHINE SHOP

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1	x		
2			
3			
4			22. Drawing not offered at this school.
5			
6			
7			28. No response from this school
8			
9			
10			
11			
12			
13	x		
14	x		
15			
16	x		
17	x		
18	x		
19			
20			
21		x	
22	---	---	
23	x		
24			
25			
26			
27			
28	---	---	

No. of schools correlating Drawing & Machine Shop 7
No. of schools which offer " " " " 8

Correlation for Machine Shop = $\frac{7}{8}$ = .875 x 100 = 87.5%.

NOTE: Blank space in Column II indicates Machine Shop is not offered at this school.

TABLE XIII

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND SHEET METAL

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1	x		
2			
3	x		
4			11. Correlation through necessary pattern development.
5			
6			
7			
8	x		19. Students draw plans of project before actual construction.
9	*		
10			
11	x		
12			21. Correlated to some extent.
13	x		
14	x		22. Drawing not offered at this school.
15	x		
16			
17	x		28. No response from this school.
18	x		
19	x		
20			
21	x		
22	---	---	
23	x		
24			
25	x		
26			
27			
28	---	---	

No. of schools correlating Drawing & Sheet Metal 13
No. of schools which offer " " " " 13

Correlation for Sheet Metal $= \frac{13}{13} = \underline{100\%}$.

NOTE: Blank space in Column II indicates Sheet Metal is not offered at this school.

Symbol * in Column II indicates teachers opinion if Sheet Metal was offered at this school.

TABLE XIV TABLE XIV TABLE XIV

THE CURRENT STATUS OF CORRELATION BETWEEN MECHANICAL DRAWING AND FOUNDRY

School No.	Column I Drawing Correlated YES	Column II Drawing Correlated NO	Column II Problems Suggested YES	Column III Problems Suggested NO	Remarks Column II	Remarks Column III
1	x		x			
2						
3	x		x	x		
4			19. Students draw plans of projects before actual construction.			
5						
6						
7						
8			22. Drawing not offered at this school			
9						
10						
11			28. No response from this school.			
12						
13						
14	x		x			
15						
16						
17						
18	x		x			
19	x		x			
20						
21	x		x	x		
22						
23	x		x			
24						
25						
26						
27						
28						

No. of schools offering Drawing & Foundry 4
No. of schools which offer Drawing & Foundry 6

Correlation = $\frac{4}{6} = .666\frac{4}{6} = .66\frac{4}{6}\% = .66\frac{4}{6}\% = 66.6\%$.

Blank Space in Column II indicates that Drawing & Foundry is not offered at this school.

TABLE XV

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND FORGING

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2			
3		x	
4			22. Drawing not offered at this school.
5			
6			
7			28. No response from this school.
8			
9			
10			
11			
12			
13			
14		x	
15			
16			
17			
18	x		
19			
20			
21		x	
22	---	---	
23	x		
24			
25	x		
26			
27			
28	---	---	

No. of schools correlating Drawing & Forging 3
No. of schools which offer " " " 6

Correlation for Forging = $\frac{3}{6}$ = .50 x 100 = 50%.

NOTE: Blank space in Column II indicates Forging is not offered at this school.

TABLE XVI

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND WELDING

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1	x		
2	x		
3	x		
4			22. Drawing not offered at this school.
5			
6			
7			28. No response from this school.
8			
9			
10			
11	x		
12			
13	x		
14	x		
15			
16			
17			
18	x		
19			
20			
21		x	
22	---	---	
23			
24			
25	x		
26			
27			
28	---	---	

No. of schools correlating Drawing & Welding 8
No. of schools which offer " " " 9

Correlation for Welding $= \frac{8}{9} = .888 \times 100 = \underline{88.8\%}$.

NOTE: Blank space in Column II indicates Welding is not offered at this school.

TABLE XVII

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND PLASTICS

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2			
3			
4			10. Little correlation.
5			
6	x		22. Drawing not offered in this school.
7			
8	x		
9	x		24. Correlation to Drafting not in Drawing class but in the Crafts class by requiring students to draw plans, etc.
10	x		
11			
12			
13			
14		x	
15	x		28. No response from this school.
16			
17			
18	x		
19			
20			
21	x		
22	---	---	
23		x	
24	x		
25			
26	x		
27			
28	---	---	

No. of schools correlating Drawing & Plastics 9
No. of schools which offer " " " 11

Correlation for Plastics = $\frac{9}{11}$ = .818 x 100 = 81.8%.

NOTE: Blank space in Column II indicates Plastics is not offered at this school.

TABLE XVIII

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND LEATHERCRAFT

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2			
3			
4			9. Correlation in Designs and Patterns.
5			
6			
7			22. Drawing not offered at this school.
8		x	
9	x		
10	x		24. Correlation to Drafting not in Drawing Class but in the Crafts class by requiring students to draw plans, etc.
11			
12	x		
13			
14		x	
15	x		
16	x		28. No response from this school.
17			
18	x		
19			
20			
21	x		
22	---	---	
23		x	
24	x		
25			
26	x		
27			
28	---	---	

No. of schools correlating Drawing & Leathercraft 9
No. of schools which offer " " " 12

Correlation for Leathercraft = $\frac{9}{12}$ = .75 x 100 = 75%.

NOTE: Blank space in Column II indicates Leathercraft is not offered at this school.

TABLE XIX

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND ELECTRICITY

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2			
3			
4			9. Correlation through Wiring Diagrams.
5			
6			
7			19. Students draw plans of projects before actual construction.
8			
9	*		
10			
11			22. Drawing not offered at this school.
12			
13			
14			28. No response from this school.
15			
16	x		
17	x		
18	x		
19	x		
20			
21		x	
22	---	---	
23		x	
24			
25			
26			
27			
28	---	---	

No. of schools correlating Drawing & Electricity 4
No. of schools which offer " " " 6

Correlation for Electricity = $\frac{4}{6}$ = .666 x 100 = 66.6%.

NOTE: Blank space in Column II indicates Electricity is not offered at this school.

Symbol * in Column II indicates teachers opinion if Electricity was offered at this school.

TABLE XX

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND METAL SPINNING

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1	x		
2			
3			
4			9. Correlation in Designs and Patterns.
5			
6			
7			22. Drawing not offered at this school.
8	x		
9	*		
10			28. No response from this school.
11			
12			
13			
14			
15			
16			
17			
18	x		
19			
20			
21		x	
22	---	---	
23		x	
24			
25			
26			
27			
28	---	---	

No. of schools correlating Drawing & Metal Spinning 3
No. of schools which offer " " " " 5

Correlation for Metal Spinning $= \frac{3}{5} = .60 \times 100 = \underline{60\%}$.

NOTE: Blank space in Column II indicates Metal Spinning is not offered at this school.

Symbol * in Column II indicates teachers opinion if Metal Spinning was offered at this school.

TABLE XXI

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND ART METAL

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1	x		
2			
3		x	
4			9. Correlation in Designs
5			and Patterns.
6			
7			10. Little Correlation.
8	x		
9	x		22. Drawing not offered at
10	x		this school.
11			
12	x		24. Correlation to Drafting
13			not in Drawing class but
14		x	in the Crafts class by
15			requiring students to
16			draw plans, etc.
17			
18	x		28. No response from this
19			school.
20			
21	x		
22	---	---	
23		x	
24	x		
25	x		
26	x		
27			
28	---	---	

No. of schools correlating Drawing & Art Metal 10
No. of schools which offer " " " " 13

Correlation for Art Metal = $\frac{10}{13}$ = .769 x 100 = 76.9%.

NOTE: Blank space in Column II indicates Art Metal is not offered at this school.

TABLE XXII

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND CERAMICS

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2			
3			
4			7. Correlation in Perspective and Dimensioning.
5			
6			
7	x		22. Drawing not offered at this school.
8	x		
9		*	
10			28. No response from this school.
11			
12			
13			
14		x	
15	x		
16			
17			
18	x		
19			
20	x		
21	x		
22	---	---	
23		x	
24			
25			
26			
27			
28	---	---	

No. of schools correlating Drawing & Ceramics 6
No. of schools which offer " " " 8

Correlation for Ceramics = $\frac{6}{8}$ = .75 x 100 = 75%.

NOTE: Blank space in Column II indicates Ceramics is not offered at this school.

Symbol * in Column II indicates teachers opinion if Ceramics was offered at this school.

TABLE XXIII

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND JEWELRY

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2			
3		x	
4			9. Correlation in Designs and Patterns.
5			
6			
7			22. Drawing not offered at this school.
8	x		
9	*		
10			24. Correlation to Drafting not in Drawing class but in the Crafts class by requiring students to draw plans, etc.
11			
12	x		
13			
14		x	
15	x		
16	x		28. No response from this school.
17			
18	x		
19			
20	x		
21	x		
22	---	---	
23		x	
24	x		
25			
26			
27			
28	---	---	

No. of schools correlating Drawing & Jewelry 8
No. of schools which offer " " " 11

$$\text{Correlation for Jewelry} = \frac{8}{11} = .727 \times 100 = \underline{72.7\%}.$$

NOTE: Blank space in Column II indicates Jewelry is not offered at this school.

Symbol * in Column II indicates teachers opinion if Jewelry was offered at this school.

TABLE XXIV

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND WOODCARVING

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2		x	
3			
4			9. Correlation in Designs and Patterns.
5			
6			
7			10. Design drawn and proportioned to fit project.
8			
9	*		
10	x		22. Drawing not offered at this school.
11			
12			
13			24. Correlation to Drafting not in Drawing class but in the Crafts class by requiring students to draw plans, etc.
14		x	
15			
16			
17			
18	x		
19			28. No response from this school.
20	x		
21			
22	---	---	
23		x	
24	x		
25			
26	x		
27			
28	---	---	

No. of schools correlating Drawing & Woodcarving 5
No. of schools which offer " " " 8

Correlation for Woodcarving = $\frac{5}{8}$ = .625 x 100 = 62.5%.

NOTE: Blank space in Column II indicates Woodcarving is not offered at this school.

Symbol * in Column II indicates teachers opinion if Woodcarving was offered at this school.

TABLE XXV

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND PRINTING

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1		x	
2	x		
3			
4			9. Correlation through use of Drafting tools (lay-out).
5			
6			
7			
8			10. Correlation to layout, bill of materials, etc.
9	*		
10	x		
11			22. Drawing not offered at this school.
12			
13			
14		x	28. No response from this school.
15			
16			
17			
18			
19			
20	x		
21		x	
22	---	---	
23		x	
24			
25			
26			
27			
28	---	---	

No. of schools correlating Drawing & Printing 3
No. of schools which offer " " " 7

Correlation for Printing = $\frac{3}{7}$ = .428 x 100 = 42.8%.

NOTE: Blank space in Column II indicates Printing is not offered at this school.

Symbol * indicates teachers opinion if Printing was offered at this school.

TABLE XXVI

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND PHOTOGRAPHY

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2		x	
3			
4			22. Drawing not offered at this school.
5			
6			
7			28. No response from this school.
8		x	
9		x	
10			
11			
12			
13			
14		x	
15			
16			
17			
18			
19			
20			
21		x	
22	---	---	
23			
24			
25			
26			
27			
28	---	---	

No. of schools correlating Drawing & Photography 0
No. of schools which offer " " " 5

Correlation for Photography = $\frac{0}{5}$ = 0%.

NOTE: Blank space in Column II indicates photography is not offered at this school.

TABLE XXVII

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND LINOLEUM BLOCK

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2		x	
3			
4			9. Correlation through use of Drafting tools (lay-out).
5			
6			
7			
8			21. Correlated to some extent.
9	*		
10			22. Drawing not offered at this school.
11			
12			
13			28. No response from this school.
14	x		
15			
16			
17			
18	x		
19			
20	x		
21	x		
22	---	---	
23			
24			
25			
26			
27			
28	---	---	

No. of schools correlating Drawing & Linoleum Block 4
No. of schools which offer " " " " 5

Correlation for Linoleum Block $= \frac{4}{5} = .80 \times 100 =$ 80%.

NOTE: Blank space in Column II indicates Linoleum Block is not offered at this school.

Symbol * in Column II indicates teachers opinion if Linoleum Block was offered at this school.

TABLE XXVIII

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND SILK SCREEN

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2		x	
3			
4			9. Correlation through use of Drafting tools (lay-out).
5			
6			
7			
8			22. Drawing not offered at this school.
9	*		
10			
11			28. No response from this school.
12			
13			
14			
15			
16			
17			
18			
19			
20	x		
21	x		
22	---	---	
23			
24			
25			
26			
27			
28	---	---	

No. of schools correlating Drawing & Silk Screen 2
No. of schools which offer " " " " 3

Correlation for Silk Screen = $\frac{2}{3}$ = .666 x 100 = 66.6%.

NOTE: Blank space in Column II indicates Silk Screen is not offered at this school.

Symbol * in Column II indicates teachers opinion if Silk Screen was offered at this school.

TABLE XXIX

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND BOOKBINDING

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2		x	
3			
4			22. Drawing not offered at this school.
5			
6			
7			28. No response from this school.
8			
9		*	
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22	---	---	
23			
24			
25			
26			
27			
28	---	---	

No. of schools correlating Drawing & Bookbinding 0
No. of schools which offer " " " 2

Correlation for Bookbinding = $\frac{0}{2}$ = 0%.

NOTE: Blank space in Column II indicates Bookbinding is not offered at this school.

Symbol * in Column II indicates teachers opinion if Bookbinding was offered at this school.

TABLE XXX

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND AUTO MECHANICS

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1	x		
2	x		
3			
4			2. Not adaptable to our classes.
5			
6			
7			9. Correlation through Blueprint Reading.
8			
9	*		
10			16. Correlation with Auto Mechanics through Drawing problems taken from auto-mobile components.
11			
12			
13	x		
14	x		
15	x		22. Drawing not offered at this school.
16	x		
17	x		
18	x		28. No response from this school.
19			
20			
21			
22	---	---	
23			
24	x		
25			
26	x		
27			
28	---	---	

No. of schools correlating Drawing & Auto Mechanics 10
No. of schools which offer " " " " 10

Correlation for Auto Mechanics $= \frac{10}{10} = \underline{100\%}$.

NOTE: Blank space in Column II indicates Auto Mechanics is not offered at this school.

Symbol * in Column II indicates teachers opinion if Auto Mechanics was offered at this school.

TABLE XXXI

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND SHOP SAFETY

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2	x		
3			
4			10. Safety stressed.
5			
6			22. Drawing not offered at
7	x		this school.
8	x		
9			28. No response from this
10	x		school.
11			
12			
13			
14			
15			
16	x		
17			
18	x		
19	x		
20			
21			
22	---	---	
23			
24			
25	x		
26	x		
27			
28	---	---	

No. of schools correlating Drawing & Shop Safety 9
No. of schools which offer " " " " 9

Correlation for Shop Safety $= \frac{9}{9} = \underline{100\%}$.

NOTE: Blank space in Column II indicates Shop Safety is not offered at this school.

TABLE XXXII

THE CURRENT STATUS OF CORRELATION
BETWEEN MECHANICAL DRAWING
AND HOME MECHANICS

Col. I	Column II		Column III
School Key No.	Drawing Problems Correlated to Shop		Remarks Refer to School No. given
	YES	NO	
1			
2			
3			
4			10. Correlation to those topics which can be of use at home.
5			
6			
7			
8			
9			
10	x		
11			
12			
13			
14		x	
15			
16	x		
17	x		
18	x		
19			
20			
21			
22	---	---	
23			
24	x		
25			
26	x		
27			
28	---	---	

No. of schools correlating Drawing & Home Mechanics 6
No. of schools which offer " " " " 7

Correlation for Home Mechanics = $\frac{6}{7}$ = .857 x 100 = 85.7%.

NOTE: Blank space in Column II indicates Home Mechanics is not offered at this school.

VITA

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THESIS TITLE: CORRELATION OF MECHANICAL DRAWING AND INDUSTRIAL ARTS SHOP COURSES IN THE HIGH SCHOOLS OF NEW MEXICO

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The content and form have been checked and approved by the author and thesis adviser. The Graduate School Office assumes no responsibility for errors either in form or content. The copies are sent to the bindery just as they are approved by the author and faculty adviser.

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