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AMERICAN COUNCIL ON INDUSTRIAL ARTS TEACHER EDUCATION

Research in Industrial Arts Education

NINTH YEARBOOK 1960

NINTH YEARBOOK - 1960 - AMERICAN COUNCIL

ON INDUSTRIAL ARTS TEACHER EDUCATION

Research in Industrial Arts Education

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NINTH YEARBOOK - 1960

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This book is dedicated to the memory of

Robert L. Thompson
1908 - 1959

Teacher

Author

Teacher Educator

Friend

OFFICERS OF THE AMERICAN COUNCIL ON INDUSTRIAL ARTS TEACHER EDUCATION

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Foreword

Satelites, space-ships, medical miracles, and electronic brains --- everywhere apparent are man's physical gains. International publicity spotlights these attainments of research in the physical sciences and imposes them upon the consciousness of even the least educated. People the world over invest increasing faith in the contributions of research. They expect its benefits to pervade every area of human effort.

All fields of human endeavor sense the impetus of aroused expectation. Any critical appraisal focused upon education demands the evidence of carefully conceived and thoroughly conducted research. Concentration upon triviality, and haphazard trial and error can no longer be countenanced in an exploding world.

Such is the situation which confronts industrial arts. Of late, the profession has shown growing concern over the significance, the quality, and the quantity of its research. That this concern is well founded is indicated by the conclusions of several contributors to Yearbook Nine. It is the earnest hope of the Editor, the authors, and of the Yearbook Planning Committee that the Ninth Yearbook will forcibly impress industrial arts educators with the crucial need for a zealous dedication to research. This edition might well be used as a text for the preparation of research workers in industrial arts.

It is a pleasure to express the sincere gratitude of the American Council on Industrial Arts Teacher Education to the McKnight & McKnight Publishing Company for its magnanimous contribution to the industrial arts profession in underwriting the yearbook program. The unwavering interest and the eager cooperation of all representatives of the Company in the development and publication of yearbooks has been most remarkable.

The contributed thought and effort of each author is thoroughly appreciated by every member of the Council. This Yearbook is dedicated to the memory of Dr. Robert Thompson for his work in planning

and organizing this volume. Finally, every member of the Council is deeply indebted to Dr. Raymond Van Tassel, who so willingly and competently carried on the editorship after the untimely death of Dr. Thompson.

The American Council on Industrial Arts Teacher Education is happy to present Yearbook IX, *Research in Industrial Arts,* to the profession.

Toronto, Canada
April 20, 1960

John Fuzak, *President*
American Council on Industrial
Arts Teacher Education

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CHAPTER I

The Real Crisis in Education

Alonzo G. Grace
New York University

The American system of education is not without its critics at home and abroad. It probably never will be. Constructive criticism by intellectually honest individuals cannot be dismissed easily by those who seek the advancement of education. Criticism not founded on fact, however, but based on some unrevealed ulterior motive, or on outright opposition to the principle of universal education, is detrimental to the best interests of the country.

The great danger confronting the United States, however, is the trend of events and forces from within our own country which tend to weaken American character. These accomplish exactly what the Communist would desire; namely, disunity, uncertainty, abdiction to fear, retreat from reason, confusion, name calling, suspiciousness of men and institutions. We need to keep our educational feet on the ground.

The real crisis in American education is not in the shortage of teachers. Somehow, we shall solve this problem. It is not in the lack of adequate physical facilities. Buildings will be erected. It is not a matter of money. We have the funds for luxuries. Billions of dollars are appropriated for the military, for highways, for foreign aid. Perhaps, the financial problem is more one of the source and distribution of funds. The real crisis in American education, in my judgment, is in our educational policy. We have no national policy.

It should not take a crisis to initiate national policies in education. Unfortunately, this appears to be the case, for Soviet penetration of outer space had an immediate and unbelievable effect on the people of the United States, irrespective of our successful efforts in this direction. The educational system, as indicated, did not escape the impact of this accomplishment. For example, some would develop a policy that would place the emphasis on the education of the intellectually elite. Greater emphasis on science and mathematics is urged by many citizens. The need for emphasis on science, mathematics, and

technology hardly is a matter of dispute in view of the age in which we live. The kind of creative genius we need, however, will not be uncovered by so called crash programs. We are not holding our own in the field of the creativity and, we will not if we continue to conform to standard research designs and fail to encourage those with creative talent. We must get our facts straight. Thus far, we appear to grasp at any straw that might be the panacea for improving our educational system to meet Soviet competition. Over ten years ago in my annual report to the State Board of Education of Connecticut, I stated that every child, youth and adult of this country should understand the nature of the Communist ideology and should know the Russian people and their culture and, also, that we should not remain in a state of illiteracy regarding our own way of life.

We should not forget that in this country a period of recession has a marked influence on the career objectives of youth. When engineers, scientists, technicians are not employed, fewer youths are concerned with careers in these areas. The Soviet system directs the career of youths to fit the manpower needs of their economy. Choosing a career in the Communist countries is by no means a matter for individual choice.

We need a basic program of research in education. The pitifully small financial support available for educational research is sufficient reason for our failure to influence the course of American education or to point out gaps in our manpower needs. When the critics voice their opinions, the research data for effective rebuttal or for identification of our strengths and weaknesses prior to some crisis should be at hand. It is not. Few local school systems have a ready answer (based on research) concerning the ability of children to read, their ability in arithmetic, knowledge of the American way. Few significant studies on learning, motivation or values are in progress. What training and education will be necessary to meet our manpower needs?

This presentation will be limited to the consideration briefly of two basic national educational policies in the United States: (1) the need for a national policy, (2) research involved in a national policy. It will not consider all of the issues and trends or other possible national policies.

A National Educational Policy Is Needed

The role of the federal government in the determination of educational policy has been an issue of long standing. It seems rea-

sonable, however, that agreement should be reached concerning the national aims of education and the role of research in the advancement of education.

Education the world over is involved in new relationships between the individual and the state and groups within the state. The national aims of education, therefore, are of deep concern and importance to men and nations. Whether the education of the individual be for his ultimate subordination and subservience to the state or whether man, by nature free, shall be educated as a master of his own destiny and progenitor of law and order, humanity, social justice, and everlasting peace represent the extremes.

At a conference of the International Union of Local Authorities[1], held in Brighton, England, in 1951, it was stated by the delegate from Yugoslavia that the primary aim of education in Yugoslavia is "to forward the popular revolution. Education and culture have become the first cares of the state. The young are to be brought up in the revolutionary pattern. The center of gravity is the state. The children in their latter years are to serve the state." Perhaps, this is sufficient to indicate the extremes in national purposing and how, under totalitarianism, the issuance of one directive can change the entire educational policy.

The primary aim of education under totalitarian auspices is indoctrination in the ideology of the party. The principal goal is the creation of the national, political human being. In the case of the Nazis, it was the creation of the National Socialist human being; and in the case of the Communist, it is the creation of the National Communist human being. Freedom, the right to private judgment, the dignity of the individual, the search for and the dissemination of the truth, no longer are the possessions of the individual for the individual now is a servant to the state and the state is master of the individual.

"The first aim of education," commented the London Daily Mirror,[2] "is to get our values right. We must understand from the start that we have to develop not more machine-like aptitudes but the whole worth of human beings. Intelligence needs to be directed by

[1] Grace, Alonzo G. "Education for What?" School Executive Vol. 72 December 1952. Pp. 64-67.

[2] *Editorial.* London Daily Mirror. June 28, 1951.

such qualities of character as goodness, kindness, and courage. If not, we might produce a Dr. Goebels, but we would have forgotten our civilization." This probably is a fair statement of the aims of education as conceived by nations interested in free men interested in a free society.

Over the years the aims of education in the United States have been derived from the deliberation of voluntary, national educational associations, or committees of educators. In large measure, these represent a somewhat extensive statement of what the educational system is expected to accomplish. We have done little to ascertain whether or not these aims are translated into actuality in the classroom.

It would seem that in our fear of federal control, we have decentralized our educational system to such an extent that the accomplishment of our aims remains largely a pious hope. The aim and spirit of education in the United States could be expressed in the following manner: (1) To provide the kind and amount of education that will develop the individual to the highest point of his potentiality or within the limit of his ability. This should mean not only mass education--that is, the education of all the children of all the people--but it means within a mass education system the identification and education of talent to the highest degree; (2) To insure the national security. This would involve a constant inventory of our manpower needs and the training and education required to meet these needs. In both of these objectives, research is implicitly involved and is a primary requisite for knowledge of how well the objectives are being attained.

The Role of Research in this Policy

Research in education follows the structional pattern of education in the United States. It is a decentralized operation. The federal government attempts to encourage research by allocating financial aid for projects approved by the United States Office of Education upon the recommendation of an advisory committee. Even the pitifully small appropriation for this encouragement is circumscribed by rules and regulations frequently required by congressional act. Thus, the scope of the research program is limited to certain specified areas. Funds for the basic research required for the advancement of education are practically non-existant so far as government is concerned.

The situation is more deplorable at the state level. Practically every state will have a research director and in many cases, a research division or bureau. However, state appropriations for educational re-

search are limited almost exclusively to the assembly of statistics concerning enrollment, attendance, per pupil costs, allocation of state aid, and similar items. The director of research frequently is assigned other functions. Thus, at the state level little significant research is in progress primarily because such a program is not viewed as significant by legislators. Unfortunately, vigorous support by policy board and administrators is not observable. Thus, instead of basic studies in the areas of reading, values, behavior patterns, learning, motivation, or teaching methods, we assemble statistics - and this with no uniformity. We do not even keep a record of the courses composing the various curricula. Thus, curricula trends are a matter of general observation and conjecture.

WILL TRADITION DEFEAT This NEED For NATIONAL POLICY?

In the course of our civilization, organized states have ascended and flourished only to die as inevitably individuals must die. For example, the Persian government enacted wise laws, their morals were the simplest and perhaps the most correct in the Pagan world. It is said that they were the only people, with the exception of the Macedonians, who ever enacted a law against ingratitude. The Persians continued to be the most powerful people in the world as long as their system of simplicity in organization continued. However, as a result of the influx of enormous wealth, acquired largely through the conquest of surrounding countries, discipline became lax and laws were violated. The manners of the people began to change, and a nation that once was able to conquer Libia, Egypt, and the magnificent Empire of Asyrea, two centuries later succumbed to an army of not more than thirty thousand Greeks led by Alexander the Great.

A review of the history of man's effort to rise from bondage and servitude would reveal this significant fact: *that men are able to discover defects in institutions and to indicate remedies, but reverence for tradition and the force of habit offer much resistance to required change. Frequently, therefore, it becomes necessary to establish and to build up institutions on new principles and on fresh ground in order that goals be attained.* The educational system is no exception among the social institutions that minister to the needs of mankind. The lag between the state of man and the needs of his society is not always explainable. For example, why do people, irrespective of educational background, training, or culture, in time of war accept the common goal and remove all impediments to the attainment of that goal? Why has it

not been possible that a similar formula could be discovered for world peace? Is it not possible that we have reached such a stage of material perfection in this miraculous age that we are in danger of degeneration and decay? Could it be possible that in our desire to make life more endurable we have merely intellectualized the procedures and made more palatable the practices of the ancient Paleoith? Will we be able voluntarily to adopt a sensible national education policy based on research or will we continue to permit crises to determine our educational failures?

It is likely that the great debate of the future will be in the area of educational policy. However, we soon must be able to indicate how much education through schooling is necessary to protect us from our own indiscretions and to maintain our freedom within the sphere of the democratic framework. Our citizens will have to ask the question: How much formal schooling will be necessary to protect our governmental policy and to protect us from our own indiscretions? Shall it be universal higher education for everyone? That being the case, someone will have to answer the question: Who will do the dirty work now? Are we confusing equality of educational opportunity with equal education for all? We must soon realize that every individual is important in our society irrespective of the honest labor in which he is engaged.

One of the most important responsibilities of the federal government through the United States Office of Education is the encouragement and support of educational research. Compared with agriculture, business, industry or the military, the funds for research in education are limited indeed. However, before financial aid for research, the United States Office of Education should develop a continuous inventory of research in progress and research proposed. Once this inventory – involving state authority and local authority reporting through the state and the program in universities, private agencies, and organizations – is available, a better case for a major investment of funds for this purpose may be made. In the meantime, the need for national purposing in education becomes essential in view of the world situation and the ease with which so many of our citizens are willing to grasp at foreign educational systems as a basis for our own advancement.

CHAPTER II

Significant Research in Industrial Arts Teacher Education

(1930 - 1959)

by
Paul L. Kleintjes and Paul E. Powell
Long Beach State College

This chapter reviews research done in the area of industrial arts teacher education that is of importance in making contributions and indicating trends in various aspects of teacher education. We need to publicize such research because so little has been done in this area and to show where further work needs to be done. The research reviewed has been done by students, industrial educators while in formal training programs, or by others – from any source as long as it has implications of significance for industrial arts teacher education.

To assist in selecting and reporting significant studies, a letter was sent to one hundred and fifty-six institutions preparing industrial arts teachers, asking them to make a discriminating choice of those studies which they considered to be especially significant. The departments were asked to submit abstracts, annotations or bibliographies. We were impressed with the lack of response. In many cases a follow-up letter was necessary to solicit a response from those people charged with directing and exerting leadership in the development of programs and research. Replies were received from only forty-two institutions. Sixteen of the institutions responding reported that they had no studies of significance to report. Twenty-six sent abstracts, annotations, bibliographies or booklets that listed, in some cases, all of the research done at that particular school.

A few institutions reported reasons for not submitting studies in the area of industrial arts teacher education. At one university "doctoral students have been encouraged to engage in experimental research in connection with their course work" and "with plans for development and improvement of the program of teacher education at the University." Another department chairman reported:

> "Our graduate program has four options for written work. Very few students avail themselves of the opportunity of writing a thesis or special problem. Most of them take the graduate course paper route, which means that they do three quite substantial papers without credit. This permits them to take three electives."

After a review of the material sent by the teacher training institutions it was found necessary to survey and study the research sources available. These included: (1) Appendix D of the doctoral dissertation written by Thomas G. King, "Fundamental Procedures of Research for Industrial Education," Wayne State University, 1958, in which King listed doctoral dissertations accepted by American universities from 1930 to 1955 that had been written in the area of industrial arts teacher education; (2) a compilation by John Whitesel of Miami University, Oxford, Ohio, entitled "Graduate Studies in Industrial Arts and Vocational Industrial Education Done in the United States During the Year 1953-1954"; (3) *Research in Industrial Education,* summaries of studies done from 1930 to 1955, published by the U. S. Department of Health, Education, and Welfare, Vocational Division Bulletin Number 264, Trade and Industrial Series Number 65; and (4) *Dissertation Abstracts,* Volumes II through XIX.

No master's theses appear in the studies selected as significant. There were at least three reasons for the lack of studies at this level: (1) because most of the master's studies reviewed were written by candidates who were not concerned with teacher education at the time they wrote their studies, (2) because some institutions do not require a thesis, and (3) because the departments did not indicate that they believed studies done in the area of industrial arts teacher education were significant.

The major problem encountered by the authors of this chapter was that of determining significance. If anyone has the right to select and reject pieces of research, he is weighing his opinion against those of the author and the colleagues or superiors who may have directed the work in progress. The authors of this chapter asked institutions to indicate significant studies. The validity of a significance rating based on the opinion of the submitting institution is questionable when some institutions submitted studies not even remotely concerned with teacher education. Because so few studies were reported it was necessary to review studies from other sources

and determine their significance. This selection, from annotations and abstracts, made the task of determining significance extremely hazardous.

Some of the studies reported in this chapter are significant only as a pattern for future or continuing research. It is not the purpose of this chapter to rate or analyze research. Comments concerning the material were added when considered necessary to point out significance.

The following studies are considered to be significant. The reviews of the studies were designed to present enough information so that the reader is aware of what has been done and of the more significant findings. Studies of interest may be examined more completely by referring to *Dissertation Abstracts*, securing the study through interlibrary loan, or purchasing the microfilm copy as catalogued in *Dissertation Abstracts*.

Most of the studies listed may be purchased, for a very nominal sum, printed on microfilm. The microfilm copies should make a valuable addition to the library of any department of industrial arts teacher education. The studies that follow are reported in alphabetical order by author.

Author: Biggam, William R.
Title: Instructional Aids in Industrial Arts Education.
School: Bradley University
Date: 1958
Source: *Dissertation Abstracts*, Volume XIX, No. 7, p. 1663.

Purpose of the Study:

(1) To determine the present thinking among industrial arts educators relative to the importance of and the need for training in instructional aids as a part of the pre-service and in-service professional education of industrial arts teachers; (2) to determine methods and practices by which training institutions and supervisors of industrial arts can better provide pre-service and in-service training in instructional aids, and (3) offer suggestions for the content of a college course of study in instructional aids.

Findings:

1. Industrial arts teachers are not properly prepared to utilize effectively the varied aids available for shop teaching.

2. Training in aids should be a required phase in the undergraduate training of industrial arts teachers.

3. Course should be both theoretical and practical.

4. Industrial arts teachers are reluctant to use newer type of teaching aids.

Comments:

Suggestions as to outcomes, course organization, and a college grade course of study given in appendix.

Author: Brandon, George L.
Title: An Appraisal of the Preparation of Industrial Education Supervisors in Ohio Colleges for Teacher Education.
School: The Ohio State University.
Date: 1952
Source: *Dissertation Abstracts,* Volume XII, No. 11, p. 2511.

Purpose of the Study:

To analyze and appraise preparation local industrial education supervisors receive in graduate industrial education courses in Ohio colleges for teacher education.

Findings:

Compiled a list of 114 activities performed by local supervisors. Supervisors indicated that both pre-service and in-service preparation is needed to perform most of the activities and that very few activities required no preparation.

An analysis of course provisions indicated:

1. Too many emphases placed upon organization and operation of the local program.

2. Course provisions for supervisory activities related to teacher preparation with beginning trade teachers are inadequate.

3. Preparation is inadequate for curriculum development, observation and evaluation of teachers, maintaining a program of staff meetings, conferences and work shops.

4. Strongest provision was in developing and implementing a philosophy of education, utilizing resources of the school, industry and community, and making policy for the organization and operation of the program.

Comments:

Source material for graduate and undergraduate programs and courses on supervision. It appears that departments of industrial teacher education are not giving adequate attention to the training of industrial arts supervisors.

Author: Brown, Robert D.
Title: Industrial Arts Competencies Needed by Elementary Teachers.
School: University of Minnesota.
Date: 1955
Source: *Dissertation Abstracts,* Volume XVI, No. 1, p. 69.

Purpose of the Study:

This study was designed to determine the industrial arts competencies needed by elementary teachers and provide information for developing a curriculum which would prepare elementary teachers in industrial arts.

Findings:

Those findings of interest to teacher educators indicated that the elementary teacher should know and understand the objectives of industrial arts at the elementary level and should have knowledge of a wide variety of useful industrial arts activities. They should know how to integrate an industrial arts activity with the work of a unit and how to demonstrate a manipulative skill in such a way as to facilitate the pupils learning of it. A comprehensive list of specific competencies is provided with recommendations as to the degree of ability to be developed.

Comments:

A source useful in the determination and organization of curriculum materials for elementary teacher education in industrial arts.

Author: Callan, Louis J.
Title: Industrial Arts Teacher Education Programs: A Comparative Analysis and Evaluation of Selected Teachers and Colleges.
School: The Ohio State University.

Date: 1952
Source: *Dissertation Abstracts,* Volume XII, No. 11, p. 2515.

Purpose of the Study:

The frequently used statement, "Teachers teach as they were taught," offered a challenge to investigate: (1) how teachers of industrial arts are prepared for their profession, and (2) what they are called upon to do in the public schools.

Findings:

A study of college catalogs was made of the thirty-nine institutions having chapters of Epsilon Pi Tau. The study was made on the basis of admission requirements, scholarship standards, residence requirements, graduation requirements and curriculum patterns.

One hundred and forty graduate members of Epsilon Pi Tau were surveyed concerning adult education, type of shop organization, responsibilities and salaries.

The implications for teacher education reported were:

1. Need of revision of the teacher education program. The pattern of subject matter is too narrow, with heavy emphasis on drawing, woodwork, and metalwork. Widespread neglect is shown in the areas of transportation, general shop, ceramics, elementary industrial arts, driver education, handicrafts and textiles.

2. Only one out of twenty-five teachers actually use college preparation in their minor field. (The author concludes the minor should be eliminated.)

3. The teachers felt inadequately prepared. Their technical preparation was incomplete and their practice teaching was particularly faulty.

4. Because industrial arts departments are attached to Colleges of Education, Engineering, Liberal Arts and others, the majority of technical preparation is influenced by course work designed primarily for specialized technical or vocational purposes.

5. Traditionalism still characterizes the majority of industrial arts teacher education programs.

6. Colleges "preach" a better policy, "in the projection of modern programs," than they follow.

Author: Decker, George C.
Title: An Industrial Arts Master's Degree Program: With Particular Reference to the State of New York.
School: The Ohio State University.
Date: 1943.
Source: *Abstracts of Doctoral Dissertations,* No. 63, The Ohio State University Press, 1943.

Purpose of the Study:

To develop, for industrial arts majors on the master's level, a graduate program which will meet the needs of secondary school teachers of up-state New York.

Findings:

Nine purposes of a graduate program were developed. These are: (1) to increase the amount of general education; (2) to increase the amount of professional education; (3) to overcome deficiencies; (4) preparation for change of professional work; (5) provide education in the techniques of research; (6) to meet increased certification requirements; (7) to increase subject matter preparation in industrial arts; (8) to prepare for professional advancement; and (9) to keep abreast of modern educational developments.

Of the above purposes, principles were proposed for the development of a graduate program as follows: administration, educational articulation, selective admissions and guidance, curriculum patterns, and anticipated outcomes.

Comments:

Should be of value in appraising existing programs and as guides for revision and/or development of new graduate programs.

Author: Ensman, Leo M.
Title: Relation of Interests, Ability, Courses Taken, Scholastic Achievement, and Other Factors to Success in Industrial Arts Teaching.
School: University of Missouri.
Date: 1957.
Source: *Dissertation Abstracts,* Volume XVII, No. 10, p. 2212.

Purpose of the Study:

To ascertain the relation between teaching success, as rated by supervisors, of 110 beginning industrial arts teachers who were graduated from Kansas State Teachers College of Pittsburg and the following factors: general and pre-collegiate background, collegiate preparation, selected interests, mental abilities, and the school, community and teaching assignment.

Findings:

Factors concerning general and pre-collegiate background of these teachers, taken separately, do not provide a sound basis for recruitment, counseling, placement, or hiring of beginning industrial arts teachers.

There appears to be a tendency for individuals with high scholastic marks, greater number of hours in various areas, and other factors concerning collegiate preparation which might be expected to accompany teaching success, to receive higher ratings.

Degrees of interest and mental abilities of the students involved in this study appear to have little or no relation to teaching success.

Apparently, size of school should be considered when placing and hiring teachers.

Successful, as well as unsuccessful, teachers seem to be leaving the teaching profession.

Factors studied here, in combination, or other factors not identified, appear to be affecting the ratings more than these same factors taken separately.

Comments:

With the need for selective recruitment and devices for predicting teaching success this study is meaningful and has implications for further study in terms of techniques, time, and area.

Author:	Gaines, Thomas R.
Title:	Relation of Work Experience in Industry to Industrial Arts Teaching Practices and Success.
School:	University of Missouri.
Date:	1955.
Source:	*Dissertation Abstracts,* Volume XVI, No. 3, p. 476.

Purpose of the Study:

To ascertain the relationship of work experience in industry to teaching practices and rated success in teaching by industrial arts teachers.

Findings:

College cooperative industrial work experience programs do not play a prominent part in the training and experience of industrial arts shop teachers.

There seems to be little or no relationship between whether or not industrial arts teachers have work experience in industry and the teaching practices followed regarding:

1. Conservation of student's time in school shop work.
2. Project cost and elimination of waste.
3. Selection of course content.
4. Teaching methods and techniques.
5. Industrial arts shop safety.
6. Care and maintenance of equipment.
7. Shop housekeeping.
8. Shop management.

There seems to be little or no relationship between whether or not industrial arts teachers have work experience in industry and the teaching success ratings given by industrial arts supervisors.

Comments:

Findings were based on a comparison of fifty-one industrial arts teachers with no work experience in industry and ninety-eight with four or more years in industry. A local sampling was used.

Author: Giachino, Joseph W.
Title: An analysis of the Success Qualities That Should Be Emphasized in the Training of Candidates to Become Competent Teachers of Industrial Arts.
School: The Pennsylvania State University.
Date: 1949
Source: *Penn State Abstracts,* Vol. XII.

Purpose of the Study:

1. To identify the essential qualities which teachers of industrial arts need for success in teaching.

2. To determine whether or not any relationship exists between the educative experiences provided by institutions of teacher education for preparing teachers of industrial arts and the qualities considered by supervisors of industrial arts as contributing to success in teaching industrial arts.

Findings:

1. Supervisors of industrial arts and teacher educators are not in agreement as to what contributes to success in teaching industrial arts.

2. There is need for a closer bond of understanding between teacher educators and supervisors if there are to be better trained teachers of industrial arts.

3. There is a need for accreditation of industrial arts teacher education.

Comments:

Provides excellent list of qualities and factors which influence teaching success. Shows great need for further study to isolate factors essential to teaching success. Provides a pattern for such research.

Author: Gimbel, Armin F.
Title: The Granting of Graduate Credit for Manipulative Work.
School: Bradley University.
Date: 1953
Source: *Dissertation Abstracts*, Volume XIII, No. 6, p. 1037.

Purpose of the Study:

A study of the status of the practice of granting graduate credit for manipulative work, both on the master's and doctoral levels, the degree to which the practice is pursued at present and why the practice was initiated in the various schools.

Findings:

The material and information gathered is discussed under the following headings: personal data and opinions of respondents, opinions of department heads and college teachers, opinions of department heads concerning their programs and opinions of supervisors concerning teacher training.

Comments:

The results were not reported in the abstract.

Author: Hastings, James R.
Title: A Study of the In-service Education Needs of the Industrial Arts Teachers of New York State and Suggested Ways of Meeting These Needs.
School: New York University.
Date: 1953
Source: *Dissertation Abstracts,* Volume XIV, No. 2, p. 310.

Purpose of the Study:

To find answers to these specific questions:

1. Present status of programs which provide in-service education opportunities.
2. Current status of professional preparation and experience of industrial arts teachers in the State of New York.
3. What are the needs for in-service education?
4. What types of courses and activities are helpful in meeting these needs?
5. What needs can be met by existing facilities within the state?
6. What recommendations should be made for development of a program of in-service education to better meet the needs of industrial arts teachers utilizing existing agencies?

Findings:

Answers to the specific questions are presented in narrative and tabular form. The in-service needs of teachers were grouped as: general professional, professional-technical, and technical needs. Means of meeting these needs were classified as activities for credit, activities for no credit, and information and research services. A comprehensive listing of major needs of industrial arts teachers is provided with specific recommendations for meeting these needs. These data are presented under the classifications noted above.

Comments:

This study, while concerned with the industrial arts teachers of New York State provides ample material for consideration and imple-

mentation in any area. The recommendations for meeting needs are most worthy of consideration.

Author: Hiser, Paul T.
Title: The Development and Use of Pre-Student Teaching Evaluation Procedures in Industrial Arts Teacher Education.
School: University of Maryland.
Date: 1958
Source:

Purpose of the Study:

This study presents the development and application of a pre-student teaching evaluation procedure in the industrial arts division of the State University Teachers College at Oswego, New York, 1950-1956. The structuring of a rating instrument, a cumulative record form and isolation of measureable traits and qualities related to teaching success are also included in the study.

Findings:

An instrument, student professional inventory (SPI), for predicting student performance in practice teaching was developed and proved to have satisfactory reliability.

As single predictors, both SPI ratings and scholastic indices had substantial value to the selection and evaluation procedures. The combined value of SPI ratings and scholarship was a stronger predictor for student teaching success than either one alone.

A cumulative record form was developed which was considered essential to a teacher education program for referral and advisement. The form requires the participation of students in initiating and maintaining their own records. This proved to be feasible and desirable.

Comments:

While local in concept this study has implications for application in any program of industrial arts teacher education. The Student Professional Inventory and the cumulative record form are especially worthy of investigation and utilization.

Author: Jarvis, John A.
Title: Student Survival Factors in the Stout Institute.
School: University of Minnesota.
Date: 1953
Source: *Dissertation Abstracts,* Volume XIII, No. 5, p. 700.

Purpose of the Study:

The study concerns itself with the regularly enrolled male students at the Stout Institute and was made in an effort to determine: (1) the relationship that may exist between college entrance tests, high school rank, selected high school subjects offered at college entrance, and honor point ratios in the college freshman technical subjects, and in all college freshman subjects; and (2) whether these college entrance tests, high school rank, and certain selected high school subjects will assist in identifying those students who will graduate in four years.

Findings:

It was found that the high school rank achieved by those who did graduate from Stout Institute differed significantly from the high school rank achieved by those who did not graduate from this college. Two-year survival at this college was likewise found to be related to high school rank.

The remaining five measures, the three entrance tests and the units of mathematics and units of industrial arts offered at college entrance, did not assist in identifying the student who would survive and eventually graduate.

All of the preceding six measures were then used to develop regression equations which would serve to predict first semester college honor point ratios in the technical area, in the academic area, and in total scholarship. Satisfactory prediction was obtainable only in the academic and total scholarship areas.

As a result of the findings the following recommendations were made:

1. That the entrance requirement based on high school rank be established for the Stout Institute.

2. That the first semester freshman college total honor point ratio and a similar academic honor point ratio be caluclated for all entering men as soon as entrance test scores are available. If students

likely to fail are identified early, it should be possible to provide assistance designed to aid them in achieving better scholastic records.

Comments:

While of localized interest and immediate significance it offers a plan and tested techniques applicable to any institution for purposes of freshman counseling or further research.

Author: Kohler, Roderick G.
Title: Status and Trends in Graduate Industrial Teacher Education in the United States.
School: University of Missouri.
Date: 1952
Source: *Dissertation Abstracts,* Volume XII,.No. 4, p. 513.

Purpose of the Study:

To ascertain the current status and trends in graduate programs in industrial arts teacher education in the United States.

Findings:

Data are furnished on the number and type of programs, when established, entrance requirements, transfer of credits, course requirements, major and minor credit ratios, thesis and dissertation requirements, comprehensive examinations, staffing, financial assistance to students, number enrolled and degrees granted.

Comments:

Pattern and techniques for a follow-up study. Significant changes should be apparent. Material for graduate program appraisal.

Author: Kroh, Damon K.
Title: Relationships of Industrial Arts to the Modern Elementary School Curriculum: Recommendations for Improvements in Elementary Industrial Arts Undergraduate Teacher Education Programs in New York State Colleges.
School: New York University.
Date: 1957
Source: *Dissertation Abstracts.* Volume XVIII, No. 11, p. 2528.

Purpose of the Study:

To prepare a set of recommendations for consideration by industrial arts departments in teacher education in New York State, with a view to the more adequate preparation of elementary school industrial arts teachers.

Findings:

1. The majority of elementary industrial arts teachers serve in a consultant capacity.
2. The teachers felt inadequately prepared.
3. Teachers and administrators recommend that college curricula include elementary school organization, methods and curriculum, and courses in child psychology and child study.
4. Recommendations were made concerning the industrial arts teacher education program in New York State.
5. A proposed curriculum was included for the four year undergraduate program in industrial arts teacher education.

Comments:

Significant in those states that have industrial arts programs in elementary schools and in those states where teachers are certificated for grades kindergarten through twelve.

Author: Kurth, Edwin L.
Title: Certain Developments and Trends in Industrial Arts Teacher Education.
School: University of Florida.
Date: 1955
Source: *Dissertation Abstracts*, Volume XV, No. 9, p. 1561.

Purpose of the Study:

To determine what means of recruitment were being employed by institutions offering courses for teachers of industrial arts, and what practices were considered to be most effective; what general education backgrounds were being provided for majors in industrial arts; what the present status of certain aspects of teacher preparation in industrial arts involved; what professional laboratory experiences were available; and what future trends and developments department heads and teachers felt would influence future preparation of teachers of industrial arts.

Findings:

The abstract listed eight recruiting practices considered to be most effective, listed nine items generally included in the pattern of preparation of majors, listed twenty items concerning the status of programs, listed twelve items regarding professional laboratory experiences rated highest by department heads and which were most frequently used, listed three general trends in industrial arts teacher education, listed twenty-three conclusions, and listed five recommendations. The conclusions, extracted from the abstract, that seemed most provocative are:

1. The recruitment plans considered to be most effective were not employed by many institutions.

2. Present enrollments in programs for teachers of industrial arts will not supply future demand for teachers.

3. Teachers of industrial arts need to be prepared to teach in both unit shops and general shops, although general shops are more prevalent in high schools.

Author: Loats, Henry A.
Title: A Program of Industrial Arts for the Preparation of Elementary Teachers, Ball State Teachers College, Muncie, Indiana.
School: The Ohio State University.
Date: 1952
Source: *Abstracts of Doctoral Dissertations,* No. 63, The Ohio State University Press, 1952.

Purpose of the Study:

To determine what course offerings would best serve the preperation of elementary teachers with respect to providing a background in industrial arts.

Findings:

A survey of 151 elementary teachers graduated from Ball State, and an examination of ninety-one courses in industrial arts for elementary teachers offered by forty-eight teacher training institutions, revealed that many activities and needs most stressed by the teachers were least stressed in the courses offered. Many factors of importance to elementary teachers were isolated. A curricular pattern to meet the

needs of elementary teachers was developed. Specific content was suggested for lower and upper division courses, graduate offerings, and in-service training opportunities.

Comments:

A rich source of material for program development in the area of industrial arts for the elementary teacher.

Author: Mitchell, John
Title: The Identification and Evaluation of Instructional Units in Organization and Management of General Shops for Industrial Arts Teacher Education.
School: The Pennsylvania State University.
Date: 1954
Source: *Dissertation Abstracts,* Volume XVII, No. 3, p. 366.

Purpose of the Study:

The purpose of the study was twofold: (1) to determine from selected outstanding general industrial arts teachers throughout the United States, present practices and recommendations for instructional units in organization and management of the general shop for teacher education; and (2) to compare the evaluations of the instructional units of all respondents and rank them in order of their importance for professional courses, units of courses, or professional shop courses in organization and management of the general shop in teacher education.

Findings:

1. The problems of organization and management, particularly as they apply to the general industrial arts shop, must be given adequate consideration by those who prepare prospective teachers as well as by those who would conduct such a shop efficiently and successfully.

2. The activities concerned with physical matters are, for the most part, considered of greater importance for the successful operation of the general shop, than those concerned with organizing personnel for instruction.

3. The activities dealing with the instructional setting—equipment, supplies, teaching materials—in most instances, rate higher

than those in which there is actual contact or relationship with the students.

4. The activities which contribute most to the successful operation of the general shop are: adequate provisions for individual instruction and a safe working environment.

5. The performance of activities concerned with physical matters, maintaining the appearance of the shop, caring for tools, and planning procedures are largely delegated to students. On the other hand, those which pertain to student personnel records, shop records, inventories, and accounts are rarely delegated.

6. With the exception of the last seven activities identified, all in the list rate as important or above.

7. The activity groups are important for the successful organization and management of the general shop.

8. There is apparently little or no significant difference in the organization and management of either the comprehensive general or the general unit shops.

Comments:

In view of the data and the conclusions derived, it is recommended that: (1) teacher educators and teachers of general industrial arts review the findings of this study so that actual shop or classroom instruction can be improved from the standpoint of organization and management; and (2) teacher educators evaluate their professional courses or professionalized shop courses concerned with the organization and management of general shops in terms of the findings.

Author: Risher, Charles G.
Title: Relationship of Scholastic Attainment to Rated Success as A Beginning Industrial Arts Teacher.
School: University of Missouri.
Date: 1953
Source: *Dissertation Abstracts*, Volume XIII, No. 6, p. 1120.

Purpose of the Study:

To ascertain the relationships existing between undergraduate marks earned in industrial arts teacher education programs, and the subsequent success of beginning industrial arts teachers.

Findings:

1. There is a low, positive relationship (.20) between rated teaching success of beginning industrial arts teachers and all undergraduate marks earned by them in professional courses in education.

2. There is a low, positive relationship (.21) existing between rated success and marks earned in technical courses in industrial arts.

3. A low, positive relationship (.22) exists between rated success and all undergraduate marks earned in academic courses.

4. A low, positive relationship (.34) exists between rated success and all undergraduate marks earned in college.

Comments:

Tends to confirm the opinion that other factors, such as personality and attitudes, are more important to success in teaching than scholastic achievement.

Author: Sargent, William T.
Title: Student Teaching in Off-Campus Programs in Industrial Arts: A Survey Directed Toward Identifying Qualifications and Responsibilities of Industrial Arts Supervisors and Cooperating Teachers and Toward Evaluating Industrial Arts Off-Campus Student Teaching Activities.
School: Wayne State University.
Date: 1957
Source: *Dissertation Abstracts*, Volume XVII, No. 6, p. 1273.

Purpose of the Study:

The purposes of this descriptive-survey of off-campus programs in industrial arts student teaching were to identify commendable aspects of current programs and to apply the findings toward developing: (1) an off-campus program for the Department of Industrial Arts, Northern Michigan College, Marquette, where augmented enrollments required expansion of student teaching facilities, (2) a handbook for student teachers in off-campus programs, and (3) a brochure for off-campus personnel with supervisory responsibilities.

The research was designed to determine: (1) qualifications and responsibilities of industrial arts supervisors, (2) qualifications and functions of industrial arts cooperating teachers, and (3) activities

which (according to competent teachers) promoted professional growth of prospective teachers.

Findings:

Literature and research supported the basic assumption that experience in public schools gave the student teacher opportunities to identify personal demands, qualifications, and skills inherent in industrial arts teaching.

Several conclusions were drawn on the basis of this study. The industrial arts supervisor was:

1. A specialist in industrial arts.
2. A teacher-educator on both graduate and undergraduate levels.
3. An administrator in structuring and coordinating the program.

Responsibilities of the supervisor called for:

1. Developing the professional curriculum in industrial arts.
2. Scheduling methods courses prior to or concurrently with the student teaching assignment.
3. Selecting off-campus schools on the bases of: industrial arts curriculum, grade level and distance from campus.
4. Selecting cooperating teachers with minimum teaching experience of 3.5 years, master's degree, and attributes of a master teacher.
5. Screening and assigning student teacher candidates with a maximum of two student teachers to each cooperating teacher.

In his capacity of guiding the student teacher toward maximum professional growth, the industrial arts cooperating teacher:

1. Advocated inducting the student into actual teaching gradually and on individual merits of readiness.
2. Planned conferences with definite purposes as planning work or evaluating the progress of the student teacher. (Time alloted to student teaching limited the number and length of scheduled conferences.)
3. Encouraged a variety of off-campus teaching experiences.

Recommendations for improving industrial arts off-campus programs were:

1. Providing in-service training in directed teaching.
2. Providing more adequate orientation of cooperating teachers through conferences, work shops, and written manuals.
3. Consulting cooperating teachers before assigning a student teacher to him.

4. Establishing a longer daily and weekly contact to permit more teaching experience.

5. Providing information about the student teacher's background, interests, needs.

6. Scheduling regular conferences with the student teacher for specific functions.

The conclusions and recommendations of this study were ultimately incorporated into: (1) a proposed off-campus program in industrial arts for Northern Michigan College, (2) a handbook for student teachers, and (3) a supervisory brochure.

Author: Sayovitz, Joseph J.
Title: Certification Status and Procedures for Industrial Arts Teachers in the United States.
School: University of Minnesota.
Date: 1955
Source: *Dissertation Abstracts,* Volume XV, No. 11, p. 2118.

Purpose of the Study:

To determine the status of certification standards for industrial arts teachers in the United States for the year 1953-54. Information collected was restricted to minimum requirements as they are prescribed by state educational agencies.

Findings:

Data are presented under the following categories:

1. General findings to include: Length of term of certificate, requirements for renewal, degree requirements, training facilities available by state, means used for certification, minor requirements and grade level validity.

2. State requirements, technical: minimum unit requirements, shop area requirements, and certification designations.

3. State requirements, professional: range of units, special methods for area and student teaching.

4. State requirements, general education: degree of institutional autonomy in setting pattern, areas of general education and number of units prescribed by state.

Recommendations are made for improving certification patterns with a view toward unity among the states.

Comments:

Presents an extensive overview of current practices which would serve as criteria for evaluation and comparison of an individual program with the national picture. Points out significant areas for study.

Author: Senteney, George William.
Title: Factors Relating to the Choice of Industrial Education Teaching as a Career and the Retention of These Teachers in the Profession.
School: University of Missouri.
Date: 1955
Source: *Dissertation Abstracts,* Volume XVI, No. 3, p. 503.

Purpose of the Study:

To ascertain the factors influencing men to enter an industrial arts teacher education program in college, why those so trained either teach or follow other occupations, how the two groups compare as to background, and how they fare in relation to each other.

Findings:

Findings are based on the questionaire replies of 1356 graduates of sixty-four teacher education institutions. Factors most influential in entering into an industrial education teaching career are: rearing in a small comunity, father employed in agricultural or related occupations, satisfactory high school shop experience. Major factors for remaining in teaching were: being trained as a teacher, working with young people, and the appeal of shop work. Most graduates failed to enter or remain in teaching because of salary and lack of opportunities for advancement. Other factors exerting influence are also presented.

Comments:

A good source of information for recruiting and counseling activities.

Author: Silvius, G. Harold.
Title: Instructional Units for Professional Courses in Undergraduate Industrial Arts Teacher Education.
School: The Pennsylvania State College.
Date: 1946
Source: *Penn State Abstracts,* Volume IX, Publication 891.

Purpose of the Study:

To make a scientific analysis of the activities performed by outstanding industrial arts teachers throughout the United States to ascertain units of instruction for professional courses in undergraduate industrial arts teacher education.

Findings:

Activities performed by industrial arts teachers which related to theory, organization, and presentation of instruction were identified. The compilation of activities was submitted to several highly successful teachers and finally 160 activities were identified. These activities were studied in terms of data received from the 750 respondents; the eighty teachers considered most outstanding by their directors, supervisors, and professors; the ninety-nine Detroit teachers taking part in the study; as well as other classified groups, such as teachers using a general shop organization; and teachers located in cities 250,000 or over. The activities were placed in rank order according to their importance as units of instruction for professional courses in industrial arts teacher education.

Training, experience, kinds of assignments, and working conditions of the participating teachers were reported.

Research studies and literature concerned with undergraduate industrial arts teacher education were reviewed and reported.

An application was made of the findings to professional courses in the industrial education curriculum at Wayne University.

The major aim of the study was to rank the activities to ascertain those that should receive major or minor emphasis, and those that should be rejected as units of instruction in industrial arts teacher education. A scientific analysis of the data placed them in rank order. Each activity was classified in one of four categories: A, B, C and D. Those with an importance rating of "A" were considered to be the most important units of instruction. Those that received a "D" were rejected as units of instruction. One hundred and forty-five units were ranked as acceptable and grouped under one of twelve headings. The classified groups were listed in rank order.

Author: Towers, Edward R.
Title: Industrial Arts Teacher Education: An Evaluation and Projection of the Undergraduate Program of The Ohio State University.

School: The Ohio State University.
Date: 1956.
Source: *Dissertation Abstracts,* Volume XVII, No. 5, p. 1038.

Purpose of the Study:

To answer questions concerning: history of the program, contribution of industrial arts to general education, sources of content, scope of industrial arts in public schools of Ohio, purposes and trends, areas in curriculum, guiding policies, criteria by which to evaluate program, how effective is the program.

Findings:

May be significant only as a pattern for similar studies of other industrial arts teacher education programs.

Author: Wall, Gustave S.
Title: Dual-Purpose Industrial Education at the College level.
School: University of Minnesota.
Date: 1951
Source: *Dissertation Abstracts,* Volume XII, No. 2, p. 157.

Purpose of the Study:

(1) To determine opinions and practices in industrial arts teacher education for purpose of creating a dual-purpose industrial education curriculum.

(2) To evaluate a curriculum proposal based on the initial findings.

Findings:

Industrial educators favored change in the distribution of total credit with equal allotment to general, professional and shop/drawing. Inclusion of industrial work experience desirable as coordinated work experience in industry. Recommends fifteen credits in one area of industrial arts for specialization. A general credit distribution by areas was developed on the basis of the survey. A proposed program for entrance into teaching and industry was acceptable to evaluating teacher educators.

Comments:

Provides a summary of current practices in industrial arts

curriculums for teachers and non-teaching majors. Offers suggestions for a dual program.

Author: Weinberg, Solomon A.
Title: Psychological Needs of Adolescence.
School: The Ohio State University.
Date: 1953
Source: *Dissertation Abstracts,* Volume XIX, No. 7, p. 1660.

Purpose of the Study:

To identify relationships between psychological needs and age through the years of adolescence and to determine the extent to which these needs are satisfied in the everyday lives of adolescents.

Findings:

The following types of needs were identified:

1. Most enduring needs of adolescence.
2. Needs that endure for boys but not for girls through adolesence.
3. Needs that endure for girls but not boys through adolesence.
4. Needs common to boys aged thirteen.
5. Needs present among adolescents aged sixteen through nineteen for girls and age seventeen for boys.
6. The most striking needs of adolescence.
7. Transition to maturity.
8. Sex difference in needs.
9. Satisfaction of needs.

Comments:

To help parents and future teachers understand adolescents. Helpful in development of course content in industrial arts teacher education.

Author: Wigen, Ray A.
Title: Technical Offerings for Industrial Arts Teachers at the Graduate Level.
School: University of Minnesota.
Date: 1957
Source: *Dissertation Abstracts,* Volume XVII, No. 6, p. 1274.

Purpose of the Study:

To determine the nature of technical offerings, to determine the legitimate and essential basis for the inclusion of technical offerings in the preparation of industrial arts teachers, and to prepare a guide for administrators and others interested in technical offerings for industrial arts teacher education at the master's degree level.

Findings:

1. There was sufficient agreement by experienced personnel concerning the general nature of graduate work to permit the formulation of general theories of graduate work.

2. The general theories of graduate work pertained to and were applicable to the specific field of technical offerings.

3. Nine specific theories of technical offerings were developed along with seventy-seven detailed statements of evidences of expected student abilities. These were included in the form of a survey instrument for evaluative purposes.

4. The guide was used and further developed so that it is possible to use the guide to develop or evaluate a technical course.

Comments:

Many industrial arts teacher education departments already allow technical course credit toward the master's degree. This study could be used to evaluate courses offered, courses under consideration, and might be used when considering allowing technical course credit on the doctoral level.

Summary

Because of the tendency to place research studies on library shelves and forget them, this Yearbook is significant. Its purpose is to reveal significant studies that have been done and areas that need further investigation. Improved techniques, less duplication, and loss of time can only come through reporting the combined efforts of the entire group of students of research. All of the new developments in the literature pertaining to industrial arts teacher education are far too large for any individual to read. It is our hope that the selection we have made will make some contribution to industrial arts teacher education.

It was not possible for the authors of this chapter to come to some definite conclusions concerning categories of research done at specific institutions, that is, whether certain schools concentrate on certain areas of research. There is some indication that a few schools follow this practice, but since we did not make specific inquiry concerning this point we could not justify conclusions concerning the possibility. One university seemed to have a number of studies done in the area of predicting success of students in an undergraduate program and predicting success in teaching. No school or department concentrated on research in industrial arts teacher education. Our findings show that more studies have been done in the areas of predicting success, student teaching, preparation of courses of study, and elementary industrial arts teacher education than in supervision, evaluation, and departmental administration. Actually, there appears to be much need for research in all areas of teacher education.

CHAPTER III

Research by Industrial Arts Teacher Education

BY J. A. Fuzak
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Introduction

The world around us everywhere attests to the miracles of physical science. Man has conquered many diseases and is reducing the threat of others. His life span has been markedly increased. He performs less and less physical labor as machines and appliances take over the physical exertion. He travels faster than the speed of sound, and flicks a switch to be entertained. The splitting of the atom and the widespread application of automation promise even greater improvement and change. Most of these miracles are the direct result of research in the physical sciences.

This has become so apparent to our national leaders, that research has become a major means for furthering our objectives for the general welfare and national safety. It has become the national policy to encourage and support research. Not only our national leaders, but the American people in general, seem convinced that research is essential to their welfare. This conviction of the people and our leaders underlies the action of the government in making federal funds available to support research on a scale that would have been unimaginable twenty-five years ago.

While the impact of research in the physical sciences is strikingly apparent on all sides, the effect of research in the social sciences is difficult to detect. Despite all of his marvelous gadgets, it is questionable whether man is more content. The consequences of social problems and conflicts are reflected in increasing tensions. There is real question whether men's basic needs are being effectively fulfilled. As a result, there is a growing tendency to look to research in the social sciences to provide information which will lead to improvement in the non-physical aspects of our culture. The truly great research challenge lies in the various fields of the social sci-

ences. As great as the challenge in any field is that within the field of education.

Research has long been recognized as one of the major responsibilities of the teacher educator. This is attested by the extent of the emphasis given to research experience within the program of his educational preparation. A major portion of this program is devoted to the planning and execution of an original research study. Graduate schools invariably indicate that the purpose behind this emphasis is to test the capability of the candidate to conceive and carry out a research study, not as an end in itself, but rather to prepare the candidate to make a continuing contribution to the discovery and extension of knowledge in his field. The profession apparently expects that the teacher educator will devote some part of his professional activity and of his professional assignment to a continuing program of research.

The concern of this chapter is with the extent and nature of the research effort of the industrial arts teacher educator over and above the research performed to fulfill degree requirements.

Responsibility of the Industrial Arts Teacher Educator for Research

All accredited institutions of higher learning subscribe, with varying emphases, to three major and essential aims:

1. Extension of the boundaries of knowledge.
2. Conservation of knowledge already acquired.
3. Diffusion of knowledge through teaching, publication and other methods.

Our institutions of higher education are the principal instrumentality created by our society through which new knowledge is created. The extension of the boundaries of knowledge must be accomplished primarily through research--especially basic, uncommitted research. The results of this research must be made available through publication, and its validity checked through criticism and re-examination by competent colleagues.

Since research is such a strong responsibility of institutions of higher education, the question may be raised as to how the industrial arts teacher educator might best contribute to research. One of the alternatives is to make his contribution through the research efforts of his graduate students. Advocates of this alternative, point out that

the research ability of the industrial arts teacher educator is thus spread out into many branches of research. However, this places the burden for most of the research in industrial arts education upon the graduate students.

Disadvantages of Dependence Upon Graduate Students for Research

Several factors make it unlikely that the graduate student will accomplish any major result in his research. His relative inexperience in research generally leads to a strong desire for positive accomplishment. This in turn may lead to an unconscious attempt to secure high consistency of findings with expectancy.

The graduate student is also faced with the pressures of residence requirements, language requirements, course and credit requirements, procedural requirements, and the satisfaction of a guidance committee. Under these circumstances he would be less than wise to set sail upon uncharted seas. The selection of his research problem, then, is made with the criteria peculiar to his situation as a graduate student in mind. Since his life as a graduate student is usually little more than subsistence level living, the availability of data and the cost of collecting it assume disproportionate importance. He is also forced to attach undue significance to the time limit in selecting his problem.

After his problem is selected, the research plan developed, and approval secured, the graduate student is committed to stay within rather close range of his original plan. He is not free to follow an unanticipated development. When pursued, these unanticipated developments are often clues which lead to major gains in knowledge. The effective research worker must have the freedom to abandon the stream of his original study in order to embark on a tributary study, whenever it becomes apparent that this way may be more significant and productive.

One of the great weaknesses inherent in depending upon graduate students for the research in a field, is that the graduate student's research is a "one-shot affair." This leads to fragmentation of research into a multitude of unrelated and relatively insignificant studies. Significant results in research are usually attained through the prolonged effort of a continuing program of inter-related research.

In attempting to overcome this problem of fragmentation, a few graduate programs promote the parcelling out of related phases of a

professor's research program to several graduate students. While this approach may offer greater promise of contribution to knowledge in a field, it too is beset by certain disadvantages. The disadvantages lie primarily in the diminution of value of the learning experience to the student. The student is spared, to a great degree, the extremely difficult task of identifying and defining his problem. He loses the valuable experience of working his way through the process. Additionally, the research undertaken is not likely to reflect a problem which nags at the student's consciousness demanding investigation. There is, therefore, less likelihood that the student's greatest creative ingenuity will be applied, or that he will experience the sense of exitement which might induce him to continue his research efforts after completion of his degree. The practice of parcelling out phases of a research program is open to question on the basis of its adequacy in testing research potential and in preparing the student to make a continuing research contribution to his field.

Finally, the practice of depending upon graduate students for research removes responsibility for research from all but a relatively small segment of industrial arts teacher educators. So long as this is the practice accepted by the profession, the majority of industrial arts teacher educators will assume little responsibility for research, since they have only slight contact with graduate students. Many who have strong research potential thus relegate themselves to the sidelines.

In view of the foregoing considerations, it seems apparent that neither the industrial arts profession nor the institutions of higher education can afford to depend upon graduate students for major contributions in research. Indeed, it is questionable whether industrial arts can be regarded as a profession until mature professional workers assume responsibility for its research.

Strategic Position of Industrial Arts Teacher Educators in Reference to Research

The industrial arts teacher educator is in a most strategic position to make effective contributions to the extension of knowledge in the field of industrial arts. He has the freedom to undertake basic, uncommitted research. It is possible for him to establish a long-range program of research without time limit, and without the pressure of

producing results immediately applicable to a specific situation. If, in the course of a research study, he discovers a very promising lead, he is free to follow it until he satisfies himself that it is not more important than the study he started upon. The industrial arts teacher educator need not be hampered by most of the difficulties which face the graduate student.

One of the very great dilemmas facing industrial arts is the dissemination of research results, however inadequate they may have been. Perhaps one of the reasons for some of the past difficulty in disseminating research results has been the unadmitted feeling that most of the studies and their findings were not very significant. While this is not a problem peculiar to industrial arts, it is more obvious than in many areas. Various attempts have been made to maintain up-to-date bibliographies of research. Other attempts have concentrated upon producing and distributing summaries of research studies. While these are important, they seem to be used, in the main, by a few graduate students and a few professors. Even where research findings seem quite conclusive, they seem to have little effect upon classroom practices. In fact, classroom teachers seem unaware of, and uninterested in, whatever research findings are available through bibliographies and summaries.

One of the more promising approaches to dissemination of research findings, with the possibility of affecting classroom practices, is the exploration and discussion of research studies by teacher educators in their classes. The industrial arts teacher educator, who is himself engaged in a program of research, has the opportunity to explain his research and point out its implications to undergraduate classes, graduate classes, professional groups, and in-service groups. If he is actively engaged in a program of his own research, he is more likely to remain aware of the research findings of others, and share in the dissemination of their findings.

The benefits to the industrial arts teacher educator of a continuing program of research are great. It serves as an excellent vehicle for professional growth, and helps him to stay abreast of developments in his field. It can bring recognition and prestige to both industrial arts and to the individual. More important, it sharpens his ability to prepare students to carry on and utilize research. He can more readily communicate the sense of challenge and excitement which will induce more of them to engage in research activity. It is

difficult, if not impossible, to sell the importance of research to students, when the salesman wants little to do with it.

Obviously, the total responsibility for research in industrial arts does not rest with the teacher educator. However, he is in the most strategic position of any professional worker in this field to carry on basic research, and to disseminate the results of research. The conclusion seems inescapable that industrial arts teacher educators have a major responsibility to themselves, to their students, and to the profession to conceive and carry on programs of research beyond the completion of their formal professional preparation.

Research by Industrial Arts Teacher Educators After Completion of Their Formal Preparation

With the emphasis being given research on the national scene, with the increased need for research in all educational areas, with the avowed purposes of institutions of higher education, with the educational preparation of industrial arts teacher educators, and in view of the strategic position of these educators in reference to the conduct of research and the dissemination of findings, one would expect to find considerable attention devoted by them to research as a continuing activity. One would expect to find a significant number of organized research projects in progress, involving industrial arts teacher educators. One would expect to find an increasing body of published research findings relating to industrial arts, apart from theses and dissertations.

Uncompleted Research by Industrial Arts Teacher Educators

The problem of locating and identifying research studies under way, other than dissertations, is a difficult one. Few channels exist for the identification of these studies. As a result, plans were developed to survey the higher educational institutions of the United States which are engaged in the preparation of industrial arts teachers. As a starting point, a questionnaire was prepared and sent to eight geographically selected institutions as a trial of the survey procedure. The results were extremely discouraging. After a second trial attempt, the procedure was abandoned as offering little promise.

The responses indicated wide variations in the meanings attached to the term "research." There was a tendency to include all

attempts at course improvement, revision of courses, improvement of facilities, and development of teaching aids and devices as research. This was the case, even though the attempts being made were so loosely structured as to leave open to question the feasibility of reporting results. Perhaps the pressures were being felt to indicate active research effort. However, the results of such a survey would have been impossible to interpret or evaluate.

This experience with an attempt to survey research in progress was substantiated in a survey of seven institutions in Michigan conducted by Dr. C. Robert Hutchcroft.[1] Two of his six questions dealt directly with the research efforts of industrial arts teacher educators. In his summary, Dr. Hutchcroft says:

> "It would be difficult, if not impossible, to draw conclusions on the basis of these returns without assuming meanings for terms used which may or may not reflect the meaning intended by the respondent. It is felt that there may be some wide variations in the meanings used for the terms 'research,' and also for the meaning of 'industrial arts.'"[2]

Since the survey procedure evidently promised to produce only information which could not be interpreted, another resource was utilized for locating organized research being conducted by industrial arts teacher educators. This was the Research Reporter Program of the American Association for Colleges of Teacher Education.[3] Currently 381 of the 487 A.A.C.T.E. member institutions have Research Reporters, who report on research by faculty members semi-annually. The listings do not include theses, dissertations, or studies already published as books or as professional articles. It is immediately apparent that not all institutions are covered, and that perhaps a number of studies might escape identification. This might be more likely in the field of industrial arts than in general areas of teacher

[1]Hutchcroft, C. Robert "Research in Industrial Arts Carried on at the Seven Institutions in Michigan Having Industrial Arts Teacher Preparation Programs. Ann Arbor. Mimeographed Summary, 1959.

[2]*Ibid* - Hutchcroft

[3]American Association of Colleges for Teacher Education. "Research Reporter Program," Vol. IX, January, 1957; Vol. X, January 1958; Vol. X, May 1958; Vol. XI, January 1959; Vol. XII, May 1959. Oneonta, New York.

education, since administrative arrangement might locate the industrial arts department in the school of engineering. However, it was felt that the studies reported involving industrial arts teacher education faculty members, might at least be indicative of the extent of their participation in continuing research activity. For this purpose, the bulletins of the Research Reporter program were studied, and the names checked against Wall's Industrial Teacher Education Directory.[4]

Thorough perusal of the Research Reporter Bulletins yielded four studies involving industrial arts teacher educators, and related to the field of industrial arts. These were:

> E. Jacobson - Study of some Attitudinal Patterns in group learning activity on the college level--Comparing attitudinal developments of freshmen with seniors in a qualitative learning situation in Industrial Education.
>
> Aspects: (a) understanding, (b) Personal adjustment, (c) Use of resources, (d) Self evaluation, (e) Interpersonal relationships, and (f) Motivations.
>
> W. Tierney - A study of present and future personnel needs in industrial arts in Maryland Secondary Schools. To determine number needed, present status in relation to certification and classification, extent of professional preparation, and participation in study programs of present personnel.
>
> W. Wagner - Use of graduate assistants in teaching woodwork.
>
> R. Wigen - Study of the development of the advanced technical offerings for preparation of Industrial Education Teachers. Includes guides and plans for administration of advanced technical offerings.[5]

In spite of the limitations previously identified, the number of research studies involving industrial arts teacher education personnel seems rather meager.

Other sources revealed a few scattered studies by industrial arts teacher educators. These were so few in number and so difficult to locate, that it seemed to serve no particularly useful purpose in

[4] Wall, G. S. (Compiler) *Industrial Teacher Education Directory.* Menomanie, Wisconsin; Stout State College, 1958.

[5] *Ibid* - A.A.C.T.E. Research Reporter

reporting, or in attempting to summarize them. Anyone wishing to learn of the few in progress can do so without great difficulty, providing that he is able to locate them.

Published Reports of Research by Industrial Arts Teacher Educators (1954-1958)

Another resource for determining the nature and extent of the research activity of industrial arts teacher educators is through published reports of research. Since the validity of research can only be determined by the criticism and re-examination of competent colleagues, the goal of all researchers must inevitably be the publication of their findings. One would expect, therefore, to derive a fairly adequate notion of the extent and nature of the industrial arts teacher educator's research activity through a careful survey of books, bulletins, and periodicals.

Once again the difficulty to be resolved in surveying published research reports, resides in the meaning attached to "research." As has been previously indicated, research has come to be applied to such a wide range of activities within the field of education, that it does not have an identifiable meaning. In educational discussions, research and the scientific method are often used synonymously. This seems an inappropriate usage, since it is possible to employ the scientific method without actually doing research. Research may be regarded as a specialized phase of scientific methodology. It involves a systematic structuring of an investigation, which usually results in some sort of formal record of procedures and a report of the results or conclusions.

In order to provide some frame of reference for the survey of literature, it was decided to limit the published research considered to that which involved systematic structuring, provided an account of procedures employed, and the conclusions or generalizations drawn. It was decided to search the most recent five year period, ending January 1, 1959 for such publications of research by industrial arts teacher educators. Again, only those which had no direct relation to degree studies, and which related directly to industrial arts were to be considered.

Some of the tools employed in this search for research reports by industrial arts teacher educators were: *The Education Index, The Industrial Arts Index, The Review of Educational Research, The*

Encyclopedia of Educational Research, The Journal of Educational Research, The Phi Delta Kappa Directory of Educational Research Agencies and Studies, The Phi Delta Kappa Research Studies Subject Index, and *The National Association of Industrial Teacher Educators Bibliography of Research Studies in Industrial Education.* In addition, all issues of two periodicals not indexed in the *Education Index* were scanned in an attempt to locate further reports of research studies.

A three year period from 1954 to 1957, covered by one of the volumes of the *Education Index*, gave a foreshadowing of the situation to be discovered in locating the sought after reports. Under the major heading "Industrial Arts", no "Research" sub-title appeared, even though such a sub-title appeared under Mathematics, History, Physical Education and Business Education, to mention a few. However, the title of each article in the *Education Index* listed under Industrial Arts and under several other headings were studied. Many of these articles were examined.

The search was prolonged, since it seemed impossible that there could be so few research reports, other than dissertations and theses, produced by industrial arts teacher educators. Support for the view of the scarcity of the research reports sought, came from H. H. London and W. W. Spence in the October 1956 issue of the *Review of Educational Research,* which stated that again most of the researches in industrial education were those of graduate students.[6] Further indication of the situation came from the 1960 edition of the Encyclopedia of Educational Research.[7] The author of the "Industrial Arts" section, Dr. C. Robert Hutchcroft, indicates that only a modest amount of research and professional literature has been produced in the past ten years, and that the research is mainly degree requirement research. The article further states that the need for research in industrial arts is urgent, and particularly pleads for experimental studies.

Only three published research reports were found for the entire five year period from January 1, 1954 to December 31, 1958 which satisfied the frame of reference earlier indicated. Two of these might not ordinarily be considered as formalized research studies, but their

[6]London, H. H. and Spence, W. W. "Research in Industrial Education," *Review of Educational Research. 26: 379-87, October 1956, p. 379.*

[7]Hutchcroft, Robert, "Industrial Arts," *Encyclopedia of Educational Research,* New York: Macmillan Co., 1960.

inclusion was decided upon after consultation with the author's colleagues and studied consideration. The three reports were:

Fuzak, John A. - *Research Report on the Role of Physical Maturation in Determining the Ability of Junior High Boys to Perform Complex Finger Coordinative Activities in Industrial Arts, and an Index to Level of Ability.* Chicago, American Technical Society, 1958.

Hornbake, R. Lee and Maley, Donald - *"Superior Practices in Industrial Arts Teacher Education, Fourth Yearbook, American Council on Industrial Arts Teacher Education.* Bloomington, McKnight & McKnight, 1955.

Micheels, W. J. and Sommers, W. S. - *The Minnesota Plan for Industrial Arts Teacher Education.* Bloomington, McKnight & McKnight, 1958.

No published report could be found of a research study known by the author to have been completed by Dr. Ray Wigen concerning the development of advanced technical offerings in the preparation of industrial education teachers. As a result, it could not be included. The Seventh Yearbook of the American Council on Industrial Arts Teacher Education on "Accreditation", edited by Dr. Verne Fryklund, was also considered.[8] However, since a major portion of the research involved the work of H. L. Helton as part of his doctoral degree requirements, it was not included.

Within the framework previously identified, any interested person may cover the entire five year output of research reports by industrial arts teacher educators in one sitting. Therefore, it does not seem sensible to summarize these reports.

Stimulation of Greater Research Effort by Industrial Arts Teacher Educators.

The conclusion is inescapable that few industrial arts teacher educators accept the responsibility for carrying on research in their field as a regular and continuing activity. Those who do, devote little of their effort to it. They apparently delegate this responsibility to their graduate students.

[8]Fryklund, Verne (Ed.) "Accreditation." Seventh Yearbook, American Council on Industrial Arts Teacher Education. Bloomington: McKnight & McKnight, 1958.

The situation is a shameful one to the profession of industrial arts teacher education. In fact, it is doubtful whether industrial arts teacher education can be called a profession unless its body of knowledge is based on sound theory which comes from fundamental research. It is unrealistic to expect that most research by graduate students can be much more than routine tabulation. To expect from dissertations the derivation of scientific generalizations, which can be applied to the solution of a wide range of problems, is like expecting to find the pot of gold at the end of the rainbow. The seriousness of this situation cannot be emphasized strongly enough.

It is crucial to the entire profession to direct its energies and best creative thought to the remedying of this disturbing problem. Several suggestions, and a few questions, will be attempted in the remainder of this chapter as a starting point for the action which must be undertaken without delay by the industrial arts teacher education profession.

Recognition of the Importance of Continuing Research by Teacher Educators

Probably the greatest single need is for all industrial arts teacher educators to develop a deep awareness of the importance of assuming personal responsibility for continuing research. In spite of all difficulties, if the importance were actually perceived by the profession, ways and means would be found to conduct worth-while research.

Professional meetings of industrial arts teacher educators might well be devoted to a consideration of ways and means to clear away obstacles so that teacher educators could carry on research as a regular part of their professional assignment. Study groups within several geographical areas might well be formed to give their attention to this problem, and to bolster and consult with each other on their research plans and activities.

Preparation for Research

It is extremely doubtful whether the present graduate program of preparation for research study is effective. Certainly, it has not produced an eagerness among industrial arts teacher educators to engage in research throughout their careers. It is entirely possible that

the present research experience of the graduate program is so distasteful that research becomes something to be avoided.

A way must be found to communicate the challenge and excitement of research. Attention must be devoted to the improvement of the research experience of the graduate student. Experimentation should be undertaken in ways of helping graduate students to identify, explore, define and plan their problems, since it is at this stage that many capable graduate students flounder. Ways that are found successful must be communicated to others who are working with graduate students.

As many labor saving devices and adequate consultative services should be put at the disposal of the graduate student as possible. This is very important to his feeling of success. Little is to be gained by the graduate student through sheer clerical labor and through uncertainty.

Professional groups of teacher educators, directly involved in guiding research studies, might profitably meet and study the problem of improving the graduate student's research experience.

Throughout their preparation, undergraduate students should be made aware of research studies and the implications of the findings. They should all be involved in research type experiences throughout their period of undergraduate preparation. The development of an individual laboratory project can be handled in such a way that it becomes a research type experience. This can lay the groundwork for later experiences, where a small group of undergraduates might actually work with a staff member in the conduct of his research. This could provide an incentive to continue utilizing research in their teaching, as well as helping to identify students who should be encouraged to prepare themselves further.

Facilities for Research

Many higher institutions have done little about providing adequate facilities for research. These facilities might well include the provision of devices and aids to simplify the laborious processes of tabulation and computation. In addition they might provide more effective consultative services to staff members than they have typically done.

Much needs to be done in the area of providing an atmosphere within the industrial arts department which is conducive to the conduct

of research. The group itself might consider how a load might be lightened from time to time, so that individual staff members might carry on research without great penalty to themselves and their families.

Another need seems to arise in connection with the opportunity to communicate with fellow research workers in their own field. It is especially important to get the ideas of many in the early planning stages of an inquiry. The opportunity to discuss ideas thoroughly with others competent in the same field provides a critical review of the research ideas, and helps to clarify the ideas to the point of making them researchable. Perhaps industrial arts teacher educators located in institutions in geographic proximity might form an informal alliance for such a purpose.

Financing Research

After the war, the United States government attempted to buy research in the behavioral sciences on a grand scale. The action seemed to assume that creative ideas could be purchased without difficulty. Perhaps this approach has been successful in producing more rapid technological improvements, but has thus far produced little of note in the behavioral areas.

Money for educational research is available. The problem lies in its distribution. Generally speaking, the project type of research, for which financial support is rather readily available, has in it many of the dangers which face the graduate student in his research. Often the investigator loses his freedom in a maze of minor regulations, but more important, he loses his freedom to follow promising leads. He is forced to keep his eye on the pre-determined goal. The project type of research can easily lead to abandonment of an individual's long range program of research. Finally, it is likely to lead to fragmentation and distortion of the total program of industrial arts teacher education.

It might be far more productive to seek ways of financing individuals to carry on whatever research they wish. This might be done through grants to faculty members during the summer time. In the case of members of the profession who have made research contributions, funds might be utilized to free them for an entire school year to carry out a part of their research program. Above all, it must be recognized by the entire profession that not all research leads to a useful product. It is as important to discover what is untenable, as it is to dis-

cover what is tenable. All in the profession must give their support and encouragement to the conscientious research worker.

Questions

There are many questions which merit thorough discussion by industrial arts teacher educators. A few of these questions are:

1. Is research a function to be performed by a research specialist employed on the industrial arts teacher education staff for that purpose?
2. Should the educational preparation of research workers in industrial arts education differ from the preparation of other professional workers?
3. Is public school teaching experience essential for those who have the creative ability and the desire to do research in industrial arts education?
4. How can individuals with strong creative research potential be identified, prepared, and encouraged?
5. Should a few institutions of higher education in the United States develop specialized facilities and specialized programs for preparing industrial arts research workers?
6. Should the American Council on Industrial Arts Teacher Education sponsor the development of active research groups from within its rank?

Conclusion

The situation with regard to research work as a continuing activity by industrial arts teacher educators is a shocking one. It represents one of the darkest blots on the reputation of the profession. If research in industrial arts education is to ever develop beyond the stage of an information gathering activity, it must develop its own body of concepts, theories, and principles which are adapted to its own field. This cannot be done by depending upon graduate students for the major share of research. Mature industrial arts teacher educators have no choice but to develop and carry on programs of research as a regular part of their professional responsibility.

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CHAPTER IV

Analytical Procedures for Scientific Research

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The meaning of research and its place in the scientific study of education have amply been dealt with elsewhere. Attention now needs to be directed to the nature of research and the procedures that are employed in scientific study.

Nature of Scientific Thinking

To understand the fundamental basis of research, one must probe deeply into the nature of scientific thinking. This aspect of man's creativity has passed through many stages of evolution. In the search for truth, for that in essence is the purpose of research, man has appealed to five sources of evidence: (1) custom and tradition; (2) authority; (3) personal experience; (4) syllogistic reasoning from apparently self-evident propositions; and (5) scientific inquiry. Man has found understanding and truth through all of these sources. However, as time passed, he found better sources than custom and tradition, authority, and personal experience from which to gain the insights that lead to truth. Throughout the long medieval period, the appeal to syllogistical reasoning dominated. Today, scientific inquiry is of paramount importance, although the other sources play important roles in man's current intellectual processes in solving the mysteries of life and nature.

It is to scientific inquiry, and its nature, that attention must be centered. The scientific method of research has for its aims the discovery, establishment, and explanation of the uniformities of nature. It is a double movement of thought, involving both inductive and deductive processes. Scientific thinking proceeds from partially known and often confused data, gathered from experiences and all manner of sources, to universal relationships expressed in terms of assumptions, hypotheses, laws, principles, and propositions. This process is followed by a counter-process, deductive in nature, which seeks

to verify and prove the hypotheses set forth in the process in order to bring their logical implications in line with the facts of the case. Scientific thinking, then, starts with facts and returns to facts to test and verify hypotheses.

Steps in Scientific Thinking

The logical steps involved in scientific thinking have often been set forth. A simple statement of these includes: (1) a preliminary observation of facts; (2) the formulation of an hypothesis; and (3) the testing of the hypothesis by a careful analysis of the pertinent data. A more elaborate outline of the steps involved in scientific thinking might include the following: (1) the identification and delimitation of a problem; (2) the survey of past experiences with the problem including the study of previous investigations of the problem; (3) the formulation of an hypothesis (or of hypotheses) representing a tentative solution of the problem under consideration; (4) the collection of data pertinent to the problem and to the hypothesis set up; (5) the careful study of the hypothesis in relation to the data gathered in order to check for agreement with facts, verifiability, and logical consistency; (6) the collection of additional data as a means of measurement, observation, and experimentation; (7) the analysis, classification, and summarization of data; (8) the formulation of new generalizations which emerge from the treatment of the data and which represent observed uniformities, explanatory principles, or scientific law. It is then quite obvious that scientific thinking begins with facts and returns to facts. The final result, of course, is generalizations drawn from sound data that have been treated by sound methods of analysis.

Certain distinguishing features characterize scientific thinking. It appeals to facts. It involves the method of analysis. There is the formulation of an hypothesis. Scientific thinking is free from emotional bias. It employs the tools of objective measure. It uses quantitative methods in the treatment of data.

Selecting a Problem

The serious student of education who wishes to engage in scientific research is first confronted with the task of selecting a problem. There are those in education who will deny the presence of problems in even their chosen field in education. There are others who are not concerned with problems. These are not the ones who will

seek to engage in scientific research. Their place in education might well be questioned. It is not difficult for one to sight problems in his field if he has a keen sense of observation. Despite the enormous production of master's and doctor's studies, there are still problems in education that require study. The inability to recognize problems is not tantamount to saying no problems exist. Out of one's own experience and out of the experiences of others, there emerge problems whose solutions would result in the advancement of the science of education. How, then, does one equip himself to identify problems of stature and dignity. A few suggestions for identifying problems include the following: (1) become a scholar in one or more specialities; (2) read, listen, and work critically and reflectively; (3) look to every obstacle as a roadblock bulging with problems; (4) start an investigation and watch the problems it germinates; (5) keep a systematic record of original ideas and a list of problems either solved or in the process of solution. Educational literature is replete with reports of problems under study and those crying aloud for solution. Hints, too, are given of problems not yet clearly delineated or identified. Those seeking problems, or a problem, are urged to read widely the reports of research completed in the numerous fields of education, to seek out authoritative statements of completed research, to trace and analyze trends, to review critical statements of leaders in the field, to probe educational prophecies, to follow research underway, and to keep a listening ear and a keen eye on suggestions made for further research by those working in the field. There are ample sources to which the student may turn to find problems of worth and dignity.

In the final selection of the problem for research, the investigator should assure himself that data for the study exist, that these data may be gathered, and that he possesses those competencies necessary for the analyses and scientific treatment of these data. Moreover, the investigator must honestly be challenged by the problem and he must personally have an affinity for it. The researcher lives with his problem twenty-four hours a day for as long a period as the solution takes. A certain compatibility, or rather felicity, must obviously exist between the investigator and the problem he chooses. Herein is one of the weaknesses in schemes whereby the investigator is given the problem to solve by an outsider. An outsider may suggest, but the eventual choice had better be the free choice of the investigator. The library and its files, the field and its ramifications, the investigator

and his experiences, the research professor and his experience--all are fruitful sources from which one can pick his problem. The process of selecting a problem should not be a hurried one; it should be a considered, sober, and tempered choice. Aid and advice, suggestions and hints from colleagues and professional workers of course should be sought; but the final choice should be a whole-hearted one by the individual who is to conduct the research.

Types of Research

Problems of worth and dignity are of many sorts. In fact, the areas of scientific research have often been classified. Each classification has a methodology of its own, but all these methodologies are in agreement and follow the canons of scientific thinking. Certainly no classification of research methods is satisfactory for all purposes and, obviously, not for all investigators. Historical research is considered a fundamental approach to educational truth. The historical method, to be described in detail somewhat later, involves the painstaking examination of original sources and documentary study. The normative-survey research utilizes such tools and procedures as questionnaires, tests, check-lists, rating scales, score cards, and interviews. For this type of research, specialized techniques for making comparisons have been developed. These include techniques for measuring central tendencies, for detecting causal relationships, and for making predictions. The experimental research is another major division of research. The classroom and the laboratory are utilized in this area of research and the processes of controlled observation and precise measurement are employed. Differences which appear when all factors save the one controlled and equated for in groups or subjects are noted and analyzed. Writers on research methods often list other types of research, for example the case and genetic methods, but these can readily be subsumed under the three major headings.

It may be said at this point that all research need not result in the awarding of the doctor's degree, nor of the master's degree. Research leading to the higher degrees is a very small and specialized area of research. The training prescribed by the universities offering doctoral work is, however, excellent preparation for research. The purpose of research, as it has been said, is to seek truth.

It is evident, therefore, that much research can be done without reference to university degrees. A most unfortunate occurrence is the

direful fact that the final thesis is the last piece of research done by the possessor of the coveted degree. It would be far more effective if that thesis were to be the first piece of research and that the newly-designated doctor would embark upon a long and fruitful career of truth-seeking through research. His educational training has prepared him for just such work.

Outlining the Problem

Once the researcher selects his problem two steps lie ahead of him. The first is to prepare a blueprint or a prospectus of the research and the second is to prepare the final report after the data have been collected and analyzed and after conclusions have been drawn and interpretations made. The prospectus is written in the future tense because it indicates just what steps will be taken in solving the problem. It is the document that the investigator will present to foundations, to authorizing agencies; and it will serve as a guide throughout the course of the study. The final document is couched in the past tense for it represents a log of what has been done. Both documents, however, cover identical topics.

First is these two documents, and perhaps the last step the investigator takes, is the formulation of a title. The title of the problem should be concise, descriptive, and accurate. It should include only the general delimitations of the field, time, place, and size or scope of the study. "A History of Industrial Education of Less-than-College Grades in the New England States, 1917 to 1929", is an example of a terse topic. "A Survey of the Hobby Interests of Men over Sixty-Five Years of Age in the New York City Area", is another. The title should be cast in the nominative form and not as an interrogation.

The title is followed by a general statement of the purpose of the study. This is usually stated in terms of the uses to which the study results may be put.

The next task the investigator faces is that of analyzing his problem with its component parts. A well-defined problem can usually be resolved into from two to four subordinate problems. The solutions to the subordinate problems taken together constitute the solution to the major problem. Suppose the purpose of the study is to investigate the relationships of selected parts of the high school record and of certain standardized test scores to the academic success in selected curricula in three technical institutes in New York State. Then three subordinate problems might be:

1. What are the relationships between these selected parts of the high school records and these standardized test scores to the success of these institute students?

2. Are there differences among the different curricula and the different institutes in regard to these relationships?

3. What are the implications of these relationships for the selection of technical institute students and the guidance of high school students regarding possible technical institute curricula?

The investigator who selected this problem for research attempted in these three subordinate subproblems to break it down into its component parts. He must now devise methodologies by which he can secure the data he needs and procedures by which he can analyze and treat these data.

Scope of the Problem

Novice investigators frequently make the mistake of selecting a problem far beyond the scope of a single individual's capacity to finish in a reasonable length of time. It is true that in the days of the high Renaissance, artists worked for twenty or more years on the painting of a single altar piece, but the tempo of life today is vastly different to those days when craftsmen devoted their lives to the creation of things of beauty. It is necessary for the present-day investigator to circumscribe his problem, to limit it, and to set boundaries to it. Limitations and delimitations are, therefore, stated at the outset. Limitations affect the assurance or scope with which generalizations are made. Such limitations which are stated at the outset are reviewed later at the time generalizations are made. The limitations must be admitted and indicated. Limitations may involve the smallness of the samples, the soundness of measures, the unreliability of opinions, the human errors of operation and manipulation, and the absence of desired controls. Delimitations are prescribed boundaries of scope and size, and the extent of these boundaries determine the frame of reference to which subsequent generalizations will apply. These delimitations are set by expediency or by necessity of finances, personnel, time, and similar circumscribing factors.

Terms and Definitions

The use of terms of a technical nature and those whose meanings are not always rigidly defined often confuse those who read the

results of research. Certainly among professional people educators have been loose and cute in their use of terms and not too careful in definition. The jargon "pedagese" is deservedly in bad odor in the field of research. It is wise, therefore, for the investigator to define the terms he plans to use in order that there be no semantic fog. This should be done immediately after the statement of the subordinate problems and the limitations and delimitations of the study. Terms of a technical nature and those used in any rare or special sense should be defined. Where citations from the literature might crisply define words or concepts, these should be included and properly footnoted. It may not be necessary to define "boy" or "girl" or "school," but it may be necessary to define "elementary grades" and "technical institute." If the investigator understands the purpose of this section of his study, to clear the air semantically, he will encounter little difficulty in developing the list of terms he should define.

Assumptions and Hypotheses

Now comes the important tasks of setting forth the basic assumptions on which the study will proceed and setting up the hypotheses which are to be tested. Beginners in research are often confused at this point and unable to recognize the difference between an assumption and an hypothesis. Assumptions are those underlying conditions believed to exist without need of proof. They are axiomatic in nature. An assumption might be that in a random sample of sufficient number a normal distribution will exist. It might again be assumed that the test battery selected by the investigator will provide the data that he is seeking in the solution of his problem. Likelihood that the basic assumptions are met should be high. Many investigators violate their stated assumptions. A frequently violated assumption is that subjects are randomly selected when a definite bias exists. Another example of a violation of an assumption is assuming a normal distribution when the distribution is actually skewed.

An hypothesis is a preconceived conclusion which it is the purpose of the study to test. The ability to formulate hypotheses has greatly facilitated the progress of science. The researcher as he studies his problems is confronted by many promising hypotheses. He must select from these those which are most reasonable and most promising. These then become working hypotheses and they serve to guide the investigator in planning his inquiry and they instigate and

direct the data that are to be collected and treated. Often, several reasonable hypotheses may be in agreement with the data. It is necessary then to collect fresh data in order to differentiate among hypotheses.

Sometimes, one hypothesis may be accepted in preference to others, even without the collection of new data. An hypothesis that a scientific investigator favors in the examination of his data is that chance is the cause of the effect or that the observed variations are attributable to random factors giving rise to random errors rather than that they are the resultant of newly identified causes. This kind of hypothesis lends itself to statistical evaluation more readily than the positive assertions so frequently employed in non-technical inquiries. This hypothesis is preferred because it involves a basic canon of science -- the law of parsimony. This law or principle suggests the use of the simplest explanation of the facts and the one which introduces the least number of new quantities, constructions, or ideas. The aim of science is to explain a maximum number of facts with a minimum number of concepts.

Every hypothesis must have testability. It is basic in science that its content must be capable of being refuted if it is to have a scientific meaning. This sort of hypothesis is known as the *null hypothesis.* In this form, an hypothesis is never confirmed, but it may be rejected. An experiment permits the facts of observation to refute the null hypothesis. The usual form of the null hypothesis is that there is no difference in the effects of the treatments under comparison except those arising from sampling or other chance factors. For example, in an experiment involving a comparison of two teaching methods -- the teaching of industrial arts by the usual teacher-demonstration method and by filmed demonstrations -- one form of the null hypothesis would be: there is no difference between the two methods with respect to the postulated outcomes. It could also be stated: the outcomes for the two methods of teaching are the same. The statistician might say it in this fashion: the true difference between the two means of the group is zero, or that the two samples are from the same population.

Once the hypothesis (or the hypotheses) is set up, the investigator then devises a method by which he can collect the data he needs and identifies procedures by which he can analyze these data.

It must be remembered that not every piece of research involves an hypothesis. For example in the study, "A Survey of the Leisure

Time Activities of Teen Age Boys in a Metropolitan Area," no hypothesis need be set up. There will, of course, be certain assumptions. Two of these would surely be that the sample of boys selected is a random one and that the instrument designated to gather the data is a proper one for the purpose to which it is to be put.

Previous Studies

Every investigator wants to know just what has been done in his field up to date. He wants to know what studies have already been made and how these were set up. He wants to know the methodologies employed by previous investigators and he wants to know what findings appear in the pertinent literature. He, therefore, must search the literature of his field and of those fields that impinge upon his own.

Once the investigator has identified, analyzed, and delimited the problem which he wishes to investigate, it is necessary to make a careful and thorough study of the progress of human inquiry in the field of the problem area selected. This is a most essential orientation for the investigator at the beginning of his research. Eventually, this review of related literature will take the form of a selected and annotated bibliography and an adequately organized chapter or section near the beginning of the final report or thesis. This chapter will consist of a critical analysis and evaluation of each research report cited and will succinctly present a statement of the problem of the research, the methodology employed by the researcher, and a summary of the findings; it will also indicate the relationship of the research to that contemplated by the current investigator.

The working bibliography will grow out of the investigator's experience, his reading, his course work, and his extended search in the library. Previous studies, theses, bibliographies, professional journals, reports of professional societies, and yearbooks are but a few of the more obvious sources that he will consult. The volume, *How to Locate Educational Information and Data* by Carter Alexander and Arvid J. Burke[1] offers some excellent tips of sources for the investigator to use. Expertness in reading ability and in note taking (and note filing) are requisite for success in canvassing the field of related literature. The investigator must always have in mind the

[1]N. Y. Bureau of Publications, Teachers College, Columbia University, 1950.

objectives of his research in order that he may effectively screen the materials to be examined.

Reporting the Previous Research

In addition to skill in rapid and careful reading, the investigator must be able to digest what he reads and to make terse and cogent summaries of each previous research that bears upon his problem. In his annotations, the investigator must identify completely the research he is citing. In the chapter or section on related literature, he should give the name of the earlier investigator, the purpose of his research, the research pattern designed and followed, the findings or generalizations derived. A good example of reporting research follows:

> "Alpern[1] attempted to identify the ability of a group of high-school students to test hypotheses and to discover relationships that might exist between this ability and I. Q., reading ability, chronological age, sex, and previous experience in high-school science. In order to accomplish the first purpose, he constructed two tests, one to measure the ability to suggest procedures to test scientific hypotheses and the other, to measure the ability to select procedures to test scientific hypotheses. He concluded that the relationship between this ability and I. Q. is positive but low, with chronological age is negative but low, and with reading ability positive and low.
>
> "He also found that boys and girls were equally able to test hypotheses. He further noted that science students with no special training in the use of scientific method demonstrated the ability to suggest and select procedures to test scientific hypotheses, and that the relationship between this ability and previous terms in high-school science was positive and low."

In footnote citations in the body of the research report, the Arabic number which indicates the citation should follow closely the name of the author. This number should be placed about a half space above the line. The citation itself should be single spaced and separated from the body of the material by a triple space. Dashes may be

[1]Morris L. Alpern, The Ability to Test Scientific Hypothesis, Ph.D.. Thesis. New York. New York University, 1944.

used at the left or center in the middle of this triple space. In the citation reference, the initials or the given name precedes the last name; the order thus differs in this respect from that used in bibliography. Book references should be given in this form in the footnotes:

[1]William P. Sears, *The Roots of Vocational Education,* pp. 37-69.

(when the reference is also included in the bibliography at the end of the report)

[2]William P. Sears, *The Roots of Vocational Education.* New York: John Wiley Sons, 1930. pp. 37-69.

If the book is referred to as a whole, no page citation is required. Periodical references are slightly different in form:

[3]F. M. Thrasher, "Social Background in Education," *Journal of Educational Sociology.* October, 1927, p. 73.

In the bibilography, it is customary to include the number of pages in each book cited (this includes the prefatory pages as well as those in the body of the book, i. e., XXI and 481 pp.).

The bibliographical survey of related factual, experimental, theoretical, and historical materials orients the investigator and the problem in terms of the adequacy of the available evidence, current ideas and hypotheses, and appropriate methods of research.

The section on related literature should, as a sort of by-product, give a picture of the historical background of the problem under investigation. If, however, the investigator wishes he may, at this point, develop a section on the background of the problem and the treatment it has been given up to date. This section should lead to a rather full section on the need and significance of the problem. In this section, the researcher should make a sound case for his study. He should be careful to point out just how his study and his findings will contribute to the field. To his own thinking, he should add what others have said about the problem and its significance. He should cull the literature of the field, the annual reports of the societies of the field, and the considered statements of respected leaders of the field. It is well, too, for the investigator to indicate here just how he became interested in the problem and how he is ultimately involved in the study.

Designing the Research Study

The most important part of the research must now be approached. This is the development of the overall design of the research and the selection of appropriate methodologies and procedures for the collection and treatment of the data. Each study calls for a unique design and a suitable methodology. In the study, "The Craftsmen of Colonial New York City," for example, the investigator must employ the methodologies of historical research. Such a study might have a theme rather than an hypothesis. Its theme might well be stated as follows: the craftsmen of colonial New York City possessed skills and artistry worthy of note. With proper delimitations set, such as the period, the locale, the crafts, the investigator is ready to set up his design. He must ask himself four basic questions: (1) What data do I need to present my study; (2) Where are the data; (3) How do I get the data; (4) After I secure the data, how do I treat them?

In regard to the first of these queries, "What data do I need?", the investigator must turn to the subordinate problems which grew out of the analyses of the general statement of the problem. Let it be supposed that one such subordinate problem dealt with the apprenticeship system as a means of training the future craftsmen of colonial New York City. The researcher must now ask himself what he wants to know about apprenticeship in the period under consideration. He must make a tentative list of the items he wants to look into. When he plunges into a study of the sources, they will in turn suggest further items for study. Once the investigator identifies the sort of data he requires, he must pose the question concerning the location of such data. Here he must call upon his knowledge of the canons of historical research. He must employ functionally his knowledge of the suitability of both original and secondary sources. He must use the original sources, he must search for their existence. In the study suggested above, he must investigate thoroughly the archives of the libraries, the historical societies, the municipal offices, and even the collections of private owners. He will have to look into public and quasi-legal documents, the ledgers and the journals of craftsmen, bills and receipts, letters, and even the newspapers of the day. As he examines the sources, both original and secondary, he must apply two most important tests. He must look for the genuineness of the material. This is the test of external criticism. Specifically, the problems of external

criticism involve the questions of authorship and textual criticism to determine all the conditions that may have influenced the production of the document and what part of the document is true to the original. Influencing conditions include such factors as time, place, purpose, and circumstances of composition. The investigator will seek answers to such questions as, "Who was the author?" This implies not merely what was his name but what were his personality, character, position, and his purpose? He will want to know the author's qualifications as a reporter, his alertness, accuracy, bias. He will want to know if the author were an interested or disinterested observer. It is well, too, for the researcher to look into the general and technical knowledge possessed by the author for learning and reporting. One will want to know, too, how soon after the events was the document written and was it written from memory, after consultation with others, after checking facts, or by combining earlier drafts. Especially, the investigator will want to find out how the document is related to other documents --Is it wholly an original source? If not, what parts are original and what parts are borrowed? How accurately was the borrowing done? These are some of the questions the investigator will want to employ as he checks for external criticism.

Next, the investigator applies the test for internal criticism. After questions of authorship and genuineness have been answered, it remains for internal, or higher, criticism to determine the accuracy and value of statements made. The shift of emphasis is from the document as such to the statements made in it. The author's motive for writing the document should be examined. Distortion, bias, and contradictions must be ferreted out. When more than one statement concerning a given event is available, those which survive the tests of external and internal criticism are subjected to additional tests in terms of whether they are: (1) made by independent observers; (2) made by different observers; (3) made by different groups with varying affiliations; and (4) made under different conditions.

As the investigator locates and approves the data he proposes to use, he must devise a plan for collecting the data. In the case of survey results, he will want to have a form or chart on which he will record the returns. In an historical study, such as the one suggested above, he will want to have a plan for his reading, he will have to know what he is reading for, and he will have to develop a system of

note taking. Each investigator will work out a scheme that will best suit him. When it comes to treatment of the data, the investigator who is using the historical method will have to identify just how he will present his material. It will undoubtedly be presented in narrative form, perhaps with some maps, charts, and tables. But will the material be presented in chronological order, or in a topical order? Again, it is for the investigator to elect the method which does most justice to the data he has gathered and which most adequately develops his theme or tests his hypothesis. In brief, these then are the steps of the researcher who selects a study involving the method of historical research. It might be said in passing that the field of industrial education, including both industrial-arts education and vocational-industrial education, abounds in problems of worth and dignity as yet unsolved. The great work of Charles A. Bennett has never been carried forward, and the pages of this respected historian in the field bristle with suggestions for more intensive studies of many of the items merely touched upon by Bennett. Many of the agencies offering practical education are of sufficient age to merit studies that might reveal the problems that they faced in their development and the ways they went about solving them. Their histories will reveal their strengths and their weaknesses. Trends will emerge from such studies, and the story of the past may, if critically studied, help present workers in the field to develop solutions to the problems they face. Research into the history of the field need not result in musty, dust-gathering tomes but may very well present the field with lively, effective, and useful knowledge that can be applied to present situations.

Researchers are directed to the standard works on the methodologies of educational research for the specifics and for the detailed descriptions of the procedures of collecting and analyzing data. A list of these will be found at the conclusion of this chapter.

The Normative-Survey and Sampling

For those who select a study in the realm of the normative-survey, some hints may be of use. Such a study might, for example, be "A Survey of the Difficulties of Beginning Industrial-Arts Teachers." After the researcher has analyzed his study into its component subordinate problems, set forth the limitations and delimitations, and defined obscure terms and those terms he is using in a unique way, he

will want to identify the sample from which he will gather his data. Here, he will want to study carefully one of the standard works on educational statistics to insure that he proceeds correctly in taking a sufficient number of cases. He will want to be certain that, in addition to having a sufficient number of cases, his sample is representative of the total universe from which he is drawing. There are ways in which to do these things and the standard texts on educational statistics point the way. The primary purpose of any sampling procedure is to obtain a sample which, with restrictions imposed by its size, will reproduce the characteristics of the population with the greatest possible accuracy. The state superintendent of schools, in the problem suggested above, might be asked by the investigator to select a sample of "typical" schools which may be used to study the difficulty of beginning industrial-arts teachers. Or, as sometimes is the case, he might specify "representative" schools in which the beginning teachers might be studied. Such samples, with all due respect to the pontifical figures on the state superintendency level, are of little value to a critical investigator. Their principal defect is that they are likely to be biased. The tendency of school authorities to select all schools that are better than "average" enters in. Even if school officials try to be entirely objective, errors in judgment all acting in the same direction may occur, outweighing any improvement in accuracy which might result from a deliberate selection of "good" schools. Two types of sampling errors are thus obvious: (1) those resulting from biases in selection; and (2) those that are attributable to chance differences between the elements of the population which are included and excluded in the sample. These errors are referred to as (1) error due to bias and (2) random sample error. Since no objective conclusions can be drawn from samples that are biased, it is important for the investigator to be certain that he has carefully controlled the selection of his sample.

Aside from errors due to bias, the simplest means of increasing the accuracy of the sample is to increase its size. Other factors being equal, the size of the random sampling error is approximately inversely proportional to the square root of the number of the units comprising the sample. The accuracy also depends upon the variability per unit of sample; or more accurately stated, on that portion of the variability per unit that contributes to the sample. Modern sampling techniques,

while placing restrictions on fully random selection, serve to reduce the variability per unit contributing to sampling error and thereby to decrease the size of the sample required for a given accuracy. Investigators should seek expert guidance in their selection of the sample with which they will work. Such guidance may be sought, as stated before, in the texts on research methods and statistics, or from seasoned and well-trained research workers.

The Survey Instrument

After the sample has been carefully and wisely chosen, the investigator next will turn his attention to the instrument, or instruments, by which he will gather his data. Questionnaires, opinionaires, check lists, rating scales and tests have been developed by research workers over the years. The methods by which they developed these instruments have been described in their studies and they offer much in the way of help to the researchers. Especially important to note are the methods they used to test the validity and reliability of their instruments. Fortunate indeed, but seldom, is the situation where the investigator finds a questionnaire or other instrument already validated and found reliable which he can use in his study. Most often, he must design and test his own instruments. An exception here is, of course, the whole list of standardized tests which have been worked over by scholars and whose validity and reliability have been tested again and again with different populations.

The questionnaire is so frequently resorted to in educational research that many of the errors that characterized early questionnaires now ought to be avioded. Sufficient has been written on the initial steps to be taken in constructing a questionnaire and the subsequent tests of its validity and reliability that it is needless to rehearse these matters once again. The same can be said for the opinionaire, the rating scale, the check list, and the structured interview. These are all devices which, if properly constructed and validated, can yield sound data.

One word of caution should be said about the use of juries. Unless this technique for validating data-gathering instruments is very carefully controlled, the jury scheme may serve no useful purpose and may contribute to very serious errors. The proneness with which

educational researchers turn to the jury method is alarming and quite the fashion these days. The jury method of validation can be sound if the jury is properly selected and given specific and objective directions on just what they are to do. On the other hand, the jury method may be buck-passing draped with the academic toga.

If a jury is to be selected, one must indicate the basis for its selection, how the jury is to be employed, how the judgments will be pooled, how the jury results will be determined, what per cent of agreement is necessary, or what proportion will be used.

The specifics of questionnaire design and format, the size and color of paper on which the questions appear, to print or not to print, the time to send, the covering letter, the reply sheet--all these details are covered in the literature on the questionnaire. In the same literature will be found hints on the amassing and classification of the data. It is not enough for the investigator to say, "I shall graph the results." He must indicate whether specific graphs such as bar graphs, line graphs, pictographs, scattergrams, and the like will be used and how. If norms are to be established, one should state if there is to be only one norm or if there are to be different norms for sex, age, ability, or grade level.

In the field of industrial education, including industrial-arts education, there is room for literally hundreds of surveys of present practices in the field. The surveys may deal with pupil characteristics, pupil interests and needs, teacher needs and interests, supervisory and administrative practices, integration with academic and technical work, and the like. Again, the survey is not for the top shelf, rather it is for the top drawer where the results gathered and the findings may serve as a sound basis for recommendations for improved and enriched practices.

Experimental Research

True experimental research is not to be entered into lightly but discreetly and, perhaps, in the fear of God. It is an area of research that is of great potential worth. The whole field of industrial education cries aloud for sound theories of an experimental nature. In their place, the field suffers from the plethora of ukases issued by

those who wear the purple of office. The pronouncements of the pundits are a sorry substitute for the tested results of experimental investigation. It would be futile to give any complete treatment of the methods of experimental research here. The reader is urged, therefore, to consult the many fine treatises that have been written in this field. It might be well, however, to mention a few items of especial importance. Controlled experimentation in education is indeed recent in origin. Early attempts to use the experimental method in education were impeded by inadequate control of the educative factors involved and by lack of the instruments of measurement. Expressed tersely, the experimental method represents the method of difference; that is, to note the effect of a single variable applied to one situation or group, but not applied to a comparable or equivalent group. The major procedure involved in experimental research is that of controlled observation, with an attempt to hold all factors constant except the single variable the effect of which is to be measured. Experimental procedure is the classic method of science, and it is frequently urged as the ultimate methodological goal of any system of investigation. Nevertheless, the experimental method has distinct limitations in the fields of the social and biological sciences. It is necessary sometimes to correlate the methods of historical research, of the normative-survey, and of the experimental approach in attacking certain problems. The purpose and the problem involved may call for just such an approach.

The Observations

The accuracy of observation, so necessary in the experimental method, has been greatly increased by standardized tests, mechancial controls, repeated observations, and statistical techniques. Intellectual curiosity and the ingenuity of the investigator are at the heart of the experimental approach. Pioneer work has been done, and can be done, without the elaborate and expensive equipment often thought necessary for laboratory experimentation. Archimedes, Galileo, and Helmholtz are cases in point. Most educational experiments are conducted in the classroom where the investigator works with groups rather than individuals. In the field of vocational rehabilitation, on the other hand, the experimentation may be with individuals and may

involve the techniques of the case study method. McCall[2] described group methods decades ago, and his description is still of value. This respected researcher spoke of the one-group method, the equivalent or parallel-group method, and the rotation-group method. A one-group experiment has been conducted when one thing, individual, or group has had applied to it, or subtracted from it, experimental some factor or factors and the resulting change or changes determined or measured. This is, perhaps, the simplest of all experimental procedures and the most feasible for classroom use, although probably the least valid. An example of such an experiment might be stated as follows: suppose it is desired to determine the effect induced by a different mental set on scores on a standardized reading test. The pupils may take one form of the test using the regular printed directions accompanying the test. Scores on this form serve as a norm against which to check performance on other equivalent forms of the test when the experimenter has sought to induce specific mental attitudes such as encouragement or discouragement. Essentials of the one-group method are: (1) an initial test, the application of an experimental factor, and a check on results; (2) a second preliminary test, the application of a second experimental factor, and a check on results; and (3) as many other styles of preliminary testing, experimental procedure, and end testing as desired.

The parallel-group procedure represents an attempt to overcome the limitations of the one-group method, since two or more groups, as nearly equivalent as possible in all respects, are used at the same time. Only a single variable is manipulated, and under as carefully controlled conditions as possible. To one group may be applied the variable, or experimental, factor, with the parallel group serving as the control for comparative purpose, following a customary or non-experimental procedure. Or, if different phases of the experimental factor may be applied to the equated groups, although in such a case, a third parallel group, following a non-experimental plan, is desirable to serve as a control for purpose of comparison.

The rotation-group method involves the reversal of the groups at intervals, in terms of the procedures designed. This method is often employed when parallel groups are not available or when there is doubt

[2]W. A. McCall, *How to Experiment in Education,* Chapter II. New York: The Macmillan Company. 1923.

about the equivalency of the groups. An excellent check list of items to be considered in designing and carrying through experimental work may be found in Bixler's[3] *Check-Lists for Educational Research.* This list includes items on experimental methods, the subjects selected, the materials of experimentations, the place of the experiment, the time of the experiment, equating groups, and the control and measurement of experimental and irrelevant factors.

Statistical Significance of Findings

The investigator now approaches the crux of his endeavors. This is the matter of his findings and their significance. It is necessary to establish the statistical significance of the findings that are revealed in the data collected. A way must be sought to demonstrate that the results may not reasonably be attributable to chance alone. The statistical formulae which are used to estimate the part that chance does play often have exacting requirements. It is pertinent to note that the use of these statistical procedures results only in an approximation of the frequency with which chance alone might account for the results obtained. Through the use of these "error" formulae, it is not possible to rule out absolutely the possibility that the particular difference obtained in any specific study would occur by chance. One can simply say that "a difference of this magnitude occurs by chance only x times in a hundred." Then one goes on to argue that it is reasonable to assume in the circumstances described that chance was not the probable cause of the difference obtained.

In approaching the statistical significance of the difference one must ask how many times in a hundred can a difference be attributable to chance, and yet be acceptable. There is no one answer to this question. It is becoming a standard practice to accept five times out of a hundred (the five per cent level of significance) as a proportion that reasonably rules out the idea that the results can be attributed to chance. There are occasions, however, where the investigator may look for the one time out of a thousand when the results could be attributed to chance. For example, if one is going to spend millions of dollars and invest thousands of hours of teachers'

[3]H. H. Bixler, *Check-Lists for Educational Research,* pp. 15-21. New York: Teachers College, Columbia University, 1928.

time, it may be necessary to reduce the element of chance to one in a thousand. In other cases, ten times out of a thousand may be sufficient.

A single experiment may reveal that chance may be the explanatory factor for a difference in ten times out of a hundred. A repetition of the same experiment may show chance operating at the level of sixteen out of a hundred to explain the same difference. A third trial might reveal a difference that could be explained by chance in eight times out of a hundred. Formulae exist for combining these probabilities to test the hypothesis that a series of experiments, no one of which shows statistical significance at the five per cent level of confidence may, in combination, yield an estimate that chance may account for the consistency of results, in a proportion that may be even less than the conventional five per cent level of confidence.

When an investigator has demonstrated that chance may not be a reasonable cause of an observable difference, he is then faced with the task of attempting to estimate what factor or factors probably did exert influence. In other words, statistical significance is a way of minimizing the possibility of chance as a factor. But when chance has been ruled out, the problem remains of explaining what factors other than chance might have been operating.

Professional Significance of Research

The concept of professional significance differs from that of statistical significance. There are numerous ways by which studies come to have a professional significance. Only a few of these ways will be suggested here. A study may be professionally significant in just one way, or it may be significant in a number of ways. Some studies are professionally significant because they cast light on new problems in the field and open up vistas that reveal new problems. Some studies are regarded as significant because they confirm or refute a recent study that is widely quoted. Sometimes the conclusions of a study have bearing upon recently emerged educational trends. Sometimes a research reports findings inconsistent with a widely held theory in the profession. A study may also be professionally significant because it represents a new synthesis of old knowledge, and the newly stated synthesis can be demonstrated to be of value either in the profession or in directing further inquiries. Some studies are significant because they bring together for the first time all the relevant and important information bearing upon a problem of interest to the profession.

And sometimes a study is professionally significant because it represents a contribution to knowledge.

There are several other ways of estimating professional significance. Sometimes new instruments of measurement are devised and utilized in the solving of a problem. Sometimes methods are developed for the reduction of errors in measurement. Techniques are developed for gathering certain kinds of data, and methods are used that make greater use of the data collected. On other occasions, methods are devised for estimating error and when this is done in an area where no such estimate has been possible before, it is considered professionally significant. Studies which achieve greater accuracy in prediction and more rigid control of experimental conditions are professionally significant.

Sometimes professional endeavor in a single community is held back or blocked because of certain difficulties. When these difficulties are identified and taken into consideration, and progress is demonstrated, the solution is regarded as significant because a practical problem has been faced and solved. A study, too, may have significance for the individual who is conducting it. It may represent for him an opportunity for intensive training, for the understanding of a frontier field, and it may serve as a starting point from which he may go on to further research. Sometimes a research is significant because it is part of a larger program of research. All by itself it may seem insignificant but when seen in relation to the entire program of which it is a part, its significance may be demonstrated as vital.

Many studies have a bearing upon social trends, and, thus, can be of social significance. Calculations can be made dealing with financial costs, with amounts of time and energy expended. A particular study may yield a statistical significance at the one per cent level, and yet when that difference is translated in terms of gain per day, per child, or per year, it might be of almost no professional or social significance. On the other hand, conclusions that have some bearing upon social patterns of action or social philosophies, or the operation of social agencies, might be said to have social significance. In all ways, the investigator should examine the outcomes of his study to anticipate their bearing upon social theories and their implications for social action.

Horizontal and Vertical Studies

"Depth" and "surface" are terms currently in vogue, and they represent factors that often have a bearing upon significance. A study may be widely conceived and may be unusually extensive in its sampling of the population. It may develop extensive methods of sampling the kinds of data gathered and it may be directed toward the tentative establishment of norms which are presumed to describe the population. The very extent of the study is a factor in its significance.

Some researchers, on the other hand, are concerned with very small numbers but are very intensive studies of the chosen sample. What is lost in extent is made up for in depth.

"Vertical" studies are associated with continuing research on the same population over longer time intervals, and usually involve the collection, at regular intervals, or similar kinds of data. Vertical studies are immensely important and more of them should be undertaken in the field of industrial education.

A study of behavior changes in relation to growth and development will be most fruitful when the research design is of the vertical style. If the intervals are too widely spaced, if few controls are exercised, assumptions about growth and change may be at variance with the facts. Vertical studies, when directed by clearly defined purposes and when carefully designed, often have significance in distinguishing differential rates of growth.

An examination of several studies, some of which have been completed while others are under way, may serve to clarify some of the purposes and techniques of research. Just four such studies will be presented.

A Research Involving the Historical Method

A research which involved basic philosophy in industrial-arts education and which utilized the historical method is one entitled, "A Study of the Art Nouveau in Relation to Industrial Arts Design." For his original sources the investigator used periodicals, reports, catalogs, illustrations, and historical and critical studies of the period under investigation. This material was treated comparatively and presented in narrative form. The Arts and Crafts Movement was shown to have had two purposes; (1) to promote forthright and honest design; and (2) to overcome the ills of the industrial age by bringing about a new social order in which the worker would be free to create objects

of beauty. Art Nouveau was shown to have been a movement of revolt against tradition, but also a movement of exploration and growth. Manual training, on the other hand, was demonstrated to have been a movement of mixed and confused objectives. The use of arts and crafts forms with their emphasis on medieval treatment and the anti-industrial philosophy of the Arts and Crafts Movement were shown to have been unrealistic and ill-suited to the objectives of manual training. Much closer integration of design with the development of projects to meet the aims of industrial-arts education was indicated as desirable in the education of industrial-arts teachers.

A Developmental Research

Work with the homebound handicapped children has been the concern of many communities. In some cities, provision is made for a corps of teachers to visit the homes of such children. One such teacher was challenged by the interest of the children she visited in the crafts and the paucity of teaching materials for the use of the homebound child, his teacher, and his parents. The study designed by this teacher sought to develop a guide to the crafts for such situations. "Handcrafts for the Homebound Handicapped" was the title selected and it was indicated in a sub-title that the study would result in "A Guide to the Crafts for Homebound Pupils, Their Parents, and Teachers." The purpose was briefly stated: "to develop a guide to the crafts for physically handicapped homebound pupils, their parents, and teachers, designed to meet pupils' needs for creative expression and to complement their interests." An analysis reveals six subordinate problems:

1. To identify the common illnesses or disabilities and resulting limitations of pupils on home instruction.

2. To identify the desires of such pupils for creative expression and their interests.

3. To investigate the principles and practices of the teaching of crafts to physically handicapped homebound pupils in selected areas and communities of the United States.

4. To establish criteria for the selection of projects feasible and desirable for such homebound pupils, and to utilize these criteria in the selection of specific craft activities suitable for such pupils within their interest range and consonant with their need for creative expression.

5. To develop a guide based on the above and designed for the use of physically handicapped homebound children, their parents, and teachers.

6. To validate the usability of the developed guide.

This study is presented to show the way in which the major topic was analyzed into its component parts. Each subordinate problem, it will be noted, is different to the major problem but the solutions of all six comprise the solution of the whole problem. The end result is a guide, validated as to usability, and based on the needs and interests of the chosen population. The value of the guide, however, in actual use as a teaching aid, must be tested after a sufficient period of its use with a sufficient number of handicapped homebound children, their parents and their teachers.

After defining the terms used and after setting delimitations, this investigator listed two basic assumptions:

"1. It is assumed that pupil interest as a motivating factor, when fully exploited, will prove highly valuable to parents and teachers of homebound pupils.

"2. It is further assumed that craft activities selected in regard to the pupil's handicap will provide purposeful and attractive experience for him."

The researcher next moves on to identify the methods to be used in gathering and treating the data. The guide, the end result, represents, then, a teaching aid based on facts and yet utilizing the creativity of the investigator in selecting projects from among the tremendous array of such according to validated criteria for their selection. Such a guide can obviously be a contribution to its field if, in its construction, the investigator follows closely the design developed for the solution of the problem as identified.

A Research in Depth

The problems of the high school dropout and of high school failures have challenged educators for decades. Recently, the figures on both dropouts and failures have startled educators and laymen alike. Especially pertinent are the high dropout rate and the number of failures in some of the vocational-industrial schools. How to predict success in any specialized trade curriculum is something school people want to know. Such a problem is faced in a study entitled, "The Prediction of Success in a Vocational Industrial Automotive Mechanics Curriculum on the Secondary School Level." As in all such predictive

studies, the investigator must be thoroughly versed in the principles and techniques of statistics. First, the investigator in this problem established criteria for success. Here it was necessary for him to set up two hypotheses. The first hypothesis states that selected tests and inventories will yield a prediction of a student's probability of graduating from the three-year curriculum. The criterion needed to test this hypothesis is the classification of a student at the end of the three-year period. At the end of this time each student in the original population will be classified as "graduate" or "non-graduate" in the case he has not completed the requirements set by the school. These dichotomous classifications will provide a criterion for evaluation of the experimental data by the computation of: (1) the biserial correlation coefficient for each experimental variable; (2) the discriminant equation utilizing all experimental variables, and the multiple biserial correlation coefficient; (3) the significance of the contributions of the different variables to the multiple biserial correlation coefficient; and (4) the discriminant equation and multiple biserial correlation coefficient utilizing the significant variables.

The second hypothesis states that selected tests and inventories will yield a prediction of a prospective student's weighted term grade averages, performance scores, and instructor's rankings. The criteria needed to test this hypothesis consists of: (1) weighted term grade averages; (2) achievement scores on a practical performance test; and (3) instructor's rankings.

The investigator must next design a plan for weighting the term grade averages, and he must design a suitable performance test. He must design criteria for instructors' rankings.

In selecting standardized tests to be used throughout, the investigator must have in mind what the literature reveals about standardized group tests in relation to the prediction of the success on the secondary school level. He must also have in mind the practicality of administering these tests in the school situation. It might be of interest to list the tests selected:

1. Clapp-Young Revision of the Henmon-Nelson Test of Mental Ability, Grades 7-12. Form A or B.
2. SRA Non-Verbal: Form AH.
3. DAT Mechanical Reasoning Test: Form A.
4. New York Arithmetic Computation Test, Mixed Fundamentals, Grades 7-12. Form A.
5. SRA Mechanical Aptitudes, Form AH: Tool Knowledge.

A Research in Teaching Methods

Teaching methods in the practical arts is a rewarding field for research. Experiments in this field call for careful design and, again, for statistical competence. The use of visual aids in teaching industrial arts is relatively new. An investigator has been concerned about the efficacy of teaching with slides in the shop situation. His research is an examination of some of the factors which may make slides effective in teaching a perceptual motor skill in a junior high school industrial-arts shop. His major problem is broken down into five specific or subordinate problems:

"1. To select certain significant factors which might influence the effectiveness of 2" x 2" slides in teaching a perceptual motor skill in a junior high school industrial-arts shop.

"2. To select a perceptual-motor skill with which to test the factors selected in sub-problem 1.

"3. To set up a means for rating performance of the perceptual-motor skill selected in sub-problem 2.

"4. To construct sets of 2" x 2" slides to demonstrate the perceptual-motor skill selected. This will include a control and several experimental sets, each differing from the others in accordance with one of the factors emerging from sub-problem 1.

"5. To assess the influence of each factor."

The basic pattern of this research will consist of showing sets of 2" x 2" slides which differ only one factor to equated groups, and testing the effectiveness of each set of slides by comparing the results of the pupil's applying the skill which the slide sets forth to teach.

6. SRA Mechanical Aptitudes, Form AH: Space Relations.

7. Kuder Preference Record - Vocational - Form CH.

8. A School Abridgement of the New York State Reading Progress Test, Grades 7-12: Form A or B.

It is obvious that this is a "vertical" study and one that will take three years, the length of the automotive mechanics curriculum, to collect the data. It is obvious, also, that this investigator must not only be versed in the computation of statistical data, but he must, primarily be able to design his research plan in accordance with the principles of statistical theory. Before he can arrive at conclusions, generalizations, and recommendations, he must not only present his findings, but he must establish their statistical significance.

The groups, it is planned, will be equated by mechanical aptitude scores and reading scores. Each group will consist of an equal number of boys and girls with high, average, and low scores on the two tests, with a total of sixteen in each group. It is expected that there will be seven groups of this size in the school available.

The investigator, with the help of a selected group of educators who are skilled in the area of audio-visual aids and industrial-arts, will select the factors that are to be tested. There will be one less factor than there will be groups, because one group will serve as a control for all of the others.

While the investigator has no way to tell what factors will be selected until sub-problem one has been solved, the design of his research may be clarified by anticipating a bit. Suppose sub-problem one reveals the following factors to be included in the slide sets: color compared with black-and-white; titles compared with a recorded sound accompaniment; diagrams included with pictures compared to no diagrams included; narrative presentation with a story line compared with straight, factual presentation; questions compared with declarative statements; worker's viewpoint compared with onlooker's. In this situation, the control set might be: black and white; sound, without diagrams; without a story line; without questions; and taken from the worker's point of view. The first experimental set would be: *color;* sound; without diagram; without a story line; without questions; and taken from the worker's point of view. The second experimental set would be: black and white; *titles;* no diagrams; no story line; no questions; worker's view. The other sets would be composed in like manner, changing only one of the variables.

It is sufficient to indicate the design, not as intricate as it may appear, to indicate the skills needed by this researcher. Moreover, he is faced with the task of making and validating his slides. Again, he will have to treat the data he collects in accord with approved statistical procedures and he will have to demonstrate the statistical significance of his findings. He may be in a position to recommend an effective way to construct slides designed to teach perceptual-motor skills.

Concluding Statement

These sample studies may serve to indicate the nature of worthwhile problems in the field and the variety of research techniques needed for their solution. They should also point to the kinds

of skills necessary for the researcher to possess.

Again, it may be said that the purpose of research is to seek truth. The more rigid the controls and the more scientific the methodology, then the more valid will be the conclusions drawn from the findings. Man has come a long way in perfecting the methods of truth seeking; and educators, and more especially, those in the various fields of industrial education, must understand and utilize the tested and validated practices of research in their work.

Below is a list of "musts" for the personal bookshelf of every researcher. It has been kept to a painful minimum in order that space on the shelf may be available for the volumes especially appropriate to the immediate and peculiar problem of the researcher. These volumes will abide, the others will change as the researcher moves from one problem to each succeeding one.

A Bookshelf on Research Methods

Basic Methods

Almack, J. C. *Research and Thesis Writing.* Boston. Houghton Mifflin. 1930.

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Statistical Methods

Edwards, Allen L. *Statistical Methods for the Behavioral Sciences.* New York. Rinehart. 1956.

Garrett, Henry E., *Statistics in Psychology and Education.* Fourth Edition. New York. Longmans, Green. 1953.

Guilford, J. P., *Fundamental Statistics in Psychology and Education.* New York. McGraw-Hill. 1956.

Lindquist, E. F. *Design and Analysis of Experiments in Psychology and Education.* Boston. Houghton-Mifflin. 1953.

Nunnally, Jim C., Jr. *Tests and Measurements: Assessment and Prediction.* New York. McGraw-Hill. 1959.

Siegel, Sidney. *Nonparametric Statistics for the Behavioral Sciences.* New York. McGraw-Hill. 1956.

Also of Help

A Manual of Style. Chicago. The University of Chicago Press. Latest revision is that of 1949).

Alexander, Carter and Arvid J. Burke. *How to Locate Educational Information and Data.* New York. Bureau of Publications. Teachers College, Columbia University. 1950.

Campbell, William G. *Form and Style in Thesis Writing.* Boston. Houghton-Mifflin. 1954.

A Good Unabridged Dictionary.

A Roget's *Thesaurus.*

CHAPTER V

A Theoretical Orientation for Research in Industrial Arts

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Introduction

The professionalization of a field begins with the general recognition, by its members, that the operating principles upon which it is based are unverified principles, not laws of nature. The process is advanced as the principles are expressed as hypotheses which can be critically tested. Professionalization is further promoted as the hypotheses are tested, proved or disproved, and grouped into a body of statements which accurately describe the field at any given time.

The purpose of this chapter is to discuss the process of hypothesis formulation, to review the methods of science that bear on this problem, and to propose a set of hypotheses for use in industrial arts research.

Literature in the field of education abounds with references toward "the science of education." Writers continue to promote the idea that educational thought and practices must be based upon valid theories. Scientific procedures of research must reinforce the speculation and empiricism out of which educational practice grows. In the words of B. Othanel Smith:

> "Empirical verification is the concluding phase of a long process of thinking leading from the definition of the problem to the logical elaboration of the hypothesis to be tested. Behind this chain of reasoning and supplying its content is a hierarchical system of concepts and previously established propositions. A hypothesis is a logical function of this system.
>
> "It is at this point that educational science is more deficient. Exact definitions and rigorous formula-

*Parts of this chapter have been adapted from the following study: John R. Lindbeck, "A Framework for Research in Industrial Arts." (Unpublished Ph.D. thesis, University of Minnesota, Minneapolis, Minnesota, 1958).

> tion and elaboration of hypotheses are conspicuously absent from reports of educational research. When a hypothesis is mentioned in reports, it is little more than a question; explicit deductions from a system of ideas and stated hypotheses are practically unknown in the literature of educational science." (17:1150)

The Methods of Science

In the sciences, *per se,* the methods utilized in isolating and formulating hypotheses, and the procedures employed for applying precise principles of measurement, follow a rather definite form. The intricacies of this pattern emerge from H. A. Reason's writings on the subject:

> "...All scientific inquiry nowadays proceeds according to a well recognized plan.
>
> "Firstly, all the known facts that can have any bearing on the question are reviewed. Secondly, a theory is invented which will explain all the known facts; this is generally called an hypothesis. Thirdly, assuming the hypothesis to be true, it is then seen what new results should follow from this theory. Lastly, experiments are then devised which should give these results if the hypothesis is a true one. The more conclusions that are supported by the experiments, the more likely is the hypothesis to be true. One contrary fact, however, must lead, if not to a new hypothesis, at any rate to a revision of the old one." (16:99)

Only by proceeding according to this well recognized plan has science been able to direct its actions toward satisfactory and successful solutions to problems. Any other plan of procedure would result in a disorganized and rather unconcerted effort. It might do well to dwell upon specific aspects of the procedure in more detail. Emergent also will be some of the difficulties encountered in the process.

It is possible, for the sake of clarity, to reduce Reason's statements regarding this scientific process to three basic steps:

1. the collection and selection of facts or coincident observations

2. the formulation of an hypothesis to fit these facts

3. the deduction of observable consequences and the invention of experiments to verify or refute the consequences, and hence the hypothesis

The Collection of Facts

All research work deals with facts selected from the observation of actual objects and events – observation, however, of a special kind. The facts, called the "foundation of science" by Faraday, are in reality sense data. Because science is primarily concerned with the impersonal human observation of events, it must necessarily employ a method of separating sense data usable in science from the less reliable observations such as optical and other sense illusions. To illustrate this one might consider a problem in the measurement of temperature, such as the determination of the temperature of a container of water. Utilizing an instrument of measurement, a thermometer, a person can observe the position of the column of mercury in relation to the graduations on the glass. The reading yielded in this instance is an example of sense data of the type usable to science.

If, on the other hand, a person determines the temperature of the water by immersing his hand in it, the result would be a rather unreliable sense impression of the type not usable to science. The fallacious nature of the second category may be further illustrated by an example of sensory illusion. Simultaneously one hand of the observer is placed in hot water, the other in cold for several minutes. Remove the hands from the water, shake them, and plunge them into tepid water. To the hand which has been in hot water, the tepid water feels cold; to the other hand it feels warm. In this case the two hands of the same observer yield at the same time a contradictory result regarding the warmth of the water. Obviously, then, there must be a method of selecting between these two types of sense data.

Coincidence observation is therefore presented as a means of distinguishing between that sense data usable to science and other sense data. (2:92-99) Reading the height of the mercury column in a thermometer is a typical judgement of coincidence. It is in this type of observation that something similar to universal agreement can be achieved, a characteristic not inherent in less reliable data. The scientist speaks of facts as coincidence observations; to him they are one and the same. In the light of this consideration, the previous reference to facts as the foundation of science may be restated in terms of coincidence observations as the foundation of science.

The Formulation of Hypotheses

It is not enough merely to accumulate a mass of isolated facts in scientific procedures. Meaning and value are derived only when there occurs a logical grouping or order to this mass. As Poincare has put it, "Science is built up of facts, as a house is built up of stones; but an accumulation of facts is no more a science than a heap of stones is a house." (15:101)

The four widely utilized devices for arranging isolated facts in scientific research are (1) classification, (2) law, (3) cause-and-effect relationship, and (4) theory.

In the *classification* techniques, grouping is accomplished through the detection of common similarities among facts.

The basis for natural *law* as a device is the seeing of "order" in an array of isolated facts.

Two observed facts, or groups of facts are said to be related as *cause-and-effect* when the observations have been made with the aid of experimental techniques. This special technique consists in making coincidence observations in pairs of experiments, where one experiment of each pair is of the control type.

Grouping facts under the heading of *theory* comes about when the observer has formulated an hypothesis or a calculated guess to explain the facts at hand, and then devised a means of verifying this hypothesis. (2:334-340)

Through the use of the first three devices (classification, law, and cause-and-effect) the researcher deals with actual objects or events. His specific task (arrangement) is completed when he has selected facts that display, respectively, similarity, order, or causal relationships. In general, however, the scientist tries to pattern the facts, including those of classifications and laws, into still more complex wholes called scientific theories, the fourth device for arrangement of facts. (2:215) Indeed, it can be held that the ultimate aim of science is the formulation of valid generalizations from facts, taking the form of verified suppositions, principles, or scientific laws. Hence, the importance of the hypothesis, for it is instrumental in achieving this end.

By definition an hypothesis is a tentative generalization formed about the character of phenomena being observed, the purpose being to provide a basis for action. The following statements embellish this definition and point up its purpose and importance:

> "...The mind does not wait for a complete enumeration of all of the facts, but jumps sooner or later to some sort of tentative supposition or provisional guess which seems to explain the situation under observation, that is, in terms of such evidence as is at hand. Once entertained, such a hypothesis becomes the starting point for further investigation.
>
> "...It appears that unless we go to nature with something in mind, we are not likely to learn much... Hypotheses are islands in the stream of thought." (13:12)

The differentiation between the terms "theory" and "hypothesis" should be emphasized. It is possible to gain insight into their uses by way of George's remarks:

> "The two devices of hypothesis and theory are so similar that they will be treated together. In practice a theory is an elaborate hypothesis which deals with more types of facts than does the simple hypothesis. In the initial stages what is later called a theory is often called a hypothesis. The logical implications of a hypothesis cannot all be seen when the hypothesis is first formulated. When a number of these implications have been worked out and have been found to fit the facts, then the hypothesis becomes a theory." (2:220)

This statement seems typical of the trend to call a device an hypothesis in the early stages of research and a theory when it has been validated. It will be so treated in this chapter.

Grouping facts together by use of the hypothesis requires different tactics than those used in arranging facts according to classification, law, or cause and effect relationship. Arrangement by these devices is related fundamentally to the observation of facts. This is accomplished, for example, by classifying facts where the researcher keeps them mentally before him, an apparently external approach, selecting some, rejecting others, according to similarities observed.

The hypothesis technique requires a different method of attack. Arrangement is only the first significant step. There remains the task of verifying or refuting the hypothesis.

Furthermore, the formulation of the hypothesis itself is a rather mysterious activity. Instead of constituting an external approach, the process involves an inward, creative, and imaginary one. It requires

retirement and reflection, a consideration of all the numerous facets of the problem at hand including the facts, plus any completed arrangements of facts by other devices, and possible ways of organizing the material into a logical whole. The approach is illusive. As George states,

> "Too little is known of mental science to enable us to understand what happens when a man is formulating an hypothesis or theory. So far as I am aware, the whole process is a complete mystery. The process is known to be vitally essential in scientific research. A man who sticks to...facts just sticks. If he will not take the perilous plunge into the world of imagination he will not even find many new facts." (2:221)

Aside from serving as a device for arranging data, the hypothesis functions in two other ways. First, it facilitates research by limiting the field under investigation, making possible the concentration of effort in a particular direction. Second, it sensitizes the researcher to facts pertaining to a study area. Unless these tentative generalizations are present and foremost in the mind, facts, relationships, and conditions appropriate to the problem may pass unheeded. It is a matter of the researcher being consciously aware of that for which he is searching. Summarily, the functions of the hypothesis are enumerated as follows:

1. limits the field of investigation
2. sensitizes the observer to pertinent facts
3. colligates the facts observed about different phenomena into some simple form. (3:186)

Science, endeavoring to control the validity and effectiveness of its research techniques, has progressed to the stage of establishing criteria for the selection of hypotheses. According to one source, they are characterized in these terms:

1. A good hypothesis is in agreement with the observed.
2. A good hypothesis does not conflict with any law of nature known to be true.
3. A good hypothesis is stated in the simplest possible terms.
4. A good hypothesis permits the application of deductive reasoning. (3:195)

In the succeeding paragraphs, these conditions relating to "good" hypotheses are expanded and treated individually to emphasize the salient features within each.

Agreement with the observed means the logical concurrence with those facts assembled for the purpose of ordering. A good check would be a systematic comparison of each of the basic facts with the hypothesis being established. Any inconsistency would immediately serve to warn the researcher of an irregularity and the necessity for revamping the hypothesis.

Obviously, there can be no point at which the hypothesis may conflict with any existing laws of nature held true. Such a condition calls for further study and observation leading to a new hypothesis. This is in keeping with the process of eliminating, controlling, or holding at a minimum any possible sources of error which may arise. The exception to this occurs when the researcher has reason to doubt the validity of an existing law according to observations he has made, and departs on a divergent course, one in which he attempts to refute an existing law.

From the standpoint of facilitating the actual research process, the criterion of simplicity is perhaps the most important. A descriptive term often used in conjunction with this criterion is "Occam's Razor." Its significance and relative implications for systematic inquiry are pointed up in the following statements:

> "When the simplicity rule is applied to choice of hypothesis it is related to the following classical examples of rules of systematic inquiry. William of Occam's rule, known also as Occam's Razor, was *Entia mon sunt multiplac anda prater necessitatem.* Hamilton expressed it: 'Neither more, nor more onerous, causes are to be assumed than are necessary to account for the phenomena'. Newton's version, given in his Rules of Philosophizing at the beginning of the third book of the *Principia,* reads: 'Rule 1. No more causes of natural things are to be admitted than such as both are true, and sufficient to explain the phenomena of those things'. Related to these rules is Descarte's resolution 'to conduct my thoughts in such order that by commencing with objects the simplest and easiest I know, I might ascend little by little, and, as it were, step by step, to the knowledge of the more complex.'" (3:240-241)

A first requisite, then, is to state the hypothesis as simply and clearly as possible, eliminating any qualifying factors which may arise.

A second ground rule is to guard against the effects of personal bias. This bias manifests itself in the researcher's efforts to prove a pet hypothesis rather than report the results of the experiment in an impersonal manner. A technique widely used to control this emergent bias is the practice of stating the hypothesis as a *null hypothesis*, i.e., that the proposed treatment is *not* effective, or that there is no significant difference between two or more methods of doing something.*

Before considering the fourth characteristic, i.e., the permission of deductive reasoning, the terms "inductive" and "deductive" reasoning should be explained and differentiated.

Inductive reasoning is a process whereby a conclusion is reached by investigating a number of particular cases. Here a common property of many cases is selected and the generalization is made that this property fits any and all cases, i.e., proceeding from the particular to the general.

The progression from the general to the particular constitutes the basis for deductive reasoning, the precise opposite of the inductive reasoning process. A researcher reasoning deductively would proceed from a general statement, accepted as true, and apply this to specific, selected cases. A conclusion reached would be true only if the basic general statement were true. In other words, the validity of the conclusions is totally dependent upon the validity of the generalization accepted as basic in a specific research problem. The truth of the concluded element under inductive conditions depends only upon the common element observed in the number of cases studied.

To insure the proper conditions for this deductive process, it is necessary to fulfill three basic requirements:

1. a general statement
2. a specific statement which satisfies all the conditions of the general statement
3. the conclusion must be one called for in the general statement (3:27-29)

The significance of the deductive process emerges from the preceding explanatory statements. Serving as the basis for formal proof it is imperative that deductive reasoning processes be included as a requirement in the formulation of hypotneses.

*If treatments are found to be significantly different, it indicates that the researcher has statistically ruled out chance as the cause of the observed difference.

The Verification of Hypotheses

As mentioned earlier the formulation of hypotheses is but a primary step in scientific procedure. Further treatment is necessary to verify or validate the hypothesis. According to Hunter:

> "The real essence of the scientific method comes in the third step of the method of science. After our problem has been found and solved to our satisfaction, then the conclusion must be validated. If a tentative conclusion has been reached, we should remember that there is a possibility that some fact or facts have not been taken into consideration that should have been considered. In other words, there is still a possibility that the conclusion is not valid or true. Therefore it must be tested. This necessity for testing our results should develop in the student that habit of openmindedness which is characteristic of the scientist." (6:217)

As indicated earlier, the procedures involved in deducing consequences and the establishment of tests for the verification of these consequences are frequently merged into a single unit of action, the third step in the process of systematic inquiry.

The area of plane geometry is a source of classic examples of the use of the hypothesis in solving problems dealing with plane surfaces. One of the basic geometric statements is the theorem, which is simply a statement to be proved. It is generally composed of two elements, namely, an "if" clause containing a condition which is assumed true for the purpose of argument, called the *hypothesis*; and a "then" clause stating what is to be proved, called the *conclusion.* (6:43-44) To illustrate this, consider the theorem:

If equals are added to equals, then the sums are equal.

In this instance, the phrase "If equals are added to equals" establishes a condition assumed valid thereby supplying the hypothesis. The clause, "then the sums are equal" completes the theorem in that it provides the concluding element for the statement. The geometrician is saying, in effect, "If action takes place under certain conditions which I assume to be true, then a definite, observable conclusion should follow as a result." After enough evidences have been gathered to support or verify this theorem, it emerges as a geometric axiom, a statement accepted, without proof, for use in the solution of future problems.

Another example of hypothetical verification, of a somewhat different nature, is the hypothesis that Columbus perhaps entertained:

If the world is round, then I can reach Asia by sailing west. To test this hypothesis, he sailed west and arrived at what he thought his destination, adding substance to the hypothesis that the world was round. In order that he might even attempt so bold a venture, it was necessary for him to gather all the available facts of the day, pertinent to the shape of the earth, and make the calculated guess that the earth was round. Obviously however, the information would be of little use to himself or to anyone else in that form. He had merely arranged the facts, utilizing the device of hypothesis. The next important step was to deduce consequences which would result from this hypothesis, accepted as true. One of the consequences, or sub-hypotheses, as they are often called, was that Asia would be reached by sailing west. It remained for him to sail west in order that the suitable test might be accomplished. The fact can be pointed up that he offered only one evidence of the world's roundness. In order to offer more proof, he might have devised other means of testing other deductible consequences, such as one pertaining to the appearance of a ship from "over the horizon." The verification of each of the individual consequences would lend themselves to the verification of the hypothesis originally formed.

In cases where the hypothesis is so simple that further explanation or elaboration is unnecessary, there is no need to write down sub-hypotheses and logically deduce from them things which can be at once observed by judgement of coincidence.

As an example, if a bacteriologist began with the idea that a certain disease was always associated, in the victim, with the presence of a certain bacillus which had not at the time been observed, this supposition could be termed his hypothesis. Were he later able to isolate as a stained preparation this new kind of bacillus, he would have verified his hypothesis. Sub-hypotheses were unnecessary for the hypothesis implied that if the bacillus could be observed, the hypothesis would have been verified.

A concluding statement by Westway serves to emphasize the place and importance of the hypothesis in research:

> "Hypotheses, rashly used, are a great danger in scientific investigation, but, properly used, they are most valuable instruments. That their use is absolutely necessary if we are to make any progress at all, will have

> become abundantly clear. But to be of real service they must be confirmed by fact, and we must be for ever on the watch for facts which may confirm or refute them. Once refuted, an hypothesis must be immediately abandoned. Any attempt to make facts square with a pet hypothesis is a sure and certain mark of the unscientific mind." (20:250)

Developing a framework for research according to such tenets of scientific method could lead to an inventory of hypotheses and hence theories in which could be placed a reasonable amount of confidence regarding their validity. Such action places the emphasis upon experimentation instead of experience, upon scientific observation rather than empiric reasoning.

Evolving a Frame of Reference for Research in Industrial Arts

In keeping with the several requirements and conditions previously described, one of the writers undertook a comprehensive study for the purpose of developing a usable set of hypotheses for research in industrial arts. (11) In part, this was related to similar, though less complete, efforts of the other writer in the area of vocational education. (13)

Space does not permit a complete description of the findings of the Lindbeck study. A summary of the approach, and samples of the findings will have to suffice. The interested reader will wish to examine the complete dissertation.

In essence, six steps were carried out in arriving at a set of hypotheses and sub-hypotheses related to the whole field of industrial arts education. These steps were:

1. The compilation of a frequency list of claims made for industrial arts as derived from the literature of the field – an inventory of occurrences.

2. The distillation of this list into major categories of claim called generalizations.

3. The enumeration and inclusion of all primary and secondary evidences offered in support of each generalization.

4. The formulation of an hypothesis based upon each generalization.

5. The establishment of a set of sub-hypotheses, based upon the evidence, for the purpose of testing each hypothesis.

6. The partial test of a selected hypothesis to illustrate the use of this study as a guide to research in industrial arts.

1. Frequency List

The purpose of the inventory of occurrences was to discover the frequency with which the claims for industrial arts occurred in the literature. This inventory process proceeded as follows:

1. A preliminary sampling of the literature revealed certain repeated claims made for industrial arts. On the basis of these claims, a master list of generalizations (tentative hypotheses) was made to guide further investigation and study.

2. A more complete analysis of the existing literature in the field of industrial arts was made to unearth further statements of claim. These claims were listed under the general statement as evidences of support for it. As new claims were found, new generalizations were added to the master list. The master list of generalizations which grew out of this process is shown below.

2. Master List of Generalizations

I. Industrial arts provides an effective means for training wise consumers.

II. Industrial arts develops an appreciation of design, materials, and workmanship.

III. Industrial arts promotes an understanding of industry and the value of the worker.

IV. Industrial arts provides a means for developing valuable leisure activities.

V. Industrial arts provides an opportunity for guidance through occupational exploration.

VI. Industrial arts provides experiences for learning and perfecting manipulative skills.

VII. Industrial arts develops desirable habits of analysis, planning, safety, cooperation, and accuracy.

VIII. Industrial arts promotes learning and understanding through manipulative experience.

IX. Industrial arts develops creative thinking abilities.

3. Primary and Secondary Evidences

After completion of the inventory process, the further consideration of scientific method and its application to the problem was possi-

ble. The procedures involved in systematic inquiry, treated earlier, may be repeated as follows:

1. The collection of facts or coincidence observations.
2. The formulation of an hypothesis.
3. The testing of the hypothesis.

In considering step one, the collection of facts, it has been stated that the researcher must concern himself only with facts or coincidence observations. Lindbeck, in making his initial inventory, found relatively few coincidence observations relating to the claims made for industrial arts education. This, in itself, was an important outcome of the study for it pointed up the need to obtain facts if we are to continue or change the elements of industrial arts in our schools.

Due to the dearth of coincidence observations, it was decided that two categories of facts would be necessary. Category one was comprised of any claims stated as facts or observed coincidentally, i.e., the results of valid experimentation. Such claims were termed "Primary Evidences," and are evidences either supporting or refuting the generalizations.

Category two consisted of the opinions of writers in the field, stated either as individuals or as a group, the latter usually being in the form of a report or survey. These were called "Secondary Evidences."

The decision to include the second category seemed appropriate in this initial effort to bring facts and claims into a frame of reference for future testing. Individual experience and opinion are of great value to the field as starting points in subjecting industrial arts education to scientific scrutiny.

4. Hypothesis Formulation

The work of the second step of systematic inquiry, the formulation of an hypothesis, occurred when the generalization had been stated and the two categories of evidences had been compiled under it. At this hypothesis stage the generalization was refined and phrased in a more quantitative form, i.e., a form more suitable to measurement. It follows, then, that each generalization was restated as an hypothesis to provide the framework for further research.

5. Sub-Hypotheses

The last step in this part of the study was to propose a series of sub-hypotheses based upon the primary and secondary evidences.

The list was not intended to be exhaustive for the possible deductions are unlimited. The list of sub-hypotheses comprises the framework for subsequent experimentation and research in industrial arts. The following is an illustrative example of one of the generalizations of the master list treated according to the steps of scientific method discussed above.

Generalization I. Industrial arts provides an effective means for training wise consumers.

A. The Collection of Facts.

Primary Evidences:

1. The Burdette Study (97-467)*. "As the scholastic aptitude of the high school boys more nearly approximates the average, the contribution of industrial arts instruction to the consumer knowledge possessed can be expected to be moderate in extent."

Secondary Evidences:

1. Mays (53-577). "Other social functions widely accepted as basic are the consumer values inherent in the knowledge of materials, workmanship, and utility of industrial products gained through the work of the school shops."
2. Ericson (24-252). "Some first-hand experience with materials, tools and machines will enable a person better to solve the problems that pertain to...purchase and use."
3. Selvidge (3-33). "[A justifiable goal of industrial arts is] to develop in each pupil the ability to select wisely, care for, and use properly the things he buys or uses."
4. Friese (26-45). "[A justifiable aim of manual arts is in] providing training in industrial arts and industrial art appreciation. ...Briefly, the object is to produce intelligent and discriminating consumers of beautiful things..."
5. Micheels (56-246). "The industrial arts shop provides the school environment in which young people learn to make better use of the things they buy."
6. Fryklund-Selvidge (79-36). "(An objective of industrial arts is) how to care for and use wisely the things we buy."

*The number 467 refers to the page and the number 97 refers to the work cited in the bibliography of the complete study. These references, however, have been omitted in this chapter.

7. Industrial Arts Policy and Planning Committee, AVA (43-3). "Those who participate in Industrial Arts programs... learn about material goods. ...They learn how to use and maintain them intelligently."
8. Bonser (10-109). "...primary emphasis will not be placed upon the production of industrial commodities, rather upon intelligent and cultivated taste in their choice and use."
9. American Vocational Association Bulletin (21-53). "(An objective of industrial arts is) to develop *in each pupil*...the ability to select, care for, and use industrial products wisely."
10. Smith (86-120). "(A proposed objective of industrial arts resulting from the Smith Survey is) to foster appreciation of good materials and workmanship. (For intelligent and discriminating selection of manufactured products for home and business consumption...)."
11. Wilber (110-43). "(A justifiable objective of industrial arts is) to increase consumer knowledge. to a point where students can select, buy, use, and maintain the products of industry intelligently."
12. Warner (100-44). "(An objective of industrial arts recommended by the Warner Study is) consumers' or utilizers' knowledges...of the products of industry."
13. Bennett (7-15). "Every man...if he is to judge the quality of the thing he purchases or uses...must know something of the process that produced it."
14. Bobbitt (9-27). "(An objective of manual arts is) to provide for the ability as a consumer to judge the qualities and values of the products of specialized occupations."
15. Collins (20-45). "It would seem, then, that (one of) the aims and purposes of industrial arts (is) ...to make us appreciative consumers of that which is good in our environment..."
16. Lindsey (51-4). "(A purpose of industrial arts is) to develop consumers' appreciation and knowledges."
17. Parker (67-211). "(One of the purposes of industrial arts is) appreciation of craftsmanship and being a good consumer."
18. Randel (74-624). "The matter of selecting, using, and caring for the products of industry can be done with a greater degree of efficiency, understanding, and satisfaction by one who has studied industrial arts than by one who has not had this experience."
19. Sink (83-166). "Industrial arts is a study of great importance for developing efficiency in selection, use, and care of industrial products."

20. Govin (32-64). "It is apparent from the preceding discussion and an examination of Table 3 and Table 5 that industrial arts makes a substantial contribution to the objective of *economic* (consumer) *efficiency*. This contribution is logical since industrial arts, which concerns itself with industrial processes and products, offers natural assistance toward becoming more efficient producers and consumers."
21. Hobson (38-118). "The industrial arts instructor is in a position to emphasize many consumer topics more forcefully, more logically, more functionally than any other member of the school staff."
22. Braton (12-20). "This statement (that industrial arts offers the logical position for teaching consumer education) cannot be doubted because the industrial arts curriculum covers so many different materials and products of the everyday life."
23. Wickler (107-36). "There are many opportunities in the industrial arts instruction for promoting consumer objectives."
24. Power (71-16). "Industrial arts is concerned with the...teaching of the intelligent purchase, use, and maintenance of materials and finished products of industry."
25. Hippaka (37-200). "(An objective of industrial arts is) to familiarize students with the products of industry in order that they might be more intelligent consumers."
26. Newkirk (63-370). "(An objective of industrial arts is to) give consumer knowledge about the selection and use of the products of industry."
27. Warrick (101-288). The results of the 1946 Warrick Survey of 274 shop instructors in the North Central Association revealed that 108 instructors listed "consumer knowledge or related information" as an industrial arts objective of major importance.
28. Shockey (80-10). "Industrial arts offers a wonderful opportunity to create an intelligent questioning attitude in the mind of the student in regard to the selection, care, use, and operation of some of these industrial products and services."
29. Whitesel (104-331). "Industrial arts must prepare the student to make more intelligent decisions regarding consumer goods."
30. Cramlet (22-108). "(An agrument for industrial arts is that) it will assist the prospective consumer in making the proper selection from the large variety of things offered for use."

B. The Formulation of an Hypothesis.

Consumer Education Hypothesis:

Individuals who have received the experiences afforded in industrial arts classes are discreet and selective in purchasing, using and caring for consumer goods as a direct result of these experiences.

C. The Testing of the Hypothesis.

Sub-hypotheses:

1. Industrial arts students score higher on the consumer goods selection test than non-industrial arts students.
2. Industrial arts students score higher on the consumer goods maintenance test than non-industrial arts students.
3. Consumer education is best taught through mainpulative experiences.
4. Industrial arts students score higher on the consumer goods utilization test than non-industrial arts students.
5. Knowledge of the process which produced an object improves the ability to judge the quality of that object.
6. Consumer education is taught more effectively in the industrial arts area than in any other subject-matter area in the school.
7. Job sheets provide the most effective means of teaching consumer product maintenance.
8. Information sheets provide the most effective means of teaching consumer product selection.
9. The maintenance aspect of consumer education lends itself best to the industrial arts area of instruction.
10. Sex has a bearing on consumer product selection, care, and use.
11. Socio-economic status has a bearing on consumer product selection, care, and use.
12. Age has a bearing on consumer product selection, care, and use.
13. Intelligence has a bearing on consumer product selection, care, and use.
14. Knowledge of, and experience with, various materials improves the ability to judge the quality of products made from these materials.
15. It is possible to devise an evaluation instrument which would serve in judging the qualityof a product.
16. Industrial arts students are better consumers.
17. Consumer education is more successful when consumer information is imparted as the occasion arises rather than devoting a unit of work to the subject.

18. Experiences in the assembly and the dissassembly of products provides an adequate means of training wise consumers.
19. Because industrial arts is concerned with industrial processes and products it offers natural assistance toward becoming more efficient producers and consumers.
20. A significant measure of consumer knowledge is acquired through industrial field trips.

Testing the Hypothesis

The final part of the study was devoted to a partial test of an hypothesis, herein summarized, to illustrate the use of the hypothesis in industrial arts research activities. The Industrial Knowledge Hypothesis was selected for treatment, with the following sub-hypothesis serving as the object of measurement:

> "Industrial arts students score higher on an industrial knowledge test, metals area, than non-industrial arts students."

Through a process of refinement, definition, and characterization, a precise statement of industrial knowledge was obtained. This served as a basis for constructing a suitable measuring instrument, the industrial knowledge test for the metals area. Great care was exercised in establishing the validity of this test by having a jury of industrial arts teachers evaluate and weigh it against the objectives and characterizations pertaining to industrial knowledge in metals area.

An additional measure of refinement was achieved by means of a pilot study preliminary to the final research project. A group of industrial arts students (defined as those senior high school boys having had industrial arts work beyond the junior high school) and a group of non-industrial arts students (defined as those having no such industrial arts experience after the junior high school) were selected for the pilot study. The test was administered to them, scored, and analyzed statistically in the same manner as proposed for the final run of the experiment. The pilot study went smoothly and according to plan, but it pointed up the problem of providing an adequate explanation of the directions pertaining to the test items. The pilot study had fulfilled its purpose, which was to bring to light any unforeseen problems and to observe the manner in which the testing proceeded.

With the pilot study and the jury evaluation complete, the final study was undertaken. Two groups, similar to those of the pilot, were selected, giving a total of twenty-one students in each of the two groups.

The analysis of covariance was the analysis used in treating the results of the final run of the test. The results led to the conclusion that there was no significant difference between the means of the groups and that therefore the fact that a student had industrial arts metals courses in high school did not necessarily mean he would display a greater degree of industrial knowledge than a student who had not had these experiences.

But in spite of the obvious nature of the foregoing conclusion, it should not be maintained that students do not derive industrial knowledge from industrial arts courses. The proper conclusion to be drawn is that according to the results of a sample survey, such evidence emerges. Perhaps the results of a more rigorous experimental study, in which the numerous sources of variation could be controlled, would yield a precise opposite result.

This sample research problem served an important illustrative function, namely, to exemplify and explain the action and thought involved in testing the sub-hypotheses for industrial arts research.

Hypotheses for Industrial Arts Education

Nine major hypotheses were formulated as a result of the several steps described earlier. A wide variety of sub-hypotheses was evolved under each major hypothesis. Space limitations permit only a statement of the major hypotheses:

I. Consumer Education Hypothesis: Individuals who have received the experiences afforded in industrial arts classes are discreet and selective in purchasing, using, and caring for consumer goods as a direct result of these experiences.

II. Appreciation Hypothesis: Individuals who have received the experiences afforded in the industrial arts classes have developed an appreciation of design, materials, and workmanship as a direct result of these experiences.

III. Industrial Knowledge Hypothesis: Individuals who have received the experiences afforded in industrial arts classes have acquired an understanding of industry and the value of the worker as a direct result of these experiences.

IV. Leisure Activity Hypothesis: Individuals who have received the experiences afforded in industrial arts classes have developed leisure activities as a direct result of these experiences.

V. Guidance Hypothesis: Individuals who have received the experiences afforded in industrial arts classes have obtained vocational guidance as a direct result of these experiences.

VI. Manipulative Skills Hypothesis: Individuals who have received the experiences afforded in industrial arts classes have acquired manipulative skills as a direct result of these experiences.

VII. Desirable Habits Hypothesis: Individuals who have received the experiences afforded in industrial arts classes have acquired the desirable habits of analysis, planning, safety, cooperation, and accuracy as a direct result of these experiences.

VIII. Learning Hypothesis: Learning is enhanced when the learner has the opportunity to receive manipulative experiences in the process.

IX. Creative Hypothesis: Individuals who have received the experiences afforded in industrial arts classes are more creative as a direct result of these experiences.

Concluding Statement

The main issue in this chapter has been preparing a case for the establishment and utilization of a set of hypotheses for research in industrial arts. It has been approached and organized in such a manner as to offer a logical argument for the acceptance of such a research framework. By first stating the need, and next turning to a discussion of scientific method as it applies to the hypothesis formulation process, the attempt was made to point up the feasibility of constructing, through the process of hypothesis testing, a valid and foundational body of theories for industrial arts.

The need emerges all too clearly. The fact that a structural void hampers the organization and progress of a discipline is difficult to dispute. This is not to argue that the structural state of industrial arts is chaotic, but merely to proffer the conclusion that this field has not achieved the desired agreement as to basic premises. This divergence of agreement manifests itself in the differences of emphasis given the aims or objectives by industrial arts teachers. The latitude of offering, due to personal emphasis (or bias), is the significant factor. For example, by emphasizing the pre-vocational or guidance aspect, one

might pay nothing more than lip service to the equally important objectives of design and consumer education.

The point which arises from the preceding paragraph is simply this: by embracing the "ought" concept to the exclusion of the "can" concept, the basis for industrial arts becomes one of individual interpretation and emphasis. To accept the latter concept, which will emerge only through establishment of a valid, theoretical basis for industrial arts, the interpretation becomes not individual, but universal, because it is based upon that which is known to be possible to accomplish through an industrial arts program.

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CHAPTER VI

Needed Research in Industrial Arts Teacher Education

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Introduction

A search for purpose and meaning has characterized the first decade of the second half of the twentieth century. The sociologist, the economist, the scientist, the novelist, psychoanalyst, politician, parent, taxpayer, teacher – virtually every element in our society has sought to understand its aims, to seek new means to accomplish them and, in a sense, to recreate society itself.

Education at every level has been subject to an unusual degree of scrutiny and analysis, both from within and from without. In this welter of appraisal, approval, rebuke, star-gazing and "straight thinking" one thing is clear: We are on the threshold of a new world. New needs, new methods, new values, new timing, new organization, different qualitative and quantitative relationships, new technical and scientific problems, new philosophic concepts, new approaches to the marshalling of political and economic forces must be sought and mastered in the interest of education.

Scientific and technological changes affecting such major fields as communication, power, conversion of raw material, synthetics, housing, heavy construction, manufacturing, etc., have already brought about a major shift in emphasis from man-machine operation to automated operation. Problems of large scale maintenance of production equipment and manufactured items is creating a whole new service industry, relying on semi-technical skills and unit replacement instead of handyman skills or integrated technical skills and knowledge. Simultaneously the pressure for artificial obsolescence coupled with technological change has created new or especially difficult problems for the consumer.

New social patterns, leisure time needs, shifts in population from city to suburb, changes in economic levels, and related factors have created, and can be expected to continue to create, new pressures on the individuals affected. Satisfactions (which no longer can

be found in the production of goods) are increasingly being sought in the consumption of goods and services, rather than through personal expression and the use of those creative skills no longer required on the job. In light of the changes that have taken place, and can be expected to take place, the need for extensive and original research to provide a sound basis for industrial arts teacher education should be self evident. Underlying any research should be a careful appraisal of the directions in which society, the school, and the American industrial system are going. This is a serious and important task for it will make possible a sense of direction and purpose that will unify any research that is undertaken. Problems in this area will embrace the work of the sociologist, the psychologist, the cultural anthropologist, the historian and the philosopher.

Determination of Objectives and Philosophy

A paramount task for the researcher is the assessment of the values, objectives and philosophy of industrial arts in the kind of society that is developing. New directions must be sought, based on broad evaluations of the social and economic structures of our society. It is obvious that the rather parochial concept of industrial arts that grew out of the early experience in dealing with the various aspects of industrialism in this country no longer has much validity on any basis other than historical precedent and the investment in plant and personnel that has come into being. Such an assessment should be based not primarily on evaluation of the status quo or opinions of those already deeply committed to the status quo but rather on the needs, directions, opportunities, position and structure that society and the educational institution of society can reasonably expect will satisfy their real needs.

There are many facets to this problem and many levels at which it can be attacked. Local, regional, national aspects may be dealt with, as well as levels of education in terms of age, sex, intelligence, educational goals and similar factors. Problems of organization, training, evaluation, guidance, the integration of subject areas, curricular relations and the like may well be included.

This area of research will have to deal with the whole problem of the role of education in a technically oriented society and consider such specific problems as the training of technicians and scientists, the training of scientific and technical aids, as well as consumer ed-

ucation, leisure time and recreational programs, etc. It may well be that industrial arts will have a very different place and form in the future and that it may disappear in its present form or find its place as part of some new or other present curriculum area (an area which itself may be subject to change). In any event, sound planning for major curriculum revision, for basic content courses, for philosophic concepts for virtually every phase of industrial arts education, even classroom teaching, must depend on a major effort to determine purposes and directions for industrial arts in a scientific and technological age.

Changing Values in Public Education

Another closely related area in which research might prove profitable is the exploration of the changing values placed on public education. There are implications in some of the studies of American public education, notably the Conant and Rockefeller reports, which reflect changes in public acceptance of some practices in selection of students, means for differentiation on the basis of ability or age, status of teachers and of different kinds of programs of education and and similar matters – all of which have a bearing on teacher education. An examination of the role of the teacher as seen by the teacher himself, the administrator, the student, the parents, and the public at large, in the light of the demands placed upon him by society and his place in the value system under scrutiny, would seem to be worthwhile. Especially is this true of the industrial arts teacher, who, because of his intimate working relationship with the boys in his classes, is often cast in a special role of father substitute-couselor-disciplinarian, and also who, because of his quasi-vocational subject specialization, may find himself in a different status from the majority of the other teachers in a school. Special consideration of value changes in respect to the place of industrial arts, however conceived, may reveal means for improving programs and methods in public schools and in teacher education.

Industrial Arts and the Changing Industrial System

Just as there are occurring significant changes in society and the values placed on education as a result of scientific and technical progress, so too have changes occurred in American industry itself. Since industrial arts is concerned with the industrial life of America as it affects the citizen and worker, it should be concerned

with the changes that have taken place. Research to determine the kinds of changes and their importance to industrial arts is desirable. Historically, industrial arts derived its initial course content partly as a result of the growth of the factory system and the need for skilled workers to man it and partly from projects or activities centered around movements such as Sloyd. The industrial complex that exists to-day is much less dependent on skilled workers than was the early factory, and activity programs based on a different concept of the utilization of creative energy are demanded to-day. The vast integrated activity—embracing research, procurement, engineering, fiscal management, industrial engineering and personnel management, sales promotion, distribution—upon which a large industry is dependent to-day offers opportunities for research in determining wherein potential industrial arts content, method and practice may be developed. Such research might be concerned with industrial complexes as they affect the citizen as well as with the problems of the worker. Technical and scientific developments in respect to occupations, processes and methods, and materials offer possibilities for research. Similarly the management of men, materials, and products offer areas for exploration in respect to content for industrial arts related areas. The kind of problems that might evolve from this exploration could be expected to include the whole area of industrial processes and how they should be related to industrial arts. Such problems as the following might be involved: the development of special machinery and equipment for industrial arts which would utilize the same means or principles as the machinery or processes used in industry; how to obtain and use models, visual aids, motion pictures, television, industrial visits, and others for the purpose of keeping abreast of industrial developments; the cost of financing new equipment and keeping up-to-date with industrial progress.

The Humanities, Science and Industrial Arts

As the pendulum swings from emphasis on the humanities to grave concern over the need for more and better science education to meet the challenges of Russian scientific progress, concern has been expressed in some quarters lest the humanities be neglected. Industrial arts is involved in this change in emphasis since it lies on the threshold of the sciences, yet its orientation is such that the humanities have an important place, especially in the preparation of teachers. The

danger of assuming that industrial arts deals only with mechanistic, materialistic, scientific and technological aspects of contemporary life without any concern for deeper meanings and better understanding of human and cultural values is everpresent. Research to help establish the true place of industrial arts in this area is required, not only in terms of content, but also in relation to larger aims and objectives as well as the individual personal values to be found in this subject area. The impact of the arts on the forms of industrial objects as well as the relation of the ideas of philosophers and essayists such as Mills, Ruskin, Carlyle, Huxley, Bellamy, Orwell and many others in helping to create the image of this industrial century might well be explored more thoroughly in relation to industrial arts.

Other Curriculum Areas in Relation to Industrial Arts

There have been successful efforts to provide industrial arts courses or programs integrated with art, science or social studies, or otherwise to provide for some interrelationships, yet a thoroughgoing examination of the totality embraced by all these areas could be undertaken to make possible a broader understanding of the underlying educational relationship involved. Consideration of objectives, means, student needs, cultural and educational values, and ultimate purposes, rather than primary emphasis on subject matter content or the mechanics of integration might prove of value in determining the extent to which a core of intradisciplinary values or content might be considered to exist. The result of study in this area could well make possible a better understanding or evaluation of curriculum, student selection and placement, scheduling, teacher preparation, administration, course content and similar factors. The possibility of objective examination of subject matter areas in terms larger than those imposed by subject specialization or other narrow ranges of interest or even existing administrative subdivisions is envisaged so that self serving direction or unconscious acceptance of values would be kept to a minimum.

Industrial Arts and the General Education Program in Colleges

Although industrial arts is almost always justified in both elementary and secondary schools as a basic part of a general education program and the formal aims and objectives of industrial arts either assume or state that it is a general education subject, there has been little or no successful attempt to extend this concept to the college

level. College programs for general or basic education are conceived as a means of providing for the more or less "universal" educational needs of college students without regard to areas of specialization in which they may be engaged. Such programs provide for many college students their principal means for understanding the broad historic, cultural, and sometimes scientific background of our society. Industrial arts, which professes to interpret our industrial civilization at beginning levels in education, is notably silent in serving a similar need at the highest levels where the opportunity and, indeed, the need seems to be most clearly apparent. Research in this area to determine the interrelationship of industrial arts with other subject areas in colleges as well as the development of specific proposals for content and treatment should be undertaken. This is not intended as a proposal for a leisure time activity program, or similar limited experience and limited objective activities, but rather for the development of a philosophy and an integrated curriculum for a new discipline for the general college.

Community and Industrial Arts

There have been attempts to bring about close working relationships between industrial arts programs in the Public Schools and certain areas of the community which they serve. Sometimes the aim has been to provide for leisure time "do it yourself" interest or to develop public relation values that will help support the financing of the relatively expensive industrial arts shops or to utilize the resources of the community for related information required for actual class-room teaching. Usually such programs have been the result of the initiative of an individual teacher. It might well be profitable to study as a research project the total effects that such programs have had and to try and develop overall guides for the conduct of a coordinated industrial arts-community program, so that the purposes and objectives of industrial arts, as they have been broadly expressed in relation to the formal school program, may be applied more broadly to the total educational needs of the community. Included in such a project should be an attempt to determine if the specific objectives of industrial arts, as conceived for the schools in a particular community, are taking into account all of the resources available, and contrarywise, whether every effort has been made to translate such aims and objectives into understanding on the part of the members of the community. The re-

lationship of industrial arts to the labor union movement, social service program, and developmental trends in the industrial community would all be involved in such a study.

Adult Programs in Industrial Arts

Perhaps one facet of the foregoing problem of industrial arts in the community is the adult program in industrial arts. Here again research can determine which segments of the community have been served by existing programs and whether or not major objectives of industrial arts are being met in terms of adult needs and interests conceived in the broadest terms. It may be that the total resources of the industrial arts department of a school are not being fully utilized, and that, as is often the case, the adult program is merely a means of making available the specialized equipment of the school shop. The development of a challenging program at the adult level to embrace more than merely the activity aspects of industrial arts and provide for different levels of interest and experience is suggested. Involved in the planning of such a program should be consideration of what its objectives should really be and the specialized methods and equipment that may be required; in short, a program should be thoroughly integrated, specifically planned to meet adult needs, rather than improvised, depending wholly on such existing teaching skills and facilities as may be easily available. The possibility that adult programs may be merely pale reflections of the casual interests of a small segment of the adult community should be taken into account.

Preparation of Teachers for Industrial Arts

There are already underway a number of research projects aimed at improving both the quantity and quality of teachers available for the public school as well as for higher education. Generally, however, the emphasis is placed on broad problems and areas other than industrial arts and the assumption is made that industrial arts teacher education would be handled pretty much the same way as any other subject area. Research is needed to determine the real needs of industrial arts teacher education. Such a study might concern itself with the background and capability of students entering the teacher colleges or otherwise preparing to teach; with the problem of specialization vz. generalization; with appraisal of the ultimate success of graduates; with the

kinds of teachers and methods of teaching employed in teaching those preparing to be industrial arts teachers; with the relation between skills and technical knowledges in course content; with possible ways to utilize for the benefit of industrial arts teachers education some of the findings of other proposed means for improving teacher preparation; with types of "internship;" with the problem of the length of time required to achieve integrated skills and understandings; with programs of industrial experience; with concepts, prejudices and practices that might militate against the most effective programs; with the problems of financing expensive modern technical equipment; with the possible utilization of "resource" persons from other disciplines and from the community at large. Such a study should be based on a forward projection of the best contemporary understandings rather than on historical review.

Certification Requirements and the Teacher Education Curriculum

Because of differing views concerning the amount of time needed to acquire skills in the industrial arts shops, the technical nature of the subject matter, the interrelationship between industrial progress and industrial arts content and other factors political and historical in nature, there is a very great range in certification requirements among the several states and research as to the effect on industrial arts teaching of such wide differences would seem profitable. Questions as to the effect of certification requirements on teacher education programs in the colleges, the mobility of teachers, professional standards, school programs, and similar problems would be involved in such a study. An exploration of possible alternative means for insuring high educational standards for teachers should be included. Such a study might include the possible effects of: a professional practice group within the teaching profession, a national model for certification, broad guides to allow individual teachers' colleges to establish their own requirements and the like. Such a study as concerned here would be aimed at providing for the special needs of industrial arts (and perhaps other areas having similar problems).

Methodology and Techniques of Teaching Industrial Arts

The historical development of industrial arts methodology and techniques of teaching has tended toward reliance of job (skill) analysis, and the use of "take home" projects as a center for teaching

method. A review of methods and techniques in terms of the most advanced knowledge in this area would be desirable. Examination of the methods used in the technical and professional schools in other subject areas—such as medicine, engineering, law, the social sciences, Professional Arts Schools, and others—might bring to light improved means for realistically coping with the problems of internships, on-the-job training, professionalization, and the improvement of skill techniques. Intimately involved in such a study would be the concept of the "project" and what it entails. Questions as to the values adhering to an object that was created under school auspices, with considerable expenditure of time, with perhaps deep personal involvement, under either permissive ("creative") auspices or (contrariwise) under express direction, often imbued with symbolic significance and having a direct comparative relationship with the high status material products of an industrial society would have to be considered.

The Theoretical vs. the Pragmatic Approach in Industrial Arts Education

Apparent trends in industrial arts indicate the existence of two schools of thought concerning how the subject should be approached. One would conceive industrial arts as primarily oriented toward technical understandings, socio-economic problems, etc., for all types of students, the other tends toward a concept of servicing the school by providing a rich, vocationally oriented, activity program for particular types of students. The different value systems involved here might be characterized in the first instance as theoretical and the second as pragmatic. The theoretical approach to industrial arts leads toward the building of a body of academic type subject matter and is considered by some to have more dignity and respectability than the pragmatic approach. The drift toward the academic rather than the pragmatical may have some advantages in achieving a higher status within a particular school system both for the teacher and the subject itself, so that the college-oriented students and the general student body might find it more in keeping with their educational and social objectives. The other direction, toward practical applications, could be exemplified by school systems where industrial arts is used to take care of the needs of those students who may have less academic motivation or aptitude. Whether this dichotomy could best be dealt with by a single

all-embracing program or by the development of two frankly different programs might be worth further exploration.

Vocational-Technical Education and Industrial Arts

Because of the changing nature of the industrial system, there are changes in both technical and vocational education requirements with an increasing reliance on scientific and engineering principles and greater emphasis on general ability to solve problems. Similarly the emphasis in industrial arts might be expected to be affected by more emphasis of these areas as well. If, as seems likely, an increased automation and greater complexity in the products of our industrial society continues, the preparation of technically trained or oriented individuals, to deal with the lower levels of technology that would be required to sustain our culture, may well be demanded of the public schools at a level different from that provided by formalized vocational-technical education. If industrial arts might be expected to reflect industrial processes, the question arises as to whether there should not also be a greater reflection of the technological growth and development in society as a whole.

Motivation in Industrial Arts

There has been a tacit acceptance of the project as a primary motivating element in the teaching of industrial arts. This, plus the opportunity to participate actively in construction processes, has been a principal technique of the industrial arts teacher in motivating students. There are, of course, many other types of motivation employed by the industrial arts teacher. Intensive research to determine the effectiveness of the various types of motivation that can be utilized effectively, embracing the most recent knowledge in the field of counseling and guidance and the experience gained in other areas and with youth groups outside of schools, would seem desirable. Such research should deal, not only with principles and practices that might appear to be effective, but might well seek to differentiate the best kind of motivation for differing levels of students considered in terms of age and social background, individual needs, concept of self-image, the status drive of the group with which the student associates himself, parental concept of status, and similar factors, as they apply both generally and to particular types of school situations.

The Use of Projects in Industrial Arts

Because of the importance of the project in industrial arts, it might well be desirable to make an intensive study of exactly what the project represents for the students, the teacher, and the parent, and the kind of value system that is associated with it. This would require an appraisal of the relation between the project and the objectives of industrial arts, however they may be developed;—the types of motivation associated with it; the extent to which the project serves the ends of authoritarian disciplines; how effectively it serves the drive for creative expression and similar considerations.

The Creative Process in Industrial Arts

Much has been written and said about creativeness in industrial arts. Exploration of the elements in industrial arts which further the creative drive of individual students, as well as an appraisal of the real objectives of industrial arts in respect to opportunities for creative expression, requires intensive research. Exploration in this area would relate both to the foregoing sections as well as to consideration of the value systems accepted by the teacher and the students. Part of such a study would be to seek a determination of exactly what the creative process is, the extent to which individual students may be expected to be able to harness their creative energy, the kind of guidance that is necessary to stimulate creative effort, the extent to which the regulated school environment can serve as a stimulus or deterrent, and the special aptitudes that a teacher might be expected to need; also involved would be a study of how creative effort, assuming it to be a highly personal thing, can be evaluated for the purpose of guidance, placement, measurement of growth and other purposes. The problem of the undirective nature of creative work as it affects planning and controlling the school course would also be involved.

Girls in Industrial Arts

If the present trend of employment of women continues, it seems probable that more than half the working force in the United States will by 1970 be women. Many of these women will be engaged in industrial pursuits. Furthermore, if industrial arts is to be considered as a general subject of education, a thoroughgoing effort should be made to explore all the implications of industrial arts in respect to women. Per-

haps because home economics has, in some schools, been used to balance the subject of industrial arts in curriculum planning, there has been less consideration of this problem than would seem reasonable in view of the long history of employment of women in industry, going back to the early New England textile mills.

Factual studies of exactly what would be involved in providing a program for the total school population instead of only the boys should be undertaken. Incorporated in such a study should be consideration of the costs, content, acceptability and similar factors.

Professional Standards

There has been a trend toward increased professionalization of teachers. Research into means of achieving the highest possible professional standards with some exploration of means employed in the legal, medical and other professions may prove desirable. Included in such a study might be the consideration of the possible professional relation of industrial arts teachers with those engaged in technical or semi-technical professions such as the various branches of engineering, architecture and the like.

CHAPTER VII

Needed Industrial Arts Research from the Viewpoint of the Supervisor Summary

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From time to time lists of problems of concern to industrial arts teachers and administrators have been assembled. The fact that these lists are basically similar in nature raises serious questions concerning the practical nature of the research studies conducted in the field of industrial arts to date.

The problems listed in this chapter represent the expressed concern of many instructors and supervisors of industrial arts. No attempt has been made to make this list all inclusive or to identify various facets of needed research.

There seems to be considerable concern for closer and more cooperative relationships among teacher educators, supervisors, consultants and instructors.

The major problems identified as possible research topics have been grouped under general headings for convenience of examination only. The degree of importance of each topic to those concerned seems to vary from state to state and from community to community. There was considerable interest in the realistic and practical nature of future research possibly giving further weight to the importance of the cooperative approach to potential studies.

I. Nature and Purpose of Industrial Arts

a. A practical approach to the interpretation of industrial arts for administrators, boards of education and the public.

b. Clarification of the meaning and purposes of industrial arts at all levels.

c. A public relations program for industrial arts.

d. Program developments in industrial arts related to occupational opportunities and preparation.

e. Program developments in industrial arts designed to interpret labor and management problems.

f. Program developments in industrial arts which develop understanding and proficiency in basic principles of industrial arts.

g. Program developments in industrial arts related to the development of consumer knowledges and skills.

h. Program activities in industrial arts designed to encourage the development of skills and knowledges related to the home workshops.

II. Curriculum Patterns and Organization

a. Curriculum patterns for the elementary industrial arts program.

b. Curriculum patterns for the junior high school industrial arts program.

c. Curriculum patterns for the senior high school industrial arts program.

d. Coordination of industrial arts programs at all levels.

e. Curriculum organization to meet changing conditions in the community, the state and the nation.

f. Curriculum patterns, trends and organization is specific areas. (Woods, metals, electronics, power mechanics, graphic arts, drafting and crafts.)

g. Industrial arts activities to meet pupil needs.

III. Physical Facilities

a. General and special lighting requirements for industrial arts programs.

b. The relationships of local building committees, school boards, administrators, supervisors and teachers in planning industrial arts facilities.

c. Techniques and procedures for more efficient and effective planning of industrial arts facilities.

d. General and special heating and ventilation requirements for industrial arts facilities.

e. General and special electrical service requirements for industrial arts facilities.

f. Modernization techniques for refurbishing industrial arts facilities.

g. The development of more efficient types of storage units for industrial arts facilities.

h. Trends in the use of portable electric tools.

i. Criteria for the selection and purchase of industrial arts furniture and machine equipment.

j. Criteria for the selection and purchase of industrial arts hand tools.

k. Criteria for the selection and purchase of consumable materials.

IV. Instructional Techniques and Materials

a. The selection and use of audio-visual aids.

b. The preparation and use of models and mock-ups for use in industrial arts programs.

c. The preparation and use of lesson guides.

d. The use and displays of industrial arts projects and activities.

e. Techniques for the development of more effective teacher and pupil demonstrations.

f. Techniques for the selection and use of textbooks in the industrial arts program.

g. Techniques for the selection and use of reference books, magazines and pamphlets.

h. The preparation and use of instructional materials (job sheets, information sheets, operation sheets, assignment sheets.

i. A program for periodic examination and study of new industrial equipment and material.

j. Techniques for planning more effective field trips for industrial arts pupils.

k. Functional programs of safety education in industrial arts areas.

V. Professional Preparation and Development

a. Certification requirements in the field of industrial arts.

b. Undergraduate industrial arts teacher education to meet changing conditions.

c. Graduate programs in industrial arts teacher education to meet changing conditions.

d. Workshops and clinics for in-service growth.

e. The place and function of the area or county Industrial Arts Teachers Association.

f. The place and Function of the State Industrial Arts Teachers Association.

VI. Evaluation

a. Evaluating teaching efficiency in industrial arts.

b. Incompetency and teacher tenure.

c. Criteria for identifying promising practices.

d. Factors affecting a program for in-service growth.

e. Evaluation of testing programs to determine teacher effectiveness.

f. The effectiveness of evaluation techniques in vocational guidance activities.

g. Evaluation factors for determining pupil growth in industrial arts.

h. The effectiveness of evaluation techniques disigned to determine acquired skills and knowledges.

i. Factors affecting the measurement of consumer skills and knowledges.

j. Criteria for determining the influence of industrial arts activities on recreational pursuits.

k. Standards of achievement in industrial arts.

VII. Industrial Arts and the Total School Program

a. The relationship of industrial arts to other areas of learning:
   (1) Industrial arts and science education
   (2) Industrial arts and art education
   (3) Industrial arts and social studies
   (4) Industrial arts and field of mathematics
   (5) Industrial arts and the language arts
   (6) Industrial arts and the guidance program
   (7) Industrial arts and agriculture
   (8) Industrial arts and home economics
   (9) Industrial arts and vocational education.

b. Industrial arts activities for the slow learner.

c. Industrial arts activities for the gifted.

d. Industrial arts activities and community needs.

VIII. Administration and Supervision

a. Criteria for the selection and placement of teachers.

b. The relationship of the supervisor to the teaching personnel.

c. Promoting realistic programs of school shop safety.

d. Techniques for the development of curriculum guides at the local level.

e. Criteria for determining budgetary needs in industrial arts.

f. Factors affecting enrollment in industrial arts.

g. Problems related to balancing teaching loads in industrial arts.

h. A realistic approach to per pupil costs.

i. Problems related to continuous program improvement.

j. A program for assisting the new industrial arts teacher.

k. The relationship of the industrial arts supervisor to the community.

l. Consultant techniques to meet the needs of the in-service teachers.

m. The relationship of the industrial arts supervisor to the teacher education program.

Industrial arts teachers and supervisors alike seem to be seriously interested in problems related to the daily teaching programs as well as those which will influence the future development of industrial arts. There is every reason to believe in their readiness to cooperate in any study which represents a real attempt to seek solutions to practical problems which may help to evaluate and improve the industrial arts program at all levels.

Of real concern, to most people, is the future direction of industrial arts and in this instance many have expressed rather strongly their interest in the problems related to the question: How can theory and practice in industrial arts education be better related?

While many industrial arts teachers and supervisors have expressed an interest in research studies for development and improvement, many more are expecially interested in the practical use of such studies after they have been completed. There is a definite feeling that far too many studies are completed and then filed without further consideration of their value. Here there would seem to be a need for some practical, more comprehensive method of publicizing the results of these studies.

As a final indication of concern for needed research in the field of industrial arts, it should be noted that more and more people are showing an interest in the operational types of studies which might generally be classified as action research.

CHAPTER VIII

Summary

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The problems concerning the lack of coordinated research in the field of industrial arts and industrial arts teacher training should be evident to the reader. Dr. Grace indicated the broad implications for improving education through research. Through research, we must evaluate our entire system of education if we hope to provide our youth with the necessary knowledges and skills to preserve the leadership this nation needs to bring it through the critical years ahead-economically, socially and from the standpoint of national defense.

Industrial arts, as a phase of education for all young people, must be evaluated and improved to take its rightful place in the development of knowledges and skills which will equip our youth, and adults, to use their potential abilities for the improvement of society. The apparent lack of foresight on the part of many industrial arts teachers and teacher educators to be up to date and to look into the future, both in subject matter and teaching techniques, has caused teachers to be on the defensive regarding the role of industrial arts education. If we believe that industrial arts should involve a study of the interpretation of industry, then many industrial arts teachers are failing to attain their aims and objectives. Too many of us are teaching those things pertaining to the era of the horseless carriage rather than of the age of jet propulsion and space travel.

Improvement in the industrial arts program can be made largely through scientific research. We must evaluate what we have done in the past and what we are doing at present in order to determine where we are going in the future. All phases of our program must be studied: teacher training, teachers, facilities, equipment, materials, teaching techniques, course content, and the role of industrial arts in the total program of education.

The Problems

Chapters II and III very graphically showed the lack of coordinated effort in scientific research in industrial arts teacher education. There are two things evident: either there is a lack of research or a lack of reporting of research in such manner that the information is available to everyone. Industrial arts teacher trainers are in the most strategic position to guide and direct research as well as to conduct research problems on their own. In the study made by Dr. Kleintjes and Dr. Powell it was evident that graduate students were not being guided on a large scale into really significant research projects dealing with industrial arts teacher education or in industrial arts education.

Research could well be cultivated in the teacher training institutions. It is here that the science and techniques of research are taught, largely because of requirements of the institutions for the granting of a graduate degree. With all of the master's degree and doctoral degree research projects conducted throughout the country, and sponsored by the teacher training institutions, it is significant that so few of these projects deal with teacher training problems as shown in Chapter II.

Dr. Fuzak and Dr. Sears both pointed out that the research done by a graduate student to complete the requirement for a master's thesis or a doctoral dissertation should be only the beginning. This experience should whet the appetite of the industrial arts educator to to delve into more and greater problems of significance to help improve industrial arts education. The writing of a graduate document as a requirement should be the beginning of an apprenticeship in research. As Dr. Fuzak implied, apparently the research requirement for a graduate degree is looked upon as a horrible experience which must be performed and then forgotten as quickly as possible. The teacher training institutions are failing to develop in the industrial arts educator a desire to become involved in more significant scientific research with the aim of improving the entire field of industrial arts education.

As a group, industrial arts teacher educators are probably as professionally dedicated to the job of educating the youth of America as is any group of educators or any serious thinking members of our society, yet they either lack the interest or the time to conduct significant research as individuals or in groups. Dr. Fuzak's comments on

this problem in Chapter III should cause teacher educators to give much thought to the development of a program of research which will improve teacher education and ultimately all phases of industrial arts education.

Another, and seemingly, more complicated problem indicated in Chapters II and III is the apparent lack of coordinated effort. In the first place it was found to be quite difficult to obtain usable abstracts of studies that have been done. Several sources for obtaining information were used but no one source seems to supply complete information regarding what can be considered as significant research studies. Of course there could be some disagreement as to the criteria for determining significant research (which makes this problem more complicated). While there have been attempts made to catalog completed research projects as degree requirements in various teacher training institutions: American Industrial Arts Association Research Committee; Micro-Film Library, Ann Arbor, Michigan; Research in Industrial Education, Summaries of Studies, 1930-1955, United States Department of Health, Education and Welfare, there is a lack of communication within institutions, between institutions and between cataloging agencies. Added to this is the lag of time between the beginning of the research project and its completion. These problems greatly handicap the coordination of research so that the efforts of many can be pooled to result in studies that may be used to improve larger areas of the industrial arts program and not a piecemeal offering as seems to be the current pattern. The research efforts of individuals who are not working under sponsorship of a degree granting requirement are even more difficult to discover. Only if the research is being done through a grant or otherwise receives publicity through publication in national periodicals do industrial arts educators reap the benefits of such individual research.

Dr. Sears, in Chapter IV, has given a clear and detailed analysis of the procedures used for scientific research. It is evident that through Dr. Sears' long experience as an authority in educational research much thought has been given to the detailed step-by-step procedures which must be followed by the researcher. There is no easy way; no short-cut. However, if the instructions in this chapter are followed the researcher will be saved much time and effort. These are the basic procedures, and if followed, will pave the way for proceeding scientifically, which is the only way pure research can be accomplished and by which industrial arts education may be improved.

The Role of Industrial Arts Educators

Taking the suggestion from Dr. Grace in Chapter I, industrial arts teachers, supervisors and teacher trainers should take the initiative to determine and to aid in establishing a national policy for the role of industrial arts education and to determine the role of research in the advancement of industrial arts education. A start has been made in this direction by the Industrial Arts Policy and Planning Committee of the American Vocational Association in its Statement of Industrial Arts in Education. A planned program of research is needed to strengthen the statement of policy and to improve industrial arts education.

Teacher training institutions must strive to improve the quality and quantity of research. The educators in these institutions must inculcate in the prospective teachers and doctoral candidates a desire for improvement in industrial arts education through scientific research.

Teacher educators, through their institutions, should initiate more research on their own. Coordinated research projects should be planned through teacher educator associations and more strenuous efforts be made to obtain grants to finance the projects. Closer communications must be established between teacher training institutions, state education departments and the federal office of education in order to coordinate all research projects for a more effective program. Unless the findings of research projects get in the hands of the classroom teacher, and he is ready and willing to test the findings, the effectiveness of the research project will be lost.

An effective plan might be initiated by a national research planning committee established through the American Council on Industrial Arts Teacher Education.

Chapter V, written by Dr. Micheels and Dr. Lindbeck, introduced the researcher to the detailed procedures for developing the hypothesis for a research project. This is one of the important phases of scientific research and is demonstrated in this chapter by showing in detail how the hypothesis was developed in a practical research problem. When a beginning researcher is ready to start a project this chapter should be extremely helpful.

Dr. Bauer, in Chapter VI, discussed needed research in industrial arts teacher education, and in Chapter VII Mr. Ketcham discussed needed industrial arts research from the viewpoint of the industrial arts superivisor. Both of these chapters provide all industrial

arts educators with many ideas in both broad areas and in specialized areas where scientific research is needed. These authors ask industrial arts educators to study problems, as they see them, on which the future of industrial arts should become a stronger part of the educational program for the youth of America.