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RESEARCH PROBLEMS UNIQUE TO INDUSTRIAL EDUCATION

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PREFACE

As can be seen from the cover page, this is a first effort by NAITTE to establish a monograph series. While the formal guidelines for the monograph series are still under development, it is envisioned that this vehicle, as contrasted with the Journal of Industrial Teacher Education, will be published on an occasional as needed basis and will focus on a single concept or topic. While the manuscripts for any one issue may come from AVA or AIAA convention programs as did this first issue, there is no limit to the possible sources of good material which might make up an issue. Each monograph will have an issue editor who will take responsibilty for everything in the area of content, while a managing editor will handle production and distribution. The executive committee of NAITTE will decide which future monographs will be published by accepting a proposal from a prospective issue editor. As managing editor for this first monograph, I ask each of you who have had an opportunity to read it to please provide me with your opinions and suggestions via the survey questionnaire which you will find stapled in the middle of the monograph.

As with any effort of this type, there are a number of individuals who have contributed to making it a success. Some of those who helped with this project include the ad hoc NAITTE monograph committee made of Jim Boone, Curt Finch, Dick Swanson and Pat O'Reilly; the typist for the camera ready copy, Linda Conti; the staff of the Department of Industrial, Vocational and Technical Education at Texas A&M who handled incidental typing, copying, and mailing; Karen Duncan, an undergraduate student in the department who assisted with the cover design, and my graduate assistant, Jack Compton who did whatever else needed to be done. Lastly, we all owe our thanks to the authors and issue editor who worked hard to provide us with thoughts worth reading.

Jerome T. Kapes, Managing Editor
Texas A&M University

INTRODUCTION

Ready, aim, fire. . . . bull'seye! The industrial education research target, like targets for any field of study, is made up of concentric circles. The bull'seye, smallest circle of them all, is in the center. The bull'seye is surrounded by outer rings that increase in size while decreasing in worth as they get further from the core.

This monograph is about focusing on the industrial education research target and the bull'seye in particular. Each field of study has reasonable boundaries. What helps define a field of study is the research that goes on within those boundaries and the research which challenges them.

As an applied field that embraces a broad base of knowledge, industrial education has a history of experiencing the joys and disappointments of education and industry faddishness. Our research agenda has at times focused on the target fringes rather than the bull'seye. Critics would go as far as suggesting that a significant portion of the research has been defined by problems and fields of study outside the important issues facing industrial education.

Sometimes a person's or organization's strength can also be their weakness. The field of industrial education, in its generous embrace of the broad field of educaton, has at times found itself at a loss for its own research agenda. The purpose of this monograph is to provide a research agenda aimed at the bull'seye--those research problems unique to industrial education. The papers in this monograph are intended to provoke senior and neophyte industrial education researchers to more carefully aim their research rifles.

Industrial education, for any number of reasonable explanations, has a limited number of researchers. Yet, as a profession we, compete against areas of study that have legions of research sharpshooters. In that industrial education has a limited number of sharpshooters with limited rounds of ammunition, shooting at someone else's target or at the fringes of our own target is a luxury that we can ill-afford. And, it is for these reasons that this monograph was produced.

The forerunner to this monograph was a National Association of Industrial and Technical Teacher Educators symposium conducted under the same title. The symposium was held during the 1983 American Vocational Association convention in Anaheim, California. At that time, Drs. Strong, DeVore, Moss and Householder addressed the topic of research problems unique to industrial education. Their original papers served as the basis for this treatise. The individual integrity, experience and expertise of the authors make these four papers a valuable collection to industrial education scholars. Beyond this, Dr. Mohamed was asked to focus his critical eye across all four papers and to provide reactions that would move us closer to a research agenda for our profession. The intent of publishing these papers as a monograph is to involve you, the reader, in this professional concern.

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University of Minnesota

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RESEARCH IN INDUSTRIAL EDUCATION: SOMETHING OLD AND SOMETHING NEW

Merle E. Strong

The old questions that relate directly to research problems unique to industrial education, have over the years, remained about the same, but they are being asked in a new context. Society has undergone many changes, but the most important change has been, especially for industrial educators, the change in technology.

We live now in a new technological era. Naisbitt's (1982) *Megatrends,* does no startle those in industrial education, but it does point out clearly, technology changes daily. The basic question, therefore, which must be asked is, "Is Industrial Education changing to reflect the new industrial environment?"

This is hardly a new question. It was being asked some forty years ago. However, no sufficient answer has been found and all our attempted answers must be subjected to constant review and revision. Somewhere in this nation, someone is still making the same window stick and identical footstool that were made forty years ago in industrial arts. It was probably not too appropriate then and is certainly less so now, and sadly enough, someone may still be trying to defend it as the good project that it might have been at some time in the ancient past.

Need for Definition

It seems appropriate to dwell, at least momentarily, on the problem we have related to purpose and definition in industrial education. All of us agree that industrial education is a broad generic term that encompasses industrial arts, trade and industry, and technical education. From here the definition gets a bit fuzzy, which makes communication with our publics very difficult. The breadth of the Vocational Educaion Data System organization at the state and local levels, and other factors, have led some to justify all industrial arts on the grounds that it is vocational. This understates the purposes of industrial arts as a part of general education. On the other hand, vocational educators claim a very broad swath of responsibilitis for trade and industrial education, including something called general-vocational education.

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It is not the purpose of this article to solve this problem of terminology. That is more likely to be influenced and clarified by politics instead of academic research. However, definitions, goals and objectives are very basic to any research effort and they may very properly be the subject of research. The developers of the "Standards for Industrial Arts Programs" are to be commended because these standards reflect somewhat on this problem. The standards to be developed on trade and industrial education may also be of some help.

The Educational Context

The context in which we find ourselves is quite interesting. The White House has been committed to lessening the federal role in all education, but at the same time, there is a new awareness among many of the value and need for a strong educational system. Most of us have read some of the numerous national reports on education such as, *A Nation at Risk, High School: A Report on Secondary Education in America,* and *Action for Excellence,* to name three of the most influential. These reports will have a profound influence on public opinion, on the opinions of professional educators and, utlimately, on program direction, particularly at the high school level. After reading these reports, a pessimist would certainly say that the reports are not constructive to industrial education, particularly at the middle school and secondary levels. With all of the emphasis on the basics, usually defined as requiring more years of English, math and science, there is just no room for industrial education.

However, we should be optimists. Obviously, we should be raising the basic skills levels for all students; obviously many of our programs in the public schools are without rigor, and obviously, there are many students in both high schools and post-high school programs without good basic skills. Would not it be great if all of our students came to us with excellent reading levels and substantial math and science skills.

A part of our research agenda them, should be to address ways that we in industrial education can become a central part of the national agenda for excellence in education.

Consider a few references from the Carnegie Report (Boyer, 1983):

> Education is in the headlines again. After years of shameful neglect, educators and politicians have taken the pulse of the public school system and found it faint. (p. 1)
>
> This Carnegie Report on the American high school begins with the conviction that the time for renewing education has arrived. We believe today that America has the best opportunity it will have in the century to improve the schools. (p. 1)

The above quotations certainly suggest the challenge and, it is hoped, the opportunity. The problem with the Boyer report, however, is that it *is* somewhat elitist and very idealistic. In fact, it *may* fail to recognize that there are great individual differences among students and amond occupational requirements.

A subheading in the Carnegie Report, entitled "The Impact of Technology" may, upon first glance, appear as a friend and good supporter of industrial education. Careful reading, however, reveals that the report discusses the same sort of history, several decades advanced, that was studied years ago. The only difference is that in the past the subjects were the reaper and the cotton gin. To quote briefly from the report:

> We recommend that all students study technology: the history of man's use of tools, how science and technology has been joined, and the ethical and social issues technology has raised. (p. 10)
>
> The great urgency is not "computer literacy," but "technological literacy," the need to see how society is being reshaped by our inventions, just as tools of earlier eras changed the course of history. The challenge is not how to use the latest piece of hardware, but asking when and why it should be used. (p. iii)
>
> The one semester study of work we propose would ask how attitudes toward work have changed through the years. How do they differ from one culture to another? What determines the status and rewards of different forms of work? In addition, students should learn about changes in the economy, job opportunities that are emerging and those that are declining. (p. 114)

Although the above content is not undesirable, it does not go far enough. The report recommends that we teach about technology and about work. But we should also teach technology and skills and how to work.

A Research Agenda

As mentioned earlier, the topics for research in industrial education have not changed much throughout the years. Rather, the context in which we operate has changed and, therefore, the answers to many of the questions that we pose should change in at least five broad areas. Further research is needed in: Curriculum, Evaluation, Organization and Methods, Linkages with Business and Industry, and Support of the Basics.

Curriculum

The most basic questions facing industrial educators is what should be taught. Industry has always been the basic focus for content. However, we may be a little like the blind man touching the elephant as we attempt to view industry.

A bulletin resulting from a recent study by Swanson (1983) and others entitled, *A View of Industry* is to be commended. Industry was described from the literature and a model useful for determining content in industrial education was proposed. This study is a good beginning in the development of a rational way of viewing industry for curriculum purposes.

What should be taught in industrial arts? The data collected in the "Industrial Arts Standards Project" showed that course offerings had changed little since 1950 (Worthington, 1982). The five top courses were woodworking, general metals, general industrial arts, architectural drafting, and mechanical drawing. The question is, to what extent to these courses represent today's technology, assuming that this is a central objective of industrial arts? If industrial arts is study of the tools and processes of industry, then research is needed to identify the content from industry that can be incorporated into an industrial arts curriculum.

This topic is, obviously, very broad, and there is room for many studies on the general topic using various kinds of methodologies. It would appear that many of the studies need to be qualitative in nature rather than quantitative. The resource for the data will need to be found in industry itself. Some of the new technologies should be the focus. However, even though "high tech" is the buzz word, data will show that many are not working in these areas. Therefore, it will probably be desirable for industrial arts to reflect on the broader work area. In trade and industrial education curriculum, we continue to have the same kinds of questions that have faced us for some time. What are the manpower needs in a district or region? While we have much data on a national and state basis, it is often not too helpful in a particular region. Also, we are a long way from having definitive information needed for program development in most cases. Models for determining manpower data for program planning purposes need further development and testing.

What is the criticality of training? In other words, once we have manpower data, what are the criteria for determining what occupations we should invest in? Cost benefit analysis was very popular at one time and still has its place, but there is still a need to develop broader models that might include such criteria as how important the occupation is to the society.

What are the changes that should be made in programs? Most of the change in trade and industrial programs will be and should be incremental-type changes instead of total curriculum changes. We need continuing research in industrial areas to determine what should be added to programs to keep up with industrial practices and just as important, what should be left out.

How can we best serve individual differences? Compentency-based, individualized, mediated instruction is expanding at a rapid rate. Research is needed to determine where it is most effective, for which individuals, and under what circumstances. The open entry-open exit system using competency-based curricula also needs further study.

Evaluation

In the future, the whole area of evaluation will become a more important area of research as we seek to establish quality and rigor in programs. National assessments of various kinds will take on new importance as will testing systems initiated by states.

The Occupational Competency testing program in trade and industrial education should be expanded and more fully used. One method of determining how students compare is to match their achievement scores with others on validated content of an occupation. Research is needed to determine what the factors are that will upgrade programs. What is the effect of time on task? What is the effect of shortcomings in facility? What is the effect of teaching related math and technology classes as compared to less applied content? What instructor qualifications have an effect on learning?

Follow-up studies, particularly on a longitudinal basis, are greatly needed. It is appalling that at the secondary level, it is hard to find a school that has follow-up information on high school students, except those in vocational education. We just do not know what happens to our high school graduates, not to speak of the dropouts, except in a general sense and some of what we think we know is not always true. The implications of good longitudinal studies are great for the improvement of program and instruction.

What has been the impact on federal support? We say we need it, yet not much research exists that provides definitive evidence of the effect it has had. Both qualitative and quantitative information can be collected that should provide definitive information on its value.

Organization and Methods

The areas of organization and methods are fruitful areas for research. In terms of types of schools, several studies have indicated that the most successful vocational education programs were not in comprehensive high schools, but rather in specialized high schools (Boyer, 1983).

These facts suggest that we should research the characteristics of successful specialized schools. What are the variables that make their programs more successful? Among these may be: time alloted, student selection, curriculum, teacher qualifications, and facilities. This research would be useful not necessarily to make the case for specialized schools, but rather to identify the ingredients that may be missing from the comprehensive high school.

There is a continuing concern that the basics not be sacrificed for vocational education. Has anyone researched the scores of students in intensive vocational programs, as compared to students in the college preparatory or general program, controlling for ability? Such research might show them that trade and industrial students have not sacrificed the basics, or that our related instruction, which should be based on principles of math and science, really does lack rigor.

The age of microcomputers has arrived, at least, from a hardware standpoint, although hardware will certainly continue to be improved. At this time, we know too little about how to utilize this new hardware for maximum efficiency and effectiveness. Recently, someone decried the fact that he had new computers, but 20-year-old textbooks. There is clearly a great need for research in the use of micros and other instructional media as a way of delivery of instruction.

Linkages with Business and Industry

Many see linkages with business and industry as a promising way to excellence. Private Industry Councils are the driving force behind new manpower programs and business-school partnerships have many advocates.

One of the statements of the Task Force on Education and Economic Growth was, "If the business community gets more involved in both the design and the delivery of education, we are going to become more competitive as an economy" (Hunt, 1983, p. 18).

It is not certain that business and industry have any easy solutions for education. However, through the use of advisory committees, industrial educators have become more attuned to business and industry than have other educators.

Research is needed to determine how best to establish linkages. What are the ingredients of a successful linkage? How can we most successfully secure the advice and council of industry representatives? What level of dollar incentives or tax incentives are required to bring about a sharing of the use of industrial facilities and equipment?

What kinds of technical assistance can be provided to industry and on what basis? Many of our schools have been in a posture of only providing training through organized classes, usually with a limit such as 10 or 12. We need greater flexibility. Some post-secondary institutions are now providing one-on-one technical assistance.

There would seem to be a need to strengthen links to Private Industry Councils. Occupational advisory committees may provide one means for doing this. Linkage models need to be developed and tested.

Industrial educators have the potential because of past experience to research most effective linkage methods and to lead the way for all education.

Support of the Basics

There is not a clear understanding of what the word "basics" means. Many agree that the basics include reading, writing and computational skills, but fewer agree about what the minimum levels should be and for whom. Computers have now been added to the list of basics by at least one study group. Some are suggesting that only transferable skills should be taught at the high school level with lists of examples of what is meant. Such lists often include such things as decision-making, creativity, imagination, innovation, conceptualization, motivation and problem-solving, to name a few.

Evans (1971) in his book on *Foundations of Vocational Education* included a chapter entitled, "Lending Intelligibility to General Education," which provides a rationale for thinking about vocational education as a method of instruction. For many youth, the academic approach lacks meaning, and academic skills for many students can better be taught through application. Industrial education, if properly taught, can provide that application, particularly, of math and science. Industrial educators will not dispute this point, but no research exists to back it up.

The survival of industrial education is dependent on demonstrating that the 3R's can be learned through practical application. Every class at all levels, high school or post-high school, should be an applied English class, math class, and science class. This will not happen automatically. Curricula will have to reflect this. Some industrial education teachers may need additional preparation, and there will need to be a commitment to the task. For many students, 11 years of English has not made much of an impact. The solution may not be to add another year of the same, but we need some answers from research.

In terms of the descriptors of generalized skills mentioned earlier, general education has no monopoly on teaching students to solve problems, be innovative, to conceptualize, or, even to think. However, we need curriculum research that will point up the means for doing a better job in these areas and evaluative research that will indicate when we have been successful.

References

Action for excellence. (1983, June). Task Force on Education for Economic Growth.

Bottoms, G. (1983, October). Voc Ed belongs on the national agenda for excellence. *VocEd.* pp. 8-9.

Boyer, E. L. (1983). *High School - A report on secondary education in America.* New York: Harper & Row.

David H., Hjelm, H. F., & Harris, R. C. (Eds.) (1980) Proceedings of a National Conference. *Vocational Education Research in the 1980s.* Bloomington: Indiana University.

Davies, E. (1983, June). A Nation at risk: An opportunity for school reform. *Citizen Action in Education, Resources for Youth.*

Evans, R. N. (1971). *Foundations of vocational education.* Columbus, OH: Charles E. Merrill.

Lewis, M. V. (1981, January). *An R&D agenda to respond to future needs in vocational education.* Columbus: The National Center for Research in Vocational Education, The Ohio State University.

Miguel, R. J. (1980). *Youth in the workplace. The Dynamics of learner needs and work roles.* Columbus: The National Center for Research in Vocational Education, The Ohio State University.

Naisbitt, J. (1982). *Megatrends.* New York: Warner Books, Inc.

Standards for Industrial Arts Programs. Reston, Virginia: American Industrial Arts Association.

Steering Committee, Human Resources Executive Program. (1982, November). Task Force, Corporate Roles in Public Education Project. *Basic skills in the U.S. work force.* The contrasting perceptions of business, labor, and public education. Center for Public Resources.

Swanson, R. A. (Ed.) (1983). *A view of industry.* St. Paul: Division of Industrial Education, University of Minnesota.

Worthington, R. M. (1982, Fall). *Vocational education as it relates to industrial education. The South-Western Pacesetter Report.*

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RESEARCH AND INDUSTRIAL EDUCATION: SEARCHING FOR DIRECTION

Paul W. DeVore

Every aspect of education in American society is being examined today. So too is industrial education. As part of the process of self-examination, various professional groups meet to identify and explore the problems and issues. The purpose of this manuscript is to (1) focus on central issues and problems facing our profession, and (2) to propose research to assist in the solution of the problems and issues.

Central to any discussion of this nature in the United States is the fundamental question of the purpose of education in a democratic society. Directly related to this question is the question of "What learning is of most worth?" This is the primary question. If these questions can be answered and a context for the answers established, then a beginning can be made on the question, "What research should the profession of industrial education be pursuing?"

The Purpose of Education

There are no final answers, nor is there one answer to the question of; "What is the purpose of education?" One's perception of purpose is related to one's world view. Thus, to pursue an answer to the questions of "What is the purpose of education?" and "What learning is of most worth?", world views must be examined carefully, not in isolation, but within a context of the reality of the world as it is today and will probably be in the projected future.

We find, on examination, that the world today and in the projected future will be more technological, not less, that the population of the world is increasing, that there are limits to the resources of the world and the natural environment, and that we are in an era of transition, from a world of low entropy and orderliness to a state of high entropy and disorder. The latter factor, entropy, may be the most significant one of all. The mentality of the industrial era has been to produce, consume and grow. The result has been the creation of very inefficient and wasteful transformation and use processes with a built-in inflation that will only increase as we continue to use more and more of the

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dwindling resources. The fewer the resources, the higher the cost. The less concentrated a resource reservoir (copper, oil, or chromium, for instance) the greater the energy required to extract, process and recycle the resources.

Each of us is aware that we have entered a new era. The evidence surrounds us. Yet, for the most part, the primary purpose and focus of the field of industrial education has changed little. The primary concern, and even justification, is still job, career or occupational preparation. This position is maintained even though there is considerable evidence that many programs are still preparing people for nonexisting jobs and nonexisting futures. This does not mean that work and jobs are not important nor that education to prepare for work is less important. The question is and always will be; "What knowledge and know-how is of most worth?"

One purpose of education should be to prepare people so they can adapt to new situations and control their own destinies. Our role as industrial educators should be to determine what learning about industry and technology is of most worth in an ever changing, dynamic, world-wide technological society. In pursuing this issue, questions will range from, "What kind of technological society can we have given the limits of our natural world and the entropy law?" to, "How can we redesign and implement a system that, as a minimum, provides for the basic needs of each and every citizen, including the provision of meaningful roles in society?" An overall answer to this question will certainly focus on the need for all citizens in a democratic society to know about and understand the behavior of the various technological systems, subsystems and their elements, so they can participate effectively in determining and controlling their collective futures. A democracy requires well-educated and knowledgeable citizens. The nature of education must be compatible with the present and projected society in which it exists.

Industrial education, born and nurtured in another era, is now in the position of examining the ways in which it contributes to these goals. The creation and development of technical means is of the intellect and the technical means of today are more intellectural not less, more theoretical not less, and more conceptual not less. It thus seems accurate to conclude that unless industrial education content and practice are based on theories and concepts relating to the behavior of the technical means and the relation of these means to human beings, their societies and the environment, that we cannot expect to educate citizens capable of creating and controlling technological systems.

Today, throughout our society, there is a recognition that the intellectual capabilities and technological understanding of our citizens must be enhanced if we are to compete successfully internationally and if we are going to manage successfully the technical, social, and environmental interfaces within our communities. We need not only intelligent and creative workers, but also intelligent and creative citizens. In what ways does the field of industrial education contribute to the education of intelligent and creative citizens for the world of today?

Over the years, one of the avowed missions of industrial education has been to study industry. The usual approach has been to find out what the practices were in industry for designing or making a product and then to develop and teach curricula to emulate these practices. It would be difficult to make the case that such curricula actually provided a true study of industry in the same sense that other disciplines study the behavior of the phenomena of their fields. If the practitioners of industrial education had been involved in study and research about industry, then they would have been involved very early in environmental issues, worker health and safety, community and worker control of industries, microprocessor controls in industry, quality control through better design, employee adaptability to technological change, the enhancement of innovation and invention, and productivity questions, among others. But we were not. Our mentality is of an earlier industrial era, an era many do not want to admit no longer exists.

The evidence seems clear. We have reached that stage of evolution where a major transition is required if the field is to continue as a viable field of education and contribute to the solution of some of society's very significant and critical problems. In some places the transition has already begun, a transition forced by those external to the field. If we, as practitioners in the field, are to guide our field to an orderly transition, then we need to begin by searching for answers to a number of fundamental questions. This will require a different research agenda than the time-honored, traditional one.

Research in Industrial Education

Most of the research in industrial education has been done as a requirement for doctoral and masters degrees. Reviews of research in industrial education have not attempted to evaluate the value of the research in terms of industry, technology and social problems, nor have they attempted to evaluate the quality of the research. Some reviews have cautioned researchers, in a limited way, about the selection of inappropriate statistical procedures and methodologies, but the critiques are few and limited.

Reviewing the research of the field by titles and place of origin provides some insight into uniqueness. For instance, one finding is that there seems to be no cumulative research base in the field. Each dissertation, even with the time honored requirement of extensive literature reviews, often stands alone, separate and isolated. Also, there does not seem to be agreed-upon research agendas, central themes, or important problems. Nor does there seem to be an on-going identifiable network of researchers pursuing research on specific topics.

The categories of research have remained fairly constant over the years, probably because the focus of research has been more on education and schooling than on industry. Categories such as history, philosophy, philosophical concepts, social and philosophical framework and goals and objectives of industrial education are usual, as are curriculum development, career development, instructional media and methods, facilities and equipment, and teacher education, including organization and administration, undergraduate programs, graduate study, course development, and recruitment. There has been considerable research on administration and supervision, leadership, public relations, and program evaluation, including standards and status of the profession. Thus, another uniqueness of research in the field is that it is primarily education and public school oriented, not industry and technology oriented. This may be the source of the primary problem in the field, the fact that the research focus has been on the practice of teaching rather than on technology and industry. The issue of the practice of teaching is important but not primary. In fact, in order of priority, the issue of practice would be the last in a series of questions concerning curriculum design and implementation. The primary questions in order of importance are:

1. *What* to teach and why?
2. *Who* to teach it to and why?
3. *When* to teach it and why?
4. *Where* to teach it and why?
5. *How* to teach it and why?

For the most part, the first four questions are ignored. The primary research questions have not been directed toward answering the questions of, "what to teach and to whom?" but rather the question of "how to teach it?" The reason for this may be that the field of industrial education, as practiced, seems to be in general agreement on the answer to the question of, "What learning is of most worth?" This may be another source of the problem. Rarely have significant philosphical differences surfaced and been debated. Occasionally there have been journal articles and conference presentations which have attempted to begin the discussion. Most have not been taken seriously by the practitioners in the field and research in the field has not been of much help in contributing answers to the questions, primarily because most research has been conducted to fulfill degree requirements or to maintain positions on faculties in universities where research and publication are requirements. After individuals attain degrees in the field and assume professional employment, few continue research. Professionals occupying positions in public schools, two-year colleges and four-year colleges, on the whole, conduct little, if any, research. What research is conducted at the university level has had little affect on practice, except in isolated project sites or pilot programs. There are few instances where successful diffusion and adoption programs for the application of research to practice have been established.

One general conclusion that can be derived from observing the field and its behavior is that little change will take place without (1) a major shift in the philosophical base, and (2) a focus on the content of the discipline, rather than on education and the practice of teaching.

The new philosophical and content base can be evolved through a research effort based on the question: "What learning is of most worth in the study of industry and technology for citizens in their various roles in a democratic and highly technological society?" The question is highly relevant and significant. We are on the threshold of transitioning to another technological era brought about by a significant change in the energy supplies of the world. If industrial education is to contribute to the solution of the most critical problem of the modern era, energy and entropy, then research should be directed toward answering questions that relate to the on-going transition of industry and technology and the meaning of these changes to the education of citizens.

"What learning is of most worth?" There seems to be a developing concensus that the learning that is of most worth is:

> that learning which serves individuals over the longest period of time and in the greatest number of situations as they live and participate in a meaningful and productive way in society.

The issue of intelligent citizenry is more critical than ever before. Being an intelligent citizen and worker today certainly involves knowing and doing in the technologies. Many recent choices with respect to our technical means have ended in disaster for some and near disaster for others. This is true whether the issue is toxic wastes from industrial processes or the disemployment of people when the primary industry in a community is closed, such as in Wierton, West Virginia and other similar towns and cities throughout the United States. People have come to realize that they have lost control of their lives and that the communities they once believed were stable and sustainable for the long-term future are vulnerable to decisions made thousands of miles from their communities. What we are discovering is that technological systems designed and developed by a mentality of another era are not sustainable. The problems and issues of today concern the search for alternatives to present technical systems, either by designing new technical means or redesigning present ones. Successful designs will require new knowledge and understanding of the behavior of systems and the relation of the various elements and components of a system to the total.

Today, our technical systems function on a global basis and decisions made by other businesses, industries, and governments affect directly business and industry in our own community.

Obviously, especially in a democratic society, the participation of all citizens is required if appropriate decisions are to be made and implemented. What learning is of most worth with respect to the design and control of technical means at the community level by citizens? At the regional or national level? Simply answered, it is the knowledge and know-how that has to do with the behavior of industrial and technological systems.

What should all citizens *know about* technical means? What should they *be able to do?* Obviously every citizen cannot know all there is to know about all of industry and technology. Therefore, the search must be for the structure of the discipline; the central themes, systems, concepts and principles that provide insight into the behavior of industry and technology, not only technically but in relation to, and within, social-cultural contexts. The goal is control of technical means by technologically literate human beings. The means to attain control is knowledge and understanding of the behavior of socio-technical systems.

This moves the educational focus from the craft or trade mentality to technology as a discipline and a science, in the same sense that biology, psychology, sociology, and other fields of study are disciplines and sciences. This, of course, means rejecting the use of the word technology to describe things, hardware, skills, industry, techniques or social phenomena. In most cases, a better descriptor would be *technical means* as used in this paper. For example, an automobile is a technical means created to transport people. Technology, as a discipline and as a science[1] can then be defined as: the science of technical means and human adaptive systems, including the study of the creation, evolution, utilization and behavior of technical means and adaptive systems in relation to human beings, society and the environment.

What Research is of Most Worth?

The definition of technology provides clues to research and scholarly activities that would be meaningful, cumulative, and have long-term application. For instance, studies concerning the creation and evolution of technical means and systems would provide insight into the relation

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[1]Knowledge covering general truths or the operation of general laws especially as obtained and tested through scientific method. A system or method based on or purporting to be based on scientific principles.

of these means and systems to human begins and society, thus establishing data for the derivation of concepts and principles concerning their behavior.

Understanding how technical means are created would aid in improving our ability to design and create appropriate technical means for our communities. Research pertaining to use of technical means and systems would provide insight into appropriate procedures, as well as problems, associated with the adoption and use of technical means by society. The latter knowledge could then be used in the design of alternatives to our present problem-plagued technological systems or for the redesign of current systems to attain a greater degree of compatibility with human beings, their communities, and the environment.

Research on the technical aspects of systems would focus on the behavior of material transformation processes. However, the operational behavior of systems and sub-systems would focus on techno-social relationships, perhaps one of the more difficult categories of research. In this research the concern would be the relation of technical means and systems to individuals, communities, work and employment, and the natural environment. Here the attempt would be to derive concepts and principles that could be used to predict the effect of the introduction of a new technical means into a social and natural context. Involved is the process of assessment and the prediction of probable impacts and risks.

Other research categories implied by the focus on technology as a discipline would be state of the art studies of evolving technical means and public policy studies concerning the adaption and use of new technologies. Included in the latter would be studies concerning employee adaptability to technoligical change and the appropriateness of given technical means and systems with respect to quality of life and sustainability of communities. Questions related to work and its meaning and preparation for work would be natural research problems. For instance, what kind of education will all people require for work in the 21st century? When is the best time to prepare people for work? For specific jobs? What intellectual, physical and social skills are required?

Each of the above research efforts would contributed to the evolution of the content and structure of industrial education teacher education programs. This is a separate and distinct, yet related, research category that must be pursued.

Educational or pedagogical research questions must be redirected, the same as industrial and technological ones. The question of educating all people for the complex technological world they inhabit will require research concerned with the entire spectrum of education. Related to pedagogical research are questions concerning the diffusion and adoption of research findings and the design, development, and evaluation of change models that can ensure the continued evolution of the field of education concerned with industry and technology.

Conclusion

The research agenda for industrial education should be derived from problems grounded in two disciplines, technology and pedagogy. This paper has focused on technology because, until this research is well underway, the "how to do it" research concerning pedagogy would have no purpose. Adopting technology as the discipline base for industrial education and directing pedagogical research toward questions concerned with the content, structure, diffusion, adoption, and teaching of the discipline will enable industrial education to continue to contribute in a unique way to American education.

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CRITICAL RESEARCH PROBLEMS IN INDUSTRIAL EDUCATION

Jerome Moss, Jr.

I puzzled over my writing task for quite a while, trying to determine what the planners had in mind. To begin with, I doubted that identifying research topics that were simply "unique" to industrial education would satisfy the intent of the planners. Rather, the criterion in mind was more likely to have been the "most significant" or the "most critical" problems, or the "central issues" that should be addressed by industrial educators. And that brought me to my second interpretation problem. As we all know, there is not an educational program called industrial education. Industrial education is a label for an abstract concept which includes the aggregate of at least three separately identified fields of educational practice -- vocational-industrial education, industrial training, and industrial arts education (or, if you prefer, technology education). These are the fields for which instructors are prepared, in which they are employed, which are functioning parts of schools and businesses, in which clients are enrolled, and about which you would normally expect research to be conducted. Why are we talking about industrial education?

Then it was necessary to remind myself that the term "industrial education" has a long, honorable history, and must, therefore, have served some useful purpose(s) to have survived. One such purpose is administrative. Whenever it becomes organizationally necessary or desirable to group educational programs, it is likely that industrial arts, vocational-industrial, and training in industry programs will find themselves clustered in some fashion on the premise that they have more in common with each other than with other programs in the organization. And so I began to pursue the questions, what do the three fields have in common? Is there enough to justify the term "industrial education" as a functional educational concept or is it simply a convenient administrative label? (Certainly this is a problem "unique to industrial education".)

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Commonalities Among Industrial Education Programs

There are at least two principal characteristics common to the fields which comprise industrial education. First, they are all fields of educational practice, and second, they all draw content from industry.

It is significant that industrial arts, training in industry, and vocational-industrial education are fields of educational practice rather than disciplines. Fields of practice are human-made to serve social purposes. Their usefulness depends upon their continued relevance to those purposes. Unlike the disciplines, as societal needs change, so too must fields of practice. Research in a field of practice addresses practical problems; it is designed to influence and improve performance, but it is understood that personal and professional values play a large role in determining satisfactory solutions. Truths in a field of practice are rarely invariant, but mostly relative; there is a *best* answer for a given situation, but rarely *the* answer for all situations. And, unlike the disciplines, there is no inherent, natural structure of the knowledge which makes up the field.

The implications of the distinction between a discipline and a field of practice are important, especially now, because the societal context in which training in industry, industrial arts, and vocational-industrial education are designed to operate is changing rapidly. Both the economic institution of industry, from which their content is derived, and the educational institution of the public school, in which two of the three programs operate, are likely to be reformed. As these two institutions -- economic and educational -- change, the most important question to us is probably: "How should each of the three fields change to enhance its utility?" A second question might be, "As the fields evolve will they increase or decrease their similarity?" "Will industrial education then become a more or less functional term?"

The Changing Economic and Educational Context

There has been a great deal of ambiguity about the definition of "industry", and recent usage of the term in the literature -- such as in banking industry, and agricultural industry -- has probably further confused the concept. There seems to be little disagreement, however, that the interaction of technological developments and a world economy will greatly alter the way we, in the USA, produce goods and services, as well as the kinds of goods we produce. Most projections are that large numbers of semi-skilled and skilled jobs in manufacturing will be lost to automation and that much of the high tech assembly work will be transferred overseas (The New Economy, 1983). For example, automotive industry sources report that 1.7 jobs are lost for every new robot installed. Professor William Abernathy of the Harvard Business School estimates that the Ford Motor Company can afford to keep only half of its 256,600 employees if it expects to be as efficient as Japanese auto firms. General Electric announced that it is now technologically possible for the company to replace half of its 37,000 workers with machines. In total, many economists estimate that the number of manufacturing jobs will shrink from their present level of 19 million to about 3 million by the end of the century. By contrast, the largest numbers of new jobs are expected to be created in the clerical and personal service areas, such as secretaries, nurses aides, janitors, sales clerks, cashiers, nurses, truck drivers, and fast-foodworkers (The Growing Gap, 1983).

While the direction of technological and economic forces are reasonably clear, opinions diverge widely about the extent of their impact. Will as many new jobs created as are destroyed? Can the U.S. allow its basic industries to atrophy? Will the government -- or how and when will the government -- intervene?

The level of skill required by workers in the so-called high tech age has also generated debate. Some authors see it as a way of upgrading the skills of the labor force and enhancing worker satisfaction. Policymakers have proposed changes in the educational system that will greatly increase the numbers of professional and technical level workers that are trained in the high technology fields, and that will upgrade the computer skills of all youth. Other authors, like Levin and Rumberger (1983), caution that the lowest-skilled jobs in America will "vastly outstrip the growth of high technology jobs. And the proliferation of high-technology industries and their products is far more likely to reduce the skill requirements of jobs in the U.S. economy than to upgrade them" (p. 19). These authors do not question that secretaries will trade in typewriters for word processors or that mechanics will use diagnostic systems employing microcomputers. But, they claim that the use of these technologies will require less rather than more sophisticated skills, and that management will continue to divide and subdivide work into repetitive and routine tasks from which fewer intrinsic satisfactions can be gained.

Thus, it is apparent that industry, however defined, is on the brink of accelerated change, and that the continued social utility of the fields that comprise industrial education is dependent upon their ability to adjust correspondingly.

At the same time that changes in the economic institution of industry forces us to examine the *content base* of the programs that make up industrial education, a rash of recent national reports critical of the educational institution of the public school is forcing us to examine the *roles* that industrial arts and vocational-industrial education can and should play (Howe, 1983). This uneasiness with the public school should not be surprising since many institutions -- the welfare system, the judicial system, the health care system, the home and family -- appear to be in trouble as well. Critics of the public school point out that the scores of high school students on standardized achievement tests have fallen recently, but, as Bok (1983) notes, this comes at a time when the school has been successful in retaining large numbers of below average ability students, when support from the traditional home and family has eroded, when the drug culture has invaded our neighborhoods, and when television has captured twenty five hours a week from the average child. Nevertheless, the public is not satisfied that youth are being properly prepared to cope with the socio-economic challenges the coming decades are expected to bring. The prescription offered by the national reports is to increase quality -- I believe to increase quality *with* continued equality of opportunity -- by adding resources and by placing greater emphasis upon the basic academic subjects. Very little is said in most of the reports about the role of industrial arts or vocational-industrial education in the high school. The implicit assumption is that they either have an unimportant role, or no role, in the desired high school curriculum. If we also take into account the relatively high cost of laboratory/shop courses and the economic woes of many school districts, then it seems clear that a national debate is underway about the role of the schools and that the school-based industrial education programs face an uphill fight for continued recognition.

But that is not so for industrial training programs. With fewer young people available to move into the labor force in the years immediately ahead, young workers will be in short supply and business and industry will be competing for them. One incentive that can be used to attract young workers is more and better training while on the payroll. Further, the need to retain the workers they hire and to implement continual technological advances will force firms to be more concerned than ever about retraining. As a consequence, training departments in industry and business can be expected to grow rapidly.

Thus, we have a changing social context for the fields of practice which comprise industrial education, and the changes may well have different impacts and implications for each of the fields. The overriding challenges facing industrial educators are to examine the content base and to rethink the role of each field in order to maximize the relevance and importance of its contribution to the educational process. There are no issues more basic to industrial educators since positions on the issues of content and purpose are prerequisite to solving most other problems. There appears to be little inquiry that is more urgent at the moment, and if industrial educators do not accept the challenge, who else will?

Using Appropriate Research Tools

Our typical ways of conducting inquiry -- using empirical-analytic tools -- are not adequate to the tasks of defining the content base and determining the desired ends of educational programs. The empirical-analytic tools enable us to address questions of *means*. That is, to describe what exists (e.g., descriptive and relational studies) and to identify more effective and efficient means toward given ends (e.g., experiments and ex post facto studies). We need, in addition, tools of inquiry that enable us to address questions of *meanings* as well as questions of *ends*. That is, to provide knowledge of interpreting and understanding meanings, and to provide "analyses of values -- of what is right and wrong or good and bad -- what is morally justifiable and intellectually sound" in order to specify desired educational ends (Copa, 1983).

Tools do exist for these purposes. For example, the interpretive sciences are designed to improve understandings and to clarify meanings. These include the conceptual analysis techniguqes of philosophic research and the interpretation of evidence and observation through historical and ethnographic research. Critical science is designed to help answer the "should be" questions, such as the desired ends of an educational program (Coomer, 1982). Critical science utilizes the evidence resulting from both the interpretive and empirical-analytic approaches in a critical analysis of the motives and interests underlying beliefs and performance, and posits alternatives which may be more morally and intellectually justifiable.

Some Conditions Necessary for Success

Presuming the need for inquiry on (and possible reform of) the content and ends of the fields in industrial education and the availability of some appropriate research tools with which to engage the problems, what are some of the other conditions necessary to help insure useful research results?

Few scholars in the industrial education fields are presently equipped to use the available interpretive and critical science research tools. And, while it is certainly desirable to begin to train young researchers in their use, we need some intensive programs to introduce current researchers to the tools, and we need to work out collaborative efforts with philosophers, historians, and anthropologists.

Short-term efforts and isolated projects will not suffice. Individuals are needed with sufficient interest to make a significant investment of time in a program of research. Graduate students can contribute, but they cannot provide the continuity that is essential. Industrial arts has benefited greatly in the past from some of these large, long-term efforts, but it is time now to initiate a new round of sustained activity.

Empirical-analytic tools will be needed in building complete programs of research. Questions about means, such as extent of transfer of learning and the contribution of programs in industrial education to students' basic academic skills, are inevitable and require the application of our traditional techniques.

Programs of research are needed in *each* of the industrial education fields. After each field has identified its content domain, its content organizer(s), and its purposes, a comparison among fields will reveal their commonalities as well as their differences. This inductive process will reveal the degree to which "industrial education" might serve as an educationally functional term. Of course, individuals who wish to start with the premise that industrial education consists of an articulated set of experiences drawn from both industrial arts and vocational-industrial education should be encouraged to initiate their own programs of research.

Finally, the foregoing four conditions lead to the suggestion that the kind of effort envisioned might best take place within the framework of centers devoted to curriculum research in each of the fields.

Summary

In summary, it has been the thesis of this paper that industrial education consists of several fields of educational practice -- industrial arts (or technology) education, vocational-industrial education, and training in industry programs. These three fields have been created to satisfy certain societal needs, and to stay relevant and useful they must be sensitive to changes in those needs. Both the economic and the educational institutions of society are in the process of undergoing significant change, and these institutions are the very well-springs of content and purpose for the fields which comprise industrial education. Consequently, it is essential that industrial educators initiate critical examinations of their fields; it is a matter of survival, particularly at the secondary school level.

To undertake the type of examination necessary, programs of research are required, and research tools from the interpretive sciences and from critical science will have to be utilized. With few notable exceptions, industrial educators have not previously been inclined to invest their efforts in programmatic research, nor have they mastered the appropriate research tools. Overcoming both these obstacles presents the immediate challenge to undertaking the necessary research.

References

Bok, D. (1983, June 9). *Commencement address.* Presented at Harvard University, Cambridge, Mass.

Coomer, D. L. (1983). *Critical science: A futuristic approach to vocational education research.* Manuscript submitted for publication.

Copa, G. H. (1983). *Research and inquiry in vocational education.* Manuscript submitted for publication.

The growing gap in retraining. (1983, March 28). *Time.* pp. 50-51.

Howe, H. (1983). Education moves to center stage: An overview of recent studies. *Phi Delta Kappan. 65*(3), 167-172.

Levin, H. & Rumberger, R. (1983, August/September). The low-skill future of high tech. *Technology Review.* 18-21.

The new economy. (1983, May 30). *Time.* pp. 62-70.

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RESEARCHABLE PROBLEMS IN INDUSTRIAL EDUCATION

Daniel L. Householder

The assumption implied by the title of this monograph -- that industrial education has a set of researchable problems not shared by other fields of study -- may itself warrant investigation. Do meaningful boundaries separate industrial education from other areas of study? It may be more realistic to view industrial education research as a locus in a network of closely-related areas of inquiry.

Research in Industrial Education

Some areas of research activity are, in fact, confined to industrial education. These studies are typically conducted by industrial educators within industrial education settings. Their primary purpose is frequently to meet graduate degree requirements. If results are published (beyond the thesis or dissertation), the articles tend to appear in industrial education journals, where they are read by those industrial educators whose interests are piqued by the titles or the subject matter. Applications of findings or generalizations from these studies are typically restricted to the industrial education sphere. Since the readers of the studies frequently are not directly involved as classroom practitioners, direct implementation of findings is rare, even within industrial education (Dyrenfurth & Householder, 1979). While these studies may use research methodologies adapted from other areas of scholarly endeavor, the fact is that such research, which is usually of the most applied genre, is of limited interest outside industrial education. Therefore, the fact that research may be unique to industrial education is, in fact, more likely to be a function of the topic under study than of the methodology or type of research.

Perhaps a more important subject for research is the development of a clear model of the interrelationships shared between researchers in industrial education and those whose inquiry centers in other fields. While careful examination might distinguish an area identified as industrial education research which has no overlap with research in other areas, it seems unlikely that this is the most important area to pursue in

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studying today's closely intertwined spheres of professional practice.

Definitions

Before beginning detailed discussion of the topic, it should be helpful to develop working definitions of the terms in the title.

For the purposes of this discussion, industrial education is considered to be those portions of general and vocational education concerned with technically based transactions between individuals, groups of individuals and contemporary global society. Many of the areas of study in industrial education are industrially-based in the conventional sense of the term; the definition is broadened here to include technologically-based transactions, whether they occur in industry or in other agencies or institutions. Industrial education is not considered to be clearly delineated from other areas of study.

A researchable problem is considered to be one of those areas of human concern amenable to investigation with contemporary instrumentation and techniques. The ultimate goal of research activity is the creation or attainment of new knowledge useful in alleviating problems or reducing uncertainty.

In view of these definitions of industrial education and of researchable problems, it should come as no surprise that the word "unique" (which implies an event occurring only at one time, in one setting, or among one group -- the only one of its kind) can rarely be used to describe research in industrial education. Rather, this discussion focuses upon researchable problems which are central to the generic field of industrial education. Researchers in fields of study outside industrial education are also interested in the same or closely similar problems. In most cases, such as follow-up studies, it is only the application within the industrial education setting that makes the research "unique" to the field.

Given these working definitions, discussion turns to those areas of human concern which are amenable to contemporary investigation, either totally within industrial education or in broader ranges of inquiry which include industrial education.

Teaching - Learning Styles

Since industrial education is involved with the communication of a spectrum of competencies ranging from those which are highly cognitive to those which are predominantly psychomotor, the need for clearer understanding of learning -- teaching style interaction is especially important.

Perhaps a simplistic example can suggest a domain of researchable problems. One school of thought in contemporary psychology, neuro-linguistic programming (NLP), holds that some individuals learn primarily through visual means, other persons learn primarily through auditory channels, while still other learners obtain their primary learning stimuli through "feeling" by touching, via kinesthetic interactions, or, in some cases, by the sense of smell. While all persons are capable of some learning through all of the sensory channels available to them, most individuals show a definite tendency to be more attentive to stimuli in their preferred learning mode. Similarly, teachers tend to have preferred means of communicating their subject matter. Lectures are primarily auditory to the learner. Demonstrations may combine visual and auditory stimuli, but only guided practice in the actual operation can provide the learner with opportunities for kinesthetic interaction with the learning task.

Some evidence suggests that industrial education teachers tend to be more highly kinesthetic than verbal or auditory. Their lectures may be somewhat perfunctory and their demonstrations poorly structured, perhaps because they do not feel the need to provide carefully-sequenced oral instruction and precisely-prepared auditory supplements for the benefit of those learners who rely heavily upon those modes for learning. Since teachers may be most interested in the actual performance of the task, they assume that learners should be introduced to the performance as quickly as possible, then given an opportunity to "go to work", where they will *really* learn. However, highly verbal learners may find little interest in or need for the actual practice, since their learning is essentially completed when they have comprehended the oral presentations. If hearing is enough for them, why should teachers persist in wasting time requiring them to practice?

Other teaching-learning dimensions relate to preferences of or the organization of the material to be learned, influences of media and methods of instruction, and the interaction of cognitive, affective, and psychomotor domains in the laboratory setting. Influences of personality characteristics of learners and instructors, the dynamics of classroom groups, and the effects of group norms upon individual performance need meticulous study to guide practice. Interaction of multiple intelligences (Gardner, 1983) in industrial education also merits exploratory investigation.

Clientele

Persons served by industrial education programs are obviously unique subjects for study by industrial education researchers. Such studies often include the processes of student recruitment and the selection of students with appropriate combinations of aptitudes, abilities, interests and experience (Buckley, 1975; Chou, 1974; Herbert, 1977; Nelson, 1963). Researchers are interested in the means by which students may be attracted to industrial education programs and attributes which predict success throughout the educational process. Sharpe (1981) studied the recruitment and retention of industrial arts teachers, for example. Characteristics of graduates, their placement in appropriate positions, and their career success are also of research interest. Graduates also serve as sources of data useful in assessing the effectiveness of industrial education curricula. Follow-up studies -- where graduates go, what they do, how much they earn, what they aspire to accomplish -- can be very helpful to industrial education planners and administrators, though they may be of little interest to educators in other fields.

Students with special needs constitute a major segment of the potential clientele of industrial education. Work in the area of industrial education for learners with special needs is, in fact, still in its infancy. Despite the fact that work in the area has been going on for some time (Householder, 1963), this is a major research area with a broad range of topics of concern to industrial education researchers (Phelps & Lutz, 1977; Scott & Sarkees, 1982).

Gifted and talented students have rarely been attracted to industrial education courses. Can the field modify its content and approaches to appeal to students of high ability? Should it? Does the contemporary availability of computer-directed processes offer opportunities to organize experiences in CAD/CAM, robotics and other computer-related activities to challenge the brightest student? Curriculum developers need the assistance of researchers to identify appropriate activities and content sequences for learners whose interests, ability levels and developmental stages span a wide range.

Human-Technology Interaction

The human-technology interaction is of interest to many specialties. Human factors specialists, sociologists, futurists, industrial engineers, designers, and physical fitness specialists are among those conducting research in human interaction with technologically-based systems. The design of video display screens to reduce eye strain, improvement of keyboards to reduce muscular effort, and efficient design of control mechanisms for automated transit systems are examples of ways in which humans interact with technologically-based systems. Potential medical problems arising from contact with materials and processes in industrial education also need careful scrutiny (Usiak & Gutcher, 1983).

Industrial education may be unique in its concern for the designing and manufacturing of technological components. This concern includes the training of equipment operators, the integration of technological systems, the assessment of the output of technological systems, the design of effective sales and distribution systems, and the development of techniques and systems for servicing manufactured products. In addition, industrial educators are deeply concerned with the effects of technology upon individuals and human organizations. Each of these areas has a range of research applications -- in most instances research opportunities which have scarely been tapped.

Technological Systems

Research dealing with the interaction of industrial education and technology has a substantial tradition already. Olson (1963) provided one of the best developed early systems for codifying technology. A substantial amount of work has been accomplished in an attempt to make technology understandable to learners. DeVore (1980) has carried on a systematic program for the development of a taxonomy of technology and the organization of the content into meaningful segments for teaching. A substantial array of research remains to be done on the organization of technological content in its most effective form for teaching learners at different levels. Long range research is still needed to determine the outcomes of a technologically-based industrial education program.

Attainment of Objectives

Another major area for research in industrial education focuses upon the attainment of objectives. To some degree, industrial education objectives are criterion-referenced. That is, those programs which intend to prepare students for immediate employment may be evaluated in terms of the degree to which graduates obtain positions related to their training. It is somewhat more difficult to assess general education outcomes. Perhaps because of this, the assessment of the attainment of industrial arts objectives has lagged substantially behind other areas of research. Some promising results have appeared in recent years, including a series of studies by Baker, Sharpe, and Renzelmen (1982); Sharpe and Baker (1982); Baker, Somers, and Sharpe (1982); and Kapes & Baker (1983). Researchers following the models in these and similarly-designed studies should validate or disprove claims that industrial education is, in fact, meeting the objectives it sets for its programs (Pinder, 1980).

The Industrial Arts Curriculum Project based much of its work upon the division of knowledge into four domains: formal, descriptive, prescriptive, and praxiological. Individuals connected with the project proposed that industrial arts or industrial technology education should be based upon praxiological knowledge. Much of their research and development activity has been based upon that organizational scheme. The profession might also seek to determine which portions of the formal, descriptive, and prescriptive domains function in areas typically covered in industrial education. Thus, a more complete approach to the organization and transmission of knowledge, might be possible in industrial education programs. It would appear that the field needs to be integrated in such a way that its formal, descriptive, and prescriptive elements are identified in addition to its praxiological elements. Lux (1979) discusses the roles of each of the domains of knowledge, but points out that fields of study or disciplines tend to focus on one of the four domains.

What is suggested here is the possibility that there are formal, descriptive, prescriptive, and praxiological elements in the areas of study comprising industrial education. That is, the field includes the abstract forms or arrangements of knowledge (formal knowledge); facts about phenomenal events and their interrelationships (descriptive knowledge); judgments about design, integrity in the use of materials, and aesthetics (prescriptive knowledge); in addition to knowledge of practice (praxiological knowledge).

Lux (1979) has pointed out the lack of unanimity among the members of the profession with regard to the elements of their content. This lack of unanimity has meant that the field has made relatively slow progress in identifying itself, organizing itself, and preparing effective schemes for transmitting the knowledge implied by the analysis. Even within such specialties as electronics or metal working, there is wide variation in the actual content being taught in contemporary courses.

The group at Jackson's Mill made an attempt to integrate various proposals in technology education and put them into a coherent prospectus (Snyder & Hales, 1981).

The human adaptive systems (ideological, technological, and sociological) operate within an environment which has both man-made and natural components. These systems operate in an interrelated way within the environment and as they interact with the domains of human knowledge.

The Jackson's Mill model for the derivation of an industrial arts curriculum incorporates features of the universal systems model and places the field in the context of a study of technology *and* a study of industry. When the time dimension is added and the program is divided into manufacturing, construction, communication, and transportation systems, the technical adaptive systems (manufacturing, construction, communication, and transportation) are, however, viewed as interconnected.

Validation of the Jackson's Mill model or the comparison of that model with other proposed systems for organizing instruction would enable the profession to proceed with greater confidence in the task of curriculum development.

Program Standards

Standards for program performance are needed to serve as criteria for evaluation and improvement of existing programs. The most detailed and comprehensive set of standards in industrial education has recently been developed for industrial arts. It includes standards for philosophy, instructional program, student populations served, instructional staff, administration and supervision, support systems, instructional strategies, public relations, safety and health, and evaluation. In addition, guidelines are provided for the management of American Industrial Arts Student Association organizations in conjunction with industrial arts programs, for the attainment of sex equity, and for serving students with special needs (Standards for Industrial Arts Programs Project, n.d.). With such standards as criteria, researchers may conduct more objective evaluation studies. Research to develop contemporary standards for other industrial education programs would also be helpful.

Projections

Projections of possible futures for industrial education and its clientele are areas for careful investigation. Isbell (1980) suggested possible goals for industrial arts teacher education in the future. Starkweather (1976) reviewed potential directions for industrial arts. By focusing upon alternative futures, The profession has an opportunity to enhance its effectiveness. Naisbitt's *Megatrends* (1982) has significant implications for industrial education research and for forecasts in the field.

Field Experience

"Field experience is probably the most praised, most criticized, most entrenched, most debated but certainly least understood part of preservice education" (McIntyre, 1983, p. 1). Field experience in industrial education may be less well understood than similar programs in other areas of teacher education.

Six phases of student teaching were identified by Caruso (1977): Anxiety/Euphoria; Confusion/Clarity; Competence/Inadequacy; Criticism/Awareness; More Confidence/Greater Inadequacy; and Loss/Relief. Seeks and Harrington (1982) described similar stages: Anticipation; Entry; Orientation; Trial and Error; Integration/Consolidation; and

Mastery (attained by few student teachers).

Industrial education teachers begin their professional careers in contrasting ways. Some follow the traditional student teaching model similar to the experience provided for teachers of other subjects. Others begin their formal teaching careers with little, if any, supervised professional practice in the actual teaching-learning environment. Industrial education researchers have an opportunity to study professional performance effects of variables in the field experiences provided for students. In addition to contrasts between the kinds of experience provided to industrial education teachers-in-training, including field experiences prior to student teaching, researchers should compare effectiveness of field experience programs in industrial education with those in other fields. Industrial teacher education needs guidance in selecting the effective types of field experiences and in the provision of optimum periods of student teaching.

Training and Development

Increasing numbers of industrial teacher education departments are consciously preparing and placing graduates in training and development positions in business and industry. Minor modifications have been made in teacher education programs to provide appropriate experiences for individuals planning such careers. McLagan (1983) has provided a research-based list of roles in training and development and a list of the competencies needed by persons seeking to fill those roles. While additional research may be needed, program revisions should be based upon the data bases available from such studies of practitioners. If the training and development field continues to be an important source of employment for industrial education graduates, increased research attention needs to be focused upon the needs and expectations in the area.

Summary

Industrial education offers research opportunities in the study of the structure of industry and technology. Much of this work requires the collaboration of scholars from other areas of study, spanning a wide range of scholarly activity.

Since the subject matter of industrial education is in the process of rapid change, provision must be made for flexibility in the structure of research programs in the field. Few findings can be considered permanent; rather, a continuous monitoring process is needed to improve the congruence of industrial education programs with the actual conditions prevailing in industry and technology.

Researchers should devote concentrated attention to the needs of the various clienteles of industrial education. Practitioners need substantially-improved. techniques for adapting their instruction to the needs of individuals. No clear line can be drawn between this research and the study of teaching and learning styles; both are clearly needed.

References

Baker, G. E., Sharpe, D. G., & Renzelman, J. (1982). Design consumer education content for your program. *Industrial Education. 71*(9).

Baker, G. E., Somers, J. K., & Sharpe, D. B. (1982). Implications for industrial arts in overcoming sexual stereotyping in industrial careers. *Journal of Industrial Teacher Education, 19*(3).

Buckley, M. R. (1975). *A multiple discriminant analysis of personality factors of trade and industrial teachers, academic teachers, and non-teacher tradesmen.* Unpublished doctoral dissertation, University of Southern Mississippi, Hattiesburg.

Caruso, J. J. (1977). Phases in student teacher. *Young Children. 33*(1), 57-63.

Chou, D. (1974). *Personality traits and characteristics of vocational-industrial teachers of selected instructional areas in the area vocational-technical institutes of Minnesota.* Unpublished doctoral dissertation, University of Minnesota, Minneapolis.

DeVore, P. W. (1980). *Technology an introduction.* Worchester: Davis.

Dyrenfurth, M. L., & Householder, D. L. (1979). *Industrial arts education: a review and synthesis of the research 1968-1979.* Columbus, OH: The National Center for Research in Vocational Education.

Gardner, H. (1983). *Frames of Mind.* New York: Basic Books.

Herbert, G. R. (1977). *A comparative analysis of personality characteristics* of industrial arts teachers in the United States. Unpublished doctoral dissertation, Virginia Polytechnic Institute, Blacksburg.

Householder, D. L. (1963). Industrial education for blind students. *International Journal for the Education of the Blind. 12*, 84-87.

Isbell, C. H. (1980). *The goals of industrial arts teacher education in the future (1985-2000).* Unpublished doctoral dissertation, Texas A&M University, College Station, Texas.

Kapes, J. T. & Baker, G. E. (1983). Exploring the effects of industrial arts on career maturity in grades 7 through 12. *Journal of Industrial Teacher Education. 20*(2).

Lux, D. G. (1979). The development of the industrial arts curriculum project. In G. E. Martin (Ed.) *Industrial Arts Education: Retrospect, Prospect.* (pp. 149-168). Bloomington: McKnight. (28th Yearbook, American Council on Industrial Arts Teacher Education).

McIntyre, D. J. (1983). *Field experiences in teacher education from* *student to teacher*. Washington, DC: Foundation for Excellence in Teacher Education.

McLagan, P. A. (1983). *Models for excellence*. Washington, DC: American Society for Training and Development.

Naisbitt, John. (1982) *Megatrends*. New York: Warner Books.

Nelson, R. A. (1963). *Personality variables of college students who signify industrial arts as a major field of study*. Unpublished doctoral dissertation, Colorado State College, Greeley.

Olson, D. W. (1963). *Industrial arts and technology*. Englewood Cliffs: Prentice-Hall.

Phelps, L. A., & Lutz, R. J. (1977). *Career exploration and preparation for the special needs learner*. Boston: Allyn & Bacon.

Pinder, C. A. (1980). Evaluation in industrial arts education. *Journal of Industrial Teacher Education. 18*(1), 75-78.

Scott, J. L., & Sarkees, M. D. (1982). *Vocational special needs*. Alsip, IL: American Technical Publishers.

Seeks, S. R., & Harrington, G. (1982, April). *Student to teacher: The process of role transition*. Paper presented at the meeting of the American Educational Research Association, New York, NY.

Sharpe, D. B. (1981). *The recruitment and retention of potential industrial arts teachers*. Unpublished doctoral dissertation, Texas A&M University, College Station, TX.

Sharpe, D. B., & Baker, G. E. (1982). Identifying consumer education for industrial arts. *The Journal of Epsilon Pi Tau. 8*(1).

Snyder, J. F., & Hales, J. A. (Eds.) (1981). *Jackson's Mill Industrial Arts Curriculum*. Charleston: West Virginia Department of Education.

Standards for Industrial Arts Programs Project. (n.d.). *Standards for Industrial Arts Programs*. Washington: American Industrial Arts Association.

Starkweather, K. N. (1976). A study of future directions for industrial arts toward the year of 2000 A. D. In L. H. Smalley (Ed.), *Future Alternatives for Industrial Arts*. (pp. 183-193) Bloomington: McKnight. (25th yearbook, American Council on Industrial Arts Teacher Education).

Usiak, K., & Gutcher, D. (1983). Effects of welding on students. *Journal of Industrial Teacher Education. 20*(4), 3-15.

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RESEARCH PROBLEMS UNIQUE TO INDUSTRIAL EDUCATION: A REACTION

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It is no small task to react to four major and diverse papers on the broad topic of "Research Problems Unique to Industrial Education." The assignment is made more difficult when one considers the backgrounds, professional experiences and orientations, and the leadership roles the presenters have played in the field of industrial education over an extended period of time. Each of the four presenters is competent and has definite long standing views and insights into the topic under discussion in this monograph.

Reactions are offered in the form of summaries of the general impressions of those points for which the presenters seem to have consensus, followed by comments on those points on which there are divergent views.

The common thread that seems to emerge in all four papers is the recognition that no cumulative and sustained research base has been generated in industrial education. The authors agree that most of the research which has been generated in industrial education has been primarily on the practice of teaching, rather than on the content, technology, purpose, and desired outcomes of industrial education. The authors attribute this problem to the research methodologies that have been used by researchers in the field. They point out that empirical-analytical research methodologies that have been used primarily by industrial education researchers are not adequate for the tasks of defining the content base, desired outcomes, and purposes of the field.

The papers also raise the question of the lack of an agreed-upon terminology regarding the definition, purpose, and philosophy of industrial education.

The analytical manner in which all four authors approach the assignment of "Research Problems Unique to Industrial Education" is commendable. One must concur with Moss in his suggestion that the assignment should focus on: ". . . the most critical and the most significant problems that should be researched by industrial educators. . . ." Nonetheless, in spite of the broadness of the assignment, the presenters were able to delineate five areas of general consensus in which research

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efforts should be directed in industrial education. These are:

1. content derivation in a changing society, economy, technology, environment, and resources;
2. policy issues regarding definition, objectives, and philosophy of industrial education's relationships with business, industry, and other educational delivery systems;
3. clienteles--the targeted groups and their objectives;
4. delivery models and forms of industrial education; and
5. impact of industrial education on businesses and industries served.

These four papers, discussed individually on the following pages, together present a challenge to industrial educators--that is, to rethink the role of industrial education and its content relative to and in the midst of a constantly changing society and technology.

Strong delineates five research agenda items with the emphasis on today's technology, skills, and "how to work". The five areas include:

1. curriculum in industrial education--specifically standards and content;
2. evaluation that would result in the establishment of quality and rigor in industrial education programs using national, state, and local assessment tests;
3. instructional organization (meaning types of schools), characteristics of specialized schools, relationships between basic and vocational education, use of micro-computers, methods on instructional delivery and other instructional aids and support systems; and
4. how to establish linkages with business and industry.
5. support of basic academic skills--that is to say--what amount of basic skills is needed to support industrial education and at what level, and what generalizable and transferable skills would be needed to complement both the academic skills and industrial education;

DeVore offers his own list of priorities for industrial education research. He suggests that such research must be focused on questions of "what", not "how". His focus was on the following:

1. what learning is of most worth; (He asserts that the answer to this question would provide the base and context of research in industrial education.)
2. the value of research in terms of industry, technology, and related social problems;
3. what to teach and who to teach it to, rather than how to teach; and
4. technical aspects of technological systems, behaviors of material transformation processes, alternative designs and

adaptations of technical systems, public policy, and employee adaptability to technical changes and quality of life.

Moss encourages researchers to use appropriate research tools such as those found in other disciplines (e.g., intrepretive sciences, which are used to improve understanding and clarification of meanings; conceptual analysis techniques of philosophical issues, which might be used to address philosophical issues).

Moss further suggests that to achieve meaningful research in industrial education may require collaborative efforts with researchers in different disciplines. He underscores that point by emphasizing that we should collaborate with other scientists such as historians and anthropologists to conduct long-term industrial education research in:

1. content domain,
2. ends and/or outcomes,
3. transfer of learning within the field and to other disciplines,
4. contributions to academic skills areas, and
5. commonalities and differences among the three programs comprising industrial education, vis-a-vis, vocational-industrial education, industrial training, and industrial arts education.

Moss further suggests the establishment of curriculum research centers for each of the three areas of industrial education.

Householder identified several areas of research important to industrial education. They include:

1. teaching and learning styles relative to the interaction of cognitive, psychomotor, and affective domains;
2. preferences in learning materials;
3. influences of media and methods of instruction;
4. interaction of cognitive, affective, and psychomotor domains in the laboratory setting;
5. influences of personality characteristics of learners and instructors; and
6. dynamics of classroom groups and effects of group norms upon individual performance.

He also advocates research on the clientele, that is: on the types of students who should be served by industrial education, their recruitment, selection, retention, aptitudes, abilities, interests, and experiences; means of attracting students into industrial education programs, prediction of student success in the programs, follow-up in training effectiveness and earnings, special needs students, gifted and talented students.

Additional areas needing research that may have been included by one or more of the authors include:

1. research efforts directed to the issues of quality and quantity of the supply of trained manpower produced by industrial education and how these interface with the demand of business, industry, and govenment;
2. research to re-examine other delivery systems of trained manpower to ascertain their effectiveness and efficiency in producing trained manpower. Examples of such delivery systems are: supervised occupational experiences, including back-to-industry for technical updating and retraining programs, work experience programs, and cooperative methods of teaching industrial education;
3. research into the areas of equity and accessibility of industrial education to disadvantaged, handicapped, displaced homemakers, and limited-English-proficient populations;
4. research into the efficacy of competency-based, individualized instruction as an alternative delivery system in industrial education. This should include open-entrance and open-exit systems and individualized prescriptive approaches of instruction; and
5. research focus using local, regional, and national data such as the census data as a basis for planning and delivery of industrial education.

Summary

In summary, the authors concurred on the need to generate a cumulative and sustained research base. They most strongly expressed the need to conduct research dealing with the content of industrial education in a changing technology, society, environment, and resources; and in specifying desired outcomes and ends of the field.

Finally, the authors also suggest that industrial educators direct their research efforts in a collaborative manner with researchers in different disciplines, the purpose being to enhance the quality and the generalizeability of the research.

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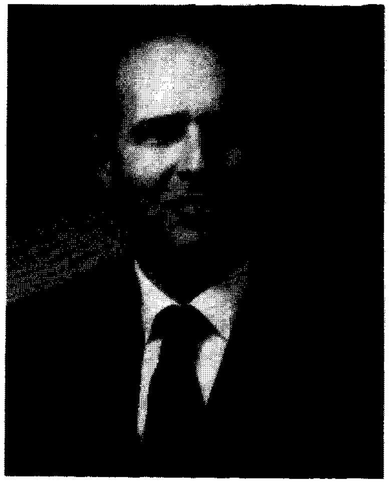

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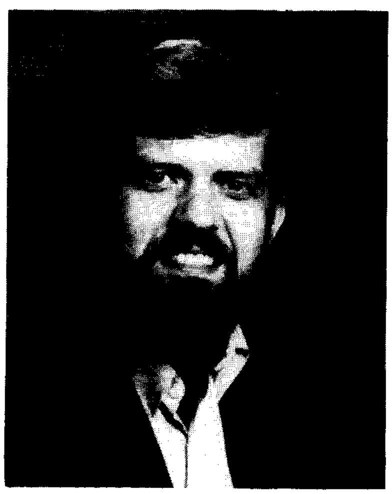

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