1971

Components of TEACHER EDUCATION

20

ACIATE

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20th Yearbook

American Council on Industrial Arts Teacher Education

1971

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With Special Emphasis Upon the Technologies of Content and Method

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Foreword

So long as teachers teach as they are taught, industrial arts teacher education must be in the vanguard of effective change in industrial arts education. This yearbook should provide a renewed focus and direction for this leadership.

Nearly a decade has passed since the publication of the 11th Yearbook, *Essentials of Preservice Preparation.* Since that time, industry and technology have advanced at unprecedented rates; industrial arts theories and practices have matured. The climate for change has never been more favorable. This further look at teacher education is both timely and important to the profession.

Throughout the years, industrial arts educators from Ohio have challenged the profession. A major purpose of this effort has been to add to this long and distinguished leadership by providing new ideas and by synthesizing others.

The editors and authors of this yearbook have drawn upon recent and current research and development in industrial and in educational technologies. By doing so, they have attempted to identify the technological components that should provide the bases for forward-looking and dynamic programs of industrial arts teacher preparation.

The ACIATE Yearbook Committee and Officers are pleased to present this work to the profession. The improvement of the technological components of our teacher education programs is a challenge to us all. Perhaps in another decade we will look back on 1971 and see this yearbook as a milestone in our progress.

On behalf of all Council members, we recognize with gratitude the McKnight & McKnight Publishing Company. For the twentieth year, they have underwritten this series. The Council and the profession continue to benefit from their professional concern as exemplified by this continuing partnership, admittedly an unbalanced one, in which the publisher invests all the capital, absorbs any losses, and returns any profit to the Council.

Donald G. Lux
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Yearbook Proposals

Each year, at the AIAA national convention, the ACIATE Yearbook Committee reviews the progress of yearbooks in preparation and evaluates proposals for additional yearbooks. Any member is welcome to submit a yearbook proposal. It should be written in sufficient detail for the committee to be able to understand the proposed substance and format, and sent to the committee chairman by February 1 of the year in which the convention is held. Below are the criteria employed by the committee in making yearbook selections.

Frederick D. Kagy, Chairman
ACIATE Yearbook Committee

Guidelines for ACIATE Yearbook Topic Selection

With reference to a specific yearbook topic:

1. It should make a direct contribution to the understanding and the improvement of industrial arts teacher education.
2. It should avoid duplication of the publications activities of other professional groups.
3. It should confine its content to professional education subject matter of a kind that does not infringe upon the area of textbook publication which treats a specific body of subject matter in a structured, formal way.
4. It should not be exploited as an opportunity to promote and publicize one man's or one institution's philosophy unless the volume includes other similar efforts that have enjoyed some degree of popularity and acceptance in the profession.
5. While it may encourage and extend what is generally accepted as good in existing theory and practice, it should also actively and constantly seek to upgrade and modernize professional action in the area of industrial arts teacher education.

6. It can raise controversial questions in an effort to get a national hearing and as a prelude to achieving something approaching a national consensus.
7. It may consider as available for discussion and criticism any ideas of individuals or organizations that have gained some degree of acceptance as a result of dissemination either through formal publication, through oral presentation, or both.
8. It can consider a variety of seemingly conflicting trends and statements emanating from a variety of sources and motives, analyze them, consolidate and thus seek out and delineate key problems to enable the profession to make a more concerted effort at finding a solution.

Approved, Yearbook Planning Committee
March 15, 1967, Philadelphia, Pa.

Previously Published Yearbooks

1. *Inventory-Analysis of Industrial Arts Teacher Education Facilities, Personnel and Programs*, 1952. Walter R. Williams, Jr. and Harvey Kessler Meyer, eds.
* 2. *Who's Who in Industrial Arts Teacher Education*, 1953. Walter R. Williams, Jr. and Roy F. Bergengren, Jr., eds.
* 3. *Some Components of Current Leadership.* Roy F. Bergengren, Jr. *Techniques of Selection and Guidance of Graduate Students.* George F. Henry. *An Analysis of Textbook Emphases.* Talmage B. Young. 1954, three studies.
* 4. *Superior Practices in Industrial Arts Teacher Education*, 1955. R. Lee Hornbake and Donald Maley, eds.
* 5. *Problems and Issues in Industrial Arts Teacher Education*, 1956. C. Robert Hutchcroft, ed.
* 6. *A Sourcebook of Readings in Education for Use in Industrial Arts and Industrial Arts Teacher Education*, 1957. Carl Gerbracht and Gordon O. Wilbur, eds.
* 7. *The Accreditation of Industrial Arts Teacher Education*, 1958. Verne C. Fryklund, ed., and H. L. Helton.
8. *Planning Industrial Arts Facilities*, 1959. Ralph K. Nair, ed.
* 9. *Research in Industrial Arts Education*, 1960. Raymond Van Tassel, ed.
10. *Graduate Study in Industrial Arts*, 1961. Ralph P. Norman and Ralph C. Bohn, eds.
*11. *Essentials of Preservice Preparation*, 1962. Donald G. Lux, ed.
*12. *Action and Thought in Industrial Arts Education*, 1963. Ethan A. T. Svendsen, ed.
13. *Classroom Research in Industrial Arts*, 1964. Charles B. Porter, ed.
14. *Approaches and Procedures in Industrial Arts*, 1965. G. S. Wall, ed.
15. *Status of Research in Industrial Arts*, 1966. John D. Rowlett, ed.
16. *Evaluation Guidelines for Contemporary Industrial Arts Programs*, 1967. Lloyd P. Nelson and William T. Sargent, eds.
17. *A Historical Perspective of Industry*, 1968. Joseph F. Leutkemeyer, Jr., ed.
18. *Industrial Technology Education*, 1969. C. Thomas Dean and Nelson A. Hauer, eds.
Who's Who in Industrial Arts Teacher Education, 1969. John M. Pollock and Charles A. Bunten, eds.
19. *Industrial Arts for Disadvantaged Youth*, 1970. Ralph O. Gallington, ed.

* Out-of-print yearbooks can be obtained on microfilm and in Xerox copies. For information on price and delivery, write directly to University Microfilms Inc., 313 N. First Street, Ann Arbor, Michigan 48107.

Contents

Preface

The seed which led to the growth of this yearbook was planted at a meeting of the Ohio Council on Industrial Arts Teacher Education in March of 1967. Members of the Council enthusiastically supported the idea with the hope that, because of such a yearbook, change would occur.

The phenomenon of change has operated on several levels in formulating and producing this yearbook. Revision of the excellent 11th Yearbook of the ACIATE, *Essentials of Preservice Preparation,* was our first objective and the reader will note some similarities between this yearbook and the one published in 1962. However, the perspective of time dictated major differences in treatment of certain topics. Briefly, the principal difference in the two yearbooks, in addition to authorship and point in time, is that the present work directs itself primarily to two "essentials" while the earlier work was addressed to three "essentials" or the totality of the undergraduate program. The two essentials of the present yearbook are the technological dimensions: (1) of content and (2) of method. Thus, the decision itself to delimit the scope of work resides in change caused by the burgeoning knowledge base of theory and practice in educational technology (method) and in industrial technology (the content of industrial arts).

Change operated in yet another way in the rationale underlying this yearbook. It was assumed that members of the American Council on Industrial Arts Teacher Education who are interested in directing positive and appropriate change would welcome this yearbook because it attempts to take literature, research findings, and theoretical structures, which may often be abstract or applicable to various fields or disciplines, and relate them directly to industrial arts. Thus, improved industrial arts teacher education nationwide was our second objective.

Change in Ohio was a third objective. It was decided to employ a procedure which would encourage chapter authors representing every college and university preparing industrial arts teachers in Ohio to engage in dialogue regarding this work. In turn, it was expected that the authors so engaged would serve as catalysts for information input, discussion, and subsequent program modification within their respective institutions.

The diligence and the excellent quality of work by the individual contributors is recognized. They performed their research and writing and met deadlines under trying circumstances — some beyond their control. In the main, the content of each chapter is the product of thought and study of the respective author(s).

Although their names do not appear as authors, special mention should be made of the aid, advice, and counsel of Charles Keith of Kent State University and Richard Kain of Ohio Northern University. They contributed time and shared their experience in an advisory capacity.

An examination of the list of authors and institutions represented, when added to the above-named individuals, leaves Wilmington College as the only Ohio industrial arts teacher preparation institution unrepresented in this volume. Menzo Stark of Wilmington College, long a leader and innovator in industrial arts education, had accepted a chapter assignment and was outlining it at the time of his death. To the memory of Menzo Stark, who contributed to this yearbook's design, we dedicate the product.

Willis E. Ray
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Editors

CHAPTER ONE

The Teacher We Wish to Prepare

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Consider these probabilities:

> This Yearbook will be distributed in April, 1971. It will be 1975 when suggestions presented here are completely implemented by teacher educators who are receptive to the ideas. The first graduates, then, who will have experienced the completely revised teacher education program will begin teaching in 1979 or 1980. With an effective working life of forty years, these teachers are likely to be in the service of education for twenty years beyond 2000 A.D. Therefore, the public school students of these teachers will all be citizens of the 21st century; some enjoying longevity will be alive in the 22nd century.

With these probabilities in mind, one may undertake the challenge of describing the teacher of the future and the educational and societal milieu in which he is likely to function.

Most industrial arts teacher educators are aware of the challenge and may agree that it originates in time-space circumstances. For example, teacher educators who read this material have been raised in a relatively stable world. Their thoughts and actions are deeply rooted in this environment. However, the teacher educator must place himself in the vanguard of innovators to encourage restructure in education wherever this is needed. He must do this in order to prepare teachers to work with children in a changed world in which the relative stability known today is unreal and in which change will have become the rule (Mesthene, 1965).

Precise descriptions of future societies are available. Obviously, there is no way to ascertain that any society so described will materialize. Many among today's seers, known as "futuribles," "futurists," or "future-planners," use sophisticated techniques borrowed from industrial, military, and other technologies to predict general possibilities from which they specify alternate societies which may emerge (Bell, 1967c; Boehm, 1970; Kopkind, 1967; McHale, 1969). Their work has suggested some of the subject matter presented here. It organizes itself into two separately treated but interdependent categories: (1) The Character of a Future Society, and (2) The Content of Teacher Preparation Programs.

THE CHARACTER OF A FUTURE SOCIETY

Can man free himself from his thoughtways and folkways to envision the future society? Analysis of present living patterns, particularly as manifested in adult society, reveals an extremely powerful disposition toward what has been characterized as a "rear-view mirror" syndrome. Nostalgia for the past does not loosen its grip. Such inhibitions may not only prevent adults from conceiving of radically new future societies evolving out of technological and other influences, but may also prevent them from viewing the present as it really is (McLuhan, 1970). This condition may be reversed as adults comprehend the sources of and influences upon mutations in the fabric of society.

Sources of Change

It is suggested that political, economic, and educational institutions are acted upon by: (1) technology, (2) increased diffusion of goods and privileges, (3) restructuring of societal institutions, and (4) changing relationships among the world's nations (Bell, 1967c, pp. 642-644). These principal sources of alteration are intertwined with current revolutionary technological developments in information processing, transportation, cybernation, systems analysis, modeling, and simulation — all considered extensions of man's senses. In a monograph which complements the subject of this chapter, Stadt and Kenneke (1970) recommend meaningful and organized study of these developments to accumulate bases for intelligent curriculum building in industrial arts.

While some fear developments which may foreshadow the collapse of the family, the decay of capitalism, and the triumph of a soulless technology (Ferry, 1968; McHale, 1969; Mead, 1970), the position here is positive. It is founded on the proposition that man possesses the ability to perfect himself in such a way that he will ultimately control or eliminate the short-term evils of technology. Technology, man's creation, will serve the good of man.

In this connection, the above-noted developments have already set forces in motion which are likely to insure the diffusion of existing goods and privileges, thus bringing society a step closer to the promise of equality. The turmoil which exists among minority groups stems, in part, from their awareness and assertion of their right to participate in society and share goods and privileges derived from technological achievements. This awareness derives from advances in areas like information processing and constitutes a force for further change.

Structures in society's institutions will also be affected. Local, state, regional and national political systems, and commercial and industrial elements of the economic system are already changing because of the influence of technology. Already, there exist more supra-municipal, county, and state structures than many politicians may wish to recognize. Corporations often attempt to hide their conglomerate nature even though the resulting structure is logical, efficient, and economical. Succumbing to "rear-view mirror" fears, often based on 1890 laws which do not apply, or scars of depressions and recessions which have long since healed, the corporate officers seem to fear to advertise the advantages of new organizations.

Finally, the current attempts at rapprochement between East and West, America's trauma of the Vietnam experience, and other international stresses will result in new, unpredictable, but hopefully beneficial changes in the relationships of the world's nations. These sources of change will affect all of society including the economy, the family, government, and education in the future.

The Economy

The era in which we live is post-industrial. The term "post-industrial" suggests a trend toward a diminishing influence of industry and the industry-oriented activities of man (Bell, 1967a, 1967b). Although past predictions for a leisure-oriented society have not materialized as rapidly as expected, there are indications that by the year 2000, American society will be more leisure-oriented, if not leisure-dominated. While the work day of 7.5 hours will not be unlike the work day of the 1970's, the work week may be only four days long. The current trend toward three-day weekends and rescheduling of legal holidays will provide the average worker with thirteen weeks of vacation during the year in the early 21st century. In this leisure-oriented society one may be able to spend approximately forty percent of his days on vacation, an equal amount of his time on an avocation and twenty percent, or more than one day a week, on neither should he so choose (Kahn & Wiener, 1967, pp. 194-198).

Certainly major individual and economic adjustments will need to accompany changes in the direction toward the leisure society. For example, the nature of today's products will change with the demand for leisure-oriented goods. Services will similarly become reoriented to this kind of society. Terms like goods, services, production, consumption, and work are likely to take on different meanings in the context of a changed society.

Economics, Work, and Mobility

For example, as the tools of production and the devices for processing information free man from his role as an extension of the machine, the distinction between work and play may become less clear. This is a phenomenon which can be observed in the attitude toward "work" of creative artists and scientists today and may pertain to many workers in the future. Like the artist or scientist, totally involved workers may be engaged in creative endeavors for much more than 7½ hours a day, four days a week. To these individuals, this kind of activity is neither play nor work — it is total involvement. They are enjoying creative leisure while producing something tangible; their efforts are highly rewarding and self-fulfilling.

The prospect of relieving man from the physical drudgery of work, as well as the displacement of skilled labor functions, is very real. The nature of alternate work roles is already exemplified in an experiment in which television, functioning as the eyes of the computer, gathers shape information which is communicated and transformed within the computer into directions which, in turn, control the work of mechanical arms. Such experiments no longer awe scientists or futurists. Rather they point to the infinite possibilities which are inhibited only by the need to increase the computer's ability to deal with mixtures of different kinds of information under the general principles of problem solving. The degree of intelligence that a man or machine displays, it is suggested, depends upon the way in which knowledge and problem-solving techniques are represented and put together. The fine details of television cameras, mechanical arm movements, and current computer technology are only incidentally important in comparison with the question of man's ability to organize the elements in a system (Real-world Machines, 1968, p. 55).

One major outcome of these prognosticated changes will be observed in worker mobility. If technology reduces the need for large numbers of unskilled workers in production, consumption, and service areas of enterprise, this group will need to gravitate toward those economic activities in which unskilled worker requirements will remain or emerge.

In addition to changing occupational patterns, different organizational structures including the emergence of "new" and the demise of "old" industries will provide impetus toward worker mobility. Other changes will foster worker mobility. During the Great Depression of the 1930's, unemployment and land blight encouraged, nay forced, a segment of the American population to become mobile, to seek better opportunities in farming or in cities (Okies and Arkies, rural poor). In the future, the circumstances of high standard of living, high rate of employment, and improved transportation and communication systems are likely to foster unprecedented individual and group movement. Ease of movement and availability of job opportunities may possibly encourage even the timid individual to try another climate, spend a couple of years in *X* city, or work with *Y* company in some distant locale. The attendant problems of increased mobility are difficult to forecast. There is evidence that all areas of this nation and most areas on this globe are becoming easily accessible and that cost or mode of travel will not be deterrents to travel and mobility.

The Family Setting

Profoundly affected will be the traditionally accepted role and structure of the family unit with its ultimate configuration and internal structure not yet discernible. The current trend toward a weakening of the structure and the bonds of familial relationships is rooted, like so many other phenomena, in our adaptation of technological processes and products.

The automobile, radio, television, satellite communication, improved interstate highway systems and improved and economical air travel have all affected family structure through the growth of individual mobility. With new opportunities awaiting individuals away from home, family bonds may appear to be restrictions. These factors which seem to forecast an accelerating decay of the family, may strengthen this basic unit of society.

Although the family and its functions are likely to change somewhat, eased individual mobility and communications may not appear to be a Circe call to the young to vacate their family nest, but may encourage family members to leave home for distant places and for purposes uniquely appropriate to their ages and interests. At the same time, for personal security and other reasons, they may wish to maintain strong ties with home, its inhabitants and its environs, as this becomes easier to do.

Genetic counseling and other scientific strides will affect the structure of, and relationships within, the family. Possibly family planning and the resultant smaller family unit will encourage closer human relationships. In the leisure-oriented society parents and children may be able to take advantage of more time to participate in activities together, which may result in stronger family bonds.

Also with more time available to spend at home, family activities lost or diminished in preceding generations can be reborn in modified form. "Togetherness" may not be scoffed at as a "camp" concept. In this connection, it is not extraordinary to preview the home becoming a center of activities similar to home activities of the pre-industrial age. Foods will be processed or reprocessed in the home with yet-to-be-designed but already conceived equipment and machines. The labor of the bygone eras will be gone, but the flavor will be recaptured. "New-town" concepts combined with communication and transportation media will bring education close to, if not into, the home and relieve the housewife from responsibilities which precluded her involvement in community and family activities. Consequently, the housewife will be able to pursue a career or a profession with relative ease while continuing to fulfill her traditional role.

Minorities will share in these life styles. Those now plagued by a weak family structure will see this problem ameliorated as they share in the benefits of the coming society. It is naive to suggest, however, that this will happen painlessly, either in terms of the family structure or other minority group problems. Technology has brought to minorities a new stage of awareness regarding the possibilities and privileges of American life. Hopefully, the diffusion of goods and privileges will be facilitated. The following example of economic gain resulting from minority participation in the benefits of society may dramatize the interest all citizens have in equality. The reader should realize that this is not *the* rationale for equality which guides the writers of this chapter.

According to Samuels (1968), if the skills of the blacks, the nation's largest minority, had been upgraded to those of white workers, unemployment could have been reduced to 2.5 or 3 percent of the available labor force without causing inflation in 1967. Jobs were available, but most blacks were not trained for them. Had they been so trained, they could have filled the jobs, increased their purchasing power, and would have assumed an appropriate portion of the tax burden.

The phenomena of technology are also affecting processes and structures in government.

Government

Decentralization of the national government is advertised at the same time that smaller governmental units like cities, counties, and states are encouraged to study and act to organize more effective and usually larger government units. Large and powerful government without adequate public control and "big" industry are greeted ambivalently. Fear of awesome impersonal power is balanced by understanding and the need for accepted and expected services which, in many cases, can be rendered efficiently only by large government units.

For example, one-half of the growth in national output in the last fifty years, according to Samuels (1968), came from investment in education, training, and health. This investment and subsequent growth in output resulted principally from government involvement in these fields. This appears to be a desirable activity of government. It is also uncertain that this growth would have been realized in this free enterprise system if such policies and actions were left to private agencies or smaller governmental units. Research by agencies like the National Institutes of Health has served to increase life expectancy and eliminate some diseases. This not only permits more people to attain a longer period of productive life — it has enlarged the work force by approximately 25 percent since 1900. The accumulated value of the resulting labor output has added 800 billion dollars to national wealth.

In other instances, towns, cities, counties, and states are being encouraged to associate on a regional basis to achieve goals which can most effectively be attained through such consolidation. Community services, quantity purchasing, and solution of pollution problems can best be undertaken and solved through an optimum-size governmental unit, often larger than most existing political subdivisions. Thus, the federal government is encouraging smaller units to combine and to employ technology-derived systems applications in serving citizens.

These examples of departures in traditional political action and thought are rooted in technology. The wise politician knows that the technology-impelled military organizations and weaponry of destruction possessed by nations today can be counterbalanced by technology-produced information, communications, transportation, food production, life extension, disease prevention, and educational modes.

In the past, politicians questioned whether action could be taken because of certain fixed ideas. Now they have learned that science and technology can help them change political attitudes much faster than ever before. Consequently, they have freed themselves from some of the shackles of the past, in turn affecting the social setting. An extreme example of the use of science and technology to effect a political outcome is noted in decisions to create the atom bomb and radar to end a war (Mesthene, 1967, p. 6).

As politicians become adept and secure in using science and technology for productive and peaceful purposes, big national government is likely to lose its detractors. Further, and for similar reasons, effective, strong supra-national governments may emerge. Citizens of the 21st century may be educated for, and in, an era in which interest in national boundaries and goals will have become secondary to government service to the improvement of the human condition throughout the world.

American citizens have been indicating acceptance and expectations of continued growth of federal government activity in social welfare, health, and education programs. The wide range of legislation in these areas over the past forty years has been hard-won. Yet, politicians who advocated these progressive steps have not suffered at the polls nor have any major programs retrogressed.

Citizens will continue to expect government to function in health and welfare, with extended interest in education. This commitment to education will hopefully insure a superior life style to Americans; it ought to help erase old world patterns of power, politics, fears, and suspicions and bring a better life to even the most primitive areas of the world.

The Educational Setting

Goodman (1968) has observed that the school structure one finds operating today is more relevant to the world of early 1900. Further, it was relevant only to the educational needs of 1/6th of the school-age population of that day. If this is true, then one must consider the wider range of individual abilities, varied styles of learning, the growth of knowledge, the revolutionized social climate, and the sheer numbers being served to judge success or failure in education today.

Knowledge is growing within the traditional framework of disciplines and fields. New fields, new combinations of disciplines, and new domains of knowledge are also emerging. Each new body of knowledge rapidly generates more knowledge and, analogous to the growth of biological organisms, combines with or causes mutations in other domains. Education will be reoriented to prepare individuals to cope with the knowledge progression. Most certainly, there will be no attempt to transmit vast accumulations of information. Rather, educational efforts will attempt to prepare individuals to cope with the phenomenon of burgeoning knowledge.

To meet these exigencies, education and schools, as presently constituted, must change drastically. The distinctly geometric progression of knowledge in the social and behavioral sciences is revealing a great deal about the nature of man. More is known about the way man learns and the ways in which he can be taught most efficiently and effectively; although, in this field, only the peak of an iceberg has been discerned. What has been learned about learning is being interrelated with what has been learned or theorized about the nature of knowledge. Already these interconnections can be observed in educational developments and practice. These provide guideposts for the future (Shane, 1967).

The curriculum of the future may concentrate on processes common to several related disciplines, Goodlad (1966) notes. One example already in implementation is the Process Approach to Science for Elementary Schools in which observation, classification, recognition and use of space-time relations, recognition of use of numbers and number relations, measurement, communications, inference, and prediction are the basic identified intellectual processes.

Shane and Shane (1969) offer a compelling peek into the future of education in a provocative statement summarized here. Because the vast learning potential in early childhood is now recognized, educational emphasis on this period of human growth and development will continue. Priorities for education of the very young, they observe, will occasion the development of a preprimary educational continuum. Programs of carefully designed experiences to increase the sensory input from which children derive their intelligence will become vogue, requiring professionally prepared childhood environmental specialists.

Educational progress with the very young, they summarize, may enable schools to accomplish a "seamless" primary, middle-school, and secondary continuum of coordinated learning experiences. A personalized curriculum can be shaped from knowledge of learning and instructional theory. An emergent instructional system will serve the educational requirements of all, permitting teachers to mediate the learning of children of different abilities.

The review continues by pointing to increasing knowledge of instruction and learning which should stimulate the development of varied instructional strategies. These strategies will be part of distinctly coordinated and articulated systems. Discussed also are biochemical and psychological mediation of learning which are likely to become tools in effective instruction. Utilized properly, these will help the learner develop his personality, concentration, and memory, and significantly increase the development of his potential. The prospect of improving these attributes should be acclaimed for it will correct the deficiencies in education which prevent creative *homo sapiens* in modern society from functioning at and realizing his fullest potential.

These developments imply new roles and responsibilities for teachers and new categories of specialist support, the report continues. The teacher will become a learning diagnostician and prognostician who may be responsible for coordinating the services needed for approximately 200 to 300 children. Forming an educational subsystem will be paraprofessionals, teaching interns, and others with complementary backgrounds. Rather than specializing in subject matter, the teacher will concentrate on coordination and direction of individual inquiry enhanced by educational technology.

Finally, the review discusses some human components of the educational system including individuals who will carry such exotic titles as: (1) media specialists, (2) information-input specialists, (3) curriculum-input specialists, (4) biochemical therapist/pharmacists, (5) early childhood specialists, (6) developmental specialists, who determine the groups in which children and youth will work, and (7) community workers and culture analysts who specialize in maintaining good communications, reducing misunderstandings or abrasions, and phasing into the life of the community the increased contributions that the schools will be making.

Thus, the challenge lies before the industrial arts teacher educator. He cannot posture himself like the man who remained in bed one morning as his wife admonished, "Be reasonable, you just can't stay in bed until they get rid of air pollution, traffic congestion, stick-ups, strong-arming, and all that!" Industrial arts teacher educators cannot climb into bed and ride out this most exciting period of educational development.

THE CONTENT OF TEACHER PREPARATION PROGRAMS

If industrial arts is to maintain its educational viability, it must be in the vanguard of developments in education and society. Two technological domains of teacher preparation programs believed to be pertinent to industrial arts viability receive primary attention in this yearbook. They are (1) content derived from acceptable interpretations and definitions of industry and technology, and (2) methods or efficient actions of teachers which are based upon educational technology. If industrial arts is to fulfill a meaningful role in the future, current practices in these domains must be dramatically altered. These practices are definitively treated in subsequent chapters.

A brief review of the foundations of the industrial arts curriculum area highlights developments which, over the years, are believed to have contributed to present circumstances.

The Nature of Industrial Arts

It is widely suggested (Warburton, 1969) that industrial arts has roots in ancient craft tradition. Instruction and learning in industrial arts, chroniclers tell us, is based on activity or doing, problem solving or empiricism, and the production of useful goods; all related in some way to the satisfaction of basic human needs. Further, historians of the subject have taken great pains to associate current industrial arts with its supposed forerunners and teacher educators transmit this information on the undergraduate and graduate levels. This latter circumstance may be of questionable value; for the manner in which the information is handled, the competencies of the professor, the receptiveness of students, and the accuracy of presentation and interpretation are critical and may have profound effects upon a developing teacher and his philosophical outlook. Teacher educators may wish to consider the elimination of all but passing reference to industrial arts precursors in undergraduate programs. Units of study in which recent learning, instructional, psychological, and curriculum content theories are presented might replace historical development. These ideas, taken together, would serve as a foundation and rationale for the industrial arts programs that students will teach.

Any "history" included may need to cover the more "recent" developments — those which are related to and out of which current practice has truly evolved. Thus one may ask whether the nature of industrial arts has evolved out of such forerunners as: (a) the ancient but still extant master-apprentice training in the crafts; (b) the programs which were designed to develop specific cognitive or sensory skills through training and practice in abstract manipulative skills and exercises; (c) programs having more broadly based objectives; adding to skills development elements of esthetics and certain attitude development, but achieved through a series of developmental exercises, which often produced useful objects; or (d) the program which purposefully adapted work with tools and materials to recultivate ancient arts and crafts and esthetic tradition because its proponents believed a defense against the incursions and evils of the industrial revolution was needed.

As suggested earlier, possibly the true nature of industrial arts begins with more recent educational concepts based upon improved understanding of human behavior, new theories of instruction and learning, and careful scrutiny of contemporary society as a source of curriculum. These seem to be appropriate sources for new definitions and directions for the program known as industrial arts.

In the last fifty years there has been much declaiming in regard to the virtues of industrial arts methods and subject matter. Realities are in conflict with the claims, since what is going on in most schools and industrial arts teacher education institutions of the nation has little relationship to the technology of the present and the future, but does have a strong similarity to the pre-1900 shopwork movements based primarily on woodworking activities (Schmitt & Pelley, 1967).

Finally, it is suggested that effective curriculum planning cannot be elicited from educational leaders who are captives of traditions, modes of thought, heritages, and value systems which are irrelevant to contemporary society and are incomprehensible to the youth of today. The determination of industrial arts content should not be rooted in the past, but should develop fresh green stems to search out needs, tools, patterns of thought, and future-oriented values. This has been undertaken and can be noted in some of the recent interpretations and definitions of industry and technology.

Industry and Technology

The definitions and interpretations of industry and technology ought to be consistent with the concept of future-planning which pervades this chapter. Any such definition or interpretation needs to accommodate itself to eventualities. Further, definitions and interpretations need not be so exclusive that ultimate blending, overlap, or complete combination with other disciplines should be precluded. Precise methods for predicting future societies may also suggest marriages of convenience among disciplines to do the required educational job.

In this context, then, it seems possible that evolution in industrial arts and other disciplines may bring them closer together. Attempts to maintain a strictly exclusive base are likely to result in curriculum areas with parallel objectives with similar activities. Curriculum trends in the sciences, certain approaches in industrial arts, and trends in social science seem to be converging.

Definitions of industry and technology are convenient as guideposts and measures of industrial arts curriculum development. They affect content selection, help establish areas of responsibility, and provide a convenient platform for dialogue and ultimate understanding within the field and among subject matter experts in other fields who may believe that "industry" and "technology" are content topics appropriate to their interest area.

Technology Defined. "Technology" has several meanings. To some it means mechanical devices or processes. Products like automobiles, hardware in business offices, or farm tractors are equated with the term "technology." The term also signifies what people do with the hardware. One who works with television or computers is working in a "technology."

A most compelling view of technology maintains that it is a systematic, disciplined approach to achieving almost any objective which requires precision, measurement, and systems substantially different from traditional religious, esthetic, and intuitive modes (Bell, 1967c, p. 643). In this context machines have always been an adjunct or a product of technology rather than the technology itself. Furthermore, technology as a total approach is an intellectual process which can be employed by almost any discipline with a knowledge base adaptable to the system. So defined, technology is seen as having developed and as continuing to create new techniques such as model construction, linear programming, and operations research.

The possibilities of systematic and sound decision-making are most compelling. Parenthetically, the knowledge of this possibility — that society has at its disposal such tools — may be a cause of the bewilderment and antagonism of youthful dissidents. Why, they seem to ask, have we not used this tool to solve the problems which confront society today? Furthermore, frustration increases among such groups when they realize that the by-products of technology are air and water pollution, poverty and unemployment, sonic booms, and destructive weaponry. They know all of these could be effectively eliminated, thereby relieving many people and nations of these problems, if technology were also applied to their solution. Industrial arts educators should have asked and responded to these questions long ago. Having thus "dropped the ball," industrial arts may have abrogated its true responsibility and created a vacuum now being filled by "environmentalists" and the like.

Technology, then, is a comprehensive process that man has developed to apply in various situations. When applied to specific areas of man's endeavors, those areas may receive an appropriate appellation, like "medical technology" or "educational technology"; consequently, we can say that there is a technology of industry. Such technology is the knowledge base and holds significant content implications for industrial arts education. In the definition and interpretation of industry and its relationship to technology lies the solution to the problems of future-planning and industrial arts education content.

Industry Defined. Since the term industrial arts was coined, there has been a series of attempts to define the limits and interpret the meaning of the term "industry." This was recognized as an essential prerequisite to the development of a consistent rationale and theoretical structure for the field. There has been, and there still is, no discernible agreement regarding the term that would be helpful in the development of a theoretical structure.

As Ray (1970) points out, the definition of "industry" as earnest steady effort in any endeavor contributes little to the development of a model of an educational curriculum. From numerous proposals presented to the field, four generalizations can be discerned regarding the terms "industry" and "technology" which have implications for content selection in industrial arts education. One definition of industry identifies it as an element of the economic institution of society which is engaged in changing the form of materials to satisfy man's wants. Industry is also more broadly conceived to encompass economic activities in areas like government, personal services, amusement, medical and health services, and finance. A third interpretation enlarges upon the term "industry," to encompass enterprise and technology. In the latter case, emphasis is on technological developments, particularly those stemming from industry and their effect on man. A fourth category is less concerned with the term "industry" and concentrates on the processes and instructional values which are inherent in an activity-oriented educational program which patterns itself after the processes of technology. Advocates of this last approach place importance upon the objectives of student understanding and appreciation of technological processes along with the development of creativity, problem solving, skill preparation for leisure, and interest in science and societal problems, particularly those which arise from, or are directly attributable to, technology (DeVore, 1964; Maley, 1966, 1967).

The four categories can be viewed in yet another way. The first leads to a delimited discipline based upon the technology of industry whose end is production and changing forms of materials to satisfy man's wants. The second has a very similar discipline base, but its broader definition of industry suggests that it is concerned with the technology or technologies of the entire economic system. The third does not seek to define the economic system but suggests the presence of a fluid situation in American institutions in which changes may be subsumed under the term "enterprise." Finally, the discipline base of technology, which emphasizes process, can accept industrial technology as a focus, a means through which students come to understand technology *in toto*. Some advocates of this approach leave the impression that activity based on industrial practice may be relevant but not totally necessary to achieve desired results (DeVore, 1970).

The exercise of presenting these interpretations certainly does not contribute to a clarification of the problems which confront the profession. Yet they do represent attempts on the part of thoughtful individuals to modify an element of the educational spectrum. All are attempts to take "future shock" out of the future by presenting the future or processes relevant to the future now. Students so familiarized will be prepared to master and control technology and the future. This kind of preparation has been and always will be a major challenge to teachers.

The Nature of Teaching

A major thesis of this chapter has been that the processes of technology can be applied in a variety of endeavors to improve man's functions and free him from the activities and work closest to drudgery. The nature of teaching is changing as a result of the development of theory in technology. Teacher preparation programs will not only need to organize content of industrial technology effectively, but they will need to prepare teachers to utilize technologies appropriate to instruction. Because teaching involves human relationships, it is a highly complex act.

There is much about teaching that still needs to be explored, particularly in the area of student and teacher behavior patterns and their interaction. Although it has the outward appearance of objectivity, teaching can be characterized as an activity largely controlled and motivated by subjective or "gut" feelings. Unfortunately, the precise instrumentation to determine the long range effects of a specific teacher and student interaction is not yet available. We are unable to attribute specific outcomes to specific classroom interactions with the assurance that other factors have not affected the outcomes. Subtleties of personality affects, for example, are difficult to determine. These play a role of such magnitude in instruction that ultimately their function in teaching will need to be precisely determined (Flanders, 1960, Hamachek, 1969). Also, teachers do not have the time or necessary support to accurately determine their own effectiveness. For these reasons, teaching still may be viewed as an art rather than a science. The essential contribution of technology is not the destruction of the "art" of teaching, but the help it may render in discovering the means by which these interactions can be improved and made more purposeful in connection with the specific function of teachers (Gage, 1968). Those who fear that technology will eliminate the critical human element in instruction or promote an instructional program totally hardware-oriented and dehumanized, have looked at only one aspect of the contributions that systems design and modeling procedures of technology can make. It is the view of the authors of this chapter that the application of systems in teaching will probably require a greater artfulness on the teacher's part than ever before because the teacher will have at his disposal more possibilities and more precise tools with which to achieve specific results. Thus teachers will be challenged toward a more demanding and creative kind of decision-making, the results of which are likely to be more fruitful than those of the past.

The Nature of Instructional Development

Instructional development is based on technology-derived systems. As in other technologies, instructional development or educational technology draws upon a variety of techniques and knowledge bases. Content selection for educational programs requires the services of experts other than the teacher. Objective and proper formulation may require interaction among teachers and specialists from other fields. Specific instructional strategies or methods rely heavily upon the knowledge of instructional media experts, as well as the educational psychologists' findings in learning theory, together with interaction analysis, nonverbal communication, micro-teaching, simulation, and role playing. Improving techniques in evaluation designed to provide feedback at all stages of instruction is important, and its theory and methodology has been developed by specialists to an extent beyond that required or expected of the teacher.

The teacher of the future should not be expected to develop theories, educational or instructional, or to be expert in such things as media development. However, he should be aware of research findings and developments in the field and how they pertain to the instructional systems he administers.

Teacher education programs will need to carefully structure those experiences which will produce teachers with instructional development competencies such as those reviewed by Glaser (1967) and Saettler (1968, pp. 270-277).

Briefly, teachers will need to know that instructional systems design begins with a specification of goals or purposes for the system which include: (1) the instructional objectives to be achieved; and (2) the frame of reference for decisions about the functions of subsystems, the major parts of the total system, and the ways in which they may be connected to fulfill system goals.

The teacher must be able to describe a variety of elements which impinge upon his function as an instructional systems developer. In specific terms, such items as the nature of learners, the kind of teacher or teaching team required, instructional problem areas, support staff requirements, instructional resources, and staff functions need to be clearly noted. Further, classroom environment variables such as: (1) class size, (2) physical characteristics of the classroom, (3) psychological climate (permissive, authoritarian, or democratic), (4) methods or procedures and ways in which instructional media are used, and (5) degree and level of participation by learners may be included in design consideration.

Industrial arts teachers also must be competent in instructional task analysis. Such analysis is based on a knowledge of human behavior in terms of what concepts, abilities, skills, attitudes, and understandings are required for a learner to achieve a specific instructional goal. This analysis provides the teacher the means for decisions about those learner qualities that can be developed; the kind of behavior that can be facilitated by particular procedures, methods, or media; and furnish yet another reliable basis for the design of instructional systems.

With these prerequisite design elements determined, instructional development proceeds to a next stage which includes such processes as the implementation of research on learning and the structuring of instructional messages. Not yet done with his task as designer and implementer, the industrial arts teacher of the future needs to be able to oversee or directly participate in planning, producing, selecting, managing, and utilizing various human and machine components of the instructional system. Finally, the competent teacher will not fail to include instructional systems evaluation involving the systematic scientific observation and measurement of the total system in terms of its goals and purposes (Glaser, 1967).

SUMMARY

Certain basic assumptions have been made regarding the competencies and profile of the industrial arts teacher of the future. Teacher educators urgently need to examine these assumptions and the conclusions which they offer.

The society of the future, *circa* 2,000, will be significantly different from that of the early 1970's; although most of the elements out of which the new society will emerge exist today. The difference in society can occur democratically and within the long established and dearly held values of American society. This will be true, particularly if the leadership in this nation recognizes and capitalizes upon the revolutionary agent — technology — which can foster increased equality, a mobile, leisure-oriented population benefiting from science and technology's conquest of the problems which plague society today.

The possibilities of changes so wrought by a citizenry which can control science and technology for its own welfare requires industrial arts teacher educators to investigate and modify, if not revolutionize, current practices in teacher preparation. The many details which need to be studied for possible revision are categorized in two areas of technology: the content of industrial arts which is defined as *industrial* technology; and the teaching methods of industrial arts which can be subsumed under the term *educational* or *instructional* technology.

Scrutiny of these two domains of industrial arts teacher education will reveal that they are mutually supportive. The procedures, techniques, and organizational patterns of *technology* are magnificently revealed in a study of *industrial* technology. Similarly, *instructional* technology, which is applicable to most subject fields, has also adapted from *technology* those elements which permit more certain, efficient, and controlled instruction. Both take on aspects of the dominant force — technology — which is likely to modify the family, the economic system, government, and education.

Somewhere in this exciting context the industrial arts teacher educator must place himself and he must dedicate himself to influence positive and appropriate progress and change.

The ideal Ferkiss (1969) expresses at the close of his book, *Technological Man,* is a fitting one with which to close this chapter. It aptly summarizes the challenge to industrial arts educators.

> Technological man will be his own master. Prior to his emergence, the outlines of technological civilization must remain dim save for the knowledge that it will have to rest upon a unified view of the universe, on ecological balance and on fidelity to the essential identity of the human species. Technological man will create his own future, and it may contain some surprises even for him . . . .
>
> The new gifts are all about us today, and the newer ones in store are unpredictable in their nature and their timing. Upon man's ability to recognize them for what they are and to convert them into what his development requires rests not only his future but, for all we know, that of all creation (p. 272).

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CHAPTER TWO

The Character of a Complete Program

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To describe the character of existing programs in industrial arts teacher education challenges a researcher with an instrument capable of continual assessment. The profile status is a changing one. In spite of this, the elements of a complete program, patterns into which they tend to flow, and influences that act upon the development of programs can be identified. These are described in this chapter and in some respects offer a portrait, although an eclectic one, of teacher education programs in industrial arts.

In the 1880's there were two key sources of manual training teachers, according to Bennett (1937, p. 446). These were the Worcester Polytechnic Institute in Massachusetts and the Manual Training School of Washington University in St. Louis. The graduates of these schools completed extensive courses in the type of content adopted in the manual training high schools; but there were no professional courses in these early years.

The first program of teacher education to include professional courses in manual training was Teachers College during the academic year 1887-88. In 1893-94 a two-year diploma program for manual training teachers was started. The Teachers College program was the prototype of industrial arts teacher education as we know it today.

During this same period, short courses in sloyd which Gustaf Larsson conducted for public school teachers in Boston, evolved into a training program focused on handwork skills. Larsson's school gave diplomas to 361 teachers in the two decades from 1892 to 1912. His program was representative of the European approach seen earlier in Germany, Switzerland, and

Finland; that of offering technical skills to supplement the education of both practicing and prospective teachers.

Professional education courses as a major element of baccalaureate programs have expanded greatly since 1920, especially in state-supported institutions. The general acceptance of professional, liberal, and technical (subject matter) elements in the teacher education is approximately two generations old, suggesting the relative youthfulness of this field within education.

TRADITIONAL ELEMENTS

The term "traditional" is not synonymous with "antiquated" or "obsolete." It refers to the accepted elements that have evolved while being modified by hundreds of private and state-operated institutions which prepare teachers. These elements can be identified as *General Education, Professional Education,* and *Specialized* (Industrial Technology) *Education.* The mix, emphases, and relative values as perceived in current programs provide an arena of academic discussion.

General Education

Requirements in general education are often established by the college or university rather than the department preparing the professional teacher and are partially influenced by accrediting agencies. General requirements usually include a block of elective credits and often several specified courses in various disciplines. Courses that will satisfy requirements of the university and at the same time are highly supportive of the career preparation of the teacher are frequently specified. Recommended electives also play a supportive role while being counted toward general requirements.

The philosophical definitions, positions, and resulting tendencies of programs of general education are developed by Phillips in Section II of the ACIATE 11th Yearbook (Lux, 1962). The 4th Yearbook of ACIATE (Hornbake and Maley, 1955) also discusses general education in the context of superior practices in industrial arts education. It is unnecessary to further review the collection of theories and practices of general education in American institutions except to note its importance. Phillips (Lux, 1962) makes five specific recommendations that characterize the role general education plays in contemporary programs:

1. Industrial arts majors should have the same general education opportunities as any other major in the college or university.
2. The general education program must provide some flexibility to meet student needs.
3. The general education program should develop an attitude of interest in learning and a confidence in the areas of understanding.
4. The special education phase of teacher education has the responsibility to relate the general education understandings to the objectives of industrial arts so that proper implementation can be carried on.
5. The industrial arts college faculties can "show the way" to general education in method and in evaluation by teaching their general education industrial arts courses in an exemplary fashion and carrying on research to further improve offerings (p. 55).

Traditional disciplines that have evolved as contributors to the general education of college graduates include the "hard" sciences, fine arts, mathematics, social sciences, applied arts, and communicative arts. General education is considered a common bond between industrial arts teachers and teachers in other disciplines. Therefore, it serves a professional purpose in addition to the social-cultural values usually attributed to liberalizing or general education.

Professional Education

Three views of the professional preparation of a teacher are discernible in practice. The first maintains that the art of teaching is a divine gift. Accordingly, teachers naturally evidence skills usually associated with instruction. The second is the concept that a person of reasonable mental and physical ability can be "processed" through a rather standardized system and emerge with the special competencies of a professional teacher. The third approach is eclectic by design and does not dismiss the contributions of the first two. It is based on the premise that the professional sequence is a process which acts upon the individual and results in (the production of) a competent entry-level teacher. In this last approach, continuous analysis of the changing tasks of teachers and accurate assessment of individual progress toward goals within a flexible system of professional experience is paramount.

Despite periodic attacks from critics, professional education remains a pillar rooted in the preparatory requirements for teaching. Frequently, debates center on issues of content and the sequencing of professional courses rather than the issue of their very existence.

Despite differences, the professional phase includes several groupings such as foundations, behavioral science, methods, and student teaching. "Methods" courses cover the gamut from tests and measurements to laboratory planning.

Foundations. Early orientation to career fields is important. Such orientation, if received by a varied student body, can also be an effective recruiting device since a large number of students choose to major in industrial arts after they enter college. The typical requirement of an introductory course to American education, which emphasizes the historical and philosophical base, is not the type of orientation valued here. Too often these courses neglect the role and contributions of the practical arts as an integral part of American education. Further, these courses are usually offered in the junior and senior year when it is too late for optimum effectiveness in orientation or recruitment.

Foundations courses may also include introduction to the role of a teacher in addition to identifying the elements of instruction as distinguished from an introduction to education as a social system. Functions of this category could be listed as follows:

1. Career orientation
2. Interrelation of knowledge
3. Tasks of teaching
4. School and society.

Competencies. The role and nature of the teacher's tasks are affected by accelerating change as are other areas of human endeavor. Three broad eras of teacher function can be characterized: (1) the historical era of "the information dispenser," (2) the current era of "activities manager," and (3) the future era of "diagnostician, strategist, and evaluator."

In this framework, courses in the professional phase dealing with educational psychology, sociology, instructional systems, organizational problems, evaluation systems, clinical experiences, course and curriculum construction, facilities planning, and other are noted.

Practice. Appropriate practice and application of theory is essential in the development of a professional. Consequently, student teaching is an integral part of this category. Yet a look at current practices reveals a wide variation in terms of length in both the school day and in the number of weeks devoted to student teaching. It seems, however, that quality and timing of student-teaching experiences are far more important than the amount of time involved.

The category of practice needs to be viewed in a larger context than student teaching alone. All field experiences should contribute to the culminating experience of student teaching. Observational experiences at all levels in various types of educational programs should permeate the professional sequence. Real and simulated experience should be available and complement studies throughout the college program. These and clinical experiences provide valuable pre-student-teaching experience especially if they are integrated into professional courses.

Observational and field experiences must be designed as an integral part of the professional sequence. They cannot be totally effective if they are viewed as prerequisite hurdles to be jumped immediately prior to student teaching. Field experiences should be provided early and continuously, and should be a relevant part of the total instructional system.

Internship, as used in medicine, has not been a major factor thus far in teacher preparation. Although some innovations were attempted in the late 1950's, the role of internship, as teaching becomes more professionalized, has yet to be fully realized. Andrews (1967) calls for greater effort in this direction. He proposes that the intern concept be considered well beyond its current application in Master of Arts in Teaching (M.A.T.) fifth-year programs. The Association for Student Teaching (1968) has adopted the following definition of internships in teacher education:

> The internship in teacher education is an integral part of the professional preparation of the teacher candidate, having been preceded by successful observation-participation and student teaching or equivalent clinical experiences in a school environment, and is planned and coordinated by the teacher education institution in cooperation with one or more school systems. The intern is contracted by and paid by a local school board, assigned a carefully planned teaching load for a school year, and enrolled in college courses that parallel his professional experience. The

intern is supervised both by a highly competent teacher who is recognized for his supervisory capacity and is assigned released time to devote to the supervision of interns and by a college supervisor who makes a series of observations and works closely with the school supervisor and the intern (p. xi).

Internship integrated into the total undergraduate sequence may constitute the most potent vehicle for learning more about professional teacher behavior. Currently, the main differences between student teaching and interning are:

1. The well-defined authority of the intern
2. Some type of salary arrangement for the intern
3. The post-degree nature of internship.

Andrews' (1967, p. 238) views on professional education are premised upon continued differentiation of instructional responsibilities ranging from assistant teacher, through intern, resident, and professional teacher. As teachers move toward the top of a pyramid of team teaching, an impact upon the length, level, type, and sequencing of professional experiences will be witnessed. Systems will be more efficiently designed to produce the necessary entry level of competencies. Thus different configurations of professional sequences will emerge, each relating to the type of certificate awarded.

Selection and Retention. Professional educators often neglect two contributions of professional course work (especially in periods of critical teacher shortages). These are in the areas of selection and retention. A system within the professional sequence needs to be designed to help uncommitted unqualified students to identify other paths to the baccalaureate degree. Admission criteria are obviously not adequate for predicting success or commitment to teaching. Point-hour averages from professional courses of unproven relevance and quality are also not dependable as sole screening devices.

Regardless of criteria selected, however, we need to remember that we are a long way from developing a foolproof screening system. The professional phase of teacher preparation, therefore, may need to meet the challenges presented by retention or selection of students as potential teachers. Student teaching as a selection device comes too late in the sequence and is therefore ineffective. Two standards adopted by the American Association of Colleges for Teacher Education (1969) illustrate the professional posture on this phase of the complete program:

Standard: The institution applies specific criteria for admission to teacher education programs; these criteria require the use of both objective and subjective tests.
Standard: The institution applies specific criteria for the retention of candidates in basic programs who possess academic competencies and personal characteristics appropriate to the requirements of teaching (pp. 9, 10).

Thus, we have a formidable challenge to design an effective selection and screening process.

Specialized (Industrial Technology) Education

Three categories are identifiable in technical education. The first may be considered a core of technologies. Regardless of what taxonomy of industry or technology is used, it seems that an identified content area common to all teachers in industrial arts is desirable.

There seems more agreement than ever before that the source of industrial arts content is the economic institution of American Industry and its resultant technology. This idea seems to have taken strong root only recently, having been championed by Warner and others in the 1930-1940 decades and strengthened by multi-million dollar curriculum research projects in the 1960's.

A second category supplements the core and may be considered a highly specialized segment of the core. This is the concentration or specialty which the teacher-in-preparation decides he wishes to teach. Thus a student either elects to build on core courses and become a generalist, or elects specialization as a particular area of the technology. Seventy percent of the jury in Heilman's study (1963, p. 105) supported this concept.

Coordinated experiences in industry can be considered a third phase of the technical experiences of the program. This experience should ideally complement the concentration mentioned above.

The 1961 Task Force Report (National Commission on Teacher Education and Professional Standards, 1963) highly values both broad field orientation and single field depth with supporting study in auxiliary disciplines. Concentration in at least one field of study for both elementary and secondary fields is stressed with the fate of the "pure generalist" being implicit.

The converse is also true. The exploration of broad fields is recommended to support the competencies of the single area specialist.

The profession thus faces a dilemma in preparing subject matter specialists demanded by the current market, and also in gearing for flexibility required by emerging interdisciplinary approaches.

Major issues regarding the specialized subject matter do not revolve around quantitative questions as they have in the past. Teacher educators now face a series of problems such as:

1. How to simulate contemporary industrial practice.
2. How to conceptually organize the technical courses.
3. How to provide for areas of concentration within industrial arts.
4. How to equate industrial experience, technical college credits, and other aspects of proficiency with required courses.
5. How to distill an appropriate high school curriculum from more technical and sophisticated university courses.
6. How to overcome the lag inherent in certification and accreditation systems coupled with university procedures of modifying curriculum.
7. How to raise and allocate resources to support relevant technical curricula.

Names of courses and divisions of technical content are actually of secondary importance. Programs could differ greatly in this respect; but, if they focus on and solve these problems, they will remain relevant and maintain their individuality.

PATTERNS

The three elements of a complete program as discussed above can produce or be arranged in a variety of patterns. Programs or patterns vary according to the way in which respective teacher education faculties answer three fundamental questions: (1) What is the ideal proportion of professional, technical, and general education? (2) In what way should courses, elements, and experiences be sequenced? (3) What length is optimal for the total program or its segments? Patterns, then, will be explored with these three questions as points of departure.

Proportions/Mix

The three basic elements seem to vary little from a somewhat balanced distribution throughout an undergraduate program. Competition within institutions, accreditation guidelines, and a general desire for peaceful coexistence among disciplines in their claim upon undergraduates' time tend to maintain the levels. These factors also produce a pendulum effect. The baccalaureate program developed by William E. Warner at The Ohio State University adhered to a ratio of 1/3 Technical, 1/3 Professional, and 1/3 Related Academic (General Education). Micheels and Sommers (1958) recommended as much as one-half the program composed of general education; a distinct move away from the Warner ratio. This ratio of one-half general education can be approached or exceeded in some institutions because industrial arts is accepted as general education in some or all of its offerings beyond those required in a student's special concentration.

Another effect on the distribution is achieved by special sections and courses which are established for education majors as survey or introductory courses in a specific discipline—courses not open to majors of that discipline. In some instances, such courses can meet objectives of the industrial arts specialized curriculum in addition to general education goals. This is particularly true in the sciences, mathematics, and fine arts. This concept was applied in the formulation of *The Minnesota Plan* (Micheels and Sommers, 1958). This practice, while contributing to the efficiency of producing the teacher, can be at odds with the liberalizing goals of general education.

A tacit agreement between professional educators and those in the humanities, sciences, and other areas of the university limits the velocity and direction of the pendulum which swings from one-third to one-half general education. Anything less than one-third of general courses threatens the cultural, communicative bases of the baccalaureate. Less than a proportional share of specialized content courses poses a similar threat to the respectability of the major concentrations and a commitment to the clientele to be served by the graduate.

The National Commission on Teacher Education and Professional Standards took this position (1963):

> Precise allocation of percentages of credits among the three major aspects of teacher education is not a sound basis for program planning. Because students enter with widely varied backgrounds of experience and formal study, college programs should be individually planned. In general, a reasonable balance in a five-year program for prospective elementary and secondary schoolteachers is 40 to 50 percent general education (including electives), 30 to 40 percent subject matter specialization in teaching fields, and 15 to 25 percent professional education courses and student teaching. No one plan or pattern of curriculum organization has been shown to be superior (p. 11).

Robinson (1959, p. 18) identified a trend toward more general education for industrial arts majors during the decade 1948-1958. The average number of semester hours climbed from thirty to forty-nine. Professional course requirements remained static, about 18 semester hours, during the same period.

Distribution of semester hours applicable to different areas varied little from 1958 to 1963 according to Heilman (1963, p. 78). The trends noted by Robinson seemed to be consolidated in this later period. The average professional requirement was 18.5 hours, for general education it was 40.9; and for industrial arts technical courses it averaged 32.6 semester hours. These averages do not necessarily total a complete four-year program of approximately 124 hours. However, they are indicative of the mix which reveals fluctuation between general and technical courses with the professional education requirements remaining relatively static.

There is a variety of certification requirements and of teacher education programs in different states. These need to be scrutinized for trends.

Heilman (1963, p. 106) asked his jury to recommend a percentage for the three divisions of study. The results reflect the same general ranges predominant since the four-year degree became the standard for industrial arts during the Great Depression of the 1930's and are summarized in Figure 2-1.

Since the aforementioned study formulated a complete program in 1963 via the consensual method which compared favorably to certification practices of the period, it may be "safe" to use it as a profile of the complete program of the "Sixties." Heilman (1963) accordingly tells us that:

	Percent of Program	Percent of Jury Agreement
General Education	21 - 50	70
Professional Education	Up to 20	67
	21 - 35	33
Industrial Arts	36 - 50	50
	21 - 35	30

Fig. 2-1. Responses to Heilman's Questionnaire on Distribution of Divisions of Study in Undergraduate Industrial Arts Teacher Preparation Programs.

> The proposed program included about 40 percent general education, 18 percent professional education, 39 percent industrial arts, and 3 percent unclassified elective courses.
>
> Some states tended to rely upon the institutions of higher education to establish the requirements for a degree in industrial arts . . .
>
> General education requirements have increased gradually and have been recognized as an essential part of the industrial arts teacher's professional preparation.
>
> Professional education requirements . . . were about the same as those required for the last fifteen years . . . (pp. 160, 161).

What mix produces the best teacher? We only know the general proportions that potential teachers take. Hours are not important. Rather, the programs that are designed for individuals within these ranges are important. It is evident that industrial arts programs tend to reflect the status of general teacher education requirements in the respective states.

Sequencing

The ACIATE 11th Yearbook (Lux, 1962) notes the merits of all three divisions of the complete program beginning with the freshman year. The professional and technical areas increase until graduation with the general education proportionately decreasing. This seems to be an accepted and typical pattern.

The sequential offering of professional courses is often established and is dictated by prerequisite knowledge and skills necessary for a successful student-teaching experience. Here we are speaking of psychological and methodological foundations.

It is essential for the undergraduate to have early conceptions as to what the science (or technology) of teaching entails.

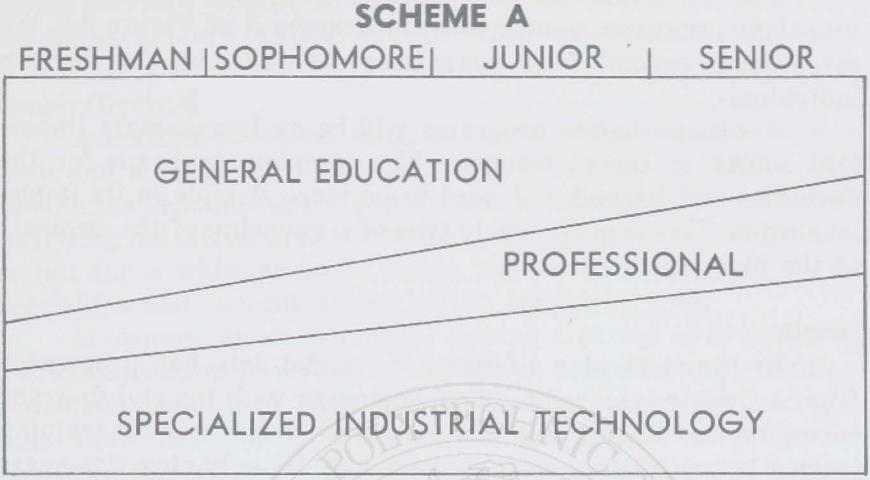
Technical skills and knowledge can be sequenced with the same care. One pattern might be to conceptualize the structure of industry early in the program, proceed to in-depth specialization based upon an accepted taxonomy, and then in later semesters provide a synthesizing experience. Other patterns of technical course sequencing are possible and provision for individuals of different backgrounds to enter at various points should be considered. Sequencing is an important factor in this phase of a complete program and it is often neglected. We often fall into an 1890 syndrome that "wood precedes metals," "hand tools precede machine tools," "letterpress precedes offset," "lectures precede demonstrations," and other dubious, shallow premises.

The position of the ACIATE 11th Yearbook (Lux, 1962) regarding general education as a part of each year is well supported by The National Commission of Teacher Education and Professional Standards (1963) recommendations:

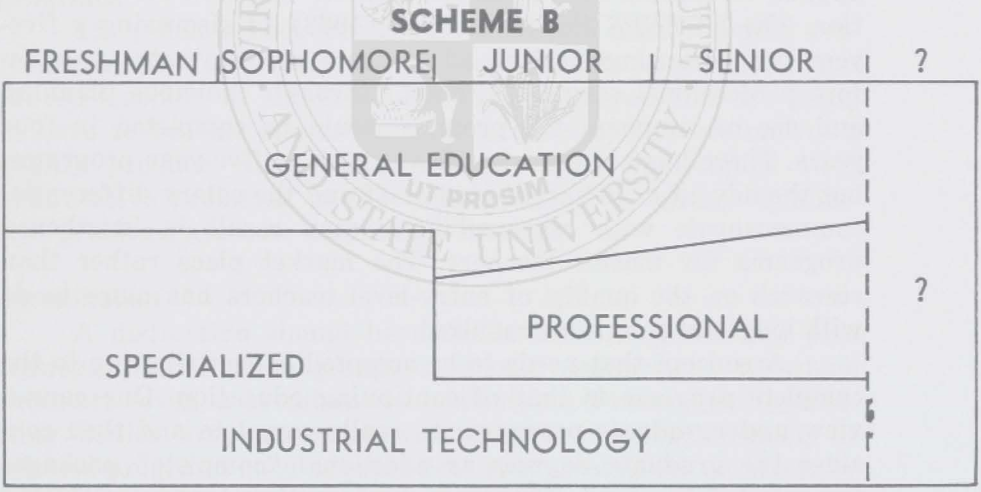
> Work in general education should not be relegated exclusively to the first two years of college, nor should it be the sole responsibility of the undergraduate college. It should be a part of each college year . . . (p. 15).

It is important that technical courses be offered early during the first year. In other disciplines, the prospective teacher builds his teaching subject concentration onto lower division courses that are general education requirements. In industrial arts, it is desirable to place some major technical courses in the lower division the first two college years. Benefits of offering all facets of the program in the early college years include motivation and recruitment, as well as reinforcement of sequential educational experiences over a longer time span. Scheme *A* of Figure 2-2 symbolizes the situation. However, these benefits must be realized in alternate patterns.

There must be increased consideration for the student who makes a belated occupational choice. This is especially true if the potential of two-year, post-high-school technical programs as a resource for career teachers is recognized. The baccalaureate program that becomes too rigid will not serve those who decide at a late interval to go on for a degree in education.



A Schematic of a Typical Model for Distribution of the Course Elements in an Industrial Arts Teacher Preparation Program.



An Alternative Model to Accommodate Students Who Transfer from a Two-Year Program.

Fig. 2-2. Two Models of Possible Distributions of Course Elements in the Preparation of Teacher Education Programs.

Four-year institutions should design alternative sequences into their programs as suggested in Scheme *B* of Figure 2-2. An extra term beyond four years may be advisable for certain individuals.

Associate degree programs will be an increasingly important source of career teachers. The complete program for the Seventies and beyond will need to be more flexible in its implementation. This is particularly true of sequencing of the elements of the program.

Length

In the span of a lifetime, industrial arts has progressed from a field in which the school custodian with his eighth-grade education and kit of tools was employed as the manual training teacher to a profession that employs only those having five years of higher education in some states.

The factor of length of higher education can change a program in an infinite number of ways. The concept of time can be applied to courses as well as the number of years for certification. The *NCTEPS Position Paper* (1963) in discussing a five-year program suggests that all teachers need an extra year before professional service; although through judicious planning and use of summers the program could be completed in four years. There has been no significant rush to five-year programs, but the advent of differentiated staff and the salary differential commensurate with responsibilities may result in lengthened programs for master teachers. The market place rather than research on the quality of entry-level teachers has more to do with length of programs required.

A concept that needs to be accepted as contributing to the complete program is that of continuing education. One cannot view undergraduate programs as really complete and then consider the graduate degrees as additional "complete" packages for selected teachers. The concept of continual and articulated professional study should be acquired during the undergraduate years.

INFLUENCES

Any program of higher education is subject to a variety of influences within the academic community. A program of professional service resulting in a certificated occupation of stature in the taxpayer's eye is always subject to a variety of influences.

Supply/Demand

According to recent data, the general teacher shortage is over and a cycle of over-supply is expected in the 1970's. Although the demand-supply gap is narrowing, industrial education including industrial arts will remain an exception to the general trend; for a while at least. There will be varying demands on specialties and concentrations within industrial arts.

Is oversupply an influence? During a period of oversupply, teacher education programs tend to raise selection and retention standards, usually by raising point-hour average requirements. Also, there is a tendency to increase the number of programs requiring five or more years of preparation. During the 1960's, emergency certificates were granted to personnel with less than a baccalaureate degree in order to man classrooms. This was hardly a time to experiment with higher standards and longer programs.

The public schools are going to demand higher-quality performance. In fact, there is also considerable concern for improved teaching in higher education. The universities are going to have to become concerned with producing and evaluating a quality product. Since 1945 we have been preoccupied with quantitative problems in the undergraduate program. Qualitative problems are now becoming *a la mode*.

Accreditation

A distinction should be made between regional and professional accreditation groups. Regional commissions, of which there are seven, accredit entire institutions. Professional accrediting bodies are concerned with only the college, school, or selected programs such as education. It is possible for a university to be regionally accredited while its college of education fails to receive professional approval and vice versa.

The American Association of Colleges for Teacher Education (AACTE), while no longer an official accrediting agency, has been a significant factor in shaping teacher education. Even now, according to the constitution of the National Council for Accreditation of Teacher Education (NCATE), the AACTE develops and conducts a program of evaluation of standards and development of new and revised standards. AACTE also provides financial support for NCATE which was formed in 1954.

Heilman (1963, p. 93) felt that by 1963 NCATE had already shown an impact on state certification, with twenty-nine states accepting NCATE evaluation of credentials for reciprocity agreements.

In the early years, manual training was actually excluded from accreditation standards. Now, as the industrial arts education baccalaureate programs parallel other teaching programs in the general and professional phases, we work within frameworks approved and influenced by NCATE and AACTE. It should be noted that the AACTE has a record of promoting innovation and recognizing excellence. It is not an association that perpetuates mediocrity through minimal and static standards. Industrial arts programs for the Seventies and beyond can benefit from the encouragement of this group.

In reviewing two recent American Association of Colleges for Teacher Education (1967, 1969) documents on standards and evaluation criteria, directions and trends in accreditation can be discerned. First, a latitude of design and innovation is encouraged. Second, there is an emphasis of quality in the art of teaching, and third, a concern is manifested for evaluating this performance and providing feedback in a systematic manner.

Professional Associations

One of the most obvious influences of professional groups upon the character and evolution of baccalaureate programs is the clearing house and dissemination function. Through annual meetings, committee interaction, and journal publications, an interchange of ideas provides a fertile atmosphere for change.

To elaborate upon the impact of the American Council on Industrial Arts Teacher Education and the contributions of its Yearbooks would be a superfluous exercise in this chapter. A companion group also sponsored by the American Industrial Arts Association (AIAA), is the American Council of Industrial Arts Supervisors. Since 1950 and 1951, respectively, these two groups have been the most influential arms of the AIAA in formally or informally affecting teacher education. In 1939, when

AIAA was formed, the status of undergraduate programs was a major issue. The profession acted in some cases to see that inadequate programs were discontinued.

The complexities of accreditation and certification today call for professional groups to use sophisticated techniques in shaping the nature of programs and evaluating their relevance.

Epsilon Pi Tau as an honorary fraternity has also contributed to the upgrading of programs through techniques of focusing attention upon national issues and a quest for excellence. Recognition of leaders within the undergraduate program is a source of internal growth.

The Mississippi Valley Conference has always held the improvement of higher education programs as a prime responsibility. In the early years it was a singular power. According to Barlow 1967) "The National Association of Industrial Teacher Educators . . . also had a stimulating effect upon the improvement of industrial arts teacher education (p. 206)." The influence of groups such as these is difficult to measure and the contributions of individuals who hold memberships in several of these groups makes assessment more difficult, although it suggests the importance of the association. It is even more difficult to predict the role of these groups in the future. One has only to asks: What would be the nature of a complete program in industrial arts if such professional associations and fraternities, and their clearing house functions, did not exist?

The Industrial Arts Division of the American Vocational Association has made significant contributions through its publications, the most recent being *A Guide to Improving Instruction in Industrial Arts* (1968).

A national group with an increasing influence upon the character of teacher education is the National Commission on Teacher Education and Professional Standards (NCTEPS or TEPS). This is an agency of the National Education Association. Since industrial arts is in the mainstream of education, the similarities between programs for industrial arts teachers and teachers of the other disciplines far outweigh the specialized differences (largely content). Therefore, the framework and recommendations established by such groups need to be considered else we succumb to the pitfalls of dichotomous structures.

Research

The dissemination of research findings should certainly be a prime contribution to the nature of a program. Industrial arts has a historical record paralleling most of education in this field.

Research in the years before World War II had severe limitations. It was primarily brief individual studies, perhaps due to the nature of the graduate theses from which they originated. This research was usually funded by the thinly stretched pocketbook of the graduate student. In some cases, there were outstanding contributions by groups of graduate students in seminars or classes where the professor provided the continuity of leadership. There were status studies, recommendations, and some professional books appearing in this era. Barlow (1967) reviews several studies with the conclusion that they at least provided some direction toward improvement.

The late 1950's and early 1960's saw an upturn in the number of research studies. In this era our profession witnessed a predominance of survey-type studies as compared to experimental studies. Little evidence of impact from research results on the nature of teacher education programs exists. This does not mean that research has made no contribution. Cyphert and Spaights (1964) claim that "research might have very little impact on teacher education programs nationally or regionally, and at the same time have considerable influence upon practice at one institution (p. 295)." In the same source (p. 154), L. D. Haskins states that a natural effect of research is to stimulate further research. Change in practice only results as a cumulative effect over a considerable span of time.

Cyphert and Spaights (1964, p. 298) claim more research was produced in education during 1958-1963 than in all previous years combined. They attribute this to two factors: (1) university emphasis on research as a criterion for promotion, and (2) increased availability of funds.

Streichler's (1966) *Review and Synthesis of Research in Industrial Arts* covers a comparable period, essentially 1960-66. Although critical of the status of research, the impact upon practice, and low standards observed in some instances for the period covered, Streichler observes improvement in quality in the following ways: (1) more research conducted within a framework of theory, (2) team research in the testing of theories, and (3) evidence of adoption of refinements in research standards and techniques. Streichler also foresaw the influence of major curriculum studies then underway.

Major curriculum projects have indeed provided a new mold for teacher education programs at institutions conducting such research. The Industrial Arts Curriculum Project at The Ohio State University and the American Industry Project at Stout State University are cases in point. The teacher education programs at these institutions have been designed for implementation of particular curricula as well as for effective classroom performance. This is an example of the structure of research projects having more impact than the actual results of educational research. At the risk of over-generalization, it appears that industrial arts has modified its teacher education programs to a far greater extent as a result of curriculum research than as a result of any other type of research. This represents the "state of the art" in education today.

SOME PROGNOSTICATIONS

The sport of crystal ball gazing is particularly dangerous when one makes his predictions on the printed page. Nevertheless, this writer is willing to make the following prognostications:

1. Variations from the four-year undergraduate program in terms of length will be influenced only by the scarcity of teachers and the acceptance of differentiated staffing.
2. Programs will cooperate and actually form partnerships with public schools on a magnified scale in field, observational, and clinical experiences in the professional sequence.
3. General education requirements will be liberalized in the total program, mainly through student pressures and relaxing of accreditation in spelling out specific courses.
4. State certification pressures upon undergraduate programs will ease in deference to the integrity of the institution and the standards of professional associations. This will accelerate reciprocity between states.
5. Research of greatest importance to industrial arts teacher education will fall into two main categories: (a) curriculum research done primarily under the di-

rection of industrial arts educators and (b) experimental research focused upon identifying teacher practices that are consistently effective. This second category will probably be answered by interdisciplinary research projects. From this we will see longitudinal studies within various disciplines exploring a variety of systems to guarantee a competent entry-level teacher.

6. Innovations, variations, and adaptations will characterize the majority of teacher education programs in the Seventies and beyond. Programs are likely to look less alike in their specific course configurations but may become more similar in terms of their objectives and the means used to attain the objectives.

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CHAPTER THREE

Technological Dimensions of Content and Method

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Technology: industrial science; the science or systematic knowledge of the industrial arts, . . . any practical art utilizing scientific knowledge, . . . applied science contrasted with pure science (*Webster's New International Dictionary*, 2nd Ed., 1960, p. 2590.

This chapter is concerned (1) with interpreting the general term *technology* and the more specific term *industrial technology* and (2) with exploring the relationships which these terms have had or may have in the future with educational processes and instructional phases involved in industrial arts.

THE MEANING OF TECHNOLOGY

The word *technology* has many shades of meanings. It denotes the fragmented parts as well as the generalized whole of the concept. Interpretations so widespread and inflated become ambiguous and lead to confusion. Skolimowski (1968) calls it an "extraordinarily complex phenomenon whose dimensions and parameters cannot be clearly defined nor understood without careful analysis (p. 426)." The word technology is used to refer to very simple and restricted activities, such as the technology of driving nails; or it may be generalized to encompass all of the history of man's struggle to actively control and change the physical environment. That technology was born of man partially explains its complexity since it springs from his interests and works. It is the manifestation of the inner spirit of man, or at least of certain men throughout history to the present. It reveals an inner drive to improve upon those conditions which exist at a particular time.

When man found a need for forces larger than could be produced by his own muscles, he started the long journey from the primitive use of the hammer to today's machinery whose forces may be measured in finite and precise ways. This story has been duplicated in each of the areas where man's senses or abilities were not equal to the requirements for successful competition of the goal he set for himself. In this way he has extended not only his knowledge about, but also his ability to control his material environment.

In contrast to the brilliant advances in the control of his material environment are the problems yet to be solved within his social environment. The frustrations accompanying these latter make the former seem like child's play. Yet, like man, technology must obey the natural laws discovered and defined by scientific methods. Technology seems to have attained the power of self-regeneration. It propagates itself by the stimulation it develops in man through opening the doors to knowledge and understanding and providing the power to achieve. It is not only the path by which man's accomplishment is fulfilled but also the means and ways by which his new dreams are dreamed and his new goals set.

Kranzberg (1964) has emphasized this complex, all-inclusive aspect of technology in his statement that "the story of how man has utilized technology in order to master his environment is part of the great drama of man fighting against the unknown . . . . (p. 2)." What is not known, it is worth noting, is expanding at about the same rate as that which is known.

It is necessary to analyze, separate, and categorize knowledge for understanding, but in this process also lies the inherent danger of obscuring and hiding future effects which such knowledge may have upon other phases of life and the environment. Recent events, such as the growing concern over pollution from wastes, have publicized man's inability to accurately foretell the impact of his new inventions upon himself and the world he lives with. So today certain areas of technology are beginning to be minutely examined for their effects upon the environment and man. Many phases of these events may possibly unfold as they progress to illustrate how dynamic and powerful the interaction may be between specific technologies and the expansion of man's intellectual powers to cope with their problems. As expanding relationships with other societal institutions add to the complexity of technology, so they also emphasize for the educator the need for awareness of his social responsibility for technology within those fields of study that deal with technology.

CERTAIN GENERAL CHARACTERISTICS OF INDUSTRIAL TECHNOLOGY

Technology emerged from the primitive survival needs of man. From this has developed an accumulation of knowledge which today has been formalized into the study of materials, processes, tools, and machinery that produce the artifacts to satisfy these basic needs. This is the physical or hardware aspect of technology. The organizational pattern of the crafts which industrial arts has followed until recently has its roots in this early history.

There are differences of opinion expressed in the literature concerning man's relationship to and his future control of technology. Forbes gives more importance to the influence of technology than is conveyed by merely saying that it results from man's activity. He believes it "partakes more and more of the nature of man" and reveals man's innate desire to shape his life according to his own choices (Forbes, 1968, p. 98). Technology, he contends, has no "internal dynamism" of its own. Rather, technology develops and changes as a result of earlier imperfections or because of "impulses from outside technology," but this does not insure the survival of all achievements. It seems that Forbes is trying to caution those who would elevate technology to the status of a "golden calf." Many of the technologies have been advanced to degrees of sophistication which have obscured them to the great majority of people with almost the same impenetrable cloak that surrounded medieval witchcraft. There is always the possibility that man may become lost in the mysteries of technology. This presents an ever-increasing challenge to education to maintain the sanctity of human values and the rights of man to enjoy the fruits of his labors.

While Forbes would place man in control over technology, there are others, such as Ellul, who believe the methods developed to insure the continuity of the system of modern technique have become self-directing. Ellul says that man's role is that of a "device for recording effects and results obtained by various techniques," and that he must make his decisions by using a scale based only on the criterion of efficiency (Ellul, 1964, p. 449). Trends in some industries support this contention that man's role is an act that could be done equally well or better by a machine.

These differences may continue to be philosophical questions arguable from now on. However, the criterion of efficiency will probably continue to dominate evaluation techniques applied to technology regardless of what means are used in the early stages of decision-making. Even though the tools developed to aid his judgment become very sophisticated, it will be man's wisdom that will always be tested and evaluated by the results of these decisions. Perhaps in this element of control there is a relationship between technology and man that has direct implications upon both the selection of content material and the way it is used in the educational process.

Other general characteristics of the newer technologies concern changes in the economic, managerial, and social areas of an industrial society. Galbraith, in his definition of technology, emphasizes the division of a practical task into its subordinate parts as an important method of attack upon new problems. The refinement of this concept has been an important factor contributing to the success of American industry (Galbraith, 1967, p. 12). Venn notes that while change has always been a significant aspect of technology, it is the rate at which change takes place that has become relatively more important than the certainty that the change would eventually occur. He attributes the present exponential rate of change to the scientific activity of the past decades (Venn, 1964, p. 3).

These recent achievements have led man to believe in the unlimited quality of his ability to solve insurmountable problems. Cetron (1967) discusses this characteristic of certainty and predicts that some of man's problems will be solved by scientific breakthroughs during the next few centuries. This technological optimism is explained by Ellul's second law, which he calls self-augmentation (Ellul, 1964). It is the technique of solving problems by systematic concentration of the efforts of the anonymous many in contrast to discovery or invention by the single man of genius. Efforts such as the atomic Manhattan Project, the concerted work to find a cure for cancer, the NASA space program, and the presidential and Congressional pronouncements and budgetary considerations concerning air and water pollution are examples of the performance and importance given to this method of researching for practical solutions. With the proper mixture of time, money, and dedicated men, today's impossibility becomes tomorrow's reality.

This analysis of the picture of technology has so far only painted the line, space, and color onto the canvas, producing a rather sordid, flat, uninspiring picture of the past. The spark of life, a hope of the future, is lacking and is needed before technology will be accorded a role of lasting importance in shaping the destiny of man. Olson (1963), with the finesse of an artist, adds the touch that is needed to give the warmth and brilliance that makes for the permanence of a masterpiece when he states, "The primary role of the technology is seen as man's means to liberating his fellowman from the shackles of poverty, ignorance, drudgery, sickness, superstition, danger, fear, and in so doing freeing him for living on a higher plane (p. 57)." He continues by defining technology as "the material culture" which will reveal the "meaning and purpose in living," and trigger the release of his energies and efforts to seek the summit of human excellence (Olson, 1963, pp. 58-59).

DIMENSIONS FOR INDUSTRIAL ARTS CONTENT EMERGING FROM THE NEW TECHNOLOGIES

Until recently there was general acceptance that industrial arts subject matter ought to be selected from the techniques and supporting energy systems man has developed from the production of material objects. This content, coming from many technologies, has been sifted into courses of study from the categories of (1) production operations and supporting techniques and skills, (2) tools and machines, (3) control systems, (4) energy systems, and (5) methods of measurement. This technical subject matter has existed in a variety of organizational patterns and has been given varying degrees of emphasis as the philosophical thought of the period dictated. Research is expanding this technical dimension with new synthetic materials, as well as continually reconstructing older materials. The time is fast approaching, if indeed it has not already arrived, when an acceptable representation of the general classes of materials, or "families" will, of necessity, be reduced to a relatively few types. Improvement in the quality of a material and matching it to the performance requirements of the product seem to be industrial practices in line with the objective of change for increased efficiency. This produces volumes of technical knowledge whose mass defies common methods of information retrieval without considering the teacher's need for selection and assimilation. However, the expanding technology increasingly will force the refinement of the selected representative content of industrial arts. The acceleration of technological change is continually reducing the period of time that any specific knowledge can be expected to remain valid. How fast specific content becomes useless not only necessitates the sifting and weeding out of subject matter, but also becomes an economic problem directly affecting the type, form, and completeness of the communications media to be used in the classroom.

THE DIMENSION OF INITIAL PERFORMANCE LEVEL REQUIREMENTS FOR EMPLOYMENT

The influences resulting from automation are changing the role of the worker in the production system. He is being further and further removed from the direct control of the machine or process by control systems, which are far more efficient and discriminating than man. Jobs for the unskilled and untrained are diminishing in industry. Thus, entry into industrial employment requires more knowledge and a higher level of performance for greater numbers of beginning workers than has been the case in the past. Pressures to provide the programs that will make the high school graduate employable are increasing on the educational system from many sources. This apparent dilemma of knowledge-level requirements for employment matched against a time table which is being increasingly squeezed promotes a more thorough search for relevant subject matter in all areas of teaching. The nature of industrial arts activities of the future may be very different from those of the present as the relentless limitations of time dictate with increasing emphasis.

EDUCATIONAL TECHNOLOGY

The technology which has developed to produce the material culture as it is known and enjoyed today throughout the world is chronicled and stored within the communications media. The story of the printed word, together with all graphics, is an example of the interdependence of all the technologies. Communications may be likened to the life blood of progress. The relationship of man to his material environment is a vital part of the story of civilization which has been selected for transmittal through organized instruction. The problem becomes one of determining how best to transmit and use the selected material to produce the desirable outcomes, behavior changes, and attitudes.

The history of pedagogy contains many experiments and approaches to the methodology of teaching. The search has been to develop the most efficient method of instruction, one with a high percentage of predictable success. Industrial technology has reached its present level of success through the development of certain methods and systems such as mass production, quality control, research and development, and others. As these techniques of production and decision-making have become more refined, the predictability of achievement has risen. Successful practices have always been examined to find the key to the venture and such influence is a natural development in education under the name of "educational technology."

After the recent period of developing a mechanized educational system, the trend now is to strip away the devices, the machines, and the hardware, each of which has had its try-out in recent experiments. The goal now is to structure a process of educational operations and activities "designed to systematically produce a reproducible effect (Komoski, 1969, p. 74)."

The influence of the mechanization and mass-producing techniques of industrial technology upon all institutions, including education, has not escaped its opponents. Some writers have expressed a concern that the effect of this influence may be dehumanizing if it is applied to the educational process. Silvern (1968) is one of a number of educators who have countered this fear with the thought that "education . . . is simply part of an information flow in an informational channel; it is information processing in which many or most or all the elements are humans; it is the acquisition, identification, analysis, sorting, storage, retrieval, and transmission of information between teachers and learners . . . (so) that the most efficient and effective method of information processing is sought in each learning situation

(p. 20)." For some readers, this view of education may appear to be a cold, dictatorial means of indoctrination that raises the fear of which power structure will control the selection of the information.

Mager (1968) suggests a definition of education based upon examining the student outcomes that a teacher may hope will result from his efforts. His statements indicating the areas which formal instruction may influence in terms of student changes are that the student should:

> Know more than he knew before,
> Understand something he did not understand before,
> Develop a skill that was not developed before,
> Fee differently about a subject than he felt before, or
> Develop an appreciation for something where there was none before (p. 8).

Today, successful achievements in industrial technology result from careful planning. This must be based upon research in all areas involved with the production, marketing, and consumer reaction to the product or service expected. The industrial complex which has given the highest standard of living to our society has also developed a profound faith in the methods which it used to achieve these levels. Instructional systems are products reaching the market today. The necessity for clarification of all elements of instructional systems by whatever means necessary is the lesson which industry offers to education as the road to success. Komoski (1969, p. 72) describes it as an indigenous technology within education built on a working knowledge of human learning. The Aerospace Education Foundation (1968) relates this lesson to education as follows:

> An instructional system is designed by first identifying the student entry-behavior capability, the desired terminal behavior and the change that must be produced. All presentations are then designed to produce those changes. Finally, the relevant sets of media, methods, response modes, and instructional interactions are developed and validated. This is not to say that there is only one best medium for any objective; sometimes this is true but not always (p. 149).

Komoski (1969) notes that the early concept of technology meant the "techniques for logically arranging things, activities or functions in ways that could be systematically observed, understood and transmitted . . . (p. 74)." The question is: Can this concept which has been so closely associated with the machine-world of industry be made to apply to the educational process?

Heinrich (1968) believes it does apply. He says "As technology applies to instruction . . . any move toward analysis of curriculum into specific objectives and then devising means of achieving them is a step in direction of technology (p. 4)." However, those elements which may eventually become part of an indigenous technology of education will have been tested and proven to be effective (Ely, 1968, p. 7).

Chase (1970) says that "the concept of large-scale research and development as a systematic approach to the attainment of educational goals is relatively new (p. 299)," and that practical results are in the early stages. The United States Office of Education is financing fifteen regional laboratories, nine university-sponsored R&D centers, and several other agencies whose aim is "production of improved instructional materials and other products for schools (Chase, 1970, p. 299)." Among these agencies started within the past five years are two centers for vocational and technical education. Informed observers are encouraged that these agencies are guided by sound goals that will produce significant gains in the quality of education. Improvements that will come from these centers in the future may be attributed largely to their recognition that a fragmented approach to the complex process of learning will never produce lasting results. According to Chase (1970), movements to improve the process of learning will be spearheaded toward all factors that influence the educational problem.

SUMMARY

The general education approach to the study of the technological phases of industrial development is relatively new in comparison to the history of other subject fields represented in the public schools. This time element along with the fact that industrial arts must relate to and change with the dynamic results of industrial technology has caused its history to be top-heavy with concern about what subject matter should be taught. This emphasis would indicate that industrial arts development may be subject to the weaknesses resulting from what the educational technologist terms the fragmented approach. The laboratory method of involving the learner within a real situation, which has been an inherent part of industrial arts since its beginning, has tended to minimize such weaknesses in the area of methodology but this may not be true for the future since the realness of industry is becoming more difficult if not impossible to synthesize within the school environment.

It was stated before that the lesson in successful achievement which educational technologists can learn from industry is the clear understanding of goals and the means for their attainment. Goals, defined as an individual's educational achievement in harmony with his ability in a democratic system, are complex in origin and dynamic in continuity. It is, of course, this complexity of the end product of the educational system that seemingly sets the educator's role apart from that of the industrialist, yet this in no way reduces the importance of analysis and clarity of the understanding of goals.

What are the technological dimensions of content and method in industrial arts? This is a question that must be met with a constantly changing answer. Effective answers will result only from a massive, concerted and continuing effort supported by sufficient time, money, and the allegiance of the educators and practitioners of our profession. Such an attack does not seem so remote today since the organizational patterns have been tested by educational ventures in other fields. When it will start awaits the voice of leadership.

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CHAPTER FOUR

Theoretical Bases of Content

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The wants and the desires of a particular time and its society are reflected in its schools. Society in its entirety, however, is not articulate (Venable, 1958, p. 52). As a whole, it cannot give action specific expression to its wants and its desires. The aims of education must come from some articulate person or group . . . often the teacher.

Serious minded industrial education teachers have, within recent years, taken serious steps to develop, experiment with, and to publicize various innovative programs calculated not only to provide more adequate and accurate presentation of the industrial aspects of society, but also to provide a hopefully relevant education and to permit the learner personally to discover "the joy, excitement, and mystery of the world we live in (Carson, 1965, p. 4)." The inherent contemporary approaches that seem to mark these innovative programs have lately been categorized as the problem solving approach, the research and experimentation approach, the creativity and design approach, the functions of industry approach, and the conceptual approach (Nelson & Sargent, 1967, pp. 18-25). A number of reports of particular individual programs involved have variously appeared in issues of *Industrial Arts and Vocational Magazine, The Journal of Industrial Arts Education, School Shop,* and the *AIAA Convention Proceedings.* A serious and detailed study of a selected number of the innovative programs was accomplished by Cochran (1968) as a doctoral study. More recently, the study was made public via the publication entitled *Innovative Programs in Industrial Education* (Cochran, 1970).

The dynamic and progressive character of modernization increasingly makes doing business with only the same old goods at the same old stand less a practicality than a characterless convention. Within recent years, new insights in education have called for a new picture of knowledge (McLuhan, 1963, pp. 57-70), and penetrating analyses of desirable human skills have suggested new content priorities in the curriculum (Berman, 1968, pp. 1-12). For industrial arts, the earlier constraint of the practitioner and the technologist must stand ready to be complemented with interpretations broad enough to encompass the diverse outlooks of the researcher and the scholar (Scheffler, 1966, p. 31). As a school subject, "industrial arts must stand the test, be measured by the same standard as any other . . . school subject (Russell & Bonser, 1914, p. 23)." Few can deny the fundamental position which content must posit for itself if industrial arts is to serve adequately as one acceptable discipline within the planned curriculum of the modern school.

It is often held that the universals serve as the heart of a culture and at the heart of universals are the values, the rules by which a people order their social existence (Smith, Stanley, & Shores, 1957, p. 85). School aims, while variously stated, invariably are stated as if the school and its curriculum ought to accomplish designated ends. Aims, so stated, are statements of value judgment. Once recognized and accepted, aims necessitate selection of such curricular means as will ensure their attainment.

While "concerned with excellence, maximum self realization, and the achievement of a rational man in our time (Anderson, Macdonald, & May, 1965, p. 70)," as more specific goals to accomplish, secondary school curriculums in general have been guided by aims relevant to the needs of society as well as the individual (Venable, 1958, p. 17). Where both are concerned, the rational powers of the human mind have served basically to further personal and social effectiveness. Their development has long served as the central purpose of the school:

> The purpose which runs through and strengthens all other educational purposes - the common thread of education - is the development of the ability to think. This is the central purpose to which the school must be oriented if it is to accomplish either its traditional task or those newly accented by recent changes in the world. To say it is central is not to say that it is the sole purpose, but that it must be a persuasive concern in the work of the school (NEA, 1961, pp. 11-12).

Appreciated is the fact that "intellectual rigor, consists in the ability of the student to handle logical operations with the marked precision in any domain of information with which he may be required to deal (Broudy, Smith, & Burnett, 1965, p. 120)." In consequence, serious attention must be reserved for the strategic determinants of the curriculum if the educational content is to do more than only accidentally engender the ability to think clearly and consistently.

In the comprehensive study, *A Rationale and Structure for Industrial Arts Subject Matter,* Towers, Lux, and Ray (1966, pp. 3-22) note that statements for the goals of education are primarily directed to the arts, sciences, and the humanities and rarely can be related to any school program based upon praxiological disciplines. While it has generally been taken for granted in educational thinking that it is the applicative use of knowledge that justifies schooling in general, many believe that "the fruitfulness of the applied disciplines is in proportion to the consonance with the structures of knowledge as revealed in the pure cognitive disciplines (Broudy, *et. al.,* 1965, p. 51)." As such, it would seem that application of any applied discipline stands dependent on and is derived from those fundamental disciplines having primary regard for cognition. In such thinking it follows, further, that use is essentially a "corollary of learning."

For most, general education continues to direct its efforts to the building of cognitive and evaluative maps. In the effort, knowledge is used associatively (only on occasions interpretatively) and in ways to be repeated and applied. While replicative and applicative ends, especially the latter, are more readily associated with conventional industrial arts programs, industrial arts increasingly has come to appreciate a responsibility for contributing to an understanding of the technical processes underlying the culture and the subtle meaning of technology for society generally. Such understandings are less an overt skill to be practiced than a perspective to be acquired. For such ends the use of knowledge about technology must be recognized as interpretative rather than either replicative or applicative.

The applicative use of schooling, however, cannot be denied. Technology by its very definition suggests application. While interpretative knowledge proves elemental in some areas of technology, neither it nor replicative knowledge will satisfy in those moments of our technological civilization that depend on the application of knowledge to particular, unstructured, and open problems of utilization. In such instances, applicative knowledge involves much less general recall than it does problem solving. As such, it becomes a serious contributor to knowledge which, in turn, may be used either interpretatively or replicatively.

How best to organize the curriculum has long been a moot point. To insure access to multidimensional knowledge, curriculum builders have drawn knowledge from broad and varied realms. The importance of each knowledge is recognizable. The interrelationships of these realms of knowledge are also revealed when the sources of curriculums are presented clearly in chart form as, for example, that presented by Shoemaker (1955, p. 114) in wheel form and representative of discursive and non-discursive symbolization as approaches in fact and feeling to five aspects of human experience: creative imagination, space, time, memory, and power (Miel, 1963, p. 91). Such awareness suggests the problem of selectivity and weight.

Whether to pursue a problem-centered or discipline-centered curriculum is a complex decision. Eventual dissatisfaction with the subject-centered curriculum encouraged a period of fusion-course innovations calculated to help the young integrate and apply knowledge from various fields. While separateness is once more in the ascendency, the move is being "tempered with recollections" of the point reasoned so well by Lynd three decades ago; namely, the problems of a modern society cannot be solved by specialists in any one discipline (Lynd, 1939). The case for having both ways — problem-centered and discipline-centered — has been ably presented in recent years by several authors including Bellack (1956, pp. 104-112) and Foshay (1962, p. 71). Arguments can be advanced in favor of one or the other or the two combined without compromise.

However, for someone bent on improving the contribution of those in higher education, selecting the content for the curriculum brings concern over how best to get from the findings of experimental work and the theories they generate to content, and what serves as determinant for selecting this or that as content, for taking one road or another. Such determinants as philosophy, psychology, structure, and apparent need and relevance, as well as the subject matter *per se*, must serve the teacher educator as criteria or theoretical bases for selecting elements of content.

PHILOSOPHICAL DETERMINANTS

The basic thesis of a certain philosophy establishes ultimates for the teacher. These provide a parameter suggestive of direction (educational) and, in consequence, serious elements of influence in content selection. For example, the realization of self is a continuous process that begins with the birth of the individual. While the awareness of our own consciousness is a universal experience among human beings, for the idealists it is the most significant fact of individual experience (Neisser, 1967, p. 125). For him, awareness of self serves "as the irreducible element in the experience of every man (Wingo, 1965, p. 125)." For the idealist, mind is essential to the priority of consciousness. It follows then that mind is ultimate in the most inner world of experience. Accordingly, that which must be considered to be ultimate in the whole universe must be the nature of the mind or the spirit. Therefore, if material things ever do exist, they depend in some way for their existence on mind.

While such beliefs make idealism no friend of all forms of materialism, more important is a second inference which may be drawn from this principle of the priority of consciousness. If mind is essential to consciousness, then so must its powers or functions be essential. Among the more obvious is the capability of rational thought and knowledge. With rationality as one of the powers of the mind and with final reality being the nature of the mind, it follows that reason must be accepted as one of the essentials of the ultimate reality. Thus, the powers of cognition and of logical thought suggest as the goal of education the development of the mind . . . the development of the intellect. For the idealist, whatever content has served man well in developing his mind is considered acceptable content in the school, and transmission of this content is considered the serious mission for the teacher.

The realist shares with the idealist the transmission of the product of man's mind as the purpose in education. He holds that "the purpose of education is the transmission of the essential subject matter, that the art of teaching is the art of transmitting, and that school is a chief agent of cultural conservation (Wingo, 1965, p. 193)." However, what is to be transmitted, for the realist, is that body of truth which generations have created by their intellectual efforts.

For the realist, learning involves knowing the world real . . . as it really is, since the world of things and events and the relation among them is not dependent for its character or existence on its being known. This is the principle of independence. Knowing occurs directly in consciousness and with no such intermediate mental state or construct as the idealist posits. Consciousness, however, is interpreted as a process characterized by the building of certain kinds of relationships between the organism and various parts of the environment. Content in the curriculum is set by experts and is relatively fixed. Facts and skills are important elements, and science and the technological studies are considered essential in any educational program. In contrast, for the idealist curricular standards are set in terms of the ideal, and the goal is to study thoroughly whatever is selected.

Both the idealist's and realist's purpose of education as the perpetuation of tradition and preparation of the immature for adulthood is not so appreciated by the liberal, especially the progressive. Especially important to him is the person's power to grow. "The molding of the native, impulsive behavior of the human being into meaningful patterns of habit is what is meant by education in its broadest sense . . . Education, then, is the continuing process of the reconstruction of experience (Wingo, 1965, p. 233)." While total experience of the individual is sensed as the full contribution to his education, the progressive realizes that of the total, the school can provide only a portion. Accordingly, "the criterion of the value of school education is the extent in which it creates a desire for continued growth and supplies means for making the desire effective in fact (Dewey, 1916, p. 62)." Accordingly, the subject matter lies in its relation to the social entity in which the experience goes on. In addition, the social context provides the conditions necessary for the shared and communicated experiences. The value of the organized subject matter is held to be in its effective, instrumental powers. Modern naturalism and empiricism are evident in progressivism.

Perennialism, on the other hand, is a strong and continuing protest against the pattern of contemporary Western culture, with its science and technology, its industrialism, and its political and educational institutions (Wingo, 1965, p. 308). For the perennialist the major task is to shape man, to guide the evolving dynamism through which man forms himself as a man (Maritain, 1943, p. 1). Becoming a man is what is most important. Since all men have the same nature, the ends to be pursued via education should be the same for all. It follows, then, that the ultimate ends of education are universal. For the perennialist, especially, man is singularly a rational animal, and as such, "the end toward which the intellectual activity of the student tends is that of the development and perfection of the natural powers of intellect that all men possess (Wingo, 1965, p. 330)." The teacher is very important, and teaching is the art of stimulating and directing the activity of the individual's own powers so that they are developed and perfected. The ultimate purpose of education is a liberal education, and the path is a serious study of the liberal arts.

The industrial arts teacher has been quick to call himself an eclectic, where philosophical theses have been involved. Some degree of understanding and a serious appreciation of the several philosophical schools in the final analysis, however, results primarily in having a philosophy occasionally show through where educational directions (end) are concerned. Content is rarely selected without an involvement of end concerns.

PSYCHOLOGICAL DETERMINANTS

Generally speaking, images, meanings, and knowledge are ordinarily characterized as the sum of the person's intellectual content. What role each plays and how each develops is a psychological concern in learning. Each is strongly influenced by content; each is subjected to a process, thinking.

Early American pedagogical thinking found an ally in Herbartian metaphysical psychology. As a theory of learning, Herbartism combined the concepts of physical forces with the concepts of associationism. Herbart believed the soul to be a unit of the physical world and capable of initiating a force. External stimuli produced defensive responses referred to as perceptions. These struggled for a place in human consciousness. Together, as an apperceptive mass, they were believed to function as "some superfactor in soul that accepted new perceptions and assimilated and combined them with the old ones (Wolman, 1960, p. 7)." Accordingly, knowledge already shaped by the learner's experience was instrumental in determining what he was able to learn. Order was important in both the content and its presentation for the Herbartians.

The apperceptive mass found no place in the various and more recent behavioristic psychologies or associational psychologies. For the behaviorist, learning essentially involves conditioning, or responding to a stimulus through a synapse.

> Between the stimulus and the response, nothing of any consequence is thought to exist or take place insofar as learning is concerned. Educationally speaking, the individual responds to a stimulus, practices the response, and receives reinforcement to strengthen the association of the response and the stimulus. In this view, there is no such thing as content of mind, mind being either eliminated entirely or reduced to a system of responses (Broudy, *et al.*, 1965, p. 113).

The more set S-R theories and earlier psychological research have, however, in recent years, been modified by the S-O-R (Stimulus - the Organ - Response) theory of Woodworth and the SS learning theory of Tollman. Woodworth suggested that perceiving is intrinsically reinforced with cognitive connotations that "have adaptive behavior whose successful performance is reinforcing without the operation of either extrinsic drive conditions or extrinsic reward conditions (Marx & Hillix, 1963, p. 101)." Tollman set forth a cognitive type of learning theory that postulates association, order, and structure in what is learned. Behaviorism, in general, is thought in no way to influence subsequent learning.

A third kind of psychological thinking, gestalt, finds its base in the whole organism and its environs. It is the preexisting whole which is important. The appearance of any part depends on the whole in which it is embedded. In consequence, "in terms of information processing the whole is prior to its part (Neisser, 1967, p. 91)." Here, responses are not mere products of the stimuli, but really depend upon some factor within the mind of the subject. The uniting factor which serves to combine the separate elements into one whole is called gestalt: a structured form, a shape. While not the transcendental factor proposed by Kant, gestalt nevertheless presupposes more of a teleological phenomenon for learning than do any of the other psychologies. Learning seems to be interpreted as an:

> improvement in gestalt; the learned figures become more symmetric, better organized, in accordance with the law of Pragnauz (Wolman, 1960, p. 438), . . . the goal-directed tendency to restore the subject's former equilibrium. The learning process involves structure and restructure. The element to be learned exists in its own whole. Its acceptance or rejection lies contingent on a prior existing structure or field within the subject. Acceptance of the problem solved in turn restructures the perceptual field (Marx & Hillix, 1963, p. 188).

For many, however, that a whole is something more than its part continues to be an inference. Allport (1955, p. 143) says that such rationales as the whole being more than its parts are probably derived from the striking differences in the phenomenology when the parts act alone. There seems, nevertheless, a noticeable wholeness — distinct from the parts — when the parts function or serve together. Thus, continuity, motivation, and readiness are important to the gestaltist.

The degree to which any of the above three psychologies will serve and the extent to which one will function as a determinant in content selection will vary with the individual teacher educator. Whenever one functions with rich understanding, it plays a significant role in content consideration.

Where prescriptive values in an educational program are of concern, the behaviorial science view supports the suspended judgment view of man's nature, while the gestaltists harbor the optimistic point of view (Thompson, 1968, pp. 218-224). The first seems preoccupied with the look at and the search for reliable and useful information about antecedent-consequent relationships in nature and in other phenomena. Their "hypothesize-experiment-theorize" cycle is shared by scientists, and a majority of psychologists and educators. For them, "no final decision on the values most favorably related to man's welfare can ever be made, or even conceptualized, because an ever-expanding knowledge and an ever-increasing control over the variables related to man's many roles in a changing universe brings new problems and the need for different value decisions to each generation (Thompson, 1968, p. 222)."

From another point of view, from the optimistic view of man's nature held by the gestaltist, the educational implications include a directive for more emphasis on "education" (a leading from the learner) with less emphasis on "instruction" (a building into the learner), a more individual experiencing approach to education (Thompson, 1968, p. 220). Suggestive of a contemporary viewpoint in this regard is the belief expressed by Carl Rogers, the American psychologist, that human value directions emerge from the experiencing of the human organism, that one tends to cherish and choose those values which make for his own survival, growth, and development when he is free to choose and exposed to a growth-promoting climate (Rogers, 1964, p. 166).

"Values to guide behavior" continue to be desirable elements for consideration where ends of education are concerned. In *The High School of the Future* they lead the list which includes skills for effective participation, for understanding the cultural heritage, and for making a specialized contribution (Miel, 1969, pp. 51-59).

KNOWLEDGE AND STRUCTURE

With Newton, knowledge was like a star in place, a certain place. So positioned, it suggested fixity and security — as in some predetermined, encompassing, and overall form. From there it was not too great a leap to infer an overall plan, a patterning apparently comprehensible. With Darwin, the note of sureness trembled ever so slightly, and man found himself admitting continual change. With Einstein came a relativity that further eroded the sureness in understanding, the fixed position of a point in either time and place. The inquiry which prompted all three has been fundamental in causing knowledge to grow and grow — into a gigantic world of information seemingly incomprehensible and certainly overwhelming particularly to the young discovering in school. In a world where relativity has become increasingly important, even for grown-ups, modern man feels frustrated as he is faced with a super-abundance of culture and a profusion of related problems. "He is presented with more stimuli than he can possibly cope with and more experimental material than he is able effectively to organize and assimilate (Phenix, 1964b, p. 37)."

Teaching in such a world presents a challenge to the educator. Faced with an explosion of knowledge, no small measure of which can be attributed to the activity of workers within the various disciplines themselves, the continual task at hand involves selecting from the rich resources of authentic knowledge that apparently small practical portion calculated best to serve the student. Conscientious accomplishment in this respect results from an interpretation of the task as a continuing inquiry. Deciding what to teach "must always be dealt with according to the matter of society and the changing needs of each generation (NEA, 1964, p. 7)."

If content selection is to be properly considered by the teacher educator, then he must take into account a third screening parameter: structure. Structure refers to an overall organization. Knowledge can be ordered into systematic categories. Patterns are then discriminable, and these can be organized into a master plan.

In the first place, knowledge can be broken down into elements that in turn can be ordered into categories. Their order is rendered intelligible because the categories are intended to supply relationships. The recognition of patterns or relationships inherent in the content-to-be is knowledge. In general, "to learn anything means to become familiar with its intelligible patterns. Therefore, the structures of thought in the disciplines must be relevant to the learning that takes place in schools. Insofar as learning occurs, it must occur according to the forms of the disciplines (Phenix, 1964a, p. 50)."

One system of structuring knowledge is that ordinarily associated with Auguste Comte. In this scheme, subject matter serves as the basis for classifying disciplines. Throughout, the principle of dependency is primary in the scheme, and the subject matters involved are restricted to those capable of positive investigation. Consequently, only those subject matters based on sense experience can be considered.

The classical list ordinarily includes the disciplines of mathematics, physics, chemistry, biology, and sociology — in that order. Within the group, for Comte, as for many others, mathematics was the queen of the sciences, since it was fundamental as a medium for the invention of structures helpful in continued inquiry as well as a discipline that can abstract and codify "the substantive structures which other sciences have invented ad hoc and have (been) tested in their inquiries (Schwab, 1964, p. 14)."

In the order presented, physics was considered essential for fully understanding chemistry. Chemistry, in turn, was considered necessary for fully understanding biology, and so on. The system, however, admitted the possibility of some deviation from the dogmatic ordering. For example, progress in physics can only go so far without reference to chemistry, and understanding the human sociologically can hardly be done without interweaving organic chemistry, biology, and culture.

A second rationale may serve as a basis in selecting subject matter (disciplines) other than those mentioned above. The disciplines serve only as vehicles for learning a certain way of thinking about knowledge. This second scheme for structuring knowledge has for its basis of classification elements more transcendental, in general, than subject matter. For the organization of the disciplines as encouraged and practiced by Plato, subject matters are meant to be learned by three means — images, hypothetical ideas, real ideas developed in sequence — and helped further by a fourth: pure reason (Schwab, 1964, pp. 15-20). In the early stages, the images and ideas may be associated with individual disciplines. Later, these may span two or more disciplines and serve as a bridge toward unity. Viewed in another sense, the objects of Platonic inquiry are subject matters only when confrontations by them can lead to some degree of union of knowledge if the objects do something to the learner which moves him to do something to or with them: compose them, contrast them with one another, oppose one opinion about them with another, seek exceptions to apparently general rules, and so on. Its effective use leads to one or another of the states of mind given the names conjecture, belief, understanding, and pure reason (Schwab, 1964, pp. 16-17). The educational significance of the Platonic scheme lies in its efforts to solve problems, to form concepts, and to integrate curriculums. Inherent in the system is a concern for a diversity of intellectual competence, an appreciation that different disciplines require different abilities. The system must be categorized as one designed for instrumental learning, although the learner is much more important and the cognitive act is much more appreciated.

A third possible system of structuring knowledge is that attributed to Aristotle. It involves three classes of disciplines: the productive, the practical, and the theoretical. The *productive disciplines* are those concerned with making. Synthesizing is elemental in productive disciplines. Industrial arts, the fine arts, and engineering may fall into this classification. Fundamental, in all these disciplines, is ideation supported by judgment, resulting in overt physical behavior. On the other hand, in the Aristotelian category of *practical disciplines* are included those concerned with deliberate choice, decision, and action. While classical choices within the practical sciences have ordinarily included such disciplines as ethics and politics, other disciplines may be included as well. As a rule, "the deliberate actions with which the practical disciplines are concerned are those undertaken for their own sake — the actions which in themselves constitute a good life (Schwab, 1964, p. 21)." The third category, the *theoretical disciplines*, is made up of those whose aim it is to know. For Aristotle, metaphysics, mathematics, and the natural sciences were in this category. Important in these disciplines is the ability to deal with matters of high abstraction, to organize logically, and to reason inductively.

Aristotle's system is one about which few in industrial arts have customarily rallied. Ostensibly, however, it is a system which affords serious recognition to the sense that cognitive and affective development constitutes only a portion of what education should be. All three classes of disciplines are considered essential to insure the full development of the individual. Whether the school can accomplish the ideal may depend on whether the individual teacher recognizes the place for and contribution of each of the three domains in the scheme of learning.

Other disciplines than those mentioned above have since come to be included among those belonging to the theoretical category. Specific course inclusion may be less important than an awareness that a system of structured recognized knowledge has foundations in at least three categories and that all three are necessary for full educational development. A contemporary system of structured knowledge may be found in the modern taxonomy of knowledge and its recognition of the domains of cognitive, affective, and psychomotor knowledge.

What shall the schools teach continues to be the perennial question in education. Knowledge, changing in breadth and meaning, is the stock-in-trade of the school, and the teacher serves as mediator between it and the learner. His view of the nature of knowledge, derived from whatever source, is fundamental to content choice and organization. In industrial arts, as in other subject matters, the pedagogical order for teaching and learning does well to follow the logical order of the discipline. In addition, it should recognize the determinants in the psychological order of the development of the cognitive powers of the learner. The structure of knowledge, therefore, is not without its psychological aspects and for the teacher educator, structure is incomplete where the logical shows itself unmindful of the psychological.

While the unifying elements of generality, inclusiveness, and explanation mark both logical and psychological structure, apparently the laws of meaningful learning and retention particularly mark psychological organization of knowledge in contrast to such laws of logical classification as typical relatedness and homogeneity. Meaningful content logically accepted is only the meaning it bears for the learner, not its logical meaning. In contrast, "the emergence of psychological meaning depends not only on the learner's possession of the requisite intellectual capacities and ideational background, but also on his particular ideational background . . . Psychological meaning is always an idiosyncratic phenomenon (Ausubel, 1964, p. 22)." A full appreciation of the psychological and logical structure of knowledge, however, cannot be unmindful of the contributive importance of learning sequence, ordering, and the arrangement of contributions. For the teacher who is selecting content, it seems important to appreciate that *a priori* subject matter sophistication, as well as cognitive maturity, tends to account for the organization of internal ideas.

TECHNOLOGY AND MANPOWER NEEDS

In this day few would doubt Sir Peter Medawar when he said that today the world changes so quickly that in growing up we take leave not just of youth but of the world in which we were young (Medawar, 1969, p. 34). To a serious degree, he could have been talking about industrial arts education. As a discipline within the school, it plays host to both society and technology. Technology and society, however, are not discrete elements but complex combinations of institutions, ideas, values, and events (Layton, 1970, p. 24), and all of which are changing continuously. Burlingame (1938) early presented the thesis that technology served a central role in determining history and society. Whether technology causes social change or social change causes technological change continues to be unresolved. While more recent writers acknowledge that technology has social consequence, there seems clear support for thinking that, after all, "the direction in which the society is going determines the nature of its technological innovations (Daniels, 1970, p. 3)."

In earlier years, one's economic opportunity rested primarily with land or those natural resources that could be profitably extracted. In today's society, capital and professional and skilled training are said to be associated predominantly with such opportunity. However, while man seems in position to exercise greater potential collective control over the spread of his activities throughout the land, this distribution is currently determined very largely by decisions of business, government, and foundations (Siegel, 1967, p. 91)." The current activist society has more clearly recognized and interpreted its issues and has sensed itself dedicated to certain kinds of activities. In the years to come, the choice of what national objectives will serve as goals may well center on the issue of priorities. "Rather than the question of which goals to pursue, the problem will involve how much, in what quantitative combinations, and how soon (Lecht, 1968, p. 106)." Currently a number of goals pose themselves as respectable for national consideration as direction determinants. Leonard A. Lecht lists the following major goals as individual goals for 1962 and as inspirational goals for 1975: consumer expenditures, health and education, housing, international aid, national defense, private plant and equipment, research and development, social welfare, transportation, and urban development (Lecht, 1968, p. 107).

When the 1962 goals were contrasted to the estimated ones of 1975, probable areas of continuity suggested themselves, according to Lecht (1968, p. 104). In 1962, the four goals of consumer expenditures, health and education together, private plant and equipment, and urban development were the ones requiring the largest percentage of manpower. The same four are in the same position among the aspirational goals for 1975. The manpower need projected individually for all but consumer expenditures is expected to increase from 90 to 100 percent. This compares with the 44 percent increase anticipated in overall manpower needs for the eleven goals in 1975. Future technological needs, as well as manpower needs, will be consequences of priority goal choices. The manpower growth profiles available in Lecht's study show three categories of occupational growth to be anticipated for 1975: anticipated growth, moderate growth, and low-growth occupation. All three are in turn subdivided into white collar, blue collar, and service occupations. The low-growth occupation category contains a fourth division: farm occupations.

The need to expand college and university facilities to train more engineers, teachers, nurses, physicians, scientists, and social workers is reflected in the growth profiles. The need to provide more quailifed technicians in health occupations, or engineer aides and laboratory assistants, or more workers in the graphic arts is also evident from the study. In addition, the estimates point to a comparable need to enlarge and improve facilities for on-the-job training, in high school vocational education, and for retraining to prepare more persons for careers as data-processing-machine operators; as secretaries and typists; or as excavating, grading, and road machinery operators (Lecht, 1968, pp. 78-79). As occupations change and retraining takes place, general education comes to assume a more significant role. The cognitive, communicative, and social skills will come to be increasingly important for white collar and service occupations.

On the other hand, judgment, reliability, adaptability, and discipline, rather than technical competence, will be more and more valuable as operators of equipment in industry come to be monitors of automatic machinery (Lecht, 1968, p. 10). As the various forms of higher education and secondary education become related to probable manpower needs, content in education can be expected to change. As increased importance of technicians is sensed and as the increase in technical occupations is experienced, the more likely is a shift in emphasis to occur from nontheoretical skill training programs to programs combining basic education with scientific and technical studies (Lecht, 1968, p. 187).

In a society which recognizes its dependence on the many who are talented and trained, particular attention to the process and content which determines the way people acquire competence and skills is of serious consequence; ". . . professional or mechanical training takes 20 or more years and increasingly requires continuing effort to maintain competence throughout the whole of man's career (Ginzberg, 1968, p. 190)."

SUMMARY

The teacher educator must consider, among others, such determinants of 1) philosophy, 2) psychology, 3) structure, and 4) apparent need and relevance when contemplating the theoretical bases of industrial arts content. Without them, rational selection of program elements would be impossible.

On the face of things, the explosions affecting the university in enrollment, in information, and in technology invite a crumbling of gerontocracy and encourage new maps of learning if the university is to be fitted to today's world. Thus, the comprehensive responsibilities of the conscientious university professor grow year by year.

What has preceded in this chapter is recognizably transcendental, in respects (but very important, nevertheless). It is fundamental in selecting elements of content for the teacher educator. What follows in the next two chapters more nearly identifies subject matter content that suggests ways to realize the " . . . excellence and relevance to characteristics of modern technology and contemporary needs of real people with real learning characteristics and real career pattern potentialities (Stadt & Kenneke, 1970, p. 17)" that concerned educators must feel is needed in industrial arts.

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CHAPTER FIVE

Toward Elements of Content

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Although a relatively young educational field, industrial arts has evidenced a continuing concern regarding its content, particularly on the secondary school level. This chapter principally emphasizes those theories and innovations which have helped to define content elements over the years. In this connection, historical and contemporary views regarding content selection criteria, industrial arts as a field of knowledge, and bases for content derived from theory and practice are presented. This exposition should articulate with Chapter Six which discusses other forms of influences upon content and derives a content model for an industrial arts teacher education program.

Today, we in industrial education have a common yet perplexing responsibility: the teaching and dissemination of knowledge about our industrial environment. The rapidity with which new concepts, new technologies, and new elements of knowledge have created new content and new or reorganized bodies of knowledge is the significant challenge of our time. We in education must examine these new forms of information, both in the industrial and educational environments, and we must study their ramifications to determine the effect on our total educational program. The great scientific and technological advances of our time have already had notable impact on and produced many changes in our social, psychological, economic, and industrial lives. The responsibility of expounding this knowledge is ours, and we must meet it "head on" with relevant contributions to the total education of all people, regardless of age, sex, religion, or ethnic background. The challenge, therefore, is here today.

The rapid growth of knowledge, apparent in all areas of education, has caused new areas to emerge and traditional areas to change their content. In addition, new combinations of disciplines are rapidly coming into the picture. Thus, the growth of knowledge due to the technologies has produced new and reorganized content in education. This is evident today in the innovations and experiments in industrial arts educational content.

The purpose of industrial arts, past and present, has been to help children, youth, and adults to understand and use the principles of our industrial technology. This purpose is the guideline of this chapter: to review and identify the theoretical principles underlying the creative curriculums that are emerging from industrial practices today.

An ultimate goal in industrial arts is to develop people who *think:* it is not just to develop skills, projects, static ideas, memorized data, or isolated facts. The basis of all this is content: the teachable knowledge within our discipline. The problem of selecting content is not a matter of choosing discrete units of this knowledge and serving it up in neat packages in an orderly sequence. What is important today in selecting content is its relevance to the needs of the students and teachers and to the technologies of industry and education. Also, since we live in a world of constantly expanding science and technology, we are experiencing change more rapidly each decade. Often, only a matter of months may pass before we discover that what we have just learned is no longer so, and thus we must unlearn it or transform it to fit new knowledge. This, too, initiates change in content.

Industrial arts is that part of one's total education devoted to studies of industry: the elements, organizations, occupations, processes, products, materials, and problems of today's technological industry. *Total* education is: (1) the total development of each student's talents and capacities, and (2) the total development of each student's ability to "go it alone," or to understand education as a process that is continuous long after the formal schooling has been completed.

In selecting content for the study of industrial technology, we must consider the student and the desirable outcomes we expect him to achieve. Each student needs as many opportunities as possible to develop independent study skills and self-responsibility. The student must feel some degree of success and satisfaction in the learning process. Also, in order to be successful, each student must develop an inquiring mind and a talent for effective communication. Education is a process of living — not a preparation for future living. Thus, the school must provide experiences of life — life that is real and vital in the student's social and psychological environments. Selected content for the industrial arts classroom must be relevant to the moment, must occur through experienced forms of living, and must extend the student's awareness of the industrial and technological world around him. Thus, in studying the industrial society he lives in, the student must study science and industrial technology not purely in conceptual forms, but through concrete experiences relevant to life today. Education must be conceived of as a continuing process of constructing experiences: understanding the process of education *is* the goal of education.

Today, an important facet of curriculum organization is the teaching of basic concepts and elements of a discipline so that students will "know how" to progress from knowledge to concrete thinking and to the utilization of more conceptually adequate modes of thought. This can best be accomplished by formal instruction based on points of view consistent with the student's way of thinking, together with relevant application. As in the study of higher mathematics and sciences, the student must be given, at a level that he can understand and apply, concepts and techniques in the discipline that will lead him to inquire, to recognize, to analyze, and to *think.* If he thus becomes self-reliant, he will be far better able to become *totally educated.*

In the act of learning a body of knowledge, the student will encounter three processes almost simultaneously. First, there is the *acquisition* of new information — information that is different or that replaces what he has previously known or believed he knew. Second, there is the *transformation* of information — information that must be changed or rearranged in order to fit new endeavors. Third, there is the *evaluation* of information — information that must be tested in order to determine if it is appropriate to the task (Bruner, 1963, pp. 48-49). However, before the body of knowledge an industrial arts student should be learning is discussed, a brief analysis of the elements and concepts of industrial arts as a body of knowledge is presented.

INDUSTRIAL ARTS: AN INTELLECTUAL BODY OF KNOWLEDGE

Can industrial arts be thought to possess or be an identifiable body of knowledge? DeVore (1964) has thought about this. A body of knowledge, he says, has a past, a tradition, and a history that has evolved and entwined itself in man's development throughout time. It has withstood the test of time; it is accepted by scholars, past and present; and it envisions a future. For purposes of discussion, the premise that industrial arts possesses an identifiable body of knowledge is accepted.

Industrial arts has become accepted as a necessary and contributing study in educating children, youth, and adults. Since it is an identifiable discipline, we must assume at this point that the identifiable content is based on intelligence and understanding, that it involves mental activity, and that it develops through means of instruction. This assumes that the discipline has structure and employs methodology. A structure also is objectively determined; it is durable and meets the challenge of change; it provides for insight; and it is cumulative in nature. There are other qualities, but a body of knowledge has at least one other characteristic: it works from a theoretical base (DeVore, 1964, p. 6). Industrial arts does evolve from a theoretical base. Industrial arts must involve elements, ideas, and concepts, not rules and dogmas. Problem solving, research and development, and experimentation are vehicles for disseminating content or methodology.

Since industrial arts is a body of knowledge, it contains the link between the discipline and man's intellectual, social, emotional, and biological life. Applied mathematics, science, industry, and educational technology serve as the foundation for identifiable content in industrial arts education. Industrial arts is an intellectual body of knowledge.

THE SELECTION OF SUBJECT MATTER

Today, objectives (goals, aims, desired outcomes) are the foundation of the modern school curriculum, and they serve to define and select the content or subject matter of the discipline. Objectives written at the national level are general in nature, and project only the basic needs of youth in relation to society.

Objectives are basically statements of value judgments. The local school district often arrives at its objectives by combining representative ideas and values selected by local teachers and administrators. Such lists of objectives vary enormously in scope, direction, and degrees of specificity, but they generally reflect the more immediate needs of the local youth. Teachers usually derive their objectives for a course from their own value structures and state what they believe are desirable student outcomes. These latter objectives are derived from writings of other educators, and from the teacher's own past experiences with students, knowledge of the field, and competence. The objectives of the course should reflect school, community, and national philosophies. The objectives, in behavioral terms, for any specific course or program must be pertinent and relevant to the current scientific, social, and technological society; and they should at all times determine the goals or outcomes to be accomplished and serve as the bases for evaluation.

The relevant valued objectives or aims determine the principles of subject matter selection. Changes in objectives mean changes in the content. Thus, the ability to select content depends upon the realization of the objectives, and not on traditions, on ignorance, or on vested interests, as it so often has in the past. Teachers selecting content must be aware of the vast reservoir of knowledge in their particular disciplines. They must have the insight into and experience with human behavior so that they "know how" to select relevant content for their students.

Subject matter or content constitutes the knowledge, values, and skills inherent in man's involvement with man. Such subject matter is only a portion of the total culture of man, which also includes his beliefs, ideals, and loyalties. Thus, tools, materials, and processes *are not* subject matter; but the knowledge, skill, and values about the tools, materials, and processes — their concepts, specifications, elements, and uses — *are* subject matter.

Smith, Stanley, and Shores (1957, pp. 131-137) outline five criteria for the selection of content. The first criterion asks whether the content is significant to an organized discipline; the second asks whether it withstands the test of time; the third, whether it is useful; the fourth, whether it is interesting to the learner; and fifth, whether the content contributes to the growth and development of our society.

With these in mind, one may then use four general procedures for choosing content for courses in educational fields. The first, the *judgmental* procedure, requires individual but objective judgments of a skilled curriculum-builder who can utilize input from various specialists, interest groups, and advisory boards in selecting that content most appropriate to the five criteria noted above. The second, the *experimental* procedure, involves the selection of content by actually testing subject matter against a set criterion that uses the typical steps of experimentation. The third, the *analytical* procedure, is probably the best known and most widely used procedure: it consists of an analysis of what people actually do (perform) in order to discover the subject matter existing in the performance of these people. The fourth, the *consensual* procedure, involves collecting opinions from a number of people about their beliefs on what should be (Smith, *et al.*, 1957, pp. 152-167).

The experimenter and innovator, as well as the typical classroom teacher, must have an understanding of these procedures for content selection in the study of industry and its technologies. All of the procedures may be used either individually or collectively in selecting content. All four procedures involve the need for a thorough understanding and knowledge of the subject matter, along with the professional integrity required for the selection of content for courses in our discipline. In the following sections we will explore the development of the bases of content of industrial arts subject matter. Some examples are more relevant than others; some are theoretical, while others are examples of practical application; and some reveal the old and traditional, while others reflect the present, as well as the experimental future.

A REVIEW OF EARLY HISTORICAL STATEMENTS ON BASES OF EDUCATIONAL CONTENT

The earliest civilizations developed knowledges and skills by conscious imitation. One who was skilled was generally accepted as a leader, and the development of skill was emphasized for the benefit of society. Probably the Talmud, the authoritative body of Jewish tradition, best expressed the social value of work in its instruction to "teach him a trade." This idea was also stated in the Babylonian Code of Hammurabi in 2250 B.C. The "ideal" function of education in Greece was defined by Plato in the *Republic* as the preparation of the elite few for the service to the state. It was Aristotle who exemplified the Spartans for making education the "business of the state." This classic doctrine has been echoed for centuries, and by some right up to present times. The overarching objective was to prepare "the citizen" for democracy. Basically, the aim of education remained the same throughout antiquity: to cultivate the intellect and to inculcate patriotism to the state.

During the Middle Ages, the monastic schools formed a retreat and prescribed hours of labor, reading, and worship. The Renaissance broke the religious pattern, but not necessarily the educational ideas, that began in Greece and Rome. The curriculum consisted of the "Seven Liberal Arts." The trade crafts began to develop and became more specialized and differentiated with " a body of mysteries of the crafts." The new breed of educational reformers entered the scene here with revolutionary thoughts and actions. Rabelais advocated the use of objects in the learning process, and Luther emphasized trade training in the home and comprehensive education for all. Comenius and Locke were realists who advocated new theories, organizations, innovations, and curricular changes in content and methodology of education. *Emile*, by Rousseau, marked a change in educational thinking, as the content came from nature and the child became the center of pedagogical inquiry. Pestalozzi's Industrial School Experiment and England's Schools of Industry approach placed new emphasis on teaching practical and applied areas of content. Fellenberg and Birkbeck introduced science and agricultural mechanics into the curriculum. Heusinger utilized the idea of the child's desire for activity; Fowle introduced drawing into the public schools of Boston: Rensselaer provided specialized scientific training at the college level; and Froebel advocated "education for work through work." These few illustrations are examples of the unlimited number of individuals who made notable and significant contributions to the development of the theoretical bases of content and the selection of subject matter elements of industry and education during their time.

Three basic aims of educational content that were expressed or announced by these individuals and that were common in both practice and theory for all ages up to our own times can be identified. First, basic schooling must be a liberal education that will cultivate the individual's capacities for mental growth and moral development. Second, advancement of learning requires scholarship, research, and investigation over and above the regular dissemination of information available in the classroom. Finally, teaching, like any professional schooling, requires continuous study, regardless of degrees earned; and the preparation for teaching must also include specialized or technical education in one's own area of competency, as well as sufficient professional education. These aims are generally agreed upon by most educators and educational theorists and have, through the years, come to represent the basic principles for formulating the desired outcomes, or behavioral changes expected in student performance. Thus, they represent the basic principles for formulating guides to selecting content for the many disciplines in education. They represent the basic principles of educational theory and practice of every epoch before our own.

A REVIEW OF 20TH CENTURY PHILOSOPHIES AND THEORIES PROVIDING GUIDELINES FOR CONTENT SELECTION

A brief review of some thoughts and ideas of a few eminent educational reformers of this century is relevant. The purpose is to review the 20th century reformers' contributions to educational thought, out of which contemporary bases of content in industrial arts have evolved.

Dewey (1899) advocated the use of industrial tools, materials, and activities in all levels of education. In "Psychology of Occupations" from *The School and Society,* Dewey places industrial occupations at the very center of the school curriculum. The activity program, the industrial nature of society, and work as basic social understanding reflect his philosophy and emphasize his theory on content selection. Bertrand Russell (1963, p. 213) stresses three divergent theories of education. The second and third have in common the view that education can provide something positive; while the first, the negative function, considers that the sole purpose of education is to provide opportunities for growth and to remove hampering influences. Basically, no education encompasses or proceeds wholly on any one of these theories, but all three to some degree are probably found in every existing educational system. This suffices, for no one system is complete on its own.

In "The Rhythm of Education" Whitehead (1929) is in the tradition of modern educational reformers from Comenius to Dewey to Gagne and Flanders. Whitehead stresses the importance of exploiting the present moment and state of development. His insistence that education must engender intellectual power, not just inculcate knowledge, and his attention to the learning process of the individual pupil in every case aligns him with the more radical reformers of educational processes. Mead (1958, pp. 164-170) emphasizes that knowledge should not be just disseminated by the "wise old teacher" to the young, but rather the sharing of knowledge by those informed with those uninformed, regardless of age or formal education.

Bruner's principles echo the beliefs of the nineteenth century educational reformers, particularly Pestalozzi and Herbart. His idea of a spiral curriculum (Bruner, 1963, p. 6, pp. 33-54) parallels Comenius' philosophy that throughout his schooling each student should be constantly involved with the same basic subject matter, but at different levels.

What these and a number of other contemporary educational reformers are saying is that the curriculum needs to perform two functions: first, to keep everyone up-to-date in order to cope with the personal and social problems of the day; and second, to challenge the inherent and special competencies of the individual (Trump & Bayham, 1961, pp. 1-13).

THE DEVELOPMENT OF THE BASES OF CONTENT DERIVED FROM INDUSTRY

The American Industrial Revolution is generally recognized to have begun around 1825. American educational awakening also took place at about the same time, although real progress was slow until near the last quarter of the century when the secondary school was beginning to be an integral institution of our cities and towns. A meaningful education for all became the "American Goal." This unique concept made the curriculum of the common school and the academies outmoded for the sons and daughters of the working man. Thus began the rapid movement in education toward a practical and applicable approach and away from the traditional rhetoric approach, although drawing had been introduced into the high school curriculum in many cities a number of decades prior to this time.

With the advent of Della Vos's "innovative" approach to learning a trade, which was quickly adopted in this country by Runkle, Woodward, and others, the "new" approach to content and methodology in teaching elements of industry was born. The content was derived wholly through the extraction of elements of a trade or occupation by a strict analysis process.

Around the turn of the century such prominent educators as Hall, Kilpatrick, and Dewey supported the concepts of the new education. Bonser and Russell advocated their "industrial social theory" in support of the industrial education movement. These leaders of the progressive movement in education, and the many other advocates of manual training for general education purposes, all most significantly contributed to the development of content selection in industrial arts. Basically, content was derived from the industrial tasks that man does with his tools, materials, and processes, but it was child-oriented and child-centered.

A survey of the literature reveals, rather conclusively, the significant influence in content organization of such notable leaders in the field as Bennett, Selvidge, Bawden, Griffith, Proffitt, Mays, and others. The influence of these eminent industrial education leaders has been with us for the past fifty years or so. The predominant method advocated by these men for arriving at content materials for the study of industry was the analysis of occupations, jobs, and industrial operations.

The late 1920's saw the start of highly influential publications by the American Vocational Association (AVA) with its "Standards of Attainment in Industrial Arts Teaching" (1929). This major study on what a boy should be able "to do" and "to know" was reprinted in 1931 and again in 1934.

A new AVA bulletin (1946), "Improving Instruction in Industrial Arts," was completed by Mays, Bawden, and Smith. The significant aspect of this bulletin, besides the change in title, was the revised and widely accepted list of nine objectives of industrial arts. The revision of the "Guide to Improving Instruction in Industrial Arts" (AVA, 1953) significantly changed the format of the earlier bulletins from an emphasis on specifically designated operational units to an emphasis on objectives and student behavior. This revised Guide states that industrial arts should utilize all facets of industry — the tools, materials, and processes — along with science, inventions, and social and economic factors. In 1968, the AVA again revised its Guide. This revision is a major contribution to the field as it presents a totally new approach to the Guide. The format, the educational objectives, and the analysis of what industry is all about all emphasize recent developments and ideas. The Guide's contemporary style is also significantly refreshing. Content in the new Guide is flexible and provides the teaching concepts of today's technology and challenges, without losing sight of the needs of today's students (AVA, 1968). The values in industrial arts are also presented in all of these professional and significant "Standards" and "Guides" published by the American Vocational Association.

One of the earliest writers to suggest changes in the bases of content selection was William E. Warner. In *A Prospectus for Industrial Arts in Ohio* (Ohio, 1934), the emphasis in industrial arts was shifted from in-depth skill development regarding tool operations to the analysis of industry both in depth and breadth in order to understand the elements comprising industrial technology. This new and unique approach to "gaining" content for industrial arts formed the basis for many content revisions in local, state, and national curriculum guides.

In a report to the American Industrial Arts Association, Warner presented selected divisions of industry representing the technology that provide the basis for much contemporary content in industrial arts (Warner, *et al.*, 1947). He states that, at the elementary school level, industrial arts should be a vehicle for integrated activities in the classroom, while at the junior high level, industrial arts education should be breadth-oriented. Warner further stated that at the senior high level industrial arts content should be derived from various specialized areas and should provide a sound basis for a possible industrial-vocational education. He also recommended that, at the college level, the studies and activities in industrial technology must provide a sound basic core program, as well as sound technical training. His statement that the objectives of developing consumer knowledge and recreational activities are most important at later adult levels of life is perhaps more than ever significant today.

From these concepts emerged "a new industrial arts curriculum," which, in its numerous revisions, resulted in significant structural changes of content in industrial arts throughout the country. For example, there emerged Olson's 1957 research, subsequently published in his *Industrial Arts and Technology* (Olson, 1963).

THE ANALYSIS PROCEDURE IN THE CLASSIFICATION OF CURRICULAR PATTERNS OF CONTENT

The process of analyzing some form of knowledge or discipline is one of the four general procedures for selecting subject matter. In industrial arts education, it has probably been the most predominantly used procedure in the past and undoubtedly will continue to be widely used in the future, although it might lose ground to each of the other procedures: *judgmental, experimental,* and *consensual.* Those who object to this process probably do not oppose the "process," but the traditional bases of content for analysis, such as the analysis of trades, manipulative operations, and so on.

Friese (1953) enumerates some of the objections to trade-analysis techniques. He refers to the tendency of the analysis of a trade to close the boundaries of content, thus removing its "freshness." Also, he believes that traditional analysis isn't really adaptable to industrial arts; and perhaps of more importance, its tendency is to curtail student initiative and originality. These reflections have been expressed or implied by many critics of industrial arts in the past and even more so today.

Subject matter should be selected wholly on the criterion that it contributes to the meaning and fulfillment of the objectives of the course expressed in behavioral terms. The one primary purpose of all subject matter is thus to achieve the objectives of the course (Mager, 1962). Wilber (1945) suggests three directions to determining content for industrial arts: the trade-analysis approach, the student-interest approach, and the teacher-interest approach. Fryklund (1965), states that content is derived from an analysis of the essential elements or parts of an occupation or an activity. He further points out that this process is in essence an inventory process of identifying the elements and listing them in sequential order for instructional purposes.

London (1955) suggests four rather different approaches to the process of selecting teachable content. The first of these concerns the basic ideas about individuals and their social involvements that can be used as a basis of content. Second, elements of our educational needs and interest can be used to select what is worthy of being taught. Third, the ideas of "third parties" such as parents, consultants, and employers, can also be used to determine content structure. Fourth, "life activities," in total, can be used to select content that students should learn.

Hornbake (1963) evolves a theoretical structure for industrial arts from three distinct disciplines: sociology, physical science, and behavioral science. Our only responsibility in industrial arts education is to the student: what we teach must be relevant to the present needs of the student in his daily encounter with society. Teaching just skills is not enough, nor is teaching "bigger and better" skills. Our students today possess enormous amounts of talent and enthusiasm which must be tapped. The teacher in the classroom must relate our scientific and technological environment to these students. The "art and science" of teaching, including the appropriate or "needed" knowledge, is the prime factor for the fullest development of our students. Bollinger (1956) states that more curricular content stress be emphasized from the areas of mathematics and physical sciences, along with an extensive investigation of our industrial materials and processes, even at the expense of some traditional manipulative skills in some areas.

Olson (1963) classifies all content into the eight categories of industry: "manufacturing, construction, power, transportation, electronics, research, services, and management (p. 95)." He also classified knowledge by forces which shape the curriculum: "the changing economic, social, political, and cultural aspects of living (p. 20)"; and by the functions which the new industrial arts education can serve: technical, occupational, consumer, recreational, cultural and social.

In *Technology: An Intellectual Discipline,* DeVore (1964) subscribes to the tenet that technology and applied sciences are the foundations of our industrial arts programs. Man's undertakings and accomplishments have been classified according to the men who have performed them: builders, communicators, producers, transporters, developers, administrators, and craftsmen. Thus it is possible to identify content for industrial arts based on the craft or trade approach, the production elements of industry, or the foundational, technical, and cultural elements of man and his technology.

CONTEMPORARY PLANS OR SYSTEMS: THEORETICAL BASES OF CONTENT

In recent years, several persons have undertaken the classification of curricular patterns for deriving instructional content. The "arrangements" and conclusions that evolve from the identification of content constitute the body of knowledge of industrial arts. Swanson (1965) states that proposals and practices for deriving content are divided into four groups: (1) the needs created by the technological advances; (2) the trades, processes, materials, and products; (3) the application of mathematical and scientific concepts; and (4) the interpretation of industry.

Further research into the classifications of curricular content is reported by Miller (1968). Miller sees industrial arts serving five functions: (1) the interpretation and understanding of technology and industry; (2) the exploration of occupational or avocational interests; (3) the preparation for future occupations; (4) the acquisition of technical competency in basic skills and knowledge; (5) the acquisition of techniques, abilities, and habits that are supported by other disciplines. Lux (1967) compares theoretical bases of curricular innovations and classifies content on a three-point scale: (1) that based on the primary needs of youth that matched the basic concepts of the discipline; (2) that based on an organized study of industry selected either from the skilled trades, the manufacturing elements, or from construction elements; and (3) that based on selective reinforcement material from mathematics and the sciences.

Two recent pieces of research have significant implications for industrial arts and its bases of curricular content. The most publicized of these is the work of Cochran (1969). He identifies twenty programs operating in secondary schools and catalogues the various innovative programs into four groupings. These are: (1) integrative programs, (2) the interpretation-of-industry programs, (3) the occupational family programs, and (4) the technology-oriented programs. Each of the four groupings are represented by five "innovative" programs. In reporting information on these programs, program development, objectives, and structure are emphasized.

The other major research study was done and presented to the 1969 Mississippi Valley Industrial Arts Conference by Bunten (1969). He made an extensive analysis of the literature and examined twenty-two new programs to ascertain their purposes, characteristics, and limitations. Bunten's study reveals that some of the major organizational changes in the innovative programs are centered around the modification of patterns of instructional content. Also, he finds that about seventy per cent of the programs are single track, either on levels of training or on a progressive, continuous, spiraling organizational plan.

These recent classifications of curricular content show the diversity of classification systems, yet upon close examination, the differences exist more in language than in the bases of theoretical teachable content selected from industry and technology. This close inspection also reveals the importance these analyses of content, origins, and derivatives have provided the profession, especially those who theorize about and experiment with innovative curricular content.

A BRIEF ANALYSIS OF SYSTEMS AND THE IDENTIFICATION OF CURRENT CURRICULAR PROGRAMS

During the last few years, there has been a great explosion of publicized innovative curricular programs in industrial arts. The pressures of the time and such contributing influences as the National Defense Education Act institutes that began in 1966 probably provided the major impetuses for such programs. Some of the "new" programs are in reality only revisions of "last year's" programs, while others are more "new" in methodology than in content. This section will identify more than twenty of the currently publicized "new" programs that place a major emphasis on curricular change in teachable content of industry and its technologies. Before current programs on curricular innovations are listed, two significant points of emphasis must be pursued.

First, change is pervasive in our society. Changes in our media occur because of the challenge to recognize new needs of youth; because of the improvements in educational communicative technologies; because of new curricular organizational procedures; because of the recognition of needed interdisciplinary functions; and finally and most important, because of the challenge to change industrial arts content since industry and its technologies are always changing.

The second part is cumulative and varied in scope. In preparing this chapter, this writer felt compelled to identify and define the theoretical bases of content of the "new" innovative curricular programs in existence at this time. After an extensive survey of the literature was completed, a composite list of the theoretical bases, origins, or derivatives of content was formed to see the total scope of curricular bases. Then an eight-question, one and one-half page information form was sent to the administrators of some thirty identified "new" programs. The main questions dealt with were these: (1) from what source the content of the program has been derived or has emerged; (2) what the major objectives or desired outcomes are; and (3) what classes or categories of curricular patterns there are that exemplify or represent the "new" innovative program. Responses were received from twenty-eight respondents, twenty-six of which seemed pertinent for this writing.

The composite list of theoretical bases of content, origins, or derivatives of content are listed below and reflect the conclusion that all bases of education content in industrial arts can be classified as one or more of the following:

1. Crafts and trades.
2. Occupational groups.
3. Material science areas of industry.
4. Historical and cultural heritage.
5. Industrial and technological concepts.
6. Functions and systems approach of industry.
7. Math and science precepts.
8. Social, humanization, and individual needs.
9. Recreational, art craft, or creativity.
10. Problem solving, research, and development.

As we have seen, various writers in recent years have classified the bases of industrial arts content in many other ways, similar to or greatly varied from the above list. No comparisons or disagreements are noted here in favor of an all-inclusive list of common, understandable, and identifiable classifications of curricular patterns.

Following is a composite list of "new," innovative, or experimental programs. Some of these are relatively small in size and evidence little structure, while others are large in size and are highly structured. They all emphasize major content changes in industrial arts. The programs and primary administrators listed are current as of this writing. It should also be noted that the information on the following programs and the brief summarized statement on content background were obtained from information forms, the brochures and responses from the participants, other publications, and personal comments. The assignments of each program to one or more classification has been based wholly upon the interpretation of the writer. No attempt was made to support or exclude any program or parts thereof.

The following twenty-six programs list: (1) the program's name; (2) the present administrator and his address; (3) the date of original conception of the program; (4) the source of the content of the program; (5) the grade levels included; and (6) the classifications of curricular patterns that best describe the program.

1. Alberta Plan - 1963
Dr. Henry R. Ziel
University of Alberta
Edmonton, Alberta, Canada

Content Derived From: Interrelationships of Tasks and Industry and the World of Work; Functions, Technologies, and Processes Evident in Contemporary Occupations; Grades 7-12.

Classifications: (1) Industrial and Technological Concepts; (2) Functions and Systems Approach of Industry; (3) Occupational Groups; (4) Problem Solving, Research, and Development.

2. American Industry Project - 1963
Dr. Wesley Face
Dr. Eugene R. F. Flug
Stout State University
Menomonie, Wisconsin 54751

Content Derived From: Interpretation of Industry Functions and Elements of Our Industrial Enterprise; Concepts of Industry are of the Utmost Importance; Grades 8-12.

Classifications: (1) Industrial and Technological Concepts; (2) Functions and Systems Approach of Industry; (3) Social, Humanization, and Individual Needs.

3. Correlated Curriculum Project - 1966

Mr. Gordon Lebowitz
Board of Education of the City of New York
Brooklyn, New York 11217

Content Derived From: Industrial and Service Trades; Occupational Needs of N.Y.C.; Industry in General; Saleable Skill Areas for Students; Grades 9-12.

Classifications: (1) Crafts and Trades; (2) Industrial and Technological Concepts; (3) Functions and Systems Approach of Industry.

4. Coordinated Program of Vocational Education - 1964

Dr. Ray Agan
Kansas State University
Manhattan, Kansas 66504

Content Derived From: Occupations for Rural Youth; Interdisciplinary Areas of Skills; Knowledge and Job Orientation; Grades 11-12.

Classifications: (1) Social, Humanization, Individual Needs; (2) Occupational Groups; (3) Problem Solving, Research, and Development.

5. Crafts As a Vocation - 1967

Dr. Kenneth S. Hansson
Eastern Kentucky University
Richmond, Kentucky 40475

Content Derived From: Traditional and Contemporary Crafts of S.E. Kentucky; Cultural, Social, Historical Oriented; Vocational Crafts to Meet Special Needs; Grades 7-Retired Adults.

Classifications: (1) Crafts and Trades; (2) Historical and Cultural Heritage; (3) Industrial and Technological Concepts; (4) Social, Humanization, and Individual Needs; (5) Recreational, Art Craft, or Creativity.

6. Curriculum for Industry and Technology - 1960

Dr. John Mitchell
Gorham State College
Gorham, Maine 04038

Content Derived From: Interpretation of Industry and Technology; Local Industrial Needs with "Unit" Concepts; Grades 7-12.

Classification: (1) Industrial and Technological Concepts; (2) Functions and Systems Approach of Industry.

7. Elementary School Industrial Arts - 1966

Dr. William Hoots
East Carolina University
Greenville, North Carolina 27834

Content Derived From: References to Industry and Technology; Cultural-Historical-Recreational-Elements of our Environment; Grades K-6.

Classifications: (1) Historical and Cultural Heritage; (2) Industrial and Technological Concepts; (3) Social, Humanization, and Individual Needs; (4) Recreational, Art Crafts, or Creativity.

8. Enterprise: Man And Technology - 1967

Dr. Ronald Stadt
Southern Illinois University
Carbondale, Illinois 62901

Content Derived From: Enterprise, The Technologies; Systems and Components of Industry; Occupations; Grades 9-12.

Classifications: (1) Industrial and Technological Concepts; (2) Occupational Groups; (3) Functions and Systems Approach of Industry.

9. Functions of Industry - 1960

Dr. Willard M. Bateson
Wayne State University
Detroit, Michigan 48202

Content Derived From: Industry, The Institution which is Designed to Satisfy the Material Needs of Man; Major Function of Industry; Secondary Level.

Classifications: (1) Functions and Systems Approach of Industry; (2) Social, Humanization, and Individual Needs.

10. Galaxy Plan or Career Preparation - 1958

Mr. Carl H. Turnquist
Detroit Public Schools
Detroit, Michigan 48202

Content Derived From: Industrial Materials and Processes; Industrial Energy; Visual Service Systems; Grades 7-12.

Classifications: (1) Industrial and Technological Concepts; (2) Occupational Groups; (3) Crafts and Trades.

11. Georgia Plan - 1958-61

Dr. Donald F. Hackett
Georgia Southern College
Statesboro, Georgia 80458

Content Derived From: Technology with the Emphasis on Industrial Technology; Man Producing for his Material Welfare; Functions and Concepts of Industry; Grades K-12.

Classifications: (1) Functions and Systems Approach of Industry; (2) Industrial Technological Concepts; (3) Problem-Solving, Research, and Development; (4) Historical and Cultural Heritage.

12. Interpreting Industry Through Industrial Arts - 1967
Dr. Alvin E. Rudisill
University of North Dakota
Grand Forks, North Dakota 58201

Content Derived From: Interpretations of Industrial Endeavors; Management, Materials, and Production; Grades 7-10.

Classifications: (1) Industrial and Technological Concepts; (2) Occupational Groups; (3) Functions and Systems Approach of Industry.

13. Industrial Arts Curriculum Project - 1958
Dr. Donald G. Lux
Dr. Willis E. Ray
The Ohio State University
Columbus, Ohio 43210

Content Derived From: Industrial Technologies in "The World of Construction" and "The World of Manufacturing"; The Science of Efficient Action in Management, Personnel, and Production Segments of Industry; Grades 7-10.

Classifications: (1) Industrial and Technological Concepts: (2) Occupational Groups; (3) Social, Humanization, and Individual Needs; (4) Historical and Cultural Heritage.

14. Industrial Arts Education - Contemporary - 1968
Dr. Joseph Duffy
Central Connecticut State College
New Britain, Connecticut 06050

Content Derived From: Interpretation of Industry-Material Processing; Energy Processing; and Information Processing; Grades 7-12.

Classifications: (1) Industrial and Technological Concepts: (2) Functions and Systems Approach of Industry; (3) Occupational Groups.

15. Industrial Materials - 1962

Mr. Louis Melo
San Jose State College
San Jose, California 95114

Content Derived From: Material Science Areas of our Industrial Society; Correlated Science; Research and Development of Materials; Grades 7-12.

Classifications: (1) Material Science Areas of Industry; (2) Math and Science Precepts; (3) Problem Solving, Research, and Development.

16. Industrial Arts and Technology - 1937

Dr. Delmar Olson
North Carolina State University at Raleigh
Raleigh, North Carolina 27607

Content Derived From: Social-Cultural Study of Technology; To Interpret the Technology of our Society; Grades K-12.

Classifications: (1) Historical and Cultural Heritage; (2) Industrial and Technological Concepts; (3) Recreational, Art Crafts, or Creativity; (4) Problem Solving, Research, and Development.

17. Industriology Project - 1965

Dr. Jack Kirby
Wisconsin State University - Platteville
Platteville, Wisconsin 53818

Content Derived From: Interpretation of Industry; Functions, Concepts, and Technology of Industry; Grades 7-12 plus Elementary.

Classifications: (1) Industrial and Technological Concepts; (2) Functions and Systems Approach of Industry.

18. Man and Technology - 1955

Dr. Paul W. DeVore
West Virginia University
Morgantown, West Virginia 26505

Content Derived From: Technology, Interpretation of Industrial Environments; Cultural and Historical Development; Conservation of Human Resources; All Levels.

Classifications: (1) Industrial and Technological Concepts; (2) Social, Humanization, and Individual Needs; (3) Historical and Cultural Heritage; (4) Crafts and Trades.

19. Maryland Plan - 1952-1958

Dr. Donald Maley
University of Maryland
College Park, Maryland 20740

Content Derived From: Cultural, Historical, Industrial and Problems Facing Man in the Future; Broad Concepts of Industry and Technology; Grades 7-12.

Classifications: (1) Historical and Cultural Heritage; (2) Social, Humanization, and Individual Needs; (3) Industrial and Technological Concepts.

20. Occupational, Vocational, Technical Program - 1964

Dr. Jerry C. Olson
Pittsburgh Public Schools
Pittsburgh, Pennsylvania 15212

Content Derived From: Industrial, Technical, and Occupational Jobs; Vocational and Guidance Oriented; Construction, Textile, Transportation, Visual Communications, and Science; Grades 6-14.

Classifications: (1) Crafts and Trades; (2) Occupational Groups; (3) Industrial and Technological Concepts; (4) Math and Science Precepts.

21. Orchestrated Systems Approach - 1960

Dr. Lewis W. Yoho
Indiana State University
Terre Haute, Indiana 47809

Content Derived From: Systems Employed by our Society for Producing the Goods and Services Needed; Systems are Inclusive of Industry; Trades and Occupations; Individualized for all grades.

Classifications: (1) Functions and Systems Approach of Industry; (2) Industrial and Technological Concepts; (3) Problem Solving, Research, and Development.

22. Parma Approach - 1965

Mr. Robert W. Fricker
Parma Public Schools
Parma, Ohio 44129

Content Derived From: Interpretation of American Industry; Total Development of Man and his Industrial Environment, Past and Present; Grades 7-9.

Classifications: (1) Industrial and Technological Concepts; (2) Functions and Systems Approach of Industry; (3) Historical and Cultural Development.

23. Partnership Vocational Education Project - 1962

Dr. Ernest L. Minelli
Central Michigan University
Mt. Pleasant, Michigan 48858

Content Derived From: Vocational, Industrial, and Technical Occupational Areas; Functions, Processes, Products of Industry; Grades 9-12.

Classifications: (1) Industrial and Technological Concepts; (2) Occupational Groups; (3) Social, Humanization, and Individual Needs.

24. Project Able - 1965

Mr. Robert J. Daly
Quincy Public Schools
Quincy, Massachusetts 02169

Content Derived From: Occupational Families, Trades, Crafts, including Air Force and Navy Vocational Technical Requirements; Grades 10-14.

Classifications: (1) Crafts and Trades; (2) Occupational Groups; (3) Industrial and Technological Concepts.

25. Richmond Plan - 1960

Dr. George Champion
San Francisco State College
Daly City, California 94015

Content Derived From: Occupational Families of Industrial and Service Areas with Emphasis on Math-Science Precepts; Grades 11-12 with expansion planned.

Classifications: (1) Occupational Groups; (2) Social, Humanization, and Individual Needs; (3) Problem Solving, Research, and Development; (4) Functions and Systems Approach of Industry.

26. Technology for Children Project - 1966

Dr. Fred J. Dreves
State Department of Education
Trenton, New Jersey 08625

Content Derived From: Interdisciplinary Units of Elementary Content; Industrial Technology Centered Units; Activity Oriented; Grades K-6.

Classifications: (1) Industrial and Technological Concepts; (2) Material Science Areas of Industry; (3) Historical and Cultural Heritage.

CONCLUSION

In this chapter emphasis has been on the evolution and origins of content selection — the theoretical bases of man's knowledge, values, and ideas in the contemporary programs of today. Mention was made of theorists in various educational fields and of the experimenters and practitioners both past and present. Further, contemporary theorists and the innovative or experimental programs that utilized today's industrial environment and its technologies as content were reviewed. The advocated theoretical bases of content have today as throughout history been the starting point, the places of departure for the organization of content in industrial arts, the technologies, or any other educational discipline. Here, one can observe that the theorist dismembers the established program, riles up the doers and practitioners, is often publically denounced or ridiculed, and then watches the changes he originally advocated take place in new, reorganized curriculums and programs by the innovators and experimenters. Likewise, the innovators and experimenters are often highly criticized or completely ignored and rejected. Times do change: this we are evidencing today as never before. The profession is indebted to the "theorist" and to the "experimenters and innovators" for providing the stimuli for enhancing and advancing the discipline.

The profession needs to take the responsibility to "improve the content" selected for curricular programs; not for the sake of change, but to pursue the avenues of research, design, and experimentation. In this way children, youth, and adults can be helped to understand and benefit from the relevant elements and complexities of our industrial and technological society. We must theorize, experiment, innovate, and practice. We must also communicate and disseminate information about what we are doing and accomplishing in the classroom.

In conclusion, the problems of society today are so complex that we must have educated, knowledgeable people who can "think" and cope with the vastness and complexity of a world society. Change is imminent. Methodology will continue to advance, technology is our contemporary science in action, and the theoretical bases of content must be sound enough to meet the challenge of the present and future needs of our society. The society of industrial educators must face these changes, take on the challenge, and initiate the opportunity for industrial arts to be a part of the total program of education. Our educational discipline needs relevancy, and sensitivity toward people of all ages, especially the overlooked and neglected very young and the older or retired adults in our rapidly changing society. The challenge of the 70's is for our discipline of industrial arts to provide meaningful and rewarding involvement in a total educational program that leads all youth and adults to their fullest understanding of and appreciation for the technological and applied scientific aspects of the industrialized society in which we live. This can only be accomplished by the doers, the experimenters, and the innovators of the psychological, social, educational, and technological aspects, elements, and functions of the industrialized world.

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CHAPTER SIX

Scope and Sequence of Content

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It is apparent from a review of the literature that little has been written about scope and sequence of content or subject matter courses within industrial arts collegiate undergraduate programs. Also, there is some confusion and a wide divergence of opinion concerning the problem of breadth and depth of preparation as related to level of teaching responsibilities. While most of the authors of the works cited drew their conclusions from scholarly research, such as those in Lux (1962), only a few of these seem to be directly applicable to this chapter. Nevertheless, an attempt has been made to present the materials considered relative to this problem.

The basic purpose of this chapter is to develop the scope and sequence of undergraduate content or subject matter courses projected from a study of theoretical bases of content. In Chapter Four, Marschik suggests selected bases that must be taken into consideration by the teacher educator. In Chapter Five, Ginther attempts to classify or give order to several of the innovative programs and program ideas projected for schools.

Unfortunately, it is difficult to infer a teacher education program from school programs. Also, it is difficult to provide unity when contemporary proposals appear to be so disparate, at least upon first glance. However, this is a task undertaken in this chapter.

The first portion of this chapter will consider some of the influences that are exerted upon teacher educators as they plan and implement teacher education programs. The second and concluding portion of this chapter is devoted to the projection of a model (pattern) of undergraduate preparation in content or the subject matter of industrial technology. This model or pattern will suggest scope and sequence of the elements of content needed to prepare industrial arts teachers of the future.

INFLUENCES UPON SCOPE AND SEQUENCE

The major influences upon content in undergradute programs are: 1) state certification standards, 2) existing conventional programs that have evolved over the past half century, taken together with innovative programs and proposals, and 3) the problem of breadth vs. depth.

State Certification Standards

Even though state certification for industrial arts teachers varies greatly from state to state, as do program requirements of colleges and universities offering industrial arts teacher education, the state departments seem to have the greatest amount of uniformity from the standpoint of required elements of content. For example, in the State of Ohio (1963, p. 30) industrial arts preparation includes the following areas:

(1) Graphic Arts
(Including printing, photography, and duplicating.)
(2) Woods - shaping, forming, fabricating and finishing using hand and machine tools. (Including furniture construction, carpentry, and wood finishing.)
(3) Metals - shaping, forming, fabricating, and finishing, using hand and machine tools. (Including sheetmetal, coldmetal, welding, forging, foundry, and machine metal work.)
(4) Applied Electricity
(Including generation, communication, transmission, and power.)
(5) Crafts
(Including ceramics, art metal, plastics, and leather.)
(6) Automotives
(Operation, care, and maintenance of light engine-driven equipment, including the automobile, garden, lawn, and farm machinery.)
(7) Drawing, design, and planning.

Such standards will have to be modified in the very near future. There is evidence that state departments will be flexible in their interpretation of content courses that are innovative or experimental in nature; however, the need exists for cooperation between 1) college and university personnel who are designing and implementing new programs and 2) state department certification personnel who are determining if certification standards are met. This cooperation must take the form of the preparation of new and forward-looking standards.

Conventional and Innovative School Programs

Industry and technology are accepted sources of industrial arts content. Therefore, it would seem logical to assume that a knowledge of the technology of industry should be an integral part of the unique content of industrial arts. Nevertheless, Luetkemeyer (1968, p. 18) reminds us that:

> A problem arises, however, in discerning the specific content of industrial arts. For while industrial arts educators generally agree that industry is the source of their field's content, their opinions concerning the actual nature of industry are in conflict. Thus, while each of these different schools of thought has evolved its own concept of industry — with corresponding methodological principles — the dilemma of discerning a specific content for industrial arts has become more apparent.

For example, while the manufacturing and construction industries may offer the most productive source of industrial arts content, other industries, including those which are agriculturally oriented, should be considered. In fact, someone has said that it was from the slaughter houses that Henry Ford got his idea for his mass production of automobiles.

Most industrial arts educators are agreed that industry itself and the technology of industry should be the primary sources from which content is selected. In order to develop in each student an insight and understanding of industry and its place in our culture, the technical resources of industries as well as the social and economic impact of industrial technology must be studied as a part of the industrial arts program.

Manipulative activities in the industrial arts laboratory thus become the medium through which these understandings and interpretations are achieved. The student is expected to define problems, postulate solutions by design and written descriptions, develop solutions, and test products.

The writer adheres to the belief that industrial arts as traditionally conceived is too narrow. Conventional programs represent bits and pieces of a broader fabric. The scope should be broadened by introducing a multi-faceted approach to instruction in the laboratory. This broadening process would include research into the materials, tools, and processes of industry, as well as other management functions. A study of the impact of science and invention on industry would be included. In addition, industry would be examined to ascertain its influence on society, human relations, and current economics.

Such expressions as "elements of content," "curriculum changes," "interpretation of industry," "integrative programs," "occupational family," "conceptual approach," and most of the terminology that is employed in the innovative program explosion, invariably arouse mixed reactions from industrial arts educators. Most teachers and teacher educators recognize the desirability of change but they also believe in the tried and true methods and substance of the past. All of the new programs and program ideas reviewed by Ginther in Chapter Five offer direction, but the problem remains that industrial arts professionals are yet to be convinced, by actual demonstration, that any of these new programs are actually better than those of the present and past.

BREADTH AND DEPTH

Before attempting to develop a point of view relating to the problem of breadth and depth of content as related to level of teaching, it is appropriate to relate from the *American College Encyclopedic Dictionary* (Barnhart, 1954) a definition of breadth and depth. Breadth is freedom from narrowness or restraint; liberality; breadth of view. Depth is intellectual penetration, sagacity, or profundity.

There seem to be two major schools of thought among industrial arts educators concerning the problem of breadth and depth of content. The first group involves those thinkers who do not separate industrial arts from vocational education. This group maintains that the lack of depth of content on the teacher education level contributes to shallow programs on the school level. The other group views industrial arts quite apart from vocational education and is careful to insist that the general education function be paramount thus permitting attention to broad concepts and principles at the school and teacher education levels.

It is apparent from the discussions which occur at local, regional, state, and national meetings that there is general concern for improvement in industrial arts at every level. Further evidence is to be found in numerous journal articles and other publications in recent years. This seems inevitable in view of the nature and breadth of the implications from the new subject matter. Bohn's discussion (1968) of promising curriculum changes in industrial arts is an example. Statements such as those of Berger (1968), Hawkins (1968), Silver (1968), and Hoots (1968) are other examples. There also is Olson's stimulating Chapter VII in *Technology and Industrial Arts* (1957). These are but a few of the many expressions of concern for the age-old problem of breadth and depth of content as related to levels of industrial arts teaching.

Karnes (1960) states that:

> (1) general recognition of the need for improvement is a condition prerequisite to effecting substantial change for the better; (2) there is widespread concern for improvement in every aspect of education — not just industrial arts alone . . . . The one most important reason why there is so much controversy with reference to the content and activities, the methods, and instructional materials appropriate for industrial arts is the fact that there are so many unresolved issues concerning the meaning, function, and objectives of industrial arts (pp. 5-7).

In an effort to deal more specifically with the problem of breadth and depth of content at every level of teaching, leaders in the profession presently are testing and implementing innovative programs and attempting to resolve the issues of the meaning, function, and objectives of industrial arts.

All of these programs have a number of characteristics in common. The two most important are (1) increased program breadth and (2) closer representation of industrial practices. Both of these can be implemented at a gradual rate and to the extent desired. Perhaps the industrial arts teacher education program will have to display equal concern in its content for breadth and depth so that the necessary technical competencies, understandings, and appreciations which give meaning to the technology and growth of the students are available.

Many changes can be made as a result of the progress being made in curriculum development. This can be done, no doubt, without totally scrapping the present system by carefully adapting the organizational patterns and instructional materials produced by innovative projects. The essential point here is that the magnitude of the problem of breadth and depth be grasped and that pessimistic and defensive attitudes be cast aside as solutions are sought.

The problem of breadth and depth takes on different meaning at the various levels of instruction. Each level will next be considered in turn.

Elementary School Level

Industrial arts instruction at the elementary school level consists of construction activities which are part of the common learning of children. Industrial arts makes a distinct contribution to the elementary school program through its own unique content, methods, and techniques. However, there are some leaders in the field who feel that the traditional forms of elementary-school industrial arts do not provide enough breadth and depth of content to meet the needs of today's youth. For example, ignorance of products, occupations, and industries on the part of today's youth is a reflection of an educational program which does not accurately reflect American culture. The elementary school program presently contains humanistic and scientific elements; however, children also need the now-overlooked industrial element. The term "industrial element" as used by Hackett (1966, p. 58) includes agriculture, mining, construction, transportation, communication, trade, and the services, as well as the manufacturing industries. Olson has been one of the leaders of this philosophical position and proposes that children in the primary grades study about technology and the community (Olson, 1957). This would include the study of community industries such as the power industry, the construction industry, and the use of materials, tools, and machines. Olson's program would provide for a systematized approach to the study of technology throughout the elementary grades.

There is evidence that leaders in elementary school industrial arts see a need for more breadth of understanding. Programs should not be restricted to simple hand tool manipulation in the elementary school. Rather, concepts and principles of the contemporary world should be structured and presented to elementary school youth as they reflect industry and the technology.

Secondary School Level

Those familiar with the professional literature in the field of industrial arts will note that most of the efforts in curriculum innovation are directed to the secondary (junior and senior high) school. These programs seem to indicate that a broad program of industrial arts is necessary to adequately reflect the technology.

The majority of current programs at the junior and senior high school level consist of drafting, woods, and metals. This indicates a narrowness in content and represents the traditional skill-oriented curriculum. Such programs do not provide for teaching the basic concepts of industry. In contemporary industry these concepts include product design, process engineering, research and development, materials selection, materials forming, personnel methods, distribution, and product service.

If we are to modify and update curriculum content in industrial arts programs on a national basis, there must be curriculum revisions, new methods and approaches to content organization and presentation, and the development of complete and partial teaching systems. Such procedures and materials will make it possible to attack the problem of breadth and depth of content as related to the secondary level of teaching industrial arts.

Existing programs could be expanded within existing facilities, in metals, woods, and drafting with minor modifications. For example, new units of electricity and/or electronics coupled with power mechanics could be integrated within existing metals programs. Other concepts of innovative program content such as finance, research, purchasing, and industrial relations can also be integrated into these programs.

It appears that a reasonable approach to the problem of breadth and depth at the secondary level could include a technical or non-technical in-depth study of an industry. This would be stimulating to both teacher and student and would help change the "shop" to a more cognitive "laboratory for learning."

The writer feels that a perusal of industrial literature is a prime prerequisite to "an in-depth study of industry." The value of such a project is readily apparent. It provides the student with library research into each structural sub-division. Topics such as the origin and background of basic industries, organizational structure and operations, as well as their socio-economic influence are all important elements of such a study.

Collegiate Level

Perhaps at the collegiate level and at this unique point in time, the question should be: Why even talk about a problem of breadth and depth of content as related to the college level of teaching industrial arts? The knowledge explosion, revolutionary changes in industry, numerous curriculum research and development projects, and a growing dissatisfaction with some existing industrial arts programs provide a tremendous opportunity to implement breadth *or* depth in the undergraduate technical program. After all, colleges and universities have four-year degree programs in industrial arts with time to provide for an innovative sequence of undergraduate content.

The college student, because of his maturity and background, should be capable of finding relevance in industrial technology as it applies to his current society. His understanding should be similarly enhanced by virtue of his exposure to the major technology in his curriculum content.

Adult Level

A basic purpose of appropriate adult education, as of education in general, is to help equip the individual with the knowledge, insights, and skills which will enable him to make the wisest decisions in his social, economic, and political life, as well as to contribute to his personal enrichment. Acceleration of technological change particularly affects the economic status of older people. This is evident in difficulties over compulsory retirement without adequate income maintenance, the greater impact of inflation on fixed retirement incomes, and greater difficulties of retraining to compensate for obsolete skills. Each of these difficulties raises specific problems with educational content. The values of adult industrial arts programs can be stated succinctly as follows: occupational interests and hobbies.

At the adult level, the industrial arts program is ordinarily offered on an informal basis providing for the individual's need to create. It is readily apparent that industrial arts offers many other opportunities for adult education. Adults may also meet limited vocational needs or engage in do-it-yourself activities through special courses and evening school programs. Industrial arts in rehabilitation centers enables adults to live more effectively and happily. Similar programs conducted in community centers, and in public and private institutions during the day and evening, serve large numbers of adults in their quest for some form of personal improvement.

TOWARD A MODEL OF SCOPE AND SEQUENCE

Technical competencies of the industrial arts teacher revolve around the contemporary and developing industrial pattern of the culture. The teacher must be familar with, and skilled in, basic production processes in typical industries, and he must understand the structure of these industries, including their organization of personnel. He must also be familiar with characteristics of materials, considerations in product design and production planning, occupational opportunities, and the application of science, mathematics, and other subject areas to industrial developments.

The developing cultural pattern implies increased production of goods and services, reduction of blue collar workers, and shorter working hours. The preparation of the industrial arts teacher should also cover consumer education. The scope of subject matter suggests that teachers will need to be prepared to organize and administer a wide range of types of laboratories, usually dictated by particular views of what content is appropriate. Thus one type of laboratory may be appropriate for study of a family of related industries. Differing views of cognitive, psychomotor, and affective objectives attainment will certainly influence what has come to be known as the question of breadth and depth, and will in turn affect laboratory design and content organization.

Recently, several leaders in industrial arts education have renewed innovative thinking and planning with the aid of federal, state, and foundation funds. For this chapter, the writer has considered several innovative programs, namely,

1. The Maine State Plan
2. American Industry Project
3. Wayne State University Plan
4. The Maryland Plan
5. Industrial Arts Curriculum Project
6. Enterprise: Man and Technology

These programs have been selected for illustrative purposes and do not represent the total spectrum of innovation or innovative programs. The major focus is to infer from these elementary and secondary school programs, content which is appropriate to teacher preparation. For example, the Maine State Program suggests a need to increase and strengthen the prospective teacher's technical understandings and skills. The American Industry Project purports to develop in students an understanding of industry through a concept approach. Wayne State University endeavors to have its students understand industry or the functions of industry by organizing instructional material into those related activities concerned with the production of a product and the service of a product. The Maryland Plan utilizes content from the broad area of industry and technology built around experimentation and problem solving. The Industrial Arts Curriculum Project at The Ohio State University, in cooperation with the University of Illinois, is concerned mainly with industrial technology as it relates to man's needs for industrial material goods; essentially through study of management, production, and personnel functions of construction and manufacturing. The totality of man's enterprise is the arena for Enterprise: Man and Technology being proposed at Southern Illinois University.

Each of these illustrative programs have certain elements of similarity which permit one to conclude that traditional undergraduate programs are not satisfactorily meeting the challenge of today's technology. These innovative programs illustrate a shift in emphasis from skill development to the broader interpretation of the role of industry in our complex technological society.

PROJECTION OF A PATTERN OF CONTENT

A review of the preceding sections of this chapter and Chapter Five reveals the impossibility of developing a program model that is specific and all inclusive. Certainly the noted diverse philosophies, the range of theory, and the disparate definitions are hindrances to the task.

Nevertheless, sufficient commonalities and trend indicators either do exist in, or can be inferred from, innovative programs, their rationales, and objectives. Consequently a useful model or pattern of undergraduate content can be presented here.

Figure 6-1 presents a generalized pattern for undergraduate content courses in industrial technology. It is in keeping with the suggested strategy of Tischler (1968, p. 47). The reader will note that what are termed "basic, broad, and integrative offerings" comprise half or slightly more than half of all technical content in the undergraduate program; however, a large portion of the offerings provide for specialization.

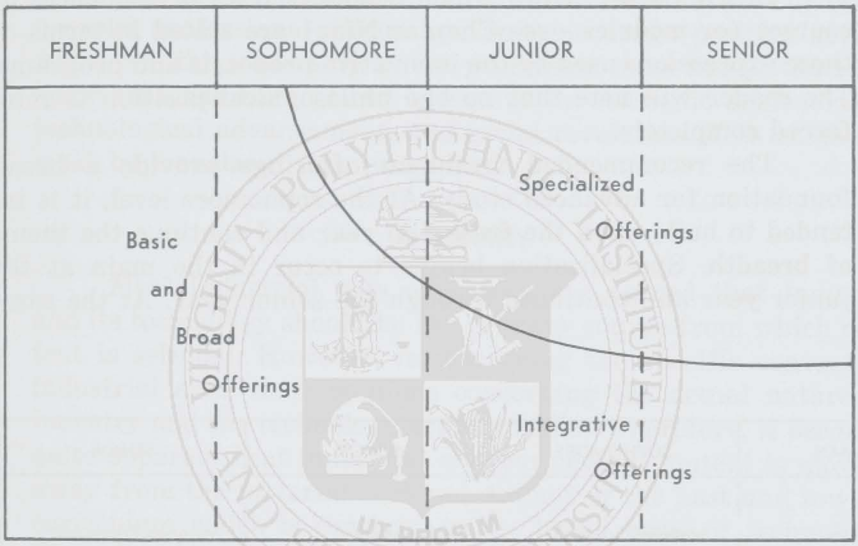

Fig 6-1. A Generalized Pattern of Content in Industrial Technology for Undergraduates.

Note also that in sequence, the basic and broad offerings occur mainly in the freshman and sophomore years, with the integrative and specialized offerings occurring mainly in the junior and senior years. Proportionately, as suggested in Chapter Two of this yearbook, these content offerings provide for from one-third to one-half of all collegiate credit.

Beyond the generalized pattern, the writer proposes more detailed scope and sequence in Figure 6-2. Most industrial arts teacher educators would agree that it is not educationally sound to offer a collection of courses dealing only with tools and materials independently and not conceptually or relatedly involved.

Therefore, the suggested sequence of an undergraduate content program represents an attempt to implement the new direction in industrial arts education into a meaningful program. This also delimits the study of industry and technology in contrast to continued proliferation of narrow disjoined courses dealing with isolated segments of skills and material without concern that these segments be related to wholes and provisions made for concepts to be developed.

In Figure 6-2, titles which denote courses or sequences of courses (or modules - see Chapter Nine) are stated in terms of those expressions used by the innovative proposals and programs. The reader will note that no one philosophical position is reinforced completely.

The recommended freshman offerings provide a broad foundation for advanced study. At the sophomore level, it is intended to build upon the freshman year and continue the theme of breadth. Specialization begins to occur in the main at the junior year and continues through the senior year. At the same

FRESHMAN	SOPHOMORE	JUNIOR	SENIOR
Orientation to Industrial Enterprise	Materials Science	Mechanisms and Mechanical Systems	Materials Processing and Fabricating
Product Research and Development	Process Research and Development	Electrical and Electronic Systems	Transportation Systems
Construction	Materials Processing and Fabricating	Materials Processing and Fabricating	Communication Systems
Manufacturing	Energy and Power	Product Service	Production Systems
Industrial Graphics	Information Systems	Graphic Communication	Special Problems
	Personnel Management	Production Management	

Fig. 6-2. Suggested Scope and Sequence of Offerings in Industrial Technology for Undergraduates.

time, the senior year provides for integrative offerings. It should be noted that no special number of credit hours has been suggested for any of the four years in the sequence; however, there is a logic to the order.

It should be understood that certain courses may be offered by other than the major department. This will depend upon college or university structure and other factors.

Hopefully, this suggested pattern of undergraduate technical content will stimulate and promote intellectual curiosity, provoke professional discussion, and encourage positive action. Above all, the leadership in the profession must accept the challenge that has been placed before us by scientific achievement, technological advancement, and social revolution. This challenge must be translated into programs.

SUMMARY

Most industrial arts educators are agreed that industry and its technology should be the primary source from which content is selected. However, in discerning the specific content of industrial arts, their opinions concerning the actual nature of industry and the technology are in conflict. Therefore, it becomes quite apparent that industrial arts curriculum content is moving away from the material-centered content of the past and toward curriculum which is centered in the broad basis of technology. Warner (1965) in his new type of definition gave an accurate explanation of the scope of industrial arts content:

> *In scope*, the emphasis at childhood or elementary school levels is in providing the basis or means for integrated activity programs; at *early adolescent* or junior high school levels in providing the orientation program concerning the technology; at *later adolescent* or senior high school levels in providing specialized elements of the technical program and a sound basis for a possible industrial-vocational education; at *young adult* or collegiate levels in providing technological studies and activities of consumption, production, and recreation in the core program, and elements of technical training in the terminal program; and at *later adult levels* in providing recreational and consumer activities for all, along with elements of the technical as required (p. 41).

It would be presumptuous for the writer to single out for recommendations any one of the many innovative research and development programs; nor would the writer suggest a resolution to the problem of breadth and depth of content as related to level of teaching. The essential point here is that the magnitude of the problem be grasped and that pessimistic and defensive attitudes be cast aside as the solution is sought.

The writer, therefore, has attempted to discuss the influences which are exerted upon teacher educators as they plan and attempt to implement teacher education programs. In addition, based upon the evidence available from selected research and development programs, the writer has suggested a sequence of undergraduate content courses which reflects the scope of subject matter being proposed by leaders in the field. Rather than being fixed and final, the proposed pattern of offerings should be considered as suggestive only. Such a pattern will need thorough trial and modification in each collegiate setting. Based upon such a trial, the elements of the technology will become apparent. In Chapter Nine, the relationship between such curriculum elements and the subelements will be discussed, and a proposal for the development of proficiency modules covering the substance of the selected curriculum elements will be presented.

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CHAPTER SEVEN

Theoretical Bases of Instructional Method

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The formal school is generally thought of as the "place" where children and adults go to learn "something." That is, the school serves as a societal institution to transmit man's accumulated knowledge to receptive learners. Those of us engaged in the teaching profession realize that the school is merely a physical structure — a building in which learning takes place, and that historically, men and women have served as the mediators or transmitters of knowledge. Teachers are thought to provide a professional service to society that helps maintain and improve desirable sociocultural conditions. Teachers provide man with knowledge and skills that enable him to perform as a resourceful and productive citizen.

It is the purpose of this chapter to review current theoretical bases of instruction. The roles of the school, the teacher, and the teacher educator in our advancing technological society will be discussed in relation to some of the new developments in teaching "skills" that will help improve the general achievement performance of the learner.

This chapter is intended to provide the teacher and teacher educator with a "cook book" review of how teachers function. It is not intended for the theoretician or philosopher who wants to sit around in a cave and attempt to identify what is "real" by observing its shadow. (Pardon me, Plato!) Industrial arts educators have been talking about improving the image and operation of their profession for years. The writer proposes to share some thoughts concerning the role of the school and the teacher and his behavior, which should help achieve the desired goal of improved excellence in industrial arts.

Some skills that the teacher needs to perform his professional practice efficiently and effectively will also be identified and discussed. The final part of this chapter will contain a review of some of the promising innovative practices that have recently been developed to help improve teaching. The subsequent chapter develops an operational model of an industrial arts teacher education program based on some of the concepts reviewed in this chapter.

TECHNOLOGY AND EDUCATION

Since Russia's launching of Sputnik in the latter part of 1957, federal legislation has been increasingly enacted for the improvement of educational programs. Large amounts of money have been allocated for the training of secondary school personnel in the physical sciences, mathematics, counseling and guidance, and foreign languages. Guidance counselors were needed to identify mentally superior youngsters and channel them into careers in the sciences, mathematics, and languages to help fulfill what was perceived by some as a critical social need. Support was also provided for the post-high-school and community college training of technicians to supplement the work of engineers.

The non-college-bound youngsters and so-called hard-core unemployed or unemployable youth and adults also received recognition with the passage of new vocational education legislation in the 1960's. In all cases, it appears that support for education was provided to prepare trained personnel in order to improve the social, economic, and personal welfare of citizens, and the nation's defense posture, although the efficacy of such programs has been questioned by scholars, politicians, and others.

The threat of social revolution in America has also helped to provide stimuli for the modification of educational programs. The civil rights movement helped initiate the desegregation of schools. Also, inequities in school staffing, budgeting, and facilities became apparent and attempts to rectify them have been achieved with some success.

An increasing number of major research and development curriculum projects evolved on a national scale. New curricula in earth science, physics, industrial education, and mathematics, for example, were developed, implemented, and evaluated in elementary and secondary schools. These innovative projects appeared to be mammoth attempts to modify and improve educational experiences for children. Generally, new instructional materials were planned to provide education considered more relevant for children and to ease their ultimate participation in an advancing technological society.

The development of instructional materials and new curricula, however, are only two of the components necessary to improve the education of children. Someone must present the new instructional programs to the students. Traditionally, this role has been performed by a teacher. Even though the development and implementation of automated instructional hardware such as computer assisted instruction (CAI) and programmed learning machines has increased, there is still an apparent need for a professionally educated person to help plan, organize, mediate, and control the learning activities of children.

Therefore, it is of paramount importance to modify existing teacher education programs in order to prepare teachers to implement what has been learned from the curriculum projects and other research efforts. All professional resources must be directed toward the goal of improving the educational, social, cultural, and economic functioning of citizens. Technological advances during the past two decades have helped increase man's life span, provided many labor saving devices, increased the availability of leisure, and developed the hardware and techniques to land men on the moon. Unfortunately, man has failed to improve his sociocultural conditions and values as rapidly. Thus, we still find evidence of social strife, war, poverty, environmental pollution, illiteracy, and other symptoms of social disintegration.

TECHNOLOGY AND TEACHERS

Because of the sociocultural changes described above, the role of the teacher has changed drastically. The teacher can no longer be an Aristotle or a Socrates — the transmitter of all of man's knowledge. The complexity of man's personal interests and the knowledge explosion have resulted in changes in concepts of subject matter which have made the former role impractical. Technological developments have removed most educational practitioners from Plato's cave and have set the stage for the utilization of elaborate laboratories of learning.

Recent developments in educational media, instructional materials, curriculum innovations, and management practices (like flexible and modular scheduling and prescription teaching) are contributing to the complexity of the teacher's role. The teacher finds himself in the same dilemma as the new physician who must decide whether to enter the practice of general medicine or select a medical specialty.

Whether the educator plans to perform as a general practitioner or as an instructional specialist, current teacher education programs are inadequate to efficiently prepare effective professionals. It would be unfair to suggest that the need for the evaluation and revision of teacher education has come about only recently because of developments in educational technology. The professional preparation of teachers has been an area of concern for decades. Undergraduate students have expressed dissatisfaction with preservice teacher training, while school administrators and lay people have complained of the failure of pedagogists to develop appropriate curriculum and methodology to improve the teaching-learning process.

Professional courses in educational methods have been developed to help prepare teachers to teach. Education students study the psychological principles of learning and pupil characteristics in educational psychology, child development, and adolescent psychology courses. They learn how to organize a classroom, prepare instructional materials, present information, and evaluate student achievement in curriculum and methods courses. Generally, these classes are taught as separate subjects without common goals or any attempt to coordinate or relate the subject matter. This usually is followed by a six to eighteen-week field experience as a student teacher under the supervision of a "master" teacher. This brief apprenticeship, often his only professional field experience, merely exposes the potential teacher to a quasi-teaching experience for a limited period of time during his final year in the baccalaureate program.

Many practitioners in education contend that college courses in teaching methods, educational foundations in history and philosophy, educational psychology, and a limited student teaching experience do not adequately prepare one to be a successful teacher. The "tricks of the trade" are often learned on-the-job, either by experience or by consulting with experienced and apparently successful teachers in the same school. Some teachers tend to become successful in spite of their teaching preparation rather than as a direct result of it.

One of the concomitant benefits of recent technological developments has been the development of media and techniques to improve the teaching-learning processes. Conceptual models in teacher preparation based on these innovative developments may utilize new media and instructional technologies to produce more efficient and effective educational practitioners. The same type of instructional theories and instructional systems that apply to the education of children may also be adapted for the preparation of teachers, physicians, attorneys, craftsmen, clergy, and personnel for other vocations.

The term "educational technology" has generally signalled the utilization of audio-visual equipment in the classroom, such as audio recorders, radios, motion picture projectors, slide and film strip projectors, and opaque projectors to improve the teaching-learning process. Recent additions have included the video tape recorder, overhead transparency projector, programmed learning machine, CAI, reading accelerator, and television. This "hardware" definition may be somewhat acceptable to educational practioners primarily because of common usage. However, the definition does not take into consideration the technology of human behavior, that is, the systematic application of knowledge or organized "practices" to achieve a particular action, goal, or object.

An instructional technologist is a person concerned with utilizing techniques and practices derived from an organized body of knowledge of "how to teach" based on scientific principles and empirical data concerning modification of student behavior. Instructional media (hardware) would not have any special relevance to technological practices other than to serve as one type of resource "tool" that could be incorporated in the behavior modification process. This may be illustrated by observing that a surgeon's scalpel is merely a mechanical device or "tool" that the surgeon "controls" in point of incision, direction, pressure, and depth. He performs this way by applying his knowledge of practices of efficient action (praxiology) in the field of medicine. The skillful teacher also uses mechanical, material, and non-material resource tools to insure efficient action in the practice of his profession. This may be illustrated by observing that a learning environment may be "structured and controlled" (non-material) by a teacher to set the stage for learning. Also, the same teacher may incorporate an overhead projector (mechanical) and multicolor transparencies (material) to provide other conditions (stimuli) to promote behavior modification.

Instructional technology, therefore, is the science of efficiently planning, organizing, mediating, and controlling instructional materials, media, methods, and people in the teaching-learning process to attain predetermined behavioral goals. This definition and application of instructional technology is consistent with the treatment of concepts of learning and instruction found in recent literature. This concept of instructional technology can serve as a basis for the improvement of education in innovative approaches to curriculum development; in the professional preparation of teachers, school administrators, and counselors; in program dissemination and evaluation; and in assessment criteria for behavior modification.

A REVIEW OF INSTRUCTIONAL THEORIES

The educational specialist who is involved in planning, organizing, mediating, and controlling learning experiences to attain predetermined achievement performance draws upon instructional theory. The information that has been traditionally used as a frame of reference for curriculum development, at least in theory, usually includes an analysis of the personal, social, physical, and psychological characteristics of the students for whom the program is intended, as well as the educational philosophy of the school system. The school system's philosophy serves as the basis to establish limitations and the scope of the instructional program. The students' characteristics serve as guides to determine what subject matter should be taught, how it is to be organized, and ways in which it can be communicated or transmitted to the learners.

Psychological principles of learning theoretically provide a foundation that "controls" or "mediates" the behavior of the teacher during his interaction with children. Unfortunately, among practicing teachers, much confusion exists regarding the principles of learning and the application of psychological theory.

For many, the application of learning theory remains a mystery. Consequently, teacher behavior, classroom instruction, and teacher-pupil interaction may not be dictated by theoretical principles of learning, but may be guided by what the teacher "perceives" as a proper method and "folklore." This phenomenon often becomes established and perpetuated in student teacher programs.

While it may be accepted that teachers "know," or are "aware" of learning theories or doctrines that explain learning, there is little evidence, if any, that these principles are *effectively* applied in the instructional program. Nevertheless, examples of the application of learning principles may be observed in existing industrial arts classes. The assignment of industrial arts instructional projects typically progresses from the production of simple projects like a book rack that requires primary or basic technical skill attainment, to a large piece of furniture which involves more complex psychomotor performance skills. Thus, we find students *bridging* skill attainment, progressing from the simple to the more complex; that is, they seem to be "learning new concepts in terms of the old."

Students in industrial arts manipulate tools and materials to study industrial processes; thus, they "learn by doing." Children also "learn from experience" with "doing" activities as, for example, they combine industrial materials or assemble hardware components using appropriate techniques and production processes. Another example of learning theory applicable to industrial arts instruction is that of "learning by trial and error." A student will continue striving to achieve a goal, such as adjusting an engine's carburetor, until he "learns" or "develops" the desired skill performance. A student who has success (reinforcement) in performing a psychomotor activity "learns" the task, whereas failure tends to provide punishment, an "unsatisfying state of affairs" (negative reinforcement). Thus, the student will attempt to modify or improve his performance to achieve positive reinforcement (reward) — "a satisfying state of affairs."

Reinforcement is the process which strengthens the resultant behavioral response to a stimulus (or stimuli). It may be rewarding and satisfying or it may be punishing and unsatisfying. There is empirical evidence to caution against using the latter technique or at least, one should use it with discretion.

The student who strives unsuccessfully to achieve a certain goal, such as the wiring of a stereo component, will be less likely to retain the knowledge which has led to the unfullfilled goal. One way to look at the process of learning, then, is for the teacher to focus upon the effect of the response upon the student. This knowledge of conditioning theory should offer assistance in finding methods to modify behavior by controlling the pattern of reinforcement.

Reinforcement of behavioral response may be verbal like "You did a good job"; non-verbal, an approving smile from the teacher; or a combination of the two — a written evaluation (letter grade or critique) and oral report or approving gesture. While the teacher has reasonable control over his verbal and written reinforcement response techniques, he is not always cognizant of his non-verbal behavior. Gestures, facial expressions, body movements, or selection of students with whom to interact — ask questions of, or engage in social or small talk — are forms of non-verbal behavior. This phenomenon is true because teachers have rarely realized the impact that non-verbal behavior might have on the achievement performance of students.

Learning theory also provides a basis for the selection of methodology employed in the teaching-learning process. A teacher who wants his students to develop problem-solving skills, that is, learn to become more self-reliant and resourceful, may mediate instruction by using the guided or directed-discovery method of teaching to achieve desired behavioral outcomes. The teacher who is primarily concerned with the mastery of subject matter, however, might stress the learning of specific skills and concepts taught by the direct and detailed method of teaching, rather than use the discovery or problem-centered approach.

The mastery of skills and subject matter may be obtained with either method of teaching. The preceding were purposely dichotomized to illustrate two theoretical positions that can have an impact on teacher behavior, instruction, and student achievement performance. Also, the example is not intended to detract from the apparent effectiveness of discovery learning as a means of improving the retention of cognitive knowledge and transfer of learning as reported in a number of empirical studies conducted during the past two decades by scholars in industrial education.

Teachers are aware of stimulus-response-reinforcement (S-R-R) practices and freely use this procedure in their classrooms. An industrial arts teacher, for example, will assign a laboratory activity (stimulus) to help elicit specific desirable behavior (response). The teacher then evaluates the student's achievement, usually orally along with a letter grade, thus providing reinforcement. If the teacher judges that the student failed to attain the desired goal, then reinforcement may be negative. Unfortunately, it is at this stage where the teacher, *not* the student, often fails. Occasionally, teachers will merely assign a letter grade, without communicating a possible method of *improving* or *correcting* resultant behavior. This technique (clarification) is extremely important if the teacher is going to make full use of the "power" of reinforcement. Merely telling the student that he did poorly or to "practice" or "repeat" a task will not insure the attainment of the desired goal unless guidance and direction (new stimuli) are provided by the teacher.

Reinforcement patterning is another technique that needs to be mastered by the teacher to effectively use conditioning techniques. This topic is discussed during the next section dealing with the relationship of learning to instructional theory.

The conditioning and cognitive learning theories or families of learning doctrine seem to enjoy a general acceptance by educational practitioners. However, too often, a theory of social-learning doctrine classified as "modeling," "imitation," or "patterning" does not receive as much overt attention (Bandura, 1961, 1962, 1963). The research in this area suggests that teacher educators should be more cognizant of their own performance, since they are serving as "models" for pre- and inservice teachers. Students may pattern their professional and social interests after those professors who are perceived as "successful," "competent," or "likeable." Stated as a doctrine or principle of learning — students will pattern their behavior and performance after those people who exhibit desirable behaviors. If Johnny perceives Professor Buckeye as his professional hero — honest, brave, reverent, knowledgeable, etc. — Johnny will identify with him, develop similar habits and interests and use Professor Buckeye as a "model" or "referent."

"Teachers teach the way they were taught." If this statement has any validity, then teacher educators should come to classes well-prepared, use organized syllabi, make students aware of class objectives and terminal performance objectives, and exhibit "efficient" and "effective" use of audio-visual media (transparencies, slides, models, etc.). They must provide proper motivation techniques; incorporate innovative practices, methods, and strategies; exhibit professional behavior in leadership; contribute scholarly writings and research reports; and sponsor and participate actively in professional organizations. Therefore, teacher educators need to communicate, verbally and non-verbally, to students to "Do as I do and say," *not* "Do as I say, not as I do."

Educators need to be cognizant of the influence that environmental conditions (people, places, things) and interaction have upon behavior and achievement. Students learn new behavioral skills and attitudes through their association with professors and fellow students in their college classes. Educational practitioners interested in preparing qualified teachers must attempt to create a physical and social learning environment that will provide the stimulus and reinforcement to promote desirable behavior and performance. Thus, it becomes apparent that the two doctrines — "patterning" and "conditioning" — appear to be somewhat related in that they contribute to a mutual goal.

Learning theory that may be applied to industrial arts instruction would conceivably involve a combination of the classical doctrines of learning discussed previously as well as the social-theory learning doctrine. While these concepts of learning may be independently appropriate in instruction, recent developments in educational technology suggest a collective function.

No attempt is made to delve into the theoretical bases of learning theory, nor is it felt necessary to prepare a comparative analysis of learning theory subscribed to by proponents of the different schools of psychology. It is necessary, however, for educators to be aware of prevailing theories from which instructional models and paradigms may be developed. Therefore, a descriptive analysis of selected learning doctrines has been included to provide a source for the teacher, the mediator of instruction. The review is limited to learning theories and concepts of learning that have practical application to educational problems and instructional technology including innovative media and methodology.

RELATIONSHIP OF LEARNING THEORY TO INSTRUCTIONAL THEORY

One can ask why it is important to establish a theory of instruction when we already have voluminous materials and information in psychological literature that contain theories of learning and development. Theories of learning and their related doctrines are merely descriptive rather than prescriptive. That is, they provide information that explains behavior — the nature of the act and the conditions that affect it.

Let us review an application of this concept to teacher behavior. Students preparing to become teachers study educational psychology although many feel that these courses fail to prepare them adequately to be successful teachers. Part of this dissatisfaction results from unrealistic expectations of the function and utility value of psychological concepts and principles of learning. As mentioned previously, learning theories merely provide a frame of reference for understanding and explaining why certain behavioral acts occur. With this as a referent, an educator theoretically could prescribe and develop certain "conditions" (stimuli) that would elicit the development (learning) of behavior. A *theory of instruction* comprises this procedure. It is a prescription in that it provides rules and directions regarding the most *efficient* and *effective* way to achieve optimal behavior performance.

Learning theory provides the basis for the development of an instructional theory by providing information about how learners of different capabilities at various levels of maturation learn to perform certain acts and develop skills during different stages of development. Not only does learning theory explain the *nature* of learning activity, it helps determine *when* certain behavior or acts of learning may be most effectively taught and at what rate.

According to Bruner (1968), instructional theory is both prescriptive and normative — prescriptive because it offers rules regarding instruction, and normative because it sets up conditions for meeting prescribed criteria which are general in nature. Bruner maintains, further, that a theory of instruction has four aspects: 1) it specifies experiences which would be most effective in teaching; 2) it specifies the structured form which should be taken by a body of knowledge in order for it to be absorbed readily by the learner; 3) it specifies sequences in which material should be learned; and 4) it specifies the relationship of reward and punishment to the teaching-learning process.

Skinner (1968) expands this last aspect with a discussion of "operant conditioning," wherein he relates the application of conditioning to the instructional process. In this process, teachers provide such stimuli to learning as programmed learning in the form of a teaching machine or computer assisted instruction (CAI). Students receive immediate feedback of their progress and immediate reinforcement of their performance. Experimental studies in learning performance effectively illustrate Skinner's notion of shaping behavior and achievement performance through reinforcement conditioning.

The concept of reinforcement (effects of reward and punishment on achievement performance) is referred to frequently by Guthrie (1952), who maintains that one learns by assimilating cues to responses. His theory of "contiguous conditioning" has also provided the basis for improving the efficacy of programmed learning. As an example, two conditions necessary for the success of programming auto-instructional devices are to require "active" responding and to "direct" or "guide" the learner to correct responses. The instructional theory of Guthrie and Estes suggests that correct responses may be obtained by massing sufficient cues and presenting them at the same time. The massing of cues tends to direct a student's behavior toward a specific response behavior. These cues (stimuli) become associated with the reinforced behavior (contiguous conditioning) (Hill, 1963; and Klaus, 1964).

The preceding discussion explains how cognitive knowledge is learned. However, the attainment of psychomotor performance skills involves the assessment of praxiological behavior (efficient actions to perform a task). As an example, a lecture provides information as to how one may paint a wall surface. It would be difficult, if not impossible, for a student to conceptualize and master the techniques and processes of painting primarily by oral symbolic exchange, whereas the student who observes a painting demonstration in addition to the lecture might have more success when attempting to imitate or replicate the techniques.

This approach to instruction assumes that learning takes place when the student *responds* to a stimulus in addition to listening and observing. That is, a student may be told or shown how to paint a wall surface, but he does not learn *how to perform* the task until he *actively* responds by *applying* his knowledge.

Whatever the basis for a teaching operation is, chances are that the learner should be able to program his activities to correspond to that operation. A complex skill requires learning in "sets," or one idea at a time. Thus, a program of instruction should organize learning so that it can be acquired sequentially. One theory of instruction provides that the learner start with that which is most familiar so he "learns the new in terms of the old."

The theories of instruction discussed earlier all emphasize that when the learner is led through a sequence of experiences reflecting a body of knowledge, the manner in which the sequence is presented affects the degree to which this knowledge will be mastered. Learning also depends on when and where new knowledge inputs are placed in the sequence. Thus, the appropriate timing and placement of educational treatment will have a significant impact upon the achievement performance and behavior modification of the learner.

Once behavior has been analyzed and a program of instruction is decided upon, teaching becomes a relatively simple operation. Intrinsic motives enter into the picture, to be sure. However, reward and punishment have a definite effect on extrinsic motivation and attention spans as well as on results of learning and performance.

Bruner (1968) states that people get more interested in what they realize they can do well. The need to learn is affected strongly by a sense of accomplishment resulting from a task that has a beginning and some sort of end. The need to excel, to be competent at some skill, is as influential as the need to simply learn. And, even after a skill has been mastered, reinforcement is necessary to strengthen and maintain the skillful behavior.

The theory of education gives one an idea of why a given sequence of events might produce the results it does; the practice of education seeks to maintain a desired activity level to accomplish the results.

Theory affects teacher behavior and performance and, subsequently, affects learning, in that it provides information regarding the nature of each act or stage of learning. Theory also contributes to the development of a practical art that enables the student to form a hierarchical order of learning. In education, as in many other fields, theories have been translated into practice. Recently, educational practices have adopted a systems approach which was first developed in other technological fields.

SYSTEMS TECHNOLOGY AND EDUCATION

As the vast amount of man's knowledge has continued to accumulate, the roles of the formal school and the teacher have become increasingly complex. In existing primitive societies, learning takes place chiefly by example and illustration. Peer-group relations and social interaction play a major role in developing dominant behavior. Mature or adult individuals participate in a limited way, joining the juvenile activity in interaction and by setting examples, but with no attempt to formally *teach* or *instruct*.

In more complex cultures, an abundance of knowledge and skill necessitates a *telling* or *teaching*, sometimes out of the context of that particular environment. Literate societies institutionalize the telling, which may result in a detraction from education.

Educated man must be a socially competent and productive person to enable him to manage and control social-cultural-technological conditions. These goals must be attained if societies are to survive and improve. The purpose of education is to enable citizens of a society to cope with its problems and increase its capacity to cope further as necessary. Skinner (1968) urges that the following steps be taken in designing such an educational system: 1) know what problems will be faced; 2) know what type of behavior will contribute to the solution; and 3) know what kinds of teaching will prompt that behavior. In designing, one also must determine who is to be taught and what, when, and how they should be taught.

Effective diversity of instructional procedures is necessary as different students have different problems to solve and different needs to be met. "A technology of teaching should permit us to diversify environmental histories and increase the range of the mutations from which the cultures of the future will be selected (Skinner, 1968, p. 236)."

The application of systems theory to educational problems may assist educational technologists in more efficiently and effectively assessing societal needs and planning behavioral modification strategies to attain the desired outcomes. The purpose of this section, therefore, is to review general systems theory and, then, show its relationship to curriculum instruction and teacher roles.

General Systems Theory

Systems theory can be considered a basic science concerned with scientific principles to achieve specific goals. The application of these principles to the management (planning, organizing, mediating, and controlling) of systems involves men, machines, materials, and money. The primary purpose of systems research and the application of systems theory is to obtain the most efficient and effective procedures of achieving the primary goals of a program while using existing technological practices and resources.

Systems analysis involves the drawing of computer simulations, flow-charts, and models to graphically analyze relationships among and between the components of the system. Graphic analogs, rather than abstract mathematical models, will provide more efficient analysis, synthesis, and evaluation of systems. The continuous nature of teacher education programs permits systems designers to (1) identify problems and goals related to teacher education, (2) seek alternatives and devise total configuration of the best possible alternatives, (3) implement and maintain an efficient instructional system, (4) evaluate the system and cycle feedback into the system, and (5) review, evaluate, and revise the system. Refer to Figure 7-1 for a graphic model that illustrates the continuous feedback interaction cycle that may be used to develop teacher education instructional systems.

An operational system is one that is designed, implemented, and operated to achieve stated goals most efficiently. Therefore, carefully designed and measurable instructional objectives should serve as the basis to insure effective functioning of the systems approach. After the operational goals have been identified, the next task is the analysis of the components and sub-

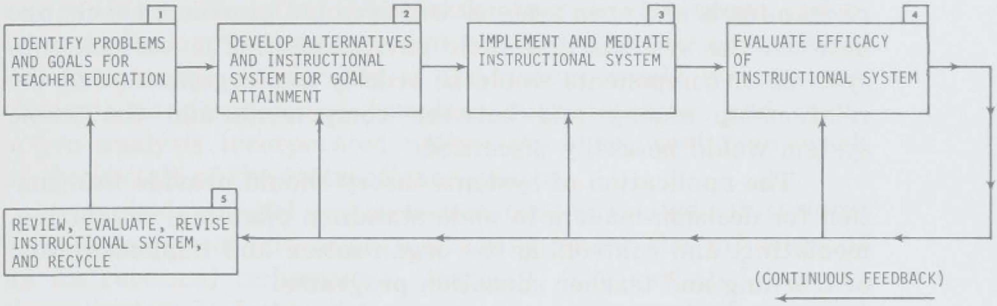

Fig. 7-1. The Application of Systems Analysis to the Development of Teacher Education Instructional Systems.

systems and their function as related to goal achievement. Alternate functional relationships and components may be detailed, and alternatives for goal achievement may be structured.

Systems have other characteristics. They usually consist of a collection of independent but interrelated parts which are maintained in an orderly environment to insure attainment of established goals.

Systems can be characterized as being (1) organized and orderly; (2) comprised of objects, elements, or components, and relationships among and between components and the whole; (3) designed to function as a whole by virtue of interdependence of the parts; (4) synthesized in an environment to accomplish progress to a goal; and (5) possessed of structure, functions, and development (Ryan, 1969).

General systems theory applies to the development and functioning of all systems in general. Systems may be categorized as man-made or natural. A man-made system refers to organizations or structures of related components devised by man, whereas natural systems refer to such phenomena as solar systems, electromagnetic forces, and the human organism (Ryan, 1969). A system may be open or closed. A closed system is one that does not provide for the exchange of components or energies. An open system, however, provides the means for the exchange of energies, materials, or information with its environment.

These theoretical constructs can be applied to the development of teaching and teacher education systems. These would be man-made and open systems which would provide an exchange between the systems and their environment. The various sub-systems or components would be orderly and organized, and the relationship among and between components and the whole system would be easily discerned.

The application of systems theory should provide information for decision-makers in understanding, planning, organizing, mediating, and controlling the organization and implementation of teaching and teacher education programs.

Instructional Systems

Educators are actively involved with personnel systems, administrative systems, curriculum and instruction systems, and various other components or educational sub-systems in their professional activities. Therefore, the term "system" as it commonly applies to education is quite familiar. However, the meaning of the term as it applies to education within the context of systems analysis, is more encompassing and has different connotations.

Education is a systematic process involving the interaction of teachers, students, media, methodologies, learning environments, budgets, and many other components. The mutual relationships among and within these components, as they relate to the educational enterprise as a whole, comprise an educational system. The instructional system, which is the topic of this section, is in reality a sub-system or component of the total educational system.

The principal components of an instructional system are the teacher, students, and instructional materials. The instructional objectives serve as the operational goals for the system and as the referent for the organization and operation of the learning environment. In reality, the teacher's selection of materials, media, and methodologies to achieve the desired terminal performance goals for his students establishes the parameters of an instructional system. The feedback component or phase provides continual evaluative information on the efficacy of the individual components of the system upon which modification and improvement are based.

In this chapter, an operational instructional system is defined as the synthesized and interrelated components of a process within a conceptual framework, insuring continuous, orderly, and effective progress toward a stated goal (Heinich, 1968). Sub-systems, or components of the system, would include such elements as programmed learning, micro-teaching, and interaction analysis incorporated within the conceptual framework of the gestalt of the instructional system.

An instructional system is composed of related sub-systems or components of education interacting under the influence of an instructional technologist (teacher). The mediated instructional system is designed to insure the attainment of specified behavioral performance goals by controlling the influences (stimuli) acting upon the learner and is structured to insure that the learning will occur and that student practices and responses are appropriate to desired outcomes.

Auto-instructional materials, such as programmed learning machines, are examples of instructional media that may be incorporated as an integral part of the instructional system to guide and control student progress in the learning environment. In this connection, theory comes alive, for the student learns by doing with structured guidance and direction, not by random doing or trial and error; he attains successful experience (reinforcement) as a consequence of his actions (response) to the programmed instructional materials (stimuli). Theory further comes alive as one considers the new and developing roles of the teacher.

Figure 7-2 illustrates how a student functions with a programmed learning machine (PLM). Notice that the student is recycled back through the system for clarification of resultant behavior if he fails to attain the desired response.

The Teacher's Role in Instructional Systems

A teacher who establishes a learning environment in order to reach established goals is emulating a manager in business or industry in the sense that he *plans* an instructional process, *organizes*, *mediates*, and *controls* it. He coordinates and integrates the activities of people and physical resources to provide effective and efficient accomplishment of the prescribed objectives of the instructional system.

The identification of the various sub-systems or components of the educational system differs somewhat among educa-

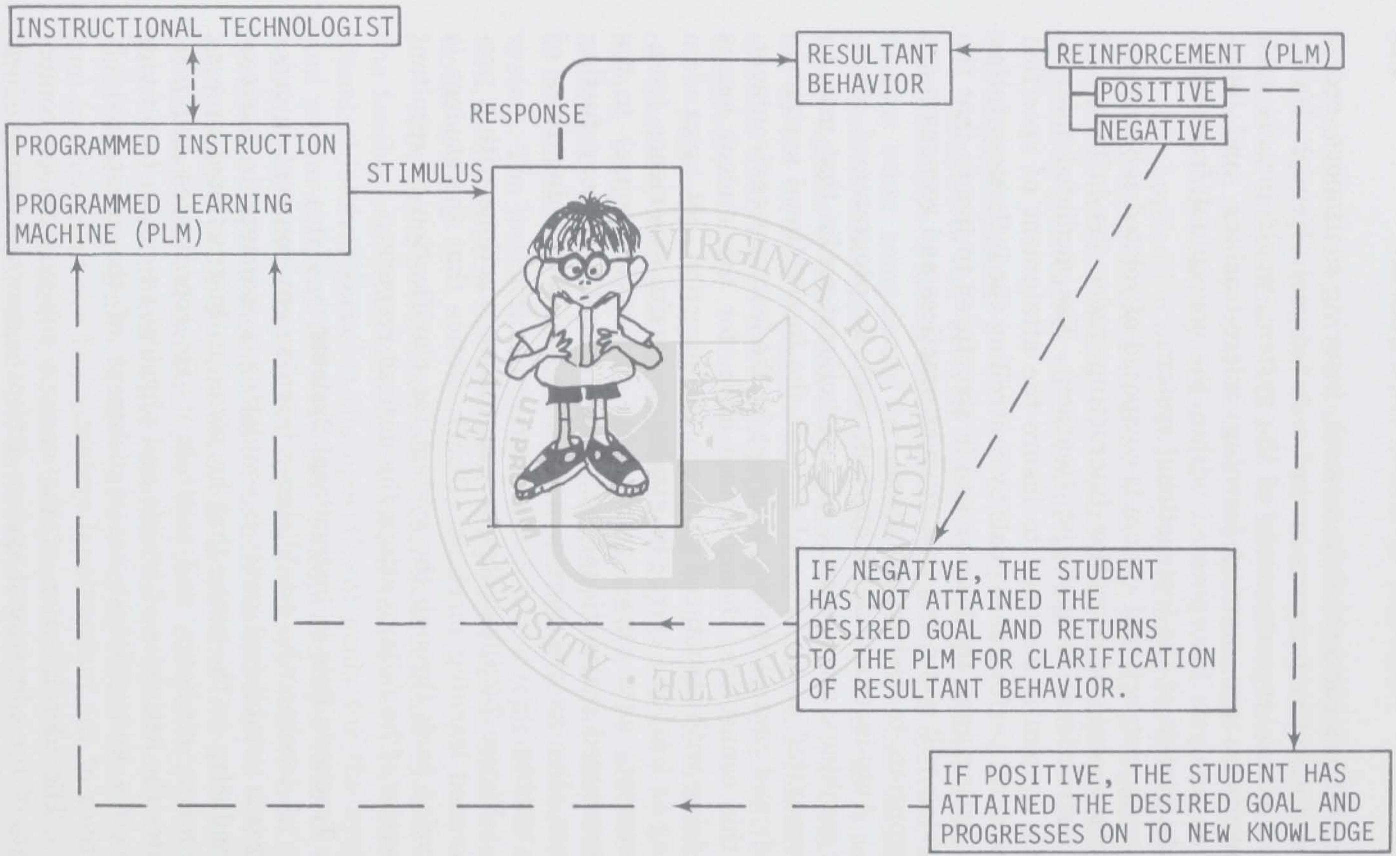

Fig. 7-2. An Operational Analysis of a Student Functioning with an Auto-Instructional Device.

tors. Basically, however, most of the analyses in the literature can be categorized or structured into an "input-process-output" model. The teacher's managerial functions are based on the following elements of the model: (1) *establishing behaviors* exhibited by those entering the instructional program as influenced by social, cultural, genetic, and psychologically imposed conditions; (2) *instructional goals,* the expected terminal performance objectives that students should exhibit after completing the instructional program; (3) *instructional procedures* designed, implemented, and controlled to actuate behavior modification; and (4) *performance assessment* which attempts to evaluate the attainment of the desired or expected behavioral performance. Refer to Figure 7-3 for an operational model of the input-process-output system applied to instruction.

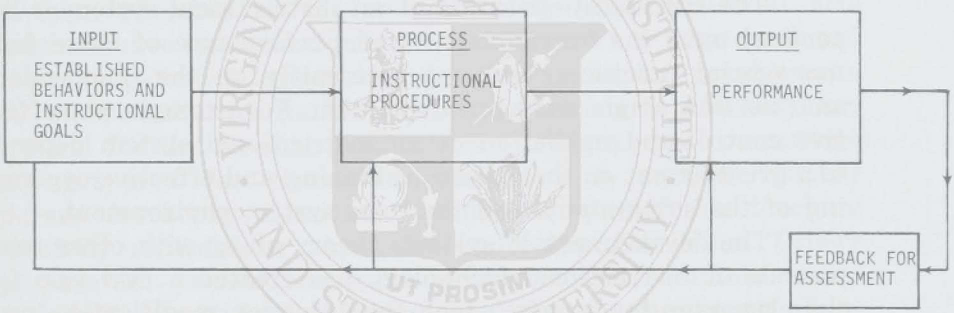

Fig. 7-3. An Input-Process-Output Model Applied to Teaching-Learning Processes.

With the elements of the model in mind, the teacher *plans.* He *formulates* desirable goals and objectives and establishes a frame of reference that provides guidance and direction for subsequent performance — the selection of media, methodologies, learning materials, policies, and programs to achieve the stated goals. In *organizing,* he *creates, structures,* and *supplies* the learning environment to provide effective functional interaction between sub-systems, coordinates resources, and delegates responsibilities that will insure the achievement of instructional objectives and terminal behavioral performance. In *mediating* instruction, the teacher *coordinates* students and resources with component sub-systems to insure the most efficient attainment of expected goals. Guidance, direction, and encouragement are provided by the teacher to improve motivation, readiness, learning set, success orientation, and subsequent achievement performance. When he *controls,* he insures that the functions of components are compatible and are functioning as planned, thus providing an evaluation of the operational performance of the total system. *Monitoring, reporting,* and *correcting* the instructional program provide the necessary feedback that assists in determining whether the learner has attained the specified behavior or goal achievement as planned in the instructional system. This process also provides for the transfer of information within and between individual components of the whole system, thus providing necessary functional communication. As a manager of instruction, the teacher is performing as a professional who is in "control" of the teaching-learning environment.

The successful operation of an instructional system is dependent upon the overall integrated performance of these four managerial functions, and not necessarily on the independent analysis of a single managerial function. For example, the effective control and mediation of an instructional system depends to a great extent on the efficient planning and effective organizing of the sub-systems and the total system environment.

The development of systems theory along with other components of instructional technology has created a new role for the classroom teacher in which the behavior modification process is no longer left to chance. Instructional technology provides the means for more intelligent control of the teaching-learning process.

The teacher's role has changed from a transmitter of knowledge to that of a manager who utilizes management technology to "mediate" instruction. He is a planner, organizer, supervisor, director, coordinator, and evaluator of the teaching-learning process. Not only must he diagnose the needs of society, the community, and the students, he must also prescribe educational treatment, "mediate" instruction, and provide the clarification and reinforcement of behavioral performance.

Instructional programs will also become more individualized to provide educational growth for all children; current educational programs are designed primarily for group instruction. To help attain this goal, the teacher must function as an educational clinician — a behavioral diagnostician, prescriber, and director. Just an an artist provides the guidance and direction of a paint brush on canvas to create an artistic masterpiece, the teacher employs coordinated skills to help children achieve desired goal performance.

Instructional technology will help educational practitioners to be more successful in performing professional tasks to help students achieve their goals. It should be apparent, however, that the tasks described above cannot be effected by one person. Instructional systems and educational technology require the preparation and utilization of specialists who will perform particular functions within the system.

Differentiated Staffing

Instructional technology has provided the catalyst for the division of labor in education. Traditionally, industrial arts teachers have specialized in a technical area. They have developed their competencies in electronics, power mechanics, graphic arts, or other technical fields. Most industrial arts teachers are trained for the secondary school level while a small percentage are prepared for elementary education. A smaller number pursue further professional training to qualify for teaching mentally retarded or physically handicapped children. Others prepare for professional roles as supervisors, administrators, or industrial arts teacher educators. However, the impact of instructional technology on the teacher's role may be such that further changes in the professional preparation of industrial arts teachers regarding areas of specialization will become necessary.

As more emphasis is placed on providing for the educational growth and development of individual children, it becomes imperative that teacher education provide training for the kinds of competencies that will allow the teacher to manage the instructional system. An analysis of four managerial functions of the teacher helps to determine general teacher behavior or performance objectives for teacher preparation.

While all teachers may be trained initially as general practitioners, the professional is cognizant of the need and demand for educational specialists. *Diagnosticians* for example, are needed to analyze the cognitive, affective, and psychomotor performance achievement of children to determine their current level of performance. This task will require the development of techniques, media, and materials that would assist in achieving these desired goals. Educational diagnosticians will need to be knowledgeable in learning theory, sociology, cultural anthropology, philosophy, and psychology to provide a theoretical basis for diagnosis and subsequent prescription of educational treatment.

Perhaps the most effective and efficient manner in which educational technology may be applied to teaching is to incorporate a "clinical" approach as illustrated in Figure 7-4. Experts in substantive areas would be primarily responsible for the development of instructional materials, media, diagnostic techniques, prescription, and methodologies. The industrial arts teacher, therefore, would serve as a member of the clinical educational team. As such, he might receive a prescription for teach-

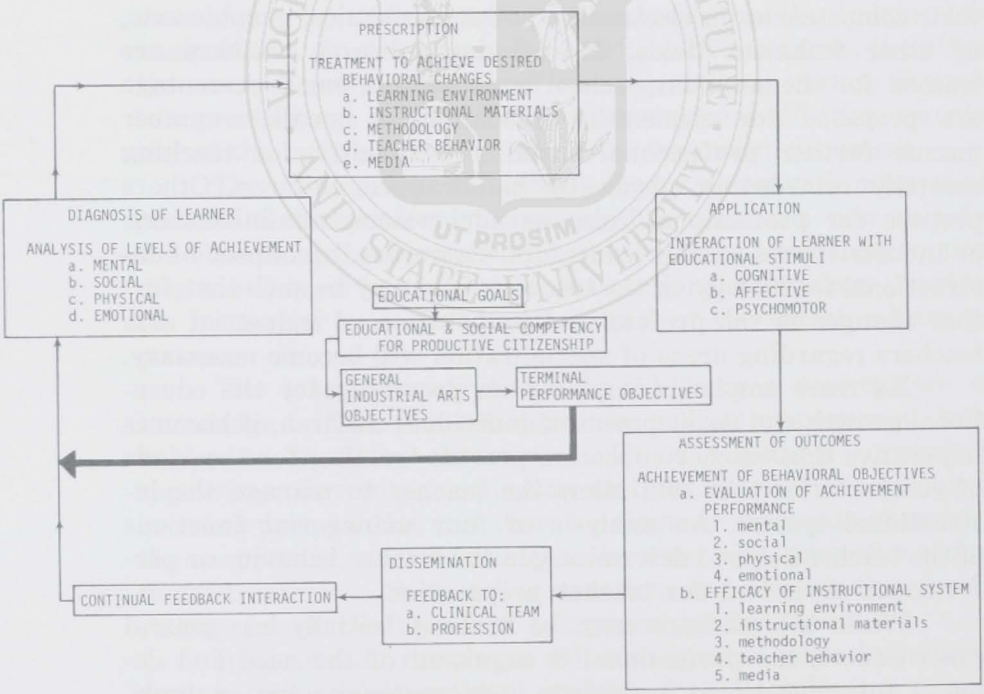

Fig. 7-4. The Functions of a Teaching-Learning Clinician.

ing (educational treatment) which he would apply or integrate in the classroom. Diagnostic assessment of individual terminal behavioral change could be the responsibility of the teacher, whereas overall achievement performance would be critically evaluated by an evaluation specialist. Refer to Figure 7-5 for a schema that may be used by a team of educational clinicians to perform a systematic analysis of an instructional problem.

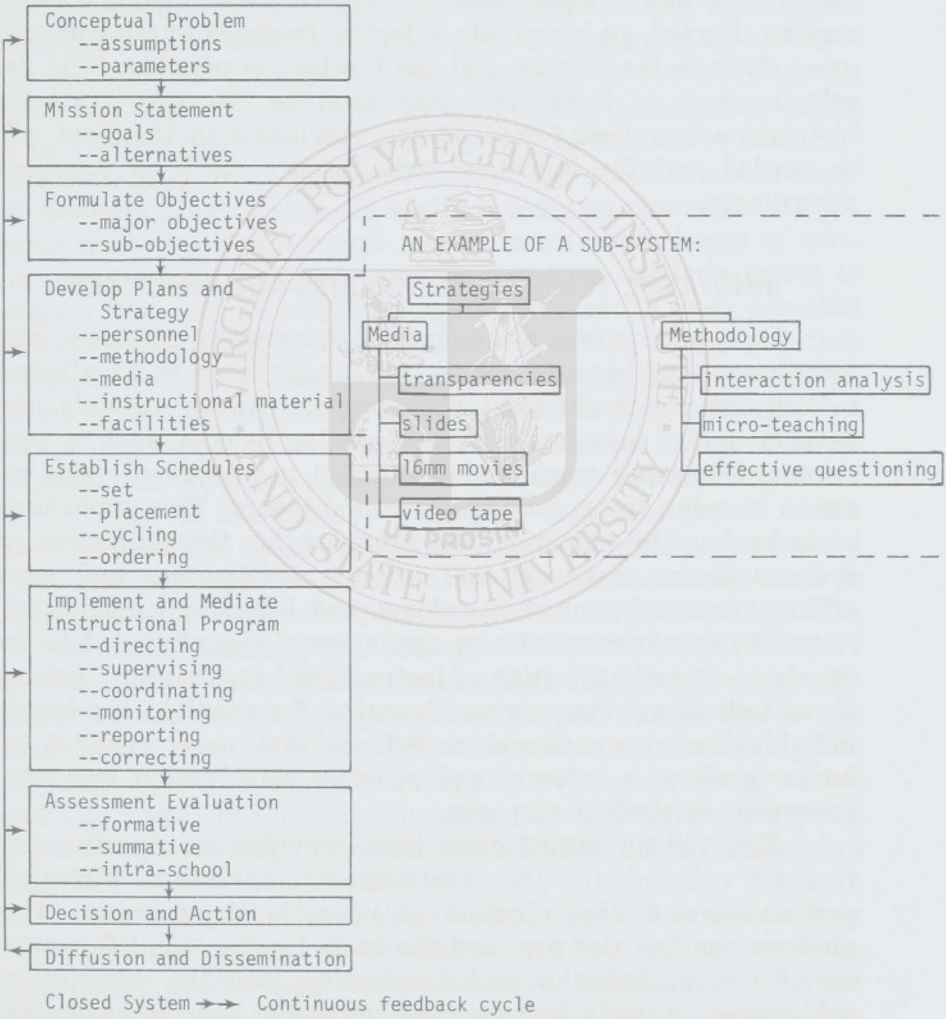

Fig. 7-5. A Model for the Systematic Analysis of an Instructional Problem.

The utilization of auto-instructional teaching devices has led to the establishment of learning centers or resource areas in a growing number of schools. Auto-instructional teaching devices incorporate an instructional program that is based upon an organized body of knowledge. Students may enter the program at their prescribed levels and proceed to complete programs at a rate appropriate to their individual capabilities. Instruction would become highly individualized. A control over the standardization and completeness of subject matter being taught may be effected, an immediate objective feedback of student progress, both to the learner and the teacher, is possible. This developing area of instruction may soon be integrated into an instructional system. Consequently, specialists in the field will be needed and the industrial arts teacher must be prepared accordingly.

INNOVATIVE TEACHING TECHNIQUES AND PRACTICES

In recent years, a number of innovative practices and techniques have been developed and implemented in an attempt to improve the teaching-learning process. As an example, the development of auto-instructional learning devices, such as programmed learning machines, has helped to narrow the gap between learning theory and instructional theory. This application of technology to education has provided for the utilization of systems theory to educational systems development and more efficient transmission of knowledge and behavior modification.

The development of new media has also contributed to the development and utilization of instructional systems and instructional technology. Programmed learning, for example, is a highly individualized instructional experience that uses terminal behavior goals as a referent and provides clarification and reinforcement to student response.

Behaviorally stated goals have provided an objective and realistic referent for the establishment, operation, diffusion, evaluation, and dissemination of educational programs. This phenomenon has also provided the basis for the scientific analysis of teacher behavior and functioning, and the selecting of achievement criteria based on desired goals, and the evaluating of the desired performance objectives.

As systems applications become rooted in instruction, they should be continually modified by increased knowledge of the sub-elements of systems. It is important for instructional technologists to evaluate new developments; therefore, some examples of attempts to put theory into practice are reviewed. Their relationship to instructional systems application in teacher education is obvious.

New media, resources, and techniques have contributed to the improvement of the efficiency and effectiveness of behavior modification systems. But these new technologies are not yet the panacea for educational reconstruction. A number of questions regarding the efficacy of media can be postulated, such as their relative merits in economically providing achievement performance in the most efficient manner. Any medium or technique of mediating instruction can easily become an overused or overrated methodological concept incorporated in the hopes of solving all of education's problems. It is not the writer's intent to suggest that such innovations are insignificant in their potential impact upon learning achievement. However, it appears that too much emphasis could be placed on such techniques as interaction analysis, simulation learning, and the like, primarily because they are new or "innovative" practices without much emphasis on objective data derived by empirical means.

A few of the recent innovations that incorporate media and techniques to achieve specified behavioral goals are reported here without critical comment. It is an insurmountable task to report on all of the contemporary innovative approaches involving media and teaching methodology. Therefore, a representative sample of those innovative practices that consistently appear in literature relative to the professional preparation of teachers is presented. These practices include simulation, structuring behavioral objectives, micro-teaching, interaction analysis, verbal and non-verbal communication, video tape, discovery learning, effective questioning, programmed learning, cybernetics, and computer assisted instruction.

It is recognized that these techniques and practices may be categorized under two headings — performance or teaching skills, and methodology or prescriptive treatment. The first category relates to those skills and practices that are necessary to perform efficiently as an effective teacher. The latter category contains those techniques or media that would serve as the stimulus to elicit the desired teaching skills or would provide the vehicle to help develop the prescribed performance skills listed in the first category.

The scope of this chapter does not allow for a detailed report of related research and the analysis and synthesis of formative or summative evaluation data regarding the efficacy of the innovative practices. In most cases, empirical evidence exists that lends support for the implementation of the technologies reviewed. It is suggested that the reader refer to the bibliography for references to more detailed analyses of the innovative practices and media.

"Mastery Learning," a teaching strategy developed by Bloom (1968), is reviewed in the final part of this section. This description should provide an example of how theoretical bases of learning theory, instructional theory, and systems theory may be incorporated with educational media in the design of an instructional strategy. Please refer to the original report for a more comprehensive analysis of the strategy.

Swanson incorporates some of these innovative practices and techniques in his model of professional courses for teacher preparation in Chapter Eight.

Preparing Instructional Objectives

Educational objectives encompass what must be taught, how to know when it has been learned, and what materials and procedures will best accomplish this teaching-learning situation. The teacher decides on goals to be met and selects content, methods, material, and procedures relevant to the goals. He then applies the subject matter and causes the student to interact with it in accordance with the principles of learning. Finally, he evaluates student performance according to the set goals.

In order to be satisfactorily reached, goals must be stated clearly and unequivocally, preferably in terms of specific performance of behavior which can be observed. Words such as "know," "understand," and "appreciate" are of little value in stating objectives because they are not precise. How does a teacher observe that a student appreciates something? It is preferable to state objectives in specific terms, such as "identify," "list," and "name," that are not open to interpretation. These will specify the kinds of behavior that can be accepted as evidence that the learner has achieved the desired goal. To be still more specific, important conditions under which the behavior should occur can be listed and one may also want to describe how well the learner must perform to be considered acceptable. In other words, an objective should communicate all intended results.

An educational objective should adequately communicate the same intent to both the teacher and the learner. To help accomplish this goal, an instructional objective should have the following characteristics:

1. Describe the student's expected behavior and performance and not the teacher's strategies or techniques.
2. Describe a product — what the student should be like after the individual experience.
3. Describe varying conditions including time, set, and apparatus that relate to the performing of tasks.
4. Specify the acceptable level of performance (tolerance, acceptable error). For example, the apprentice will be able to lay 24 bricks in one hour; or the surgeon will be able to remove an acute appendix without complications eight out of ten times.

In teacher education, objectives need to be stated that refer to the learner's performance of tasks that must be "mastered," and which reflect appropriate behaviors of an effective and efficient teacher.

One determines behavioral performance by observing overt action which may be either verbal or nonverbal; in other words, what the learner can do, or is doing. A learning objective describes such behavior and does not describe or summarize content.

Terminal behavior is defined by naming or identifying the observable act that is acceptable evidence of achievement, as well as describing conditions necessary to exclude acts not acceptable as such evidence. In writing instructional objectives, then, a separate statement should be made for each objective. Thus, the intent of the course will be made more clear to both the teacher and the learner. Mager (1962) recommends putting a copy of the objectives in the learner's hands to facilitate teaching. If a student knows what behavior is expected of him, he is more likely to perform accordingly.

Classifying Objectives

The taxonomy of educational objectives devised by Krathwohl, Bloom, and Masia (1964), classifies educational goals into three domains: cognitive, affective, and psychomotor. *Cognitive* objectives emphasize memory or the recalling of something learned and the application of such knowledge to problems. The individual determines a problem, recalls previously learned ideas, methods, or procedures, and combines or synthesizes it with new ideas to solve the problem. Most educational objectives are in this domain.

The *affective* domain emphasizes emotion, feeling, or a degree of acceptance or rejection. Objectives range from simple recognition of certain phenomena to complex but consistent qualities of conscience and character. Most affective objectives are expressed as appreciations, interests, biases, attitudes, or emotional sets.

Psychomotor objectives emphasize muscular or motor skills, manipulation of objects or material, or an act requiring neuromuscular coordination. The objectives that can be classified as psychomotor relate to handwriting, activities in industrial arts, medicine, dentistry, physical education, home economics, and other fields in which neuromotor activities are necessary.

Extensive taxonomies have been developed for the cognitive domain (Bloom, 1956) and the affective domain (Krathwohl, 1964). Not much research has been attempted in developing a taxonomy for the psychomotor domain until recently (Simpson, 1966).

The attempt to classify objectives was undertaken mainly because teachers and curriculum specialists who state objectives do so according to such categories, making distinctions between problem solving and attitudes, between thinking and feeling, and between acting and thinking or feeling. Furthermore, evaluation of learning outcomes involves appraisal of thinking, feeling, and acting done by students. There is also a definite relationship between the classification of objectives and theory of personality and learning which is evident in dealing with individual students as well as in the interaction between teachers and students.

Each learning domain has its own behavioral variables. For the cognitive domain, the variables are knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom, 1956). The affective domain variables are receiving, responding, valuing, organization, and characterization (Krathwohl, 1964). The variables in the psychomotor domain are perception, set, guided response, mechanism, and complex overt response (Simpson, 1966). As in most instances of categorization, educational objectives are likely to predominate in one domain, but apply as well to others.

Further information regarding the analysis of the three schemata for classifying educational objectives in the three domains may be found in the above references.

Discovery Learning

Often in previous years, teachers of methods courses advised prospective teachers who voiced fears of being asked questions which they could not answer to reply, "I could tell you that Johnny, but if you look it up, you'll remember it better." This minor procrastination was, whether the educators realized it or not, either a forerunner of, or a simple explanation of the discovery method of learning.

Most proponents of learning by discovery refer to it as an hypothesis. Discovery is said to be a necessary element or condition for learning which involves problem solving, transforming or transferring information, and learning how to learn. The hypothesis is that "practice in discovering for oneself teaches one to acquire information in a way that makes information more readily viable in problem solving (Bruner, 1961, p. 26)."

Four benefits are said to accrue from discovery learning: greater intellectual potency, intrinsic motivation, memory processing, and the learning of the heuristics of discovery. Students can discover on their own, drawing from the history of their experience, and then relate this discovery to known concepts in order to solve problems.

Discovery learning can help to improve inquiry skills in which the importance of retention is not emphasized as much as the importance of thinking. Instead of being spoonfed ideas and information to be recalled on demand, students develop the cognitive processes at the same time that they are formulating new concepts. However, rote versus discovery learning is not the only issue involved in the hypothesis. Other problems arise, such as the ratio of student-teacher control regarding the rate and order of presenting stimuli, inductive versus deductive learning, and the effect of individual differences on interaction. Also of significance are the teacher's use of verbal abstractions, the separation of independent and dependent variables, and operational definition of terms. Finally, it must be determined how rules, principles, and more specific information are to be presented to students, and how rules and generalizations are to be taught.

Learning by rote limits the situations in which the learned information can be used. Bruner (1966) suggests that there are six elements to be considered in teaching a child to transfer knowledge.

1. The child must be instilled with a positive attitude, with the definite feeling that he can extrapolate related information and interpolate unrelated material. He must recognize material he has learned as an occasion for moving beyond it.
2. The child shows "compatibility," in that he approaches new material in such a way that he fits it into his own frame of reference, makes it his own, and uses it in a way compatible with what he knows.
3. Get the child activated and busy at the task of solving his own problems, with enough reward to prompt further thinking.
4. The child needs practice in the skills related to the use of information and problem solving with the teacher using psychology and heuristics to help him master these skills.
5. The child uses the "self-loop" method, as he turns around on his own behavior and reflects on it, so that he discovers what it is he has been doing and puts his discovery to further use.
6. The child learns to engineer his discoveries, to retrieve and combine information in an appropriate setting. "Contrast" is an example of this sixth element. By ex-

> ploring contrast, the learner can organize his knowledge to promote discovery where it is needed, providing him a choice among relevant alternatives.

The question of who determines the rate and order of presenting stimuli is relevant to the discussion of discovery learning. The consequences for learning will be different when the teacher selects the order in which questions and materials are considered than when students do so. Yet, the teacher is not the sole guide to the student's exploration. Other students can also contribute.

The above suggests a reason why the discovery method is far more successful in group interaction than in dealing with one individual. There are more surrogate teachers and there is a competitive, challenging, and appreciative audience.

The discovery approach requires the student to work at getting involved in things. It requires extra intellectual effort, creates an attention-getting environment, and increases the student's problem-solving expectancy. It helps to eliminate passivity and gives the student a latitude and freedom which may encourage him to actually like school. Nevertheless, the utilization of discovery learning can be a drawback. To begin with, some children have neither the motivation nor the attention span and endurance necessary to tease out a simple idea. Impulsive children may face frustration from repeatedly jumping at the incorrect answer. Those of lower mental ability may face frustration when encountering failure to synthesize and draw conclusions.

The effects of the discovery method upon achievement, retention, and transfer of technical skills and practices have been studied by a number of researchers in industrial education (Ray, 1957; Grote, 1960; Rowlett, 1960; and Tomlinson, 1962). The reader may want to refer to these doctoral dissertations for information relative to the directed discovery method and industrial education.

Effective Questioning

Taba (1962 and 1964) maintains that the questions a teacher asks have an important and profound effect on relationships between the critical areas of teacher competence, materials development, and the cognitive tasks identified with the development of critical thinking.

The method of inquiry used is a most influential teaching act. The teacher's questions set a focus that circumscribes the students' mental operations, points of exploration, and the modes by which they learn. Structured questions can also determine the extent to which students can accommodate dissimilarities in perception and cognitive skills.

Taba puts forth three process concepts which she feels preservice teachers should be taught thoroughly. First, an attempt by the teacher to raise the level of thought very early in a discussion usually results in the students returning to a lower level of thinking and an inability to sustain discussions at a higher thought level. Next, a constant change of focus will also result in an inability to sustain a certain thought level. The students' thought will alternate between several levels and eventually settle at the lowest level. Finally, teaching strategies should adhere to creating a model for thinking, lest the children acquire faulty or unproductive conceptual schemes and, thus, fail to organize information or solve problems.

Sanders (1966) has developed "a taxonomy of questions" based on Bloom's taxonomy of educational objectives. Bloom's (1956) categories of thinking encompass all intellectual objectives in education and are named *memory, translation, interpretation, application, analysis, synthesis,* and *evaluation.* Students can be taught to think through use of questions in each category. The memory type question requires the student merely to recognize or recall information with no need to compare, infer, or relate. In translating, the student uses one of several forms of communication other than the form presented, e.g., when the student is told to tell something "in your own words." In interpreting, the student finds relationships between facts, generalizations, definitions, values, and/or skills. Application questions give practice in independent use of knowledge and skills in that they present problems to be solved that resemble life in form and context. The analysis category requires solution of problems in the light of conscious knowledge of the parts and processes of reasoning. Synthesis encourages creative, original thinking by posing questions that can be answered in many ways; it distinguishes the line between convergent and divergent thinking. Evaluation requires two steps: first, appropriate standards or values are set up; then the student is presented with an idea or object and he must determine how closely this idea or object meets the standards or values.

Sanders suggests that the order in which the categories are named creates a sort of hierarchy, with memory being lowest and evaluation the highest level of questioning. The categories are sequential and cumulative, each having unique elements and, at the same time, including some form of all lower categories.

Too often, teachers rely solely on memory questions and thus stifle the intellectual climate of the classroom. Equal or more balanced use of all categories provides a useful standard in efficiently evaluating instructional materials being used. Furthermore, critical thinking includes all thought processes beyond the memory category, so it is the teacher's responsibility when composing questions, to develop students' critical thinking skills by offering plentiful experiences in each category. Students can develop higher levels of behavior in industrial arts by responding to teacher-structured problem-oriented questions that require them to evaluate and synthesize knowledge such as when creating a design solution for an automobile or a camping lodge.

Questions need not be classified in any one specific category to be good questions. The categories are arranged not unlike the colors of the spectrum; between each category is an area that is neither one nor the other, but a part of both. Questioning can be simple or complex within the same category, depending on the grade level being taught and the mental ability of the students.

Three factors which enter into determining what kind of thinking is brought about by questioning are the nature of the questions, the amount of knowledge possessed by the student, and the amount of instruction received. Concerning the nature of the question, a certain kind of question leads to a certain kind of thinking. Then, each student possesses a different amount of knowledge of the subject matter at hand and will be able to answer different types of questions accordingly. Finally, the amount and type of instruction received greatly affects the kind of thinking required. Questions asking "why" and "how" can prompt students to figure out answers interrelating parts of knowledge or practices to form a conceptual "whole" rather than simply remembering individual pieces of information.

Linguistic Behavior

Bellack (1966) has studied the teaching process through analysis of the linguistic behavior of teachers and students. He feels that most classroom activities are carried on by using language and, in his study, he attempts to describe the patterned processes of verbal interaction that characterize such activities. He also develops a theoretical view of classroom verbal behavior which serves as the basis for the system of analysis used to describe linguistic events in the classroom.

The elements studied by Bellack to determine the meaning of communication in the classroom were (1) what the student or teacher was *saying,* (2) what happened *pedagogically* while he was saying it, and (3) the *feeling, tone,* or *emotion* of the communication. Classroom discourse is compared to a game in that it is a social activity in which the players (teachers and students) fill certain roles. Also, there are certain ground rules to be observed by the participants. Bellack categorizes the verbal "moves" of the players in terms of the pedagogical functions they perform in the classroom. The categories number four:

1. *Structuring:* These moves focus attention on subject matter and launching student-teacher interaction. Structuring moves set the context for subsequent action and are effectively used to begin a class period.
2. *Soliciting:* These moves are designed to elicit response and may be in the form of solicitations, commands, imperatives, and requests.
3. *Responding:* These moves occur only in relation to soliciting moves; they fulfill the expectation of solicitation.
4. *Reacting:* These moves are not directly elicited by the three previous moves or another reacting move, but are occasioned by such moves. They shape classroom discourse by accepting, rejecting, modifying, or expanding what was previously said.

The above moves occur in certain patterns during a class. These patterns may be designated as "teaching cycles." Cycles begin with a soliciting move, or *initiating* maneuvers which get the cycle started. Responding and reacting moves are *reflexive,* unsolicited, and therefore unable to begin a cycle.

In addition to being able to describe classroom discourse in terms of pedagogical significance, analysis of this discourse reveals four types or dimensions of meanings represented by the content of the messages communicated in the classroom.

1. *Substantive* (with associated) meanings refer to subject matter, i.e., specifies concepts and generalizations.
2. *Substantive-logical* meanings refer to the cognitive processes used to deal with the subject matter, e.g., defining, interpreting, or explaining.
3. *Instructional* meanings refer to assignments and other routine classroom procedures that are part of instruction.
4. *Instructional-logical* meanings refer to didactic verbal processes such as positive and negative evaluating.

Bellack's study of language in the classroom begins with the assumption that the primary function of language is the communication of meaning. He has discovered that this language is used in a constant "game" in which pupils and teachers follow a consistent pattern of language rules common to all classrooms.

Nonverbal Behavior

Galloway (1968) believes that it is as important to study nonverbal interaction as it is to study verbal interaction. Admittedly, it is not as easy to observe nonverbal behavior and determine its meaning. It is difficult to categorize nonverbal behavior, since nonverbal messages are often elusive or vague. However, nonverbal communication does take place and such communication is likely to be informative as regards data relevant to the classroom situation.

Anthropologists, sociologists, and psychologists all agree that there is much to be learned from careful study of nonverbal behavior. The anthropologist sees the value of this study as a contribution to the study of the acculturation process. Sociologists are concerned with an analysis of role behavior and performance, and psychologists are interested in the emotional and attitudinal content of interaction.

Researchers agree that there are four major factors common to human communication: a sender, a message, a channel, and a receiver. The sender has information he wants to convey; he puts the information in the form of a message and uses a carrier or medium (the channel) to transmit the message. The channel includes the verbal and nonverbal skills of the sender and the sensory skills of the receiver. When the receiver decodes and interprets the message, the communication cycle is complete. If the receiver answers, the cycle begins again.

Because words can be arbitrary and are merely symbols (sometimes with several possible meanings), nonverbal symbols are important in communication. Tone of voice, facial expression, gestures — all of these help clarify the meaning of words used, and therefore, help interpret the sender's purpose.

Not all nonverbal expressions convey actual feelings, but may supplement verbal symbols. Students observe nonverbal signs to check the validity of a teacher's verbal statements. If there is a discrepancy between the emotions elicited by the two expressions, the student will most often accept the nonverbal sign as representative of the true message.

Since communication does not consist entirely of verbal messages, the teacher should remember that what he communicates nonverbally will help determine how a pupil interprets the message sent by the teacher. The need to accept, modify, or eliminate nonverbal behavior is a relevant subject of inquiry in teaching.

Galloway presents a nonverbal communication model in which encouraging communication and restricting communication each have six aspects and are on a continuum. Figure 7-6 is a schema of the nonverbal communication model.

Congruous-Incongruous refers to discrepancies which occur between a teacher's verbal expression and his vocal tone and gestures. Congruity means that the teacher's verbal statement is supported by his nonverbal behavior. Incongruity indicates that nonverbal symbols contradict oral expression.

TEACHER INITIATED COMMUNICATION	TEACHER RESPONSE
CONGRUITY - INCONGRUITY RESPONSIVE - UNRESPONSIVE POSITIVE - NEGATIVE AFFECTIVITY	ATTENTIVE - INATTENTIVE FACILITATIVE - UNRECEPTIVE SUPPORTIVE - DISAPPROVING

Fig. 7-6. Schema Based on Galloway's Nonverbal Communication Model.

Responsive-Unresponsive refers to the teacher's reaction to pupil response. A teacher who alters the lesson when he detects pupil misunderstanding performs a responsive act. Unresponsive acts occur when the teacher ignores pupils' behavioral response.

Positive-Negative Affectivity. Positive nonverbal expressions convey warmth, enthusiasm, and acceptance whereas negative nonverbal expressions portray aloofness, indifference, or rejection.

Attentive-Inattentive refers to the willingness of the teacher to pay attention to the pupil. Inattentiveness restricts communication and attentiveness encourages it.

Facilitative-Unreceptive. A teacher facilitates learning by responding positively to pupil needs. An unreceptive act is one in which these needs are ignored.

Supportive-Disapproving refers to expressions which show strong approval or disapproval, praise or punishment.

Galloway's study indicates the importance of including observations of nonverbal communication in interaction analysis as well as the need for an instrument to effectively record observation results.

Interaction Analysis

Although it may seem impossible to study teacher-pupil interaction because of the varied social forces in the classroom, researchers have found such interaction can be classified into specifically definable behavioral acts, both verbal and non-verbal. There are several systems of interaction analysis, the most popular one being that devised by Amidon and Flanders (1963), commonly known as Flanders Interaction Analysis. This system is concerned only with verbal behavior, not only because it is more readily and more reliably observed than nonverbal behavior, but because the developers assume that verbal behavior adequately represents an individual's total behavior.

In the Flanders system, all statements made by the teacher are classified as either direct or indirect. If the teacher is direct, he *limits* the freedom of the students to respond. If the statement (or question) is indirect, he *maximizes* the student's opportunity to respond. The system also increases the meaningfulness of total classroom behavior by placing classroom talk into three categories — student talk, teacher talk, or silence and confusion (anything happening which is neither student talk nor teacher talk).

The Flanders system is designed to be used by a trained observer as a research tool in collecting reliable data concerning classroom behavior. It is effective as an inservice training device and can be used by a teacher educator or by a teacher observing another teacher or observing a recording of his own classroom behavior.

The categories of interaction analysis are summarized, placed on a chart, and numbered. Every three seconds during the actual class or videotape presentation, the observer writes down the number of the category he has just observed.

Under the heading of *teacher talk, indirect influence,* the observer notes behavior in one of three categories: (1) accepts feeling — a nonthreatening position in which negative and positive feeling are recalled; (2) praises or encourages — release of tension; and (3) accepts students' ideas — students' ideas or suggestions are clarified, expanded, and developed. The second section of the chart is behavior known as *teacher talk, direct influence.* These categories are: (4) asks questions — intention is to have the student answer the questions; (5) lectures — facts are given, rhetorical questions asked; (6) gives directions — student is expected to comply with orders or commands; and (7) criticizes or justifies authority — intention is to change student actions to acceptable behavior, includes scolding, self-reference, and self-explanation. The third division is *student talk:* (8) student talk-response — statements from the student are elicited; and (9) student talk-initiation — observer must determine if student wanted to talk if teacher calls on student. The last category (10) is silence or confusion — communication cannot be understood by the observer.

For a comprehensive summarization chart, refer to Amidon and Flanders (1968, pp. 26-27). Needless to say, the observer must be completely familiar with such a chart in order to write approximately twenty numbers per minute. Also, the observer should spend a few minutes orienting himself to the situation before he begins categorizing and must pay particular attention to the ground rules put forth by the developers of this technique.

Simulation

Cruickshank (1968) offers simulation as the solution to the imbalance between foundational (learning theory) and instrumental (learning through practice) experiences in teacher preparation programs. Simulation is a technique which creates realistic games under controlled laboratory conditions to provide participants with life-like, problem-solving experiences related to their future or present work.

Simulation has been used in such areas as flight training, war games, business, and industry. In education, simulation was probably first used successfully in driver training. Cruickshank's laboratory materials provide a simulated classroom wherein practice is provided in solving critical teaching problems presented on film, through role playing, and in written incidents. This procedure aids preservice and inservice trainees to combine theory and practice in relation to such elements as student behavior, relationships with parents, individualizing instructional materials, evaluation, and motivation. The laboratory allows for the participants, among other things, to:

1. Assume the role of beginning teachers.
2. Have access to and the use of related information and materials which are professionally appropriate.
3. Have many and frequent opportunities to solve critical problems of beginning teachers.
4. Be exposed to a variety of potential solutions to particular problems.
5. Consider possible consequences of their behavior in solving problems.

While using the Teaching Problems Laboratory developed by Cruickshank, a participant assumes the role of the teacher, is presented with an incident — a teaching problem — and is required to do the following six things:

1. Identify the problem.
2. Identify forces and factors affecting the problem environment.
3. Locate pertinent information.
4. Project alternative courses of action available.
5. Select a "most desirable" course of action.
6. Communicate and implement a decision.

Examples of the problems presented are "feeling uncomfortable about giving failing grades," "not knowing what to do with students who finish work early," and "unhappy with classroom clerical work."

After analyzing the problem individually, the participant meets with three other participants to discuss projected solutions and, finally, a large group session explores the problem further. Additional examples of experiences for participants are constructing tests, meeting parents for conferences, preparing behavioral objectives, and using sociograms.

The advantages of simulation are many. Possibly the greatest is the opportunity to test alternatives without the expense and bother of using a real situation where experimentation with actual students may prove costly in many respects. Simulation also provides the preservice teacher with an opportunity to try out his ability as a planner, organizer, mediator, and controller of the classroom many months, or years, before he enters the public schools as a teacher.

Micro-Teaching

Micro-teaching is an innovation in teacher education in which a miniature teaching situation is created under controlled conditions. The situation replicates an actual teaching act. It has the advantage that, unlike real situations, the micro situation can be easily controlled and manipulated, and feedback regarding teachers-in-preparation is immediately available. Allen and Young (1969) advocate this method because it provides teaching interns with immediate and individual diagnostic evaluation of teaching performance by colleagues and supervisors. Progress in specific teaching techniques can be measured. Use of the videotape recorder in micro-teaching is strongly recommended, since it provides for immediate and effective feedback.

At first glance, the purposes of micro-teaching seem manyfold. It breaks down the complex act of teaching into simpler components so that the student teacher can understand it more readily and adapt himself more easily to the beginning teacher role. It provides practice in an actual classroom setting. It provides knowledge of the teaching world which may help a student determine if teaching should, indeed, be his chosen profession, by exposing him to the actual task long before completing a full program and soon enough for him to alter his educational pursuits if he decides teaching is not for him. All of these actually add up to a dual purpose for micro-teaching: (1) to provide optimum opportunity for prospective teachers to obtain pre-service training by practicing teaching under controlled conditions, and (2) to provide effective pre-internship training.

Micro-teaching allows the trainee to focus on one specific aspect of teaching and master it before proceeding to another. Bush and Allen (1968) identify nine skills which are developed by micro-teaching. These skills, which are not actually exclusive, are regarded by experienced teachers to be primary components of teacher training.

1. Establishing set — the teacher sets up rapport, or positive set, with the students. There is a definite correlation between establishing set and effectiveness of the lesson.
2. Establishing appropriate frames of reference — this presents the material to be taught from several points of view and deepens the students' understanding of the lesson or concept being taught.
3. Achieving closure — closure complements set induction in that it relates new ideas to those already known and understood by the students.
4. Using questions effectively — the student teacher views videotapes of skillful questioning after being instructed in the principles of skillful questioning techniques. Hopefully, he thus learns to ask factual, conceptual, thought - provoking, discussion - stimulating, heuristic questions.
5. Recognizing and obtaining attending behavior — the intern learns to recognize visual cues of pupil response and becomes sensitized to them so that he can alter his teaching behavior accordingly.
6. Control of participation — interns must practice to gain insight into pupil-teacher interaction and relationships. Such insight helps the student teacher to analyze and control the use of accepting and rejecting remarks, positive and negative reactions, and patterns of reward and punishment.

7. Providing feedback — feedback is "knowledge of results." There is much information of resulting behavior in a micro-lesson which provides the embryo teacher with some assessment of his performance.
8. Employing reward and punishment (reinforcement) — effective reinforcement is a powerful tool employed in the teaching-learning process. The student can assess his ability to use this when he reviews the videotape of his performance as a teacher.
9. Setting a model — observation enables the intern to analyze and imitate model teaching behavior which effectively elicits appropriate student response.

A representative sample of a micro-teaching session might read as follows: The intern prepares to teach a single idea, a self-contained lesson, within a brief period of time, usually five to ten minutes. He presents the idea to a micro-class in the presence of an evaluator who operates recording equipment. Sometimes the evaluator records his observation during the actual micro-teaching. After re-play of the videotape, during which the micro-teacher, micro-class, and evaluator all record their observations, comments, and criticisms, a discussion is held in which the micro-teacher may be the first to make recommendations for change and/or improvement.

One apparent drawback, a type of Hawthorne effect in reverse, is refuted by advocates of the micro-teaching system. They maintain that the micro-teacher is no more affected by the presence of recording equipment than he is intimidated by unfamiliar surroundings and situation during the initial days of practice teaching.

Micro-teaching helps refute the outmoded idea that a teacher only needs to know his subject well to be able to transmit knowledge of it to his students. Although one cannot perceive micro-teaching as *the* answer to all problems of teacher education as some people have suggested, it has become, and will probably continue to be, an integral and essential part of preparing teachers.

Videotape

The use of videotape in teacher preparation is increasing rapidly because it provides immediate feedback and is adaptable to such other technological aids as computers and random-access retrieval systems. In addition, technological development and cost reduction have made it possible for most schools to acquire videotape equipment.

One advantage of videotape is "recall" or comparison. The pre- or inservice teacher can record several sessions, if desired, at various time intervals, and is able to observe change in techniques and student response. Teachers can thus test their perceptions of students, observe growth patterns, and see more clearly what is involved in classroom interaction. Also, a cumulative record of the intern's performance over a long period, a semester for example, is available.

Supervisors of student teachers benefit greatly from videotaping. In the case of great traveling distances and overcrowded schedules, the supervisor may be able to view a recording of the student without having to attend the actual session. Furthermore, the supervisor and trainee can view the tape together and discuss techniques used, behavioral responses, and other elements involved in the teaching situation. As the tape is viewed, the supervisor can reinforce the teacher in positive instances of teaching behavior. He can also stop the tape, rewind it, and/or view certain sections repeatedly to implement certain behaviors. Best of all, he does not need to rely on his memory to serve him until he has the opportunity to meet the student teacher for a critique session.

Videotaping can also be used for self-appraisal of student teachers, for supervising teacher observation of student teachers, and for observation by other student groups. Videotapes are also convenient for the teacher educator to be able to illustrate a point visually rather than lecturing on it. The proverbial 1,000 words are capsulized by means of videotape so that if a teacher wants to demonstrate how to handle a particularly disruptive student, for example, he may be able to go to the videotape library or information storage bank and choose several clips to illustrate examples of successful and non-successful behavior related to handling such a situation.

Videotapes can be made into kinescopes and distributed to other institutions. This raises the possibility of an exchange program for the purpose of sharing particularly valuable situations. This may be especially applicable within a certain curriculum area. In industrial arts, for example, successful teaching techniques and practices could be beneficially shared.

Student teachers apparently receive videotape of their fledgling efforts most favorably. They see in it a means of developing self-confidence as teachers before beginning to teach.

Like micro-teaching, probably the loudest criticism of videotape recording is that it may not present a true picture of the classroom situation, since both trainee and student performance may be affected by the presence of recording equipment. There is no evidence that this effect would be any less in the presence of a supervising teacher whose observation and recording techniques are further distorted by the human element involved. Furthermore, increased streamlining and sophistication of equipment make it fairly unobtrusive. For example, Allen and Young report that the unit developed at Stanford University is portable, with all the components installed in a 20″ x 30″ wood and formica cart mounted on casters. "The vidicon camera is mounted on a removable board which sits atop the cart. The recorder is mounted in the bottom of the unit and is connected to a patch panel on the top desk. The unit also contains a small 5″ monitor, a mixer-compressor-amplifier, and a wireless microphone and receiver (Allen & Young, 1969, p. 84)."

The unit has been designed so that an undergraduate student can set it up for recording in four minutes. The recording system is relatively unobtrusive because of the absence of hanging microphones, special lighting, and multiple cameras.

Programmed Learning

Programming is the blending of what the student reads or sees (input) with his response to sequential questioning (output). The learner can progress at a rate appropriate to his individual ability; he receives information in a carefully ordered sequence and with a continual high rate of reinforcement. Skinner (1968) believes auto-instruction provides a great deal of reinforcement for all children rather than occasional reinforcement for a few.

In *linear* type programming, using a simple teaching machine, all students get the same material but proceed at their own rate. Here the reinforcement rate is kept high and the error rate low. Each bit, or frame, deals with one fact or piece of information or relationship. The *branching* type of programming allows for different directions as well as different rates of learning. Branching programs usually use multiple-choice type questions and refer the student to further work depending on his answers. Both branching and linear programming take psychological theory into consideration. They allow for individual differences and provide immediate feedback to the student. But, judging from a review of the research, branching appears to be the favored method.

Hardware for self-instruction ranges from simple slide projectors with materials arranged sequentially to an elaborate instructional station connected to a high-speed computer (CAI). Programmed instruction does not replace the teacher. Rather, it increases the teacher's responsibilities in that he must play a role in planning educational objectives which machines will help achieve. In addition, this type of automation creates new positions of employment. For example, a possible new employee in the school may be an educational technician who will help with the operation, application, and maintenance of teaching machines.

Programmed self-instruction requires a specific statement of behavioral objectives which cannot, because of the nature of auto-instruction, include social objectives such as "stimulating others" or "learning to interact with others." It is difficult to develop self-instructional materials that effectively shape problem-solving behavior because such behavior is not readily observable and, further, the reinforcing effect of using effective problem-solving procedures is not usually evident immediately.

Cybernetics

The principle of behavioral cybernetics involves human engineering analysis in which the processes of sensory feedback are utilized in behavior control. Performance and learning are analyzed in terms of the central relationships between a human operation and an instrumental situation. Learning is determined by the nature of the behaving individual as well as by the design of the learning situation.

Cybernetic theory views the individual as a feedback system which generates its own activities in order to detect and control specific stimulus characteristics in the environment.

Cybernetic research analyzes the intrinsic mechanisms which establish controls and which are controlled as in closed-looped sensory feedback mechanisms. These closed-looped mechanisms define the interactions between the individual and his environment. By contrast, conventional learning analyzes relationships between extrinsic events, stimuli, reinforcements, and observed responses — on an open-loop basis.

In addition to representing a difference in research strategies, the difference between closed- and open-loop analyses reflects a fundamental difference of opinion concerning the regulating factors in behavior and learning. Conventional learning theory holds that learning is defined by the occurrence of external events in appropriate temporal relationships. Cybernetic theory states that learning and all other aspects of behavior organization are determined primarily by the nature of the feedback-control processes available to the learner, thus requiring the design of the learning situation to fit the control capabilities of the learner.

Computer Assisted Instruction (CAI)

The model which illustrates the cybernetic theory is Computer Assisted Instruction (CAI) which has been called "one of the more promising tools of the educational revolution (Stanley, 1969, p. 24)." CAI is broadly defined as the use of computers in the human learning situation. More specifically, CAI seeks to provide for individualized instruction by storing instructional programs in a computer. The student interacts with these programs by means of electronic interface devices. The programs can be simple or complex in structure and include a broad range of subject matter.

Although CAI is still in its early stage of development, research reports indicate that students learn as well with CAI as with conventional instruction, if not better, as regards achievement and retention (Bundy, 1968). The computer program allows for logical decisions in adjusting to individual student differences regarding a learning sequence, depth and mode of material, and progress rate. A vast quantity of information can be collected concerning the student, such as sequence of learning steps, response time, number of errors, and the like. Audio-visual aids can be integrated into the computer program to enrich it and motivate students. At the same time, it can reduce some of the tedium a student may encounter. Students relate well to the computer in this technological age, especially since a number of them can use it simultaneously even when physically removed from the computer by some distance.

Learning time in CAI depends on several factors, but mainly on the number of student responses required to meet the established course criteria and on the attention span of the individual. Learning effectiveness depends on such factors as student ability, acceptance of the program and machinery, student error, age of students, and student response. Learning laboratory procedures can be greatly facilitated by using a computer.

So much for the advantages of CAI. Needless to say, the cost of such a program will be prohibitive in many school systems. A separate school laboratory is necessary to house equipment and trained technicians should be in attendance for operation and maintenance. Direct costs have been estimated to be about $500,000 for the hardware and building and a like amount for curriculum development. These figures do not include the costs of previous research and curriculum development.

Even if the device were not so expensive, there are other problems in the use of CAI. Technologically, it is a powerful tool for gathering and manipulating data but, pedagogically, it reveals little or nothing about learning or how learning occurs.

Some schools will, perhaps, associate themselves with CAI in order to satisfy "faddists" in the community or administration, and not for true educational pursuits. These and all school systems must be made aware of the kinds of skills required of personnel involved and the kinds of commitments necessary. Extensive further research in CAI is necessary, along with periodic professional assessment of such research.

Mastery Learning

Bloom (1968) believes that about 90 percent of students can master a subject under consideration, but it is the task of educators to find a means to this goal of mastery. One of the main problems of this task is to determine individual differences and relate them to the teaching-learning process, a formidable task when one considers the increasing emphasis on education for all in American society. Educators, therefore, must not only determine what skills and subject matter can be learned by the greatest percentage of a given age group, but must also provide for continuing education for our work force. In order to maintain an effective continuing education program, formal schooling should be interesting and rewarding to provide incentive for further continuous learning at a later time.

Because he believes in equal education for the majority, Bloom does not accept the normal curve as a valid indicator of average achievement. He presents Carroll's theory that, given enough time, all students can master a task. Bloom believes that this theory has fundamental implications for education, since Carroll says that aptitude is the amount of time required by the learner to attain mastery of a task. In other words, aptitude predicts the rate, rather than the level of learning that is possible. Thus, everyone can conceivably master algebra; however, some students will need a lifetime to do so, whereas some may take only a few months. This occasions the problem of finding a way to reduce the amount of time required by slow learners to eliminate the prohibitive aspect of mastering a task. Aptitude is not stable but may be modified by environmental and educational experiences. Most effective learning conditions, then, can reduce the above-mentioned time, sometimes significantly.

Quality of instruction has much to do with making the learning experience meaningful. Carroll defines quality of instruction as "the degree to which the presentation, explanation, and ordering of elements of the task to be learned approach the optimum for a given learner (Bloom, 1968, p. 4)." Students need different amounts and degrees of examples, approval, reinforcement, and/or explanations. Bloom stresses that the quality of instruction should be considered in view of its effect on individuals rather than groups of learners, and urges further research on the kinds and quality of instruction needed by various types of learners.

Verbal ability and reading comprehension play a major role in one's ability to understand instruction, particularly to understand the nature of an appointed task and the steps to be followed in learning it. Teachers need to modify instruction to fit the needs of their particular group of students. Small group learning procedures and tutoring often aid in such modification. Textbooks, workbooks, programmed units, audio-visual aids, and games are all useful in helping the student to improve his understanding of instruction.

Perseverance means that the learner is willing to spend the amount of time necessary to learn something. A satisfying state of affairs will probably increase a student's perseverance; conversely, discouragement and frustration will breed discontent and prompt the learner to give up learning a task before it is mastered. The more a student is afforded the opportunity for effective instructional resources, the more apt he is to master a subject sooner, and the more apt he is to persevere.

Time spent on learning is the key to mastery, according to Carroll. Thus, students must be allowed the time they need (individually) to learn. The low correlation between final grades and the amount of time spent on homework suggests that time *alone* does not account for the level of learning. Nevertheless, consideration of school organization problems must take the time element under advisement.

In attempting to coin an ideal strategy for learning mastery, Bloom advocates one which supplements regular group instruction with diagnostic procedures and alternative instructional methods and materials in order to bring a large proportion of learners to a predetermined achievement standard. In using this approach, the instructional staff at the University of Chicago has tried to bring the majority of students in experimental groups to a mastery of a subject within a calendar period allotted for that course. Bloom's report states the preconditions necessary for this strategy, operational procedures required for it, and some of the outcomes.

The University of Chicago group is still in possession of only limited evidence of the results of this strategy, particularly since it is comparatively new. Evidence already gathered, however, shows much success. Difference in the mean performance of a group learning a subject in 1965 without this strategy and one in 1966 employing the strategy (same level students and same subject matter) represent about two standard deviations, a highly significant difference.

"Mastery must be both a subjective recognition by the student of his competence and a public recognition by the school or society (Bloom, 1968, p. 11.)" The student is afforded reinforcement of the fact that he can cope with the task before him when there is both subjective and objective evidence of the mastery. It is known that students usually develop a liking for a subject they master, but will not pursue an area in which they perform poorly. Self-concepts will be raised by assurance of competence in the form of reward; indeed, says Bloom, one's mental health is greatly improved by frequent and objective indications of self-development. Mastery learning is powerful enough to insure mental health to the point of promoting continual learning throughout life.

At the time of the publication of the report from which the above information was abstracted, plans were being made to incorporate the ideas as a chapter in a new book — Bloom, Hastings, and Madaus: *Formative and Summative Evaluation of Student Learning*, McGraw-Hill. The reader may wish to refer to this publication for a more detailed discussion of mastery learning.

SUMMARY

There is a need to structure an instructional system to improve the preparation of teachers. The purpose of this chapter was to review sociocultural conditions which affect learning and some of the theoretical principles of learning. Also reviewed were systems analysis, instructional theory, strategies, and innovative practices that apply to the development of a paradigm for teacher preparation. It was not the intent of this writer to prepare a model program for teacher preparation, but to develop a theoretical conceptualization of the major components or subsystems which may become part of a paradigm.

The primary "elements" of an instructional program are general and may apply to all instruction, whether it is for the preparation of teachers, electricians, or physicians. Nevertheless, the elements of an instructional program must also be specific enough to be of value and use. In determining the nature and input of an instructional program, one must identify, structure, and classify what abilities or technical performance skills a teacher must be able to perform. One example of a comprehensive analysis of skills of teachers was completed by a consortium of colleges of education (Saxe, 1969). Although their study was primarily concerned with developing education specifications for elementary teachers, the information generated could serve as a referent for the development of teacher education guidelines for all levels and subject areas.

A continuous systematic analysis of teaching and educational praxiology can provide teacher educators with educational specifications for the preparation of teachers. Perhaps one way to approach this problem is to determine the major responsibilities of the classroom teacher, such as determining what subject matter should be taught at a particular time to a child with certain capabilities during a certain stage of his psychophysical maturation. This would require tasks listed under major categories such as determining subject matter, overall instructional objectives, diagnosing of the child's capabilities (maturation, needs, interests, past achievement performance), and preparation of specific terminal performance objectives for an individual child or, possibly, a group of children (input). This information may be utilized as a referent for the selection of treatment of instructional activities, including selection and implementation of media, materials, strategies, and techniques (process). Instructional treatment must then be implemented, behavioral changes observed, and then assessed (output) with feedback information (evaluation) recycling through the system for continual interaction. See Figure 7-7 for an operational model of this system.

Within each of these major headings, there would be sublevel behaviors that may be further divided and analyzed. These are the behaviors that will be utilized to determine the terminal performance objectives for teachers in training. Such behaviors may be taught, maintained, and improved utilizing some of the innovative techniques and practices previously discussed.

Pedagogists have been criticized for failing to provide practical application of theoretical knowledge to the real world. Whereas developments tend to move rapidly from the science laboratory to direct application in industrial production, this efficient diffusion is generally not found in public education. Application of theory to practice in the schools must begin to move more rapidly if society is to achieve improved excellence in education.

Research, development, and dissemination activities in teacher education are needed to help improve existing programs.

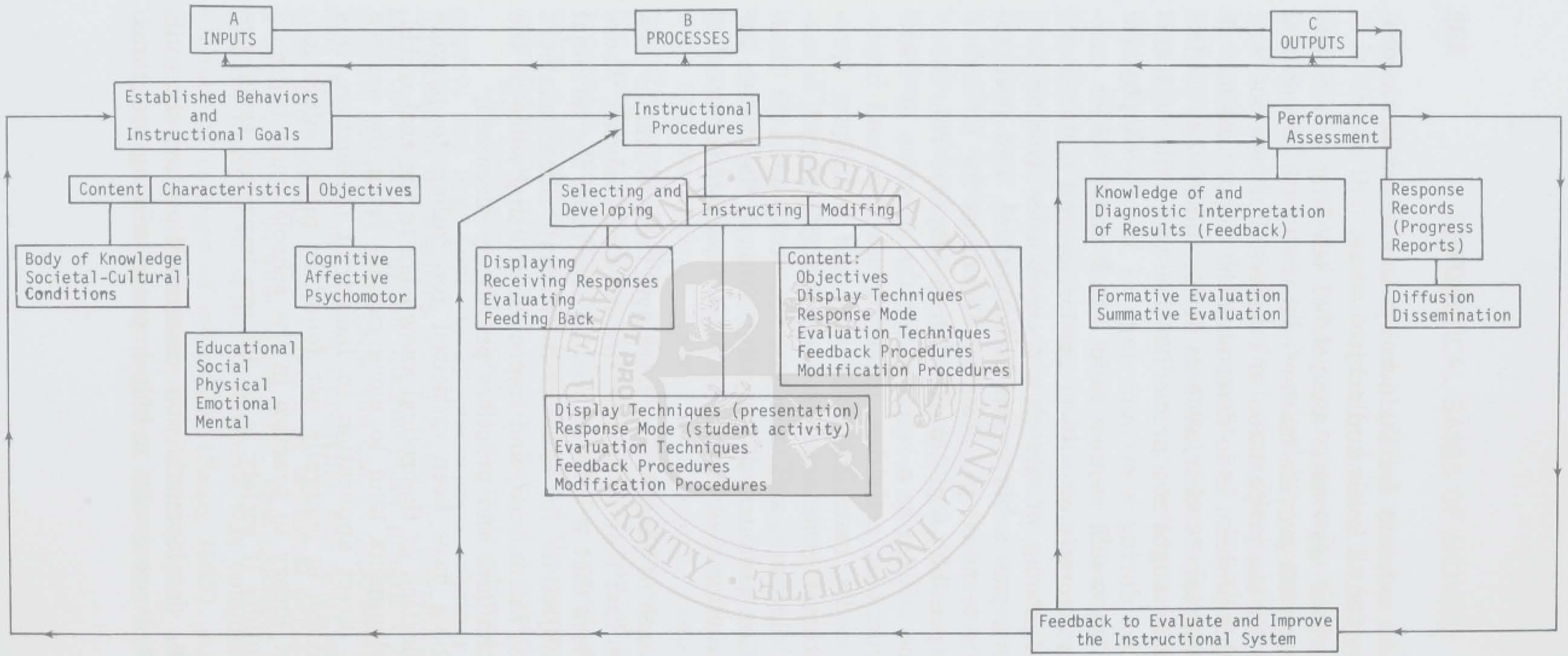

Fig. 7-7. An Operational Model for a Teacher Education Instructional System.

The preparation of more efficient and effective educational practitioners will, hopefully, increase man's accumulated knowledge and, also characterized in Figure 7-8, modify and improve his societal conditions.

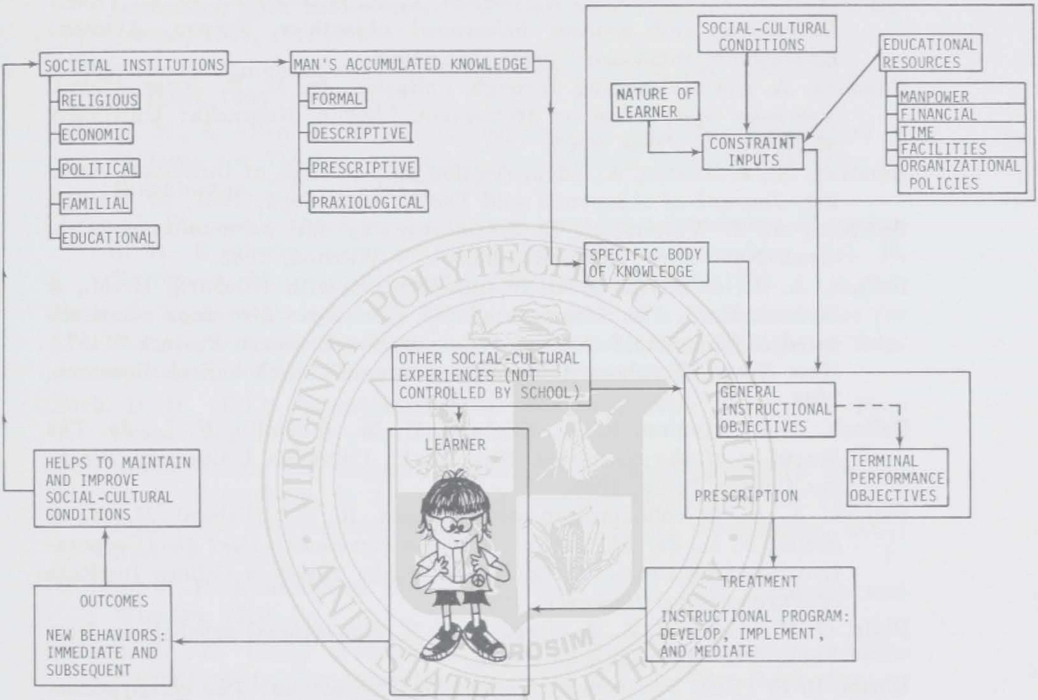

Fig. 7-8. A Model Depicting the Continued Social Interaction of Man, Education, and Society.

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CHAPTER EIGHT

Elements of Instructional Method

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What does a teacher do? Why does he do it? How should he do it? What are the results? The previous chapter provides a theoretical base to answer these and other questions conceptually. This chapter applies the preceding concepts as they should appear in the professional course sequence of an industrial arts teacher education program.

PROFESSIONAL COMPETENCIES OF TEACHERS

There are two major components of this chapter. The first is the identification of the specific professional competencies required of the industrial arts teachers we wish to prepare, and the second is the specification of course content along with the sequence of the program. The presentation is detailed enough to characterize accurately the proposed professional preparation of teachers. The list of suggested readings at the end of this chapter provides additional resources for the teacher educator who wishes to implement the proposed teacher education professional sequence.

PUBLIC EDUCATION IN THE U.S.A.

The value of the systems analysis approach to the many problems and tasks in society and education has been established. Although it promises to increase effectiveness and efficiency, the process is of little value without a prevailing value structure to guide it. Even advocates of the systems approach are careful to point this out.

The prevailing value structure affecting public education and most private education systems in the United States is the

"American Creed." Basically, this creed professes an essential dignity and quality of all men, and a government for and by the people. The fundamental American Creed has enormous implications for the structuring of an educational system. The concern for individuals is paramount. This contrasts sharply with educational systems of societies where the people exist for the state.

The constant guidepost of the American Creed is needed to develop educational systems that do not strip away notions of equality and respect for the individual. The philosophy of a school system and/or the goals of a school system are essentially a confirmation of the American Creed.

Industrial arts teachers should receive a solid understanding of the foundations of education. A separate "Foundations of Education" course for all teachers in training and subsequent reinforcement in the subject area methods courses seems appropriate.

UNDERSTANDING INDUSTRIAL EDUCATION

An understanding of the goals of public education is a prerequisite to establishing a logical school curriculum and the goals of any one dimension of the curriculum.

In the preparation of industrial arts teachers, it is our professional responsibility to discredit the petty bickering that exists between industrial arts, vocational-industrial, and technical-industrial educators. The logical commonalities of the three areas rather than the differences should be stressed.
This should be done:

1. to eliminate wasteful use of potentially productive professional energy.
2. to encourage industrial arts teachers to participate in developing articulated programs of occupational education for the students they serve.
3. to broaden the occupational horizons of the industrial arts teachers in training.
4. because the content source is the same.

The first step in achieving the above is to conceptualize the field of industrial technology from which these areas derive their content. Several models have been reviewed in previous chapters. Figure 8-1 portrays one tenable model.

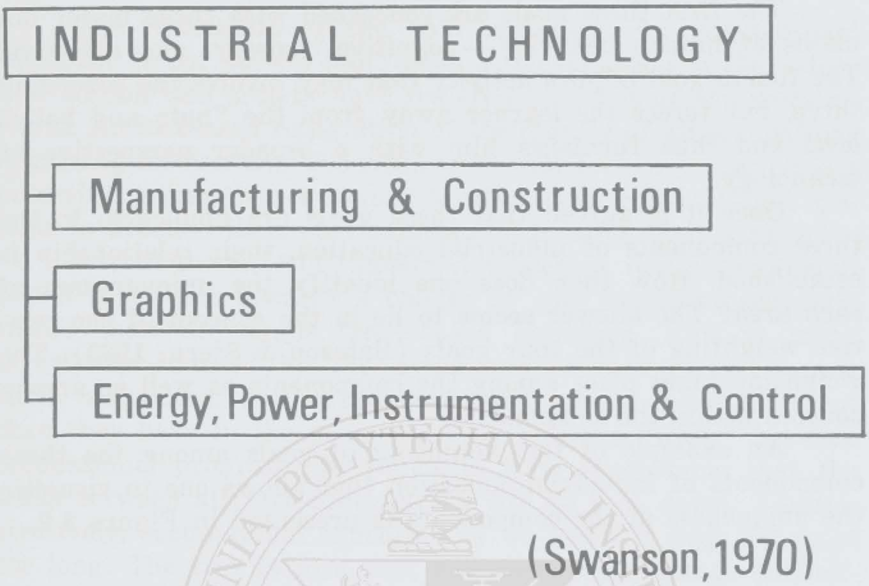

Fig. 8-1. A conceptual model of industrial technology.

The second step is to establish clearly the meaning of the eclectic term, industrial education. This generic or umbrella term includes the three instructional areas of industrial arts, vocational-industrial, and technical-industrial education. The third step is to establish and teach a set of goals of industrial education, and from these goals demonstrate the relationship of the three components. The criteria for establishing the goals of a field of education are rather straightforward. They should not conflict with the goals of the institution (American Creed), should be unique to the field of study, and finally, should be adaptable to change. For example, a set of goals for industrial education that seems to fit the criteria is:

The goals of industrial education are to teach or provide for students:

1. Contemporary industrial-technical *information.*
2. Contemporary industrial-technical *skills.*
3. Positive *attitudes* toward industrial-technical work.
4. A *broad* understanding of contemporary technology and of man's relationship to it. (Swanson, 1970, p. 3)

The first three goals are concerned with three major domains of human behavior — cognitive, sensory, and affective. The fourth goal implies activity that may involve the preceding three, but forces the learner away from the "nuts and bolts" level and thus furnishes him with a broader perspective of technology.

Once it is agreed that these goals are applicable to the three components of industrial education, their relationship is established. How then does one identify the uniquenesses of each area? The answer seems to lie in the concept of the relative weighting of the four goals (Bateson & Stern, 1963). The weighting takes place among the components as well as among courses within the components.

An example of the weighting of goals among the three components of industrial education that allows one to visualize the uniqueness of the components is presented in Figure 8-2.

	6th Grade Ind. Arts	12th Grade Ind. Voc.	13th Grade Ind. Tech.
Goal 1 - Information	15 %	25 %	50 %
Goal 2 - Skills	15 %	50 %	25 %
Goal 3 - Attitudes	20 %	15 %	15 %
Goal 4 - Broad	50 %	10 %	10 %

Fig. 8-2 A hypothetical example of weighting of goals in industrial education.

DEVELOPMENTS AFFECTING INDUSTRIAL ARTS

Legislative developments have affected the relative weighting process described previously. The implementation of the Vocational Education Act of 1963 caused an emphasis on goals one and two in industrial education. The subsequent criticism of the utilization of these monies has suggested that not enough emphasis has been placed on the third and fourth goals.

The realization of the void and need for occupational education in our society has forced a re-evaluation of the values that schools and society have fostered in terms of the working world. An increased recognition of the dignity of all occupations is gaining momentum. The realization that formal education is a necessity rather than a luxury is also forcing educational systems to broaden their curriculums and to alter their strategies.

Within the field of industrial education, occupational education is moving towards a cluster or core model presentation rather than the single trade-based approach. This is being principally induced by the dynamism of technology. Course titles, sequences, and enrollments will appear very different than they have in the past. Not only will the "walls" between occupational programs be removed, it is conceivable that the walls between all curriculum areas will be torn down. Administratively, occupational education as we know it may not exist for long. The two factors that will speed this change in individualizing industrial education are increased sophistication in the pyschology and the technology of learning. Teachers in training should be prepared for these changes, both in their conceptualization of the educational process and in their attitudes toward change.

THE NEEDS OF LEARNERS

One can observe different sets of parents who use completely different patterns of behavior in raising their children and yet "all" nourish vibrant, mentally, and physically healthy children. Sets of parents may seemingly use identical strategies with some succeeding and some not. These phenomena exist among teachers, too. There are good "democratic" teachers and poor ones. There are good "authoritarian" teachers and poor ones. There are good "laissez faire" teachers and poor ones. This reporter has observed "good" teachers in all three categories.

To generalize that the "best" teachers are democratic teachers seems quite naive. The democratic style of teaching probably best fits our societal value structure but doesn't preclude the fact that teachers exhibiting authoritarian and laissez faire patterns can be equally effective. Belabored discussions over the relative merits of the democratic, authoritarian or laissez faire (or equivalent classifications) methods seem to miss the mark in terms of fundamental psychological learner (human) needs.

If the teacher is sensitive to the fundamental psychological needs of the learner, the probability of the maximum amount of instructional achievement for the maximum of learners will increase. The very basic psychological needs of the learner that can be fostered by the teacher are the need for:

1. Love
2. Consistency
3. Respect

The lack of love, or strong positive concern, between the teacher and learner is a real problem in public education today. Many practicing teachers who once had such a feeling for their students and who lacked the professional competencies necessary to effect desired changes in them, have lost their "love" for students. They have done so out of their own frustration. In order to rationalize their poor performance, teachers begin to make generalizations such as; "Students don't care," "It's not like when I was in school," and so on. With the teacher emotionally sterilized, the resulting student concerns about being handled like an "IBM" card are legitimate.

In terms of the concept of consistency, there is less concern over whether a teacher is "democratic" or "autocratic" than as to the consistency of his behavior. Mild symtoms of schizophrenia develop in both the teacher and learner when the "manager of the educational system" constantly changes his approach for no apparent logical reason. Instructional efficiency and effectiveness are diminished greatly without consistency.

The third concept, respect, is probably the most difficult and elusive for a teacher to interpret. This reporter sees the concept of respect as a part of love, but because of the many psychologically destructive things done under the guise of love, it should be discussed separately. It is ironic that for years educators do not allow students to make decisions themselves; e.g. when to go to the bathroom, and then suddenly thrust adult responsibilities upon them. This is frustrating for the young. An understanding of learning theory (Principles of Learning) can contribute to the development of the professional behavior of respect for the learner.

The three concepts, love, consistency, and respect, need to be revealed and reinforced to students who are preparing to teach industrial arts. Traditional in-depth course work in human growth and development and learning theory, in addition to content and first-hand experiences in the industrial arts methods courses are necessary for transferral of these concepts.

PRINCIPLES OF LEARNING

To the neophyte student of learning theory, there appear to be a great many conflicting or unrelated hypotheses as to how people learn. The summation of a first experience in this area usually results in an "interested, but confused" attitude.

Scholars in the field of learning theory understand that the final word is not at hand and that much more research must, and will, be done. In the interim, the practicing teacher needs to synthesize the latest theories and research into a set of principles of learning to guide his professional behavior. These logically and/or empirically based principles should be a guide for many of the professional decisions needs in an instructional system.

Several psychologists have synthesized the learning theories and research for practitioners. Blair (1967) of the University of Illinois has developed one such synthesis. These principles of learning are presented in outline form and are accompanied by a brief interpretation by this writer. A preview of this material and references suggested in the bibliography at the end of this chapter should prove helpful.

The Principles	An Interpretation
1. We learn to do by doing	The learner must be "active" - usually in the cognitive, sensory and/or affective domains. Teachers should be aware of the behaviors they wish students to achieve and be able to select appropriate instructional activities to insure active participation.
2. We learn to do what we do (and not something else)	Students who learn to solve numerical equations will not necessarily be able to solve mathematical word problems. Teachers cannot assume transfer of knowledge or that students can perform Task #2 just because they can perform related Task #1.

3. Without a sufficient stage of readiness, learning is inefficient and may even be harmful	Nothing is to be gained in starting children on tasks for which they may not be emotionally, intellectually or physically prepared. Knowledge of the growth and development and evaluation of the learner is vital in determining readiness.
4. Without motivation, there can be no learning at all	Motivation of the learner is affected by many sources - society as a whole, the home, a friend, the teacher. The teacher structures the instructional system to capitalize on, or counter, these sources.
5. For effective learning, responses must be immediately reinforced	Students need feedback as to the acceptability of their behavior. Positive reinforcement is most effective in the long run. It has been found that although negative reinforcement alters specific behavior, it creates undesirable side-effects in many cases.
6. Meaningful responses are better learned and longer retained than less meaningful responses	Meaningfulness for the teacher and learner may be two different things. The teacher-selected coffee table project for an 8th grade student is perceived differently by the student than the student-selected skate board. Using 18th and 19th Century tools, materials and processes is less meaningful to the student than using 20th Century tools, materials and processes.
7. For the greatest amount of transfer of learning, responses should be learned in the way they are going to be used	Whenever possible, students should be subjected to intellectual, attitudinal, and sensory experiences that most closely represent the tasks they will ultimately perform in the adult world.
8. An individual's responses will vary according to how he perceives the stimulus (situation)	The influence of a specific situation on a person depends on what that situation means to him. For student "A" the gym class is a threat and the English class a challenge - while the opposite feelings may exist for student "B."
9. An individual's responses will vary according to the classroom atmosphere	More than anything the teacher controls the social climate of the classroom. His every verbal and non-verbal behavior sends messages to students that affect the learning atmosphere.

10. Every person always does the only thing he can possibly do considering his physical inheritance, his background of learning, and the present forces that are acting upon him	A student's reactions to a given situation are determined by the composite of experiences he has had. The anti-social behavior of a student telling a teacher to "go to hell" in front of his peers is not a simple outburst of disrespect but an accumulation of positively and negatively reinforced behaviors.

These ten principles, if understood by the teacher, provide the basis upon which to make decisions in planning instruction. They also serve as a guide to his own behavior and for understanding student behavior while instructing.

INSTRUCTIONAL SYSTEM

Chapter Seven provides the theoretical base for a systems approach to education. If teachers in training are to implement a systems approach, teacher educators need to build a rational argument for its use. The efficiency and effectiveness discussion of a systems approach from the previous chapter is especially appropriate. The need for a systems approach can be reinforced by examining a simple paradigm. Industrial arts teachers in training who relate their personal experiences to such a paradigm (Figure 8-3) can generally agree that the majority of the courses they have taken seem to be based only on the "selection of activities" and "activities" portions of the system. Some criticisms of non-system courses are that the goals verbalized by the teacher do not seem to relate to the instructional activities and that tests do not seem to relate to the instructional activities.

Once the importance of the systems approach has been established it is imperative to establish the specific relationships between all the elements of the system. Hopefully the relationships between the societal values, public school goals, and goals of industrial education have already been established for the reader.

The next functional relationship to convey to teachers in training is the logical development of an articulated sequence of courses that meet the educational-occupational needs of the students to be served. The courses should support a conceptual breakdown of industrial technology as suggested in Figure 8-1;

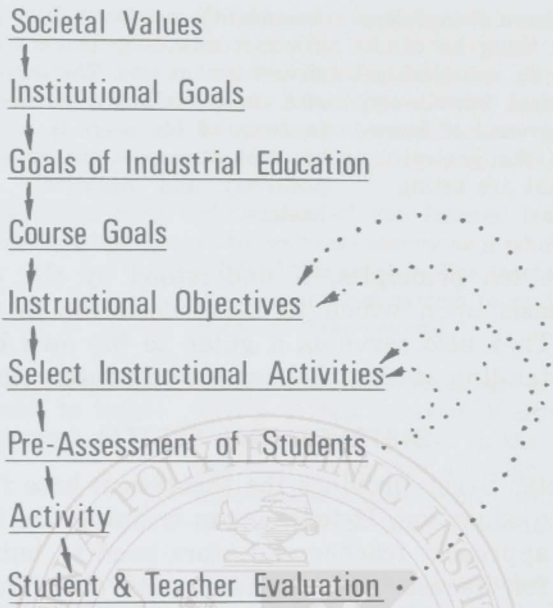

Fig. 8-3. A paradigm for a single course instructional system. (. . . = feedback from evaluation that may give cause to make adjustments that relate to the group or to individuals)

and from this could be developed meaningful course sequences. One tenable junior high school course in the sequence could be "Introduction to Manufacturing and Construction." The goals for the "Introduction to Manufacturing and Construction" course would be spin-offs from the goals of industrial education. It would be necessary for them to be stated in more specific terms and then weighted to provide meaningful direction to instructional decisions that must be made. An adaption of the four suggested industrial education goals presented earlier in this chapter for the "Introduction to Manufacturing and Construction" course could be to teach or provide for students:

1. Contemporary manufacturing and construction *information* (15%).
2. Contemporary manufacturing and construction *skills* (15%).
3. Positive attitudes toward manufacturing and construction work (20%).

4. A broad understanding of contemporary manufacturing and construction technology and man's relationship to it (50%).

The weighting process indicated provides a check on internal consistency. If the goals are properly weighted, then the percentage of time in various instructional activities should also bear the same relationship to weighting of evaluation criteria. Figure 8-4 portrays these relationships.

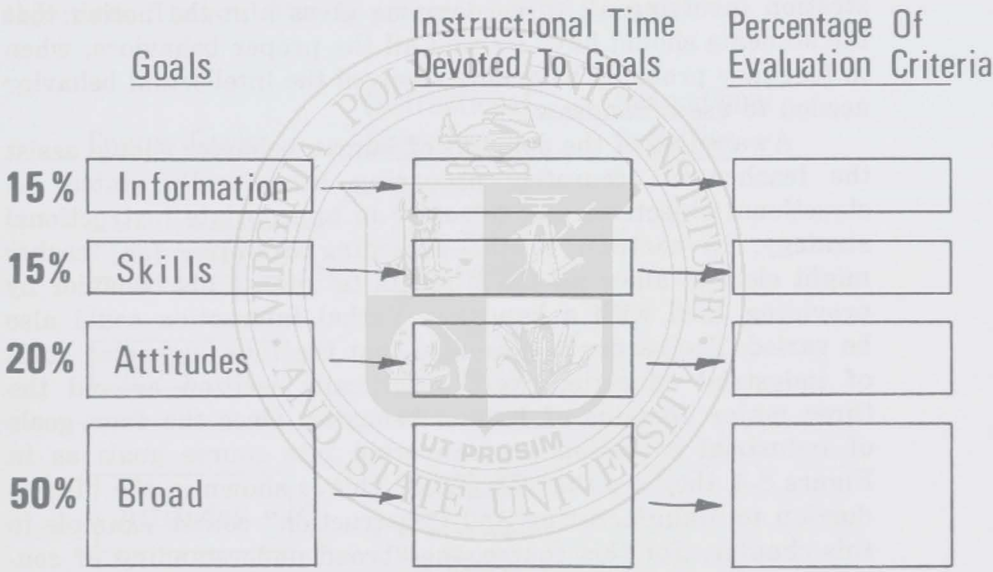

Fig. 8-4. Scheme indicating use of goal weighting and its relationship to instructional activities and evolution.

Once the more general course goals and their weighting have been established, detailed instructional objectives can be written. Instructional objectives are prepared in behavioral terms with an indication of the level of proficiency the learner should be be able to demonstrate (Mager, 1962, pp. 44-63). Since objectives should be stated in behavioral terms, it is imperative that the teacher be aware of the domains of human behavior.

The three major domains of behavior that industrial arts teachers are concerned in altering in their students are:

1. Cognitive (the intellect).
2. Sensory (the senses).
3. Affective (the attitudes).

The lack of professional knowledge of these domains in this area has created many anxieties on the part of the teacher and learner. A simple example of this is as follows: The teacher who gives a ten-minute demonstration on the handsaw to his class of twenty students can become very frustrated if he is not aware of the domains of human behavior. His active demonstration involving all three domains gives him the notion that the students should have learned all the proper behaviors, when in fact they probably have only received the intellectual behavior needed to use a handsaw.

Awareness of the domains of human behavior should assist the teacher in accurately preparing behaviorally stated instructional objectives and to select an appropriate instructional strategy. In contrast to the preceding example, the teacher might elect to allow all the students to imitate his behavior by providing each with a handsaw. Verbal interaction could also be varied. The reader is reminded that the four suggested goals of industrial education were specifically written around the three major domains of human behavior. Once the four goals of industrial education are converted into course goals as in Figure 8-4, they are then weighted. This is shown in the "Introduction to Manufacturing and Construction" course example in this chapter. For this course, the "broad understanding of contemporary manufacturing and construction technology and man's relationship to it" goal was most heavily weighted. One of many acceptable instructional objectives for this goal could read as follows:

Given a detailed model of a structure, each student will be able to list all the five conceptual stages in its construction.

For the same course one acceptable objective for the "contemporary manufacturing and construction information" goal would be:

Given a scaled plot plan the student will be able to read measurements taken at 15 checkpoints with an accuracy $\pm 5'$.

Selecting appropriate instructional activities, the next step in planning the instructional system, must be designed to most efficiently allow the greatest number of students to achieve the many instructional objectives of the "Introduction to Manufacturing and Construction" course, including those in the preceding example.

Professional judgments are paramount at this point. It is possible that the two previous specific instructional objectives, and perhaps more, could be achieved through a single instructional activity. Careful decisions must be made since one instructional activity may be designed to meet several instructional objectives. The situation is presented in Figure 8-5.

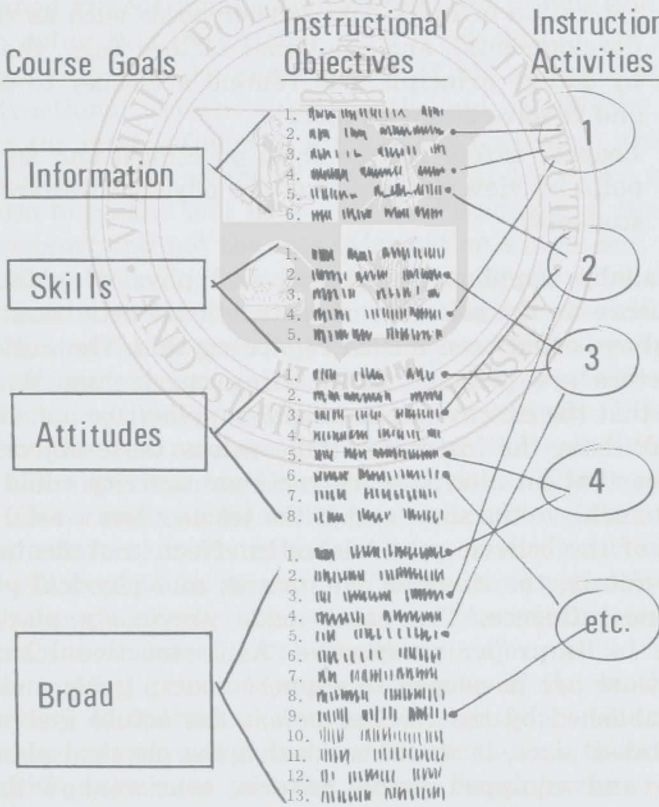

Fig. 8-5. The relationship between course goals, instructional objectives, and instructional activities demonstrating how activities may achieve several objectives.

Some factors that will influence the choice of instructional activities are:

1. Recall of contemporary industrial-technical practice (does this activity *really* represent contemporary practice?).
2. Recall of the fundamental psychological learner needs (e.g., will the student be able to maintain or increase his self-image through this experience?).
3. Estimated time to execute the instructional activity (is too little or too much time spent on this activity as judged by its relative worth as stated in course goals?).
4. Recall of the principles of learning with special consideration of individual learner needs such as cultural, developmental, and emotional factors (e.g., the "learn by doing" principle may remind a teacher to talk less and involve students more).
5. Learner safety factors from an ethical and legislative point of view (respect for the physical welfare of the students).

Available supplies, equipment, and physical plants have had influence on the selection of instructional activities. Future teachers have often been misled regarding this. The notion that these factors are primary in dictating curriculum is absurd. The fact that the exact equipment and supplies are not available should not deter the instructor if he values those objectives. It is possible that an alternate instructional activity could be developed to achieve the same end if the teacher has a solid understanding of the behaviors he wishes to effect in students.

Obviously, the supplies, equipment, and physical plant do have some influence. The point made previously places that influence in its proper perspective. As instructional hardware and software are developed to support course goals and objectives established by the teacher before the actual instructional activity takes place, it would be ideal if the physical plant were designed and equipped using criteria consistent with those applied to instructional activities; for they too should support the goals, instructional objectives, and instructional activities of the courses taught in that laboratory.

Managing and Functioning within the System

There are persons who have the expertise to discuss all the elements of an instructional system and the ability to perform in all the elements except the "activity" portion. The ability of a person to direct and function within the system assumes several unique processes. It is the only element that requires human-to-human confrontation. All the frailties of man are exposed at this point. To verbally demonstrate one's understanding of the principles of learning is a prerequisite to, but not a part of one's ability to consistently apply them in day-to-day human relations. The activity element of the system contains unpredicted quantities of behaviors to which one must react immediately. Teachers must be able to make on-the-spot adjustments from the planned instructional activities for both groups and individuals. In doing this the teacher must work within the limits of his personality and the personalities of his students to achieve the instructional objectives efficiently and effectively.

As the most influential force in the classroom, the teacher must be consciously aware of the effects of his every move. He needs also to realize that he is only the "manager of the instructional system" and not the sole information source and retrieval system. Once this is realized, a teacher will rarely feel embarrassed if he does not know the answer. Rather, he will actively assist the student in pursuing the answer. He will purposefully devise alternate sources of information (industrial advisory board, technical library, self-instruction materials). The concept of the teacher as manager rather than the sole information source will also encourage multiple activities. With multiple activities there needs to be multiple or alternate (other than the teacher) reinforcement methods. All types of instructional technology will need to be employed. The multiple activities method probably more closely represents the American concern for individuals than does the "all-together-now" concept.

As implied previously, the influence of the teacher upon the learning of individual students is significant. Many people have attempted to categorize teacher behaviors that influence students. For the most part the various breakdowns are usually verbal or non-verbal teacher behavior. A teacher's ability to purposefully control his verbal and non-verbal behavior in the classroom in the context of some logical philosophical and psychological framework helps insure his success. How then can the purposeful verbal and non-verbal behavior control be developed by teachers in training?

In developing purposeful verbal behavior skills in teachers in training, the starting point for some teacher educators may appear to be to attempt to convince these students that they should want to become good teachers. It seems wiser to assume that except for rare cases all teachers in training want to be successful teachers and that the problem is not convincing them that they should desire to be successful teachers, but to give them a meaningful program that builds the professional skills necessary for success. This confident approach can also help destroy the old notion that teaching is an "art" and not a "science" and thus establish a foundation upon which *all* teachers in training realize that through careful planning, study, performance, and self-evaluation they can become successful educators. Part of the necessary planning, study, performance, and self-evaluation on the part of undergraduates concerns the purposeful manipulation of verbal and non-verbal behavior in real or simulated teaching situations.

The shortcomings in evaluating verbal and non-verbal behavior of teachers in training has been the lack of objectivity. Today, instruments are available that are not susceptible to the daily moods and biases of an evaluator. Several methods of categorizing all classroom talk have shown to be independent of these factors. The system that seems to be most acceptable is Flanders Interaction Analysis System (Chapter Seven). A major conflict does arise in the utilization of the Flanders system. Preceding this, and other systems, is usually found a definite bias as to what is the "best" teaching pattern (in Flanders system it is indirect teaching). It was established earlier that there is not necessarily *one* good method of teaching. Since each teacher in training may be assumed to possess his own ideal, the problem is to allow him to achieve his ideal and then let him determine whether or not it is acceptable. If it is not acceptable, he can make reasonable adjustments if he has an accurate measure of his performance. Students in training should be encouraged to compare themselves to their own ideals rather than to a universal ideal. The problem is not with transmitting an ideal, but, with providing adequate feedback so that teachers in preparation can become the kind of teacher they want to be. Graphically this process is represented in Figure 8-6.

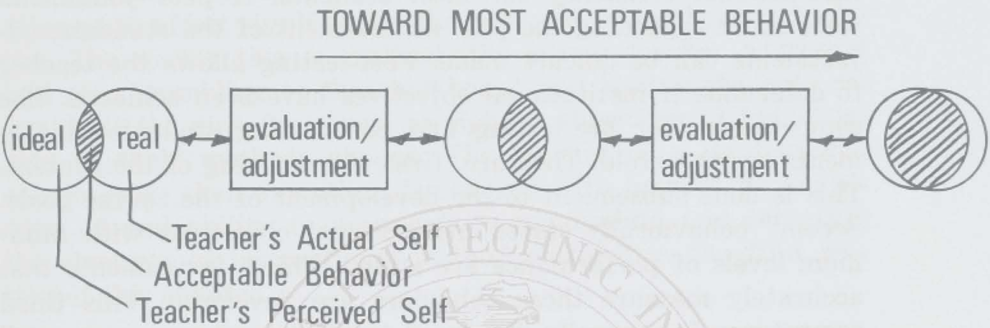

Fig. 8-6. Process diagram of how comparisons with personal ideals, real perceptions, and continuous evaluation and comparison result in improved teacher behavior.

Obviously objective self-evaluation of non-verbal behavior via videotape can assist in resolving the conflict between the teacher's "perceived self" and "actual self" and encourage adjustments in teacher behavior.

The greater the degree of professional skills in the area of purposeful teacher behavior, the less likely are there to be failures in the system. Failure in the system generally results in student discipline problems (problems other than those that can be corrected with mild negative reinforcement).

Generally the types of discipline problems public school industrial arts teachers face arise from only two sources (assuming they have developed the competencies outlined in this chapter). They are:

1. Teacher-student personality conflict (legitimate and generally unresolvable in relation to a time factor) that should be handled by transferring the student to another section.
2. A serious student psychological problem that should receive immediate professional attention by the proper authorities.

Evaluating Teaching and Learning

The expertise of evaluating teaching and learning occurs at several points in the educational system as is exemplified in Figure 8-3. The pre-testing of students before their involvement in instructional activities increases the probability of maximum instructional efficiency for most students. If poor judgments were made regarding the past achievement of the students, adjustments can be quickly made. Post-testing allows the teacher to determine if institutional objectives have been achieved. The competencies for pre-testing and post-testing student achievements are threefold. They are, first, the defining of the content. This is done subsequent to the development of the course goals. Second, behaviorally stated instructional objectives with minimum levels of performance are stated. Third, instruments that accurately measure these behaviors are developed. This third competency is generally developed in "tests and measurements" type courses and is a skill vital to maintaining the system.

THE PROFESSIONAL COURSE CONTENT AND SEQUENCE

The first half of this chapter identifies the specific professional competencies required of an industrial education teacher. The purpose of this second half is to develop from these desired competencies a logical course sequence, course descriptions, course objectives, and instructional strategies.

The Industrial Education Teacher in Training

The suggestions made in the following pages of this chapter result from an honest attempt to determine the nature of industrial education teachers in training. Between even the youngest industrial educator and his students, there is a value gap. Students are unable to appreciate the problems and concerns of the teacher educator since they have not had the experiences of the teacher educator. On the other hand, many teacher educators seem unable to remember any equivalent naivete or professional immaturity in their own pasts that they observe in their students. This often occurring stalemate results in stagnant or anxiety-filled education.

Since the responsibility of the effectiveness of a program falls on the teacher educator, he must accept the fact that the football game, Saturday's date, the world situation, or academic survival for the existing quarter are as, or more, relevant pressures to a university undergraduate than preparing for a would-be teaching position.

Like it or not, teacher educators are in competition with the legitimate pressures noted above (and others) in their attempt to affect significantly the behavior of teachers in training. The sooner this is realized, the sooner teacher educators will stop mumbling to the chalkboard and having students regurgitate the nine (or seven, or eight?) objectives of industrial arts in their methods classes. The teacher of a professional course, *more* than any other, is charged with having the knowledge of and ability to purposefully manipulate and integrate the elements of instructional method outlined in the first section of this chapter.

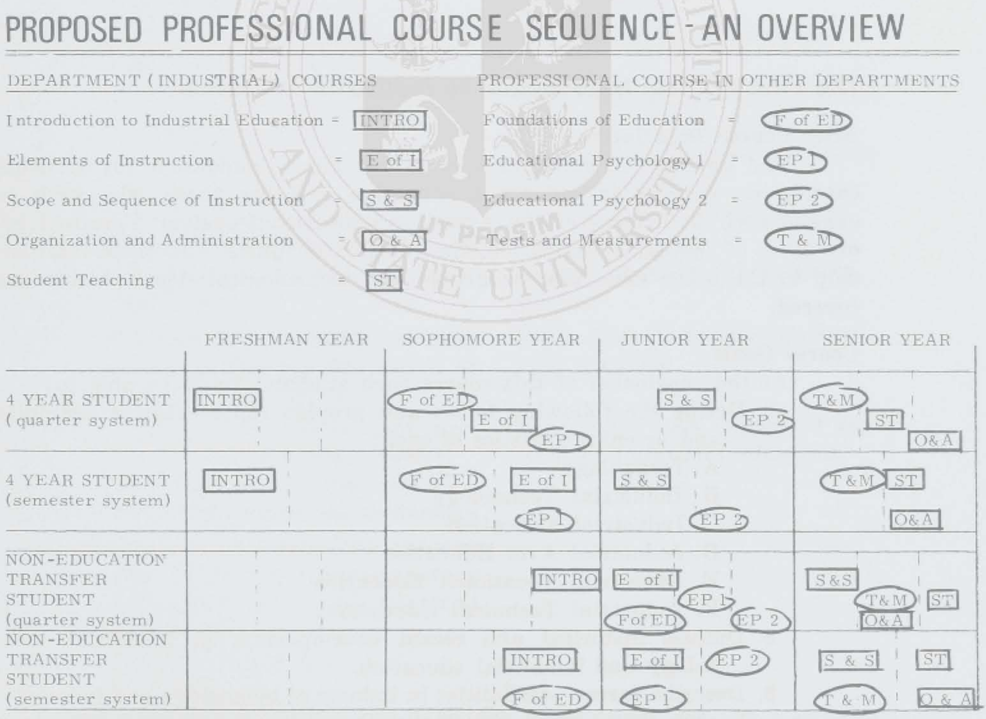

Fig. 8-7. Proposed professional course sequence - an overview.

The major factors behind the divisions and sequencing of the proposed professional courses are the logical relationship between the courses and a realization of the need to indoctrinate students early, while providing maximum time for introspection on the part of the teacher in training.

Figure 8-7 provides an overview of the proposed total professional sequence of courses. Following this figure are detailed presentations of the four proposed departmental courses for the industrial arts teacher in training.

The First Course: Introduction to Industrial Education

Brief Course Description

The purpose of this course is to provide a foundation for students considering careers in industrial education and for those who wish to expand their knowledge of the American educational system. Terminology, evolution of industrial education, the roles of its parts, and their relationship to the other education programs and technological developments are covered.

Course Goals

At the conclusion of this course each student should be able to:

1. Define the following terms and provide representative examples and/or characteristics of each:
   A. Technology
   B. Industrial Technology
   C. Industrial Education
   D. Industrial Arts Education
   E. Industrial Vocational Education
   F. Industrial Technical Education
2. Discuss historical and recent developments in industrial technology and industrial education.
3. Describe career possibilities in industrial technology and industrial education along with the prerequisite preparation for those careers.

Evaluation

Paper - Historical view of industrial technology	10%
Paper - Historical view of industrial education	10%
Paper - Occupational overview	10%
Paper - Student selected topic	20%
Quiz #1	25%
Quiz #2	25%
	100%

Required Texts

AVA, *A guide to improving instruction in industrial arts*
DeVore, P. *Technology: An intellectual discipline*
Passmore, D. *Industry and society*

Suggested Activities and Assignments—
Introduction to Industrial Education[1]

Session	*Class Activity*	*Assignment for This Session*
1	Introduction to the course	
2	Lecture and discussion on technology	Read *Technology: An intellectual discipline*
3	Lecture and discussion on industrial technology	Read *Industry and society*
4	A brief historical view of industrial technology	Each student submits a short paper (2 pages) giving an abbreviated overview of industrial technology
5	Lecture from department professor on the manufacturing and construction aspect of industrial technology	Read *I.A.C.P. rationale - A brief description* Read *The American industry project*
6	Lecture from department professor on the graphic aspect of industrial technology	Read *Visual communications - pilot program*
7	Lecture from department professor on the energy, power, instrumentation, and control aspect of industrial technology	Read *EPIC - An important segment of industrial education*
8	Field trip to industrial concern that represents a contemporary and broad picture of industrial technology	
9	Quiz on 2, 3, 4, & 5	

[1] Presented in chronological order, in quarter system format, and with a suggested 3 quarter hour credit. All sessions one hour in length.

10	Lecture and discussion on industrial education	Read *High school exits* by Evans, *School Shop* Read Trade and industrial education and industrial arts teachers should be educated in the same department by Evans, *Journal of Industrial Teacher Education*
11	A brief historical view of industrial education	Each student submits a short paper (2 pages) giving an abbreviated historical overview of industrial education
12	Lecture and discussion on industrial arts	Review AVA, *A guide to improving instruction in industrial arts*
13	Lecture and discussion on vocational industrial education	Review AVA, *Guidelines to the '70's*
14	Lecture and discussion on industrial technical education	Review ACIATE 18th Yearbook, *Industrial technology education*
15	Field trip to industrial arts, vocational industrial, and technical industrial education programs	
16	Quiz on 10, 11, 12, 13, 14, and 15	Prepare for Quiz
17	Lecture and discussion by departmental professor on the career possibilities and competencies needed for industrial technology	Each student submits a one-page occupational overview and personal evaluation based on session 17, 18, or 19
18	Lecture and discussion by departmental professor on the career possibilities and competencies needed for teaching industrial technology	Each student submits a one-page occupational overview and personal evaluation based on session 17, 18, or 19
19	Lecture and discussion by departmental professor on graduate education in industrial education and industrial technology	Each student submits a one-page occupational overview and personal evaluation based on session 17, 18, or 19
20	Course review	Term paper due on student selected topic having to do with a phase of industrial education or industrial technology (maximum 10 pgs.)

The Second Course: Elements of Instruction

Brief Course Description

The major goal of this course is to develop a sensitivity to and an expertise within the elements of instruction. It is primarily concerned with studying the teaching/learning process through reading, discussion, observation, and experimentation. The activities, assignments, and discussions revolve around industrial education situations in an attempt to concentrate on teaching/learning problems peculiar to the field.

Course Goals

At the conclusion of this course each student should be able to:

1. Identify and defend an internally consistent set of goals of industrial education.
2. Classify student activities into the major domains of human behavior.
3. Prepare instructional objectives that are behaviorally stated with a minimum level of performance.
4. Know and provide research evidence for the support of the several principles of learning.
5. Accurately use the Flander's Interaction Analysis System to classify student-teacher verbal behavior.
6. Demonstrate purposeful overt teaching behavior (verbal).

Evaluation

Three short papers	10%
Quiz #1	10%
Quiz 2	10%
Quiz #3	10%
Six Micro-Lessons (10% each)	60%
	100%

Texts

Amidon & Flanders, *The role of the teacher in the classroom.*
Amidon & Flanders, *Training manual.*
Mager, R. *Preparing instructional objectives.*
2 each, 3″ Audio Recording Tapes.

Suggested Activities and Assignments—Elements of Instruction[2]

Session	*Class Activity*	*Assignment for This Session*
1**	Introduction to the course Brainstorm the goals of industrial education	
2*	Discussion on the goals of industrial education	Read Section I, *A guide to improving instruction in industrial arts* Each student submit a copy of what he believes the goals of industrial education should be
3**	Discussion on the domains of learner behavior (cognitive, affective, and sensory) Quiz	Review and complete the response sheet for the *Selecting appropriate educational objectives* filmstrip and tape Prepare for quiz on sessions 1, 2, & the domains of learner behavior
4*	Discussion on preparing instructional objectives	Read *Preparing instructional objectives*
5**	Quiz Discussion on a system vs. a non-system approach to teaching Anecdotes on teaching and learning	Prepare for quiz on instructional objectives
6*	Lecture on the Principles of Learning	
7**	Discussion on the Principles of Learning	Each student submit a short summarizing paragraph of a supporting research study or theory for each of the Principles of Learning
8*	Lecture on evaluating teacher behavior	Read *The role of the teacher in the classroom*
9**	Discussion on the Flanders Interaction Analysis Instrument Begin training in the use of the Interaction Analysis System	Read *Training tape manual—level I*
10*	Continued training in Interaction Analysis	Train in the use of Interaction Analysis

[2] Presented in chronological order, in a quarter system format, and with a suggested 3 quarter hour credit.

* One-hour session.

** Two-hour session.

11**	Field trip to rural or suburban high school industrial education program Follow-up discussion on field trip	Train in the use of Interaction Analysis
12*	Performance quiz in the use of Interaction Analysis Discuss expectations for session 13	Prepare for performance quiz on Interaction Analysis
13**	Class divided into groups having 4-5 members Teach and tape record micro-lesson #1	Prepare and submit lesson according to model presented by teacher (course goals, instructional objectives, content outline, instructional activities, and indicated teacher behavior to be purposefully manipulated
14*	Teach and tape record micro-lesson #2 to new group	Submit plan for lesson #2 Submit tape and Interaction Analysis of evaluation of lesson #1
15**	Review professor evaluation of micro-lesson #1 Teach and tape record micro-lesson #3 to new group	Submit plan for lesson #3 Submit tape and Interaction Analysis of evaluation of lesson #2
16*	Review professor evaluation of micro-lesson #2 Teach and tape record micro-lesson #4 to new group	Submit plan for lesson #4 Submit tape and Interaction Analysis evaluation of lesson #3
17**	Field trip to inner-city junior high school industrial education program Review professor evaluation of micro-lesson #3	
18*	Teach and tape record micro-lesson #5 to new group	Submit plan for lesson #5 Submit tape and Interaction Analysis evaluation of lesson #4
19**	Review professor evaluation of micro-lesson #4 Teach and tape record micro-lesson #6	Submit plan for lesson #6 Submit tape and Interaction Analysis evaluation of lesson #5
20*	Review professor evaluation micro-lesson #5 Review the course and set the stage for the next course in the professional sequence	Submit tape and Interaction Analysis evaluation of lesson #6

The Third Course: Scope and Sequence of Instruction

Brief Course Description

The major goal of this course is to develop a sensitivity to and an expertise in organizing the elements of an instructional system into an articulated whole. It is primarily concerned with studying the teaching/learning process through reading, discussion, observation, and experimentation. The activities, assignments, and discussions revolve around industrial education situations in an attempt to concentrate on teaching/learning problems peculiar to the field.

Course Goals

At the conclusion of this course each student should be able to:

1. Develop reliable and valid means of evaluating instructional objectives and be able to rationally synthesize these measures into a comprehensive student evaluation.
2. Prepare a unit of study that takes into consideration all the elements of an instructional system.
3. Perform effectively as a member of an educational team in the implementation of an educational system.
4. Demonstrate purposeful overt teaching behavior (verbal and nonverbal).
5. Identify and use contemporary instructional media.

Evaluation

Lesson Plan	10%
Two Short Papers	10%
Instructional Media Material	10%
Quiz	20%
"TPX"	50%
	100%

Texts

Silvius & Curry. *Teaching successfully in industrial education.*
Mager, R. *Developing attitude toward learning.*

Suggested Activities and Assignments—Scope and Sequence of Instruction[3]

Session	*Class Activity*	*Assignment for This Session*
1**	Introduction to the course Discussion of a systems vs. non-systems approach to teaching	
2*	Lesson Plans (2)	Read pages 70-98 in *Teaching successfully in industrial education*
3**	Critique—Lesson Plans	Each student submits a lesson plan for a single period to every class member

[3] Presented in chronological order, in a quarter system format, and with a suggested 3 quarter hour credit.

* One-hour session.

** Two-hour session.

4*	Discussion of "Total Planning Experience"[4] (TPX) Assignment	
5**	Lecture on Instructional units	
6*	Discussion on the selection of instructional strategies and instructional activities	Read pages 274-345 in *Teaching successfully in industrial education*
7**	Instructional media workshop	Read pages 347-395 in *Teaching successfully in industrial education*
8*	Instructional media workshop and discussion on instructional media	Each student prepares instructional media materials
9**	Lecture and discussion on the evaluation of individual student behaviors Quiz on 1 - 6	Review *Preparing instructional objectives* Review *Selecting appropriate instructional objectives* filmstrip and tape Review *Evaluating student behavior* filmstrip and tape
10*	Lecture on the comprehensive evaluating of students	Read Taking the stress off grades by Lance—*PTA Magazine,* October, 1967 Continue group work on "TPX"
11**	Field trip to post-high school industrial education program	Continue group work on "TPX"
12*	Discussion on Discipline and attitudes	Read *Developing attitude toward learning* Submit one-page synthesis and evaluation of the field trip
13**	Field trip to elementary (K-6) Industrial Education program	Continue group work on "TPX"
14*	Discussion on non-verbal behavior	Submit one-page synthesis and evaluation of the field trip
15**	Pre "Total Planning Experience" Video-Taping teaching workshop	Be prepared to dry-run segments of the "TPX" on video-tape
16 17 18	TOTAL PLANNING EXPERIENCE	TPX teams team micro-lessons in public schools
19	Group discussion and evaluation of the "Total Planning Experience"	Submit group report and evaluation of the "TPX" experience
20	Orientation to Student Teaching	

[4] Total Planning Experience (TPX) is the name given a single period teaching experience in a public school that was originated by Dr. G. R. Horton, Bowling Green State University, which requires teachers in training to experience all dimensions of a classroom educational system.

The Fourth Course: Organization and Administration

Brief Course Description

This course is primarily concerned with organizational and administrative problems associated with managing and functioning in an industrial education laboratory.

Course Goals

At the conclusion of this course each student should be able to:

1. Evaluate and synthesize the recent curriculum developments in industrial education.
2. Critique courses of study using a systems approach to teaching as the criteria.
3. Describe the duties and functions of school system supervisors and department chairman in industrial education.
4. List the duties, responsibilities, and services provided by state department personnel in industrial education.
5. Establish a list of professional ethics and responsibilities of an industrial education teacher.
6. Justify the need and propose several strategies for improving public relations within the school and community.
7. Develop a logical rationale and organization and plan of a laboratory.
8. Organize on paper a total laboratory maintenance management program.
9. Organize on paper the equipment and procedures necessary to implement a laboratory maintenance management program.
10. Develop a fiscal program for the efficient management of a laboratory.

Evaluation

Debate Summary	10%
Journal Article Critique	5%
Course of Study Critique	5%
Quiz	20%
Lab Plan	10%
Lab Safety Evaluation	10%
Course of Study	40%
	100%

Texts

Cochran, L. H. *Innovative programs in industrial education.*

Olfson, L. and Harris J. W., *Profiles of significant schools—on the way to work.*

Gross, R., *Educational change and architectural consequences.*

Schmitt, M. L. and Taylor, J. L., *Planning and designing facilities for industrial arts education.*

Suggested Activities and Assignments—Organization and Administration[5]

Session	*Class Activity*	*Assignment for This Session*
1**	Introduction to the course Lecture on the recent curriculum developments in industrial education	
2*	Discussion on the recent curriculum developments in industrial education Divide class into two debate teams, one to support traditional and one to support innovative curriculum	Read *Innovative programs in industrial education,* Cochran
3**	Debate the relative merits of traditional vs. contemporary curriculum proposals	Each team submits a summary of facts, figures, positions, etc. to be used in the debate
4*	Quiz on 1, 2, and 3	Prepare for quiz
5**	Lecture on the components and organization of a course of study	Selected readings from *Teaching successfully in industrial education*
6*	Discussion of course of study assignments	
7**	Divide class into groups of 3 - 4 and critique courses of study according to the evaluation form	Submit in-class critiques
8*	Presentation from a state supervisor (s) of industrial education delineating their job responsibilities	
9**	Panel presentation from industrial education city supervisors and department chairmen delineating their responsibilities—question and answer period	
10*	Discussion on the professional ethics and responsibilities of the industrial education teacher	
11**	Discussion on the need for and several strategies for improving public relations within a school and community	Submit a critique of two journal articles dealing with school public relations

[5] Presented in chronological order, in a quarter system format, and with a suggested 3 quarter hour credit.

* One-hour session.

** Two-hour session.

12*	Lecture on developing a rationale for the organization of a laboratory	Read *Educational change and architectural consequences; Planning and designing functional facilities for industrial arts education* and *On the way to work*
13**	Visit department labs and evaluate a lab based on a particular rationale	
14*	Share and critique rationales, planning broad ideas, and resulting lab layouts	Each student submits revised plan of laboratory that was visited
15**	Lecture and discussion on the need for equipment and laws pertaining to laboratory safety Visit department labs and evaluate a lab according to safety codes	Read State School and Industrial safety codes
16*	Lecture and discussion on the need for a systematic laboratory maintenance program	Each student submits his lab safety evaluation
17**	Share proposed programs for implementing laboratory maintenance programs	
18*	Lecture and discussion on fiscal programs for lab	
19**	Review	
20*	Discuss courses of study	Each student submits his course of study

SUMMARY

The summary is both a challenge and a caution. The challenge is for all teacher educators to develop a sound understanding of the professional competencies briefly handled in this chapter. To the sincere professional this chapter is only an appetizer. In-depth individual study is a necessity.

The caution is a warning against complacency. The technology of teaching is moving as fast as the technology of industry. To be content with one's level of professional knowledge is a prerequisite to professional ineffectiveness and obscurity.

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CHAPTER NINE

Some Additional Program Considerations

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The purposes of this yearbook were: (1) to update and extend the ideas presented to the profession in the 11th Yearbook of ACIATE (Lux, 1962); (2) to effect change in the practices of industrial arts teacher education throughout the United States; and (3) more particularly, to effect change in Ohio through the professional interaction resulting from the planning and writing of this yearbook. The degree to which these objectives have been met may vary from one objective to another.

It would appear that this yearbook does update and extend (or at least focus upon) two essentials of preservice preparation: content and method. Only time will tell whether this yearbook will effect change nationally. However, there is clear evidence that the preparation of this yearbook has had far-reaching effects within the State of Ohio. Throughout the three-year preparation period, chapter authors interacted with members of their respective staffs and with the staffs of sister institutions. Programs and conferences have been held where papers were read and ideas discussed. Small groups have met together in a common purpose. From this has come the spirit of unity of purpose. Teacher education programs in Ohio are evidencing change at the time of this writing. Whether these changes have been brought about, at least in part, through the preparation of this yearbook, or because of the nature of our changing times, is a matter of speculation.

THE SETTING

In Chapter One, the editors of this yearbook describe the nature of our society in the decades ahead. Although this is a dangerous and almost impossible task, responsible persons must attempt to foresee the future in order to plan for tomorrow. Since most industrial arts teacher education programs of today reflect the past more than the present, the time has come to make some bold new departures in programming so that the future may be served.

THE COMPLETE PROGRAM

A balanced undergraduate program of teacher preparation is discussed by Horton in Chapter Two. Present patterns call for a three-part program: (1) a general or liberal education segment, (2) a content or subject matter segment (industrial technology), and (3) the methods or professional segment (educational or instructional technology). The proportion of the total baccalaureate degree in each has changed during the first seven or eight decades of the existence of industrial arts teacher education programs. Horton offers some interesting prognostications of the complete program of the future.

TECHNOLOGY OF CONTENT AND METHOD

In Chapter Three, Paige discusses the nature of the technology. He suggests that the content of industrial arts is the technology of industry. The body of knowledge is changing at a rapid rate and because of this, presents serious problems to the classroom teacher and more especially to the teacher educator. With less certainty, Paige suggests that pedagogy, methodology, or the professional component of industrial arts teacher education programs is the technology of education, instruction, or teaching. He states that the profession waits for the leadership required to conceive and implement these technologies.

DIMENSIONS OF CONTENT

Philosophy, the nature of knowledge, psychology, and the emerging patterns of work are basic to the identification of content in industrial arts according to Marschik in Chapter Four. In Chapter Five, Ginther extends the discussion by reviewing the theoretical statements of early leaders in the field. In addition, Ginther reviews a number of contemporary curriculum projects and proposals and classifies each according to a system proposed by him. Crawford, in Chapter Six, discusses some of the problems which face the teacher educator who wishes to innovate in college-level programming. He proposes that the profession draw the best ideas from several of the more significant research and development projects. The scope and sequence of a four-year program of industrial technology are recommended by Crawford.

DIMENSIONS OF METHOD

In Chapter Seven, Buffer discusses the nature of educational or instructional technology. He defines the technology of instruction or education as the planning, organizing, mediating, and controlling of the teaching-planning process in the formal school setting. Buffer reviews the recent research which provides the foundation for the conceptualization of educational technology. Swanson, in Chapter Eight, proposes a sequence of courses or experiences which he feels will provide the prospective industrial arts teacher with an understanding and a command of the technology of instruction.

THE NEED FOR PRECISE COMMUNICATION

Many persons use the term *technology* very carelessly. For precision in communication, terms as important to industrial arts as *technology* should be carefully defined and, once defined, meticulously analyzed and interpreted. Within the past few years, several writers (Gagne, 1968; Galbraith, 1967; Glaser, 1968; IACP Staff, 1969; Komoski, 1969; and Kotarbinski, 1965) have considered technology to be directly involved with technique, action, and efficiency, regardless of human endeavor. Therefore the term should not be directly associated with the *material world* or material *things* (hardware) in our environment (although man and his technology have created *things* to extend man's ability to *act*).

In this yearbook, the authors and editors generally accept the position taken by Howell (1968) when he states: "A fundamental question that faces us is, How can we use technology to improve communication for meeting and solving the problems of education? What do we mean by *technology*? Technology, as it is used here, is the science of performing skillfully some action in an orderly, efficient manner (p. 134)."

Assuming that this definition of technology is accepted, then we must recognize that when we use such adjectives as *industrial* or *educational* to modify *technology*, we must be equally precise in defining these terms.

In general, we seem to have less difficulty in precisely defining *education* than we do *industry*. Scholars in the field of education are beginning to analyze and interpret the nature of *educational* (or instructional) *technology*. Leaders in industrial arts, on the other hand, have not placed the same premium on precision in the use of the term *industrial technology;* therefore the analysis and interpretation of industrial technology continues to be less than adequate. One recent attempt to call attention to this problem has been made by Ray (1970).

THE PROBLEM OF CLASSIFICATION

Whether we are dealing with educational technology or industrial technology, there exists a severe problem of the whole-part relationships of each. To classify means to group or segregate into classes which have systematic relations.

Certain criteria should be applied when one is involved in the process of classification. Werkmeister (1948a) states: "Traditional logic . . . has formulated at least five distinct rules which should govern all classification. But of all of these rules only one is really important, the rule, namely, that in any classification the different species of a given genus should be mutually exclusive. That is to say, if we arrange our facts in groups, these groups must not overlap (p. 274)."

Expanding slightly on the above, the following three criteria are presented to guide curriculum workers as they struggle with the ever-present classification problem: *Criterion One* - the elements or classes of a given context must be totally inclusive of that context (i.e. when all elements or classes are listed, they totally represent that context, and only that context - totally exhaustive - there is nothing left out) ; *Criterion Two* - the elements or classes must be relatively mutually exclusive (i.e. there should not be an overlap among or between classes) ; and *Criterion Three* - the classification scheme should be operationally adequate (i.e. the scheme should be useful for the purpose for which it is intended).

To give substance to the foregoing esoteric discussion, let us consider, for example, the problem of an adequate classification of industrial technology. To do so, it should be recognized that we have already arrived at a point where technology is classified as one discrete class of man's knowledge, and that industrial technology also meets all of the criteria as a discrete discipline. Let Figure 9-1 represent the context of industrial technology. The problem facing the profession is to conceptualize the subelements that make up this context.

Fig. 9-1. The Context: Industrial Technology.

Many persons and groups have attempted to posit such elements. The first in the modern era of curriculum improvement was Warner (1965) when, in 1947, he proposed six divisions of industry to reflect the technology: power, transportation, communication, construction, manufacture, and management. Olson (1963) was directly influenced by the work of Warner as he projected eight elements or classes as manufacturing industries, construction industries, power industries, transportation industries, electronic industries, research industries, service industries, and management.

Another attempt at classifying the major elements of industry was that of Face and Flug (1965). Their elements include production; materials; processes; energy; communication; transportation; public interest; financing; physical facilities; research and development; purchasing; personnel, public, and industrial relations; marketing; and management.

Others have projected elements or categories of industry, industrial technology, or technology. Among these are: Yoho (1965) with manufacturing arts, service arts, construction arts, and communication arts; Towers, Lux, and Ray (1966) with management technology, personnel technology, and production technology within construction and manufacturing; DeVore (1967) with production, communication, and transportation; Duffy (1970) with material processing, information processing, and energy processing; Stadt and Kenneke (1970) with visual communications, materials and processes, energy conversion and power transmission, and electronics and systems; and Swanson in Chapter Eight of this yearbook with manufacturing and con-

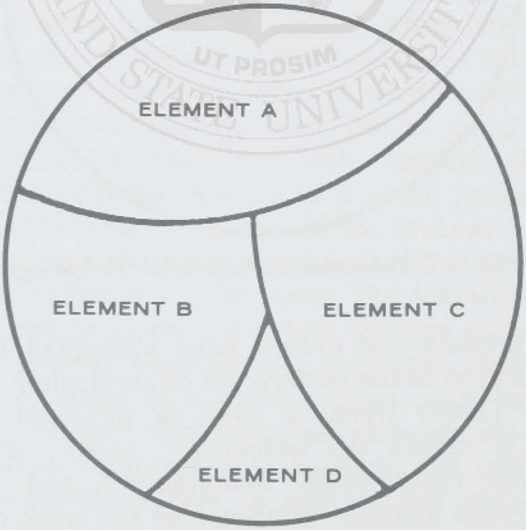


Fig. 9-2. The Elements of the Context: Totally Inclusive, Mutually Exclusive, and Operationally Adequate.

struction; graphics; and energy, power, instrumentation, and control.

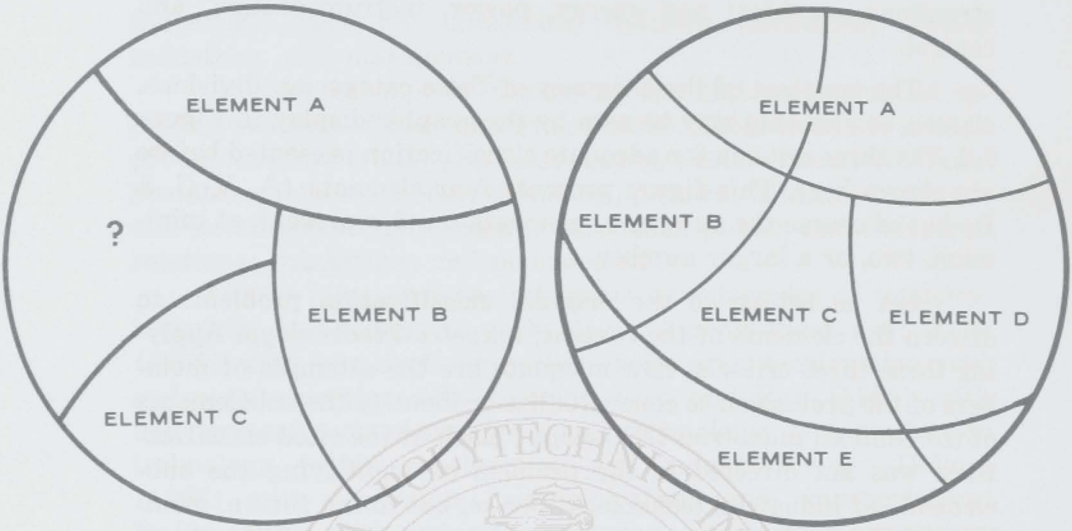
The true test of the adequacy of these categories, divisions, classes, or elements may be seen by the graphic display in Figure 9-2. The three criteria for adequate classification presented before are shown here. This figure presents four elements (A, B, C, & D) but of course the number of elements could represent, at minimum, two, or a larger number.

Let us return to the original classification problem: to discern the elements of the context, *industrial technology*. Applying these three criteria, how adequate are the attempts of members of the profession to conceptualize or identify the subelements of the context, *industrial technology*? Each of the cited classifications was not directed to the problem of identifying the subelements of industrial technology, *per se*, but in the future, members of the profession should attempt to do so. A first rule of classification suggests that some one aspect (single principle) of the "facts" must be adhered to for the entire classification. According to Werkmeister (1948b):

> . . . the classification must be based upon a single principle; that some one aspect of the facts to be classified must be selected and adhered to for the entire classification. If students are classified as blondes, brunettes, and red-heads, the rule is observed; for the "single principle" underlying this classification is "hair color." The rule would be violated, however if the students were to be classified as blondes, brunettes, and freshmen (p. 459).

In our case of industrial technology, we should categorize the elements of the science of efficient action in industry lest we commit an error of classification. Rather than classifying products, materials, or the divisions of industry, we should be attempting to identify the subelements of the body of knowledge as *industrial technology*.

Two common errors of classification are shown in Figure 9-3. Criterion One, total inclusivity, is often violated. Of course, that is the major problem with our traditional or conventional program elements. The subelements of drafting, woodworking, metalworking, graphic arts, power mechanics, electricity and electronics, and industrial crafts simply do not cover or exhaust the vast nature of the technology of contemporary industry.



Violation of Criterion One. **Violation of Criterion Two.**

Fig. 9-3. Some Common Errors of Classification.

They represent, at best, only bits and pieces of a much broader fabric.

It is Criterion Two that is most often violated in contemporary statements positing the subelements of industrial technology. It is of this danger that Werkmeister (1948a) has warned us — ". . . that in any classification the different species of a given genus should be mutually exclusive. Thus, if we arrange our facts in groups, these groups must not overlap (p. 274)." One example of this error would be to list *material processing* and *manufacturing* as two discrete subelements since it should be obvious that they overlap to some degree. Similarly, to present *research and development* and *management* as discrete subelements is another example of obvious overlap.

Figure 9-4 suggests that the problems of adequate classification do not cease when the first level subelements are established. The same criteria should be applied as we seek out and classify the subelements of the new (more restricted in scope) context. What was an *element* in one setting may be a *context* in

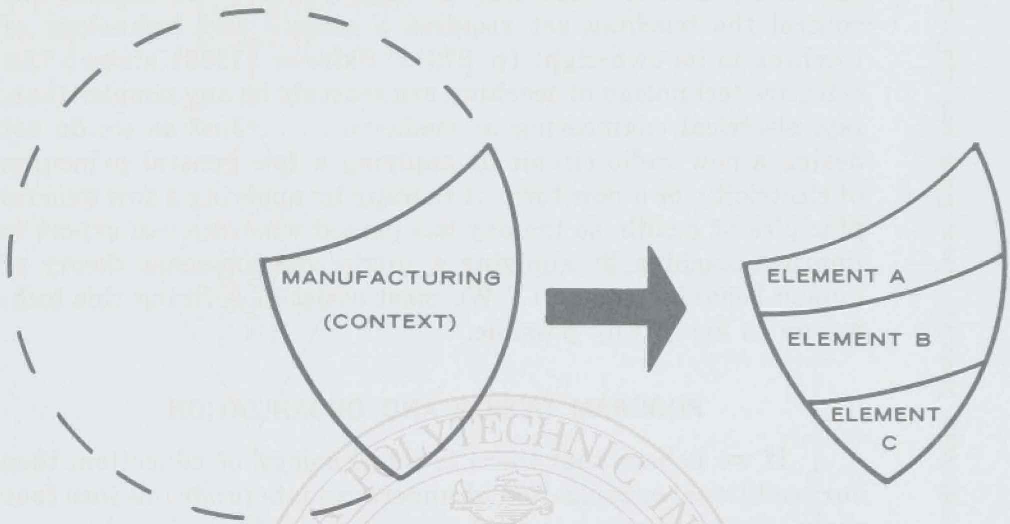


Fig. 9-4. One Element of Industrial Technology Becomes a New Context. The Elements of the New Context Should Satisfy Three Criteria.

another setting. The terms *context* and *element* are purely relative terms and designate no metaphysical entities.

One major task of the profession, then, is to logically categorize and subcategorize the body of knowledge of industrial technology. Crawford, in Chapter Six, has proposed an eclectic listing of the elements of industrial technology. The elements he proposes, however, do not satisfy the classification criteria proposed in this chapter. Nevertheless his proposal is a bold one that should be very helpful as we attempt to define and refine our subject matter elements.

It must never be forgotten that all classification schemes are man-made. Because they are conceived by man, they are, in a measure, arbitrary. The technology of industry is changing rapidly; hence the elements may change and their mutual relationships will vary over time.

A second major task in the realm of classification is to conceptualize the elements of the context *educational technology*. Although industrial technology (our specific subject matter in industrial arts) seems to be of paramount importance, we cannot stand by and wait for the generalist in pedagogy to provide the leadership needed. According to Gage (1964), "To explain and control the teaching act requires a science and technology of teaching in its own right (p. 273)." Skinner (1968) states: "An effective technology of teaching can scarcely be any simpler than, say, electrical engineering or medicine . . . . Just as we do not design a new radio circuit by applying a few general principles of electricity, or a new form of therapy by applying a few general pinciples of health, so the day has passed when we can expect to improve teaching by applying a single common-sense theory of human behavior (p. 226)." We must assist in defining this technology in every way possible.

PROGRAM DESIGN AND ORGANIZATION

If we believe that there is a technology of education, then our traditional organization of undergraduate programs into four years, eight semesters or twelve quarters, and a series of courses must be seriously questioned. Although there is some logic in the present sequencing of most courses in content and method, exit from any one course and entrance into any other course are not based upon performance in any precise sense. Courses usually do not include pretesting as an entrance requirement. Hence our undergraduate students enroll in courses whether they need them or not and move through them, over a four-year period, *en masse* instead of being allowed to progress at their own rate.

There should be direct relationships between the elements of a teacher education program and the teacher's eventual performance in the classroom. Such a premise relies heavily upon our ability to specify the behavioral objectives as bases for the selection of the elements of knowledge and experiences in our teacher education programs.

Beginning in late 1967, several institutions joined together in what has been termed the Model Teacher Education Project. This project has received its support from the United States Office of Education and has focused upon the projection of forward-looking teacher education programs for elementary teachers. Among other considerations, the design and organization of teacher education programs received critical attention. One major outcome has been the development of a flow chart (as in Figure 9-5) which describes the procedures that would be

= STUDENT
= PROFICIENCY MODULE

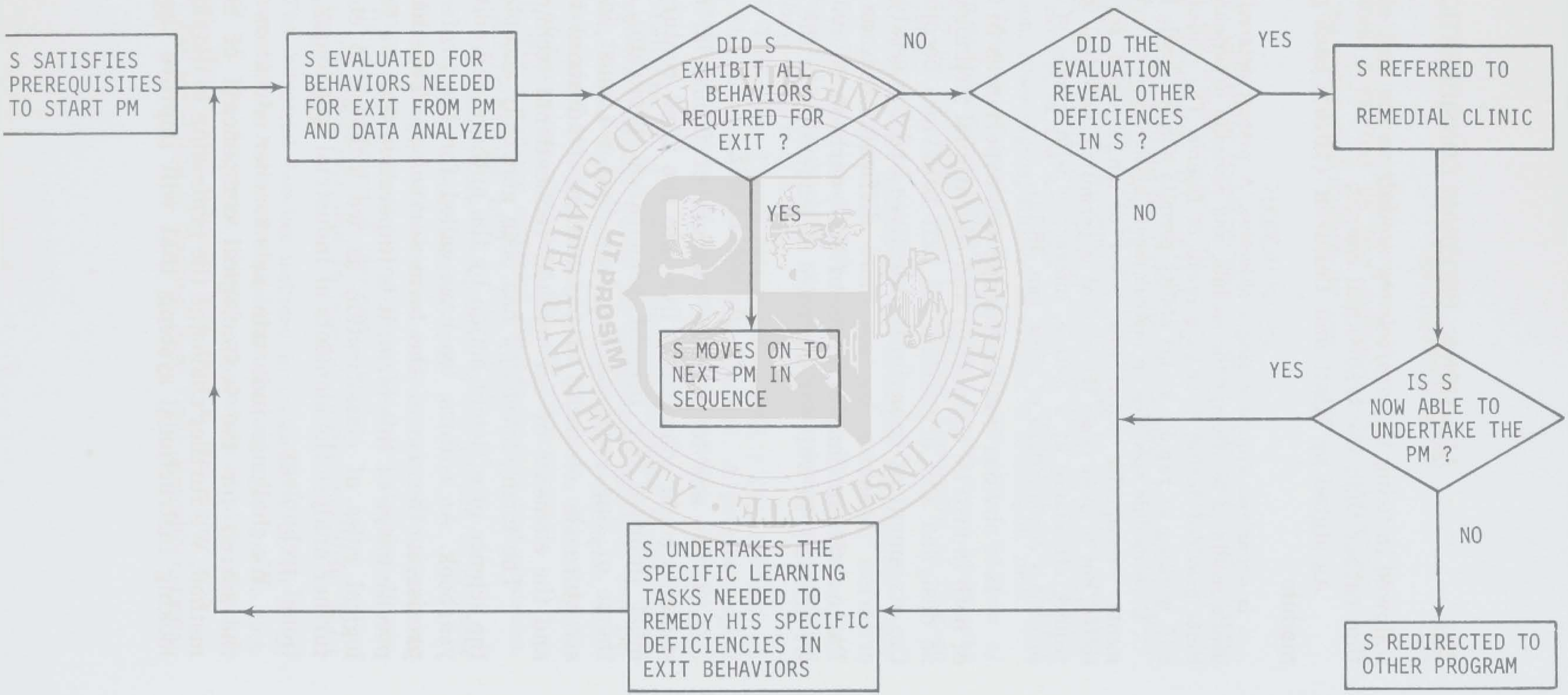


Fig. 9-5. Flow Chart of Procedures for an Instructional Module (Proficiency Module). (from Klatt and LeBaron, 1970)

followed in using the *proficiency module* as the unit of organization rather than the traditional *course*.

As stated by Klatt and LeBaron (1970), each proficiency module

> . . . is organized around a single objective. A pretest determines the student's readiness to attempt the module, and remedial experiences are sometimes provided during it, or as a result of failure. The student paces himself, working as rapidly as his ability permits him to handle the material. . . . Each module specifies an instructional objective and criterion measurements. Prerequisite experiences, based on an assumed sequencing, are stated, but in most cases the student is permitted individual instruction or require attendance at a lecture, interaction with groups of students, or sometimes combinations of these (pp. 16-18).

It is obvious that knowledge and experiences in the content of both industrial technology and educational technology could be so designed and organized. As exit behaviors become complex, the statement of behavioral objectives and the establishment of criterion measures become more difficult. But, as Professor Paige states in Chapter Three of this yearbook, to make progress we are only to wait for the voice of leadership in the profession.

A CHALLENGE

If we are to prepare teachers of industrial arts whose students could conceivably live into the 22nd century, then we must improve our present preparation programs. The main theme of this yearbook has been that we must identify and structure the elements of our content (industrial technology) and the elements of our method (educational technology).

The term *technology* has been generally accepted to mean the science of efficient action by the authors and editors of this yearbook. As editors, we have called for the profession to be precise in the use of the term *technology*. Together with the precise usage of this term, it is imperative that we follow a few logical rules of classification as we attempt to conceive and further analyze the elements of industrial technology and educational technology.

We challenge industrial arts teacher educators to continue the search for the technological components of content and method. We further challenge the profession to develop forward-looking instructional systems that will improve the caliber of the personnel prepared at our colleges and universities. We can desire no more and expect no less.

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Index