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ABSTRACT

This proposed secondary educational program, detailed in eight chapters well illustrated with photographs and working diagrams, is intended to enable people to understand science and technology in order to make more intelligent decisions regarding their use, rather than allowing them to dominate man. Written by a professor of education, this comprehensive program for all ranges of learners utilizes the product matrix, the systems approach, the critical incident evaluation of the student's performance, and PERT application to program evaluation. The educational processes under consideration include: (1) authority, (2) decision making, (3) communications, and (4) organization, intended to reinforce academic disciplines, provide a synthesizing educational environment, interpret productive society, and provide exploratory activities in career development. Laboratory methods focus on the technologies involved in the occupational clusters relating to machines, materials, tools, and processes. A detailed program rationale and a bibliography are provided. (AG)

MAN SCIENCE TECHNOLOGY

An Educational Program

H. R. ZIEL

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SCIENCE
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To my wife, Mary,

for love, understanding and

patience during a very trying period.

ACKNOWLEDGEMENTS

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Grateful acknowledgement is also accorded to the many friends and colleagues of different disciplines and different universities for their encouragement, counsel and evaluations of this program.

In addition, the author wishes to acknowledge Dr. S. Hunka for the use of his material relative to Computer Assisted Instruction from his book *The Teacher and the Computer* to be released in 1972; to Warren Hathaway for compiling the PERT charts and assistance in the description of the method from his brochure "A Network-based Approach to Curriculum Development"; to John C. Clarke for graphic illustrations; to the University of Alberta Technical Services for the photographs; to the IBM Corporation for their advice and cooperation in the use of their equipment; to the many other Corporations that have advised and assisted in the formulation of the program; to Mrs. Kaziel for the rough typing of the manuscript; to the *Gateway* for permission to quote from their publication; and to the variety of students who participated in the various applications of this program in the schools, the University and numerous research projects.

A special word of acknowledgement is accorded to Isabel and Ronald Bince for contributing their expertise.

INTRODUCTION

Authors, educators, and other experts indicate that the past decade, as well as the next, exposes us to a new post-industrial era, a super industrial phase, a reformation, or a new consciousness. Whatever concept is accepted or interpretation rendered, the fact remains that 25% of the world's population is using up 90% of the world's natural resources, energy, and water. All these goods and services ostensibly provide a higher standard of living and are frequently attributed to an improving technology.

However, our environment is becoming polluted, we are rapidly exhausting our energy resources and our air and water supply is becoming increasingly more dangerous for man, beast, and plant. It is evident that our preoccupation with using quantity as a measure of a standard of living has been accomplished at the expense of a quality standard of living. Now forecasters predict standing room only, on this planet, if population increases continue.

First technology was prominent now science is gaining in prominence. What about man? Shall science and technology dominate man or shall man use science and technology to serve man? It is the author's conviction that science and technology are dominating man. The proposed educational program, described in the following chapters, is recommended as a means for man to understand science and technology and make more intelligent decisions regarding their use.

This beginning would enable our progeny to become aware of the benefits as well as the ravages of science and its applications as a material, process, or technology.

Toffler postulates that the current lifetime has experienced more materials, processes, and technologies than 799 preceding lifetimes. If he is right, what have we done to eliminate poverty, eliminate wars, improve the democratic process, or for that matter have we educated our youth to cope with new goods and services within our productive society to better serve man?

It is the designed intent that the educational program described in the following chapters will provide students with options and alternatives as well as the consequences of their selections upon themselves and society. Experiences with a multiplicity of materials, processes, and technologies, representative of our productive society, exposes the learner to the demands imposed by technologies as well as the institutions employing these technologies. A chemical process or mechanical piece of equipment can be very demanding if it is to serve its designed purpose. Shall we as citizens, consumers, or taxpayers subscribe to such authoritarianism? Must we? There is ample evidence to indicate that as educators we can implement a program to enable youth and adults to make selections with the realization of the consequences of such selections. This type of learning environment provides students of all ages with the experience of making commitments and realizing the consequences of their choices upon themselves, society, and their future.

It is the emotional and intellectual commitment to accept or reject a material, process, or technology that results in value formation and not temporal attitudes. These statements have been verified by the use of the following described program with university students, medical doctors, average students, mental retardates, slow learners, as well as adult inmates of a correctional institution, functional retardates, and native hard core unemployables. The phase sequence of the program was altered to satisfy the objectives of each treatment group. However, besides the organization of each laboratory, three features become prominent in the application of the program. They are the product matrix, the introduction of learning material from systems to units, to components, to principles, and the critical incident evaluation of the student's performance and PERT application to program evaluation. All are explained in detail in the ensuing chapters. A brief review may prove beneficial.

The following matrix represents a sampling of processes representative of the plastics material aspect of our society. Specific products have not been recommended so that each individual instructor can make selections based upon regional preferences and availability of equipment. The important aspect of the recommended matrix is that students select a product representative of each process. It may be simple or complex depending upon machine capacity, die design, and/or raw material chemical composition affected by heat and pressure.

The product impact upon society is studied. Is the use of the product a positive trade-off in terms of re-cycling, durability, or quality? Do industries employed in producing such products contaminate air, water, or use excessive energy in terms of product utility for a better life? This constant comparison of product usefulness, need of exhaustible raw material, and social contribution mandates that product selections provide surrogate experiences representative of our productive society.

PLASTIC MATERIALS AREA

<table>
<tr><th>SAMPLE PROCESSES</th><th>USE OF MATERIALS IN SOCIETY</th><th colspan="2">1</th><th colspan="2">2</th><th colspan="2">3</th></tr>
<tr><td rowspan="2">INJECTION</td><td rowspan="14">SOCIETAL — HOME
PERSONAL — CULTURAL
INDUSTRIAL — SCHOOL</td><td>A_1</td><td>A_2</td><td>A_5</td><td>A_6</td><td>A_9</td><td>A_{10}</td></tr>
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<tr><td rowspan="2">EXTRUSION</td><td>B_1</td><td>B_2</td><td>B_5</td><td>B_6</td><td>B_9</td><td>B_{10}</td></tr>
<tr><td>B_3</td><td>B_4</td><td>B_7</td><td>B_8</td><td>B_{11}</td><td>B_{12}</td></tr>
<tr><td rowspan="2">CENTRIFUGAL</td><td>C_1</td><td>C_2</td><td>C_5</td><td>C_6</td><td>C_9</td><td>C_{10}</td></tr>
<tr><td>C_3</td><td>C_4</td><td>C_7</td><td>C_8</td><td>C_{11}</td><td>C_{12}</td></tr>
<tr><td rowspan="2">HEAT AND PRESSURE</td><td>D_1</td><td>D_2</td><td>D_5</td><td>D_6</td><td>D_9</td><td>D_{10}</td></tr>
<tr><td>D_3</td><td>D_4</td><td>D_7</td><td>D_8</td><td>D_{11}</td><td>D_{12}</td></tr>
<tr><td rowspan="2">BLOW AND VACUUM FORM</td><td>E_1</td><td>E_2</td><td>E_5</td><td>E_6</td><td>E_9</td><td>E_{10}</td></tr>
<tr><td>E_3</td><td>E_4</td><td>E_7</td><td>E_8</td><td>E_{11}</td><td>E_{12}</td></tr>
<tr><td rowspan="2">CELLULAR</td><td>F_1</td><td>F_2</td><td>F_5</td><td>F_6</td><td>F_9</td><td>F_{10}</td></tr>
<tr><td>F_3</td><td>F_4</td><td>F_7</td><td>F_8</td><td>F_{11}</td><td>F_{12}</td></tr>
<tr><td rowspan="2">TEST SAMPLES</td><td>G_1</td><td>G_2</td><td>G_5</td><td>G_6</td><td>G_9</td><td>G_{10}</td></tr>
<tr><td>G_3</td><td>G_4</td><td>G_7</td><td>G_8</td><td>G_{11}</td><td>G_{12}</td></tr>
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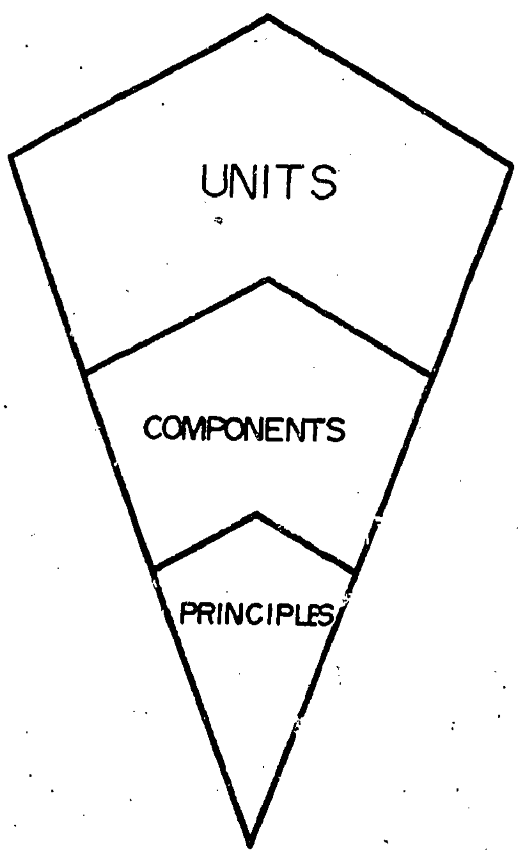
PLASTIC PRODUCTS MATRIX PARADIGM

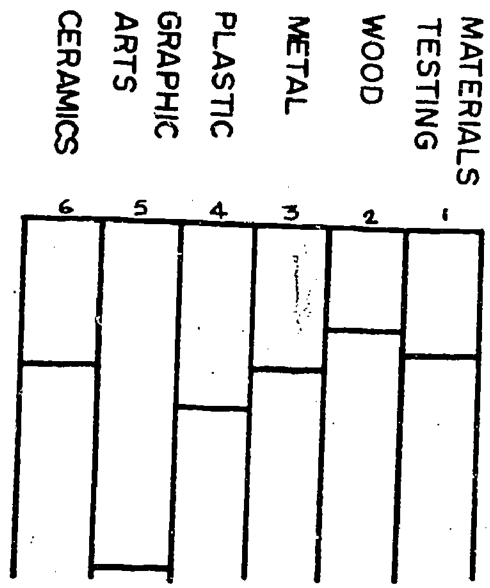
To reinforce this experience the learning is structured on a systems basis. Therefore, a systems chart and the interaction of the systems can be observed and studied. The relative merits of the product upon society, the environment, the community, man, and its contribution to a better life can be ascertained. The specific study of units, components and principles becomes the vocational objective of the craftsman, technician, engineer, or scientist. System demands and limitations represent an awareness level of learning adequate for intelligent decision making as a consumer, citizen, or taxpayer.

SYSTEMS

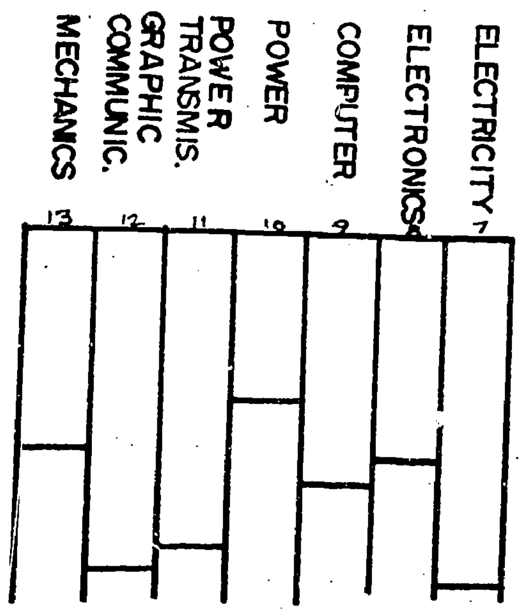


To evaluate the performance of the student, the critical incident method is recommended. This method becomes a guide to the student for further self-development and progress as opposed to the authoritarian finality of a grade. Therefore, performance criteria must be relevant to the student ability, equipment and supplies availability supplemented by adequate information sheets, tapes, or programmed instructions.

PHASE I



PHASE II



Educators have concerned themselves with the impact of middle class values, representative of teaching personnel, upon students. It is my contention that the formation of values has been abdicated to the producers of goods and services, or as some authors refer to them as technocrats. I offer the following as an example of the failure to employ technology to implement a current value that is a myth in actual practice. Democracy. People have died and nations have fallen under the banner of democracy. Current authors speak of more representation in decision making; whether it be in an institution, municipality, state or nation. How can this be possible with our current system of election of representatives whether it be a legislature or a committee? How accurately does, or can, such a representative speak for me or any one citizen on any issue? Consider for a moment the possibility of a direct vote on any issue, local, provincial, or national, by each citizen. Would this be possible? Certainly. The technology already exists whereby every eligible citizen could cast his direct vote on any issue affecting him. The results could be tabulated almost immediately. Would this not be a more representative sample of the people's choice? Would there be disparities? Certainly. But regions electing alternative routes would be required to abide by their selection. This one application of a technology to implement a value could have profound implications for the future. It need not be implemented nation-wide immediately. Suppose universities, who already have computers and an ample supply of terminals, permit each student to vote on every issue affecting him. Think of the feedback—if we really want feedback. Is it possible that this application is what Professor H. S. Broudy had in mind when he said " . . . it is the machine that may in the last act force us to become eminently human."?

It is not my intent to advocate any philosophical or political science concept. However, it is my intent to emphasize the fact that the man-science-technology constellation of confrontations can serve man or man may abdicate his responsible role and serve science and technology. It is the recommendation of this author that the incorporation of the educational program described in this text would permit every man and woman a greater option to control his or her future. Science and technology is here to stay and we must harness this dynamic force if man is to survive on this planet.

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TECHNOLOGY: MASTER OR SLAVE?

INTRODUCTION

PRODUCTIVE SOCIETY

PROCESSES FOR CONSIDERATION

- Authority
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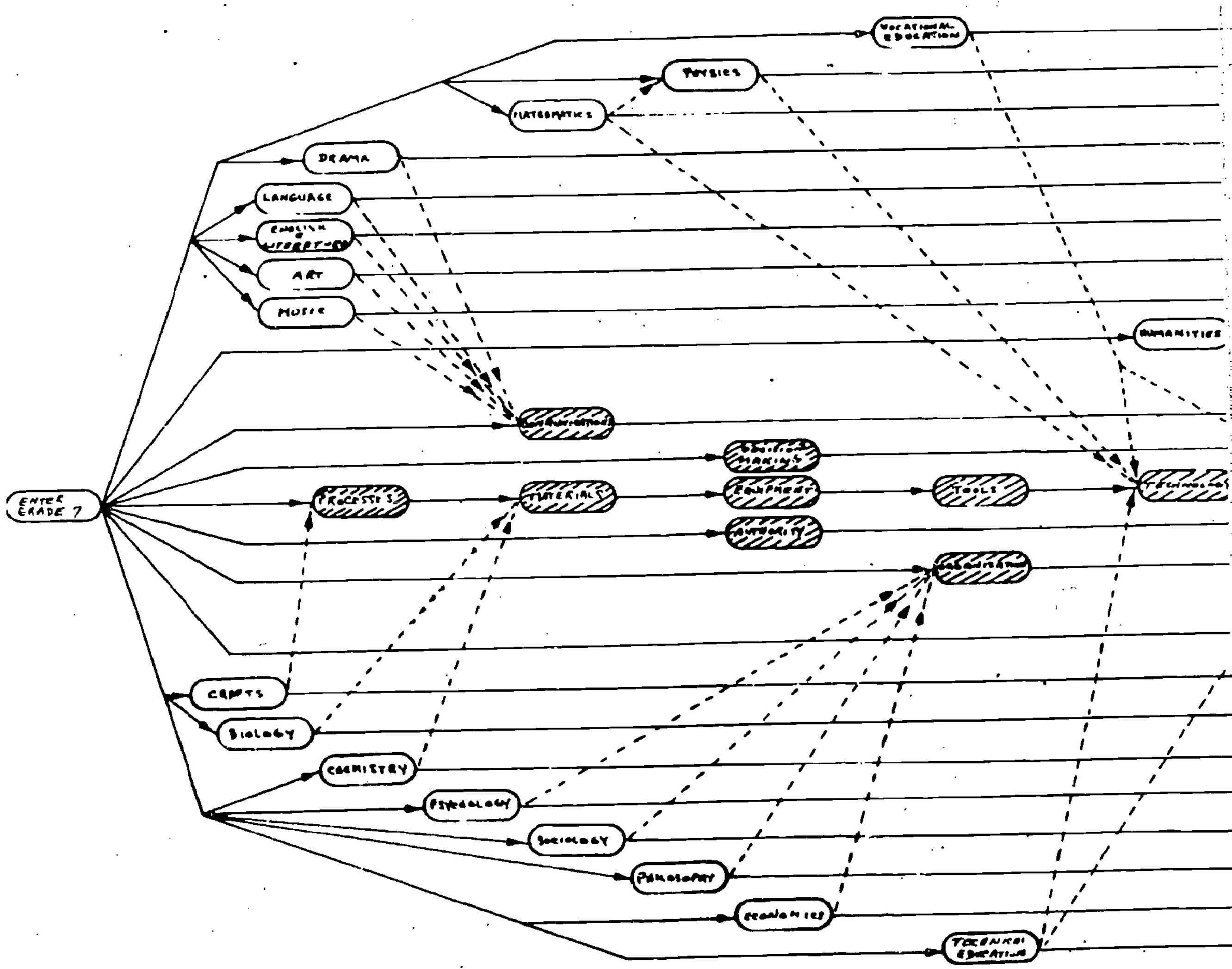
- Communications
- Organization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VOCATIONAL EDUCATION
PHYSICS
MATHEMATICS
DRAMA
LANGUAGE
ART
MUSIC
HUMANITIES
PROCESSES
MATERIALS
EQUIPMENT
TOOLS
CRAFTS
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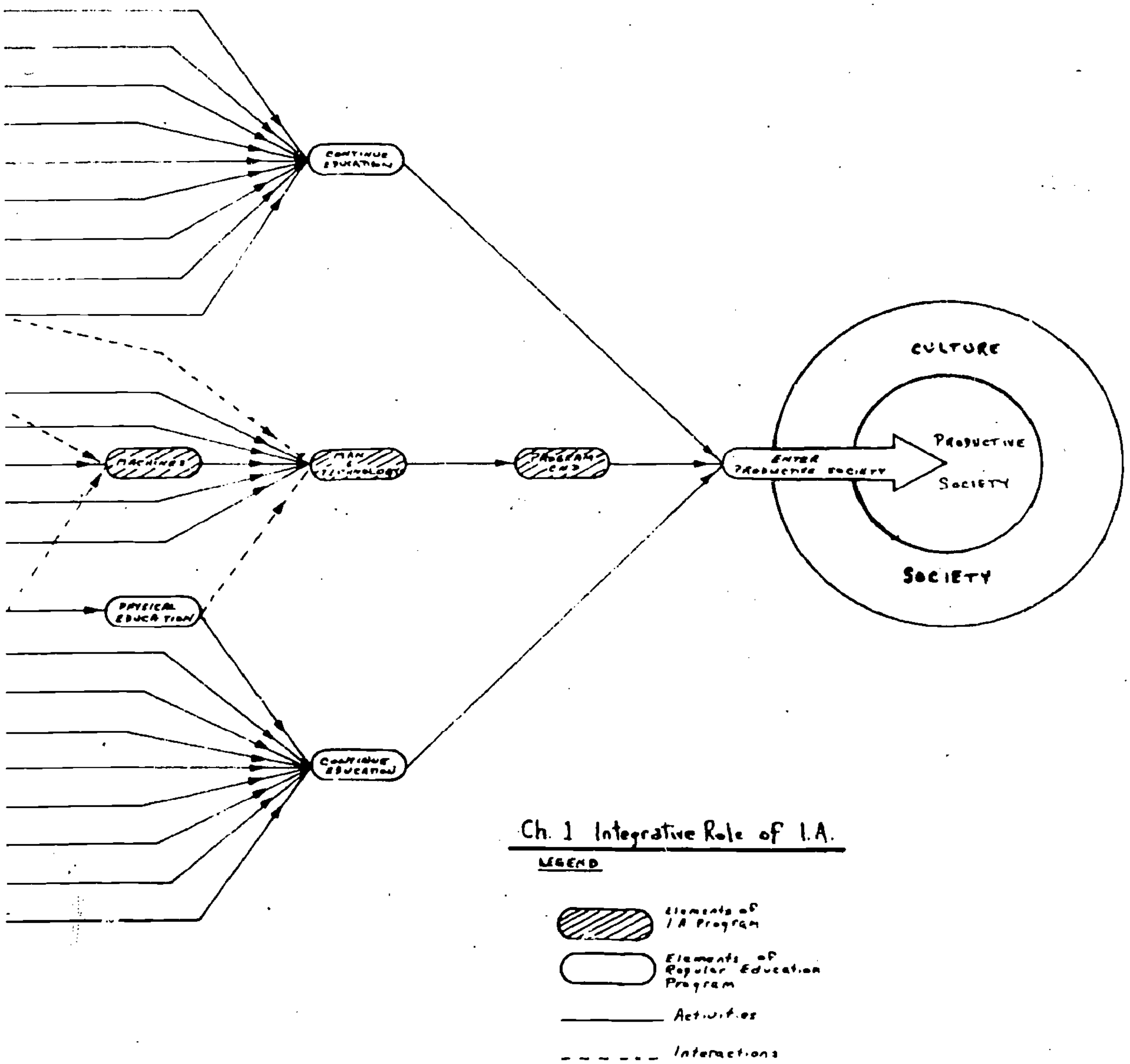

Ch. 1 Integrative Role of I.A.

TECHNOLOGY: MASTER OR SLAVE?

INTRODUCTION

Educating a society to meet cybernated challenges is a very complex and challenging endeavor. It is not my intent to indict or condemn our past practices in education. However, I do plan to explore and examine our educational practices, past and present; the demands imposed by a cybernated technological thrust upon all society, its institution and people and finally, propose a partial solution to overcome our educational inadequacies in an effort to help our citizens of 1990 cope with the problems of that day.

I don't believe it requires extensive elaboration, but it does require mention that educational institutions are more designed for administrative convenience than to stimulate learning or provide an environment conducive to learning. When I use the term 'learning,' I am speaking of an educational program designed to make education meaningful in an intellectual and emotional sense to the masses of the population and not only to the elite. Arguments of mass education versus elite education are undemocratic and very apartheid in nature and more specifically, unproductive.

Granted that we cannot separate education from society even if we, as educators, should be foolish enough to do so. The abdication of the parental responsibility to transmit complex knowledge to the schools is a legitimate expectation of a taxpayer in a democratic society. There is extensive evidence to indicate that today's youngster cannot hope to acquire the requisite knowledge to cope with today's technological society in a family situation. There is equal evidence to indicate that our attempts at educating by the 1900 format, designed for the elite, has been more of an indication that students learn in spite of the institution, rather than because of it.

Attempting to forecast twenty to thirty years into the future is a hazardous preoccupation. There are only a limited number of reliable indices to direct our attention. One of the most outstanding requirements of the future will be that most of the population, if not all of it, will require a greater command of the so-called "academic" disciplines. The mere fact that this term had to be used is a reflection that educators continue to perpetuate our educational biases and fail to recognize the highly complex nature of the productive institutions in our society and their impact upon our culture and subsequently upon our curriculum design.

What I am attempting to indicate here is that at least 80%—–hopefully, 100% of our high school population will have a command of the mathematics, sciences and humanities comparable to that evidenced by our entering freshmen in college. This is no argument that they will all move on to college, but it is a reflection of the second index of the future and that is, that all productive citizens will be required to become involved in continuing education, even at the point of retirement from an income producing career.

This poses another challenge for the elementary and secondary educators of this nation and that is that all students shall concentrate their first twelve years of education in an intellectualizing endeavor and not in an occupational preparation endeavor. Career preparation requiring science, mathematics and humanities is fundamental to the engineer, the business man, the politician, the scientist, the craftsman and every productive citizen.

This then establishes another premise that vocational education is, in fact, the more concerted preparation in the specifics of a career and cannot with any educational integrity be relegated to a high school curriculum. Whether it be a vocation in medicine, in engineering, in teaching or as a technician, we must recognize that the preparation for vocations requires first, a broad base and a command of the academic disciplines, keen awareness of human relationships, a skill of communicating and symbolizing and an understanding of the technologies that appear in our productive society as a result of the application of scientific research.

Therefore, the old administrative practice, that if a student does not or cannot command algebra, geometry or other academic subject matter, we may administratively schedule him or her to business arithmetic, math for carpenters or similarly "dumbed down" courses, is indefensible.

This proposes that curriculum builders of the future and teacher educators, will have to look upon the needs of the child in a broader and more concerted sense--to look upon teaching not as an art, but as a science. The learning standards of performance must be higher than currently expected. This, then assumes that assistance for the teacher will be required so that instruction can in fact, become more individualized and teaching will replace the "off the seat of the pants" practices, and the dialogue and jargon will be eliminated in favor of vocabulary. It would be my recommendation that any indictment of a student's lack of progress is focused first upon the "ivory tower" traditional efforts of universities who frequently fail to recognize the problems of the students. Then we focus upon the "cult of efficiency" syndrome practiced by all schools and departments of education administrators, then upon an assessment of teacher effectiveness before any indictment of student failure or student lack of interest is levied.

These are not just mere protestations. These comments are based on six years of research with actual youngsters from school systems in control and experimental situations using all the categorizations so common among school administrators.

This brings out the second educational challenge and subsequently stated as an objective in the program described. That is that youngsters cannot and in fact, should not, be required to synthesize the "pigeon holes" of learning into a meaningful whole. There must be a learning program that will provide a synthesizing educational experience so that students may recognize the significance of what is taught in the other classrooms. A surrogate exploratory experience is recommended that will give meaning to the often euphemistic formulae, theses, concepts, and theories. An interface of theory with practice, a reinforcement of an idea by experimentation has been successfully applied.

Let us ask another question. How can a secondary school student make an intelligent choice of a future career? There is ample research evidence to indicate that the school and the teacher are the least reliable sources for the majority of student career selections. Parental efforts in this direction are hampered by the problem that far too many parents still consider the craft orientation or assembly line as the prevailing symbols of our productive society. Fathers still tell their sons or suggest by implication, that extensive schooling is unnecessary; that the process of intellectualizing can be sublimated and efforts should be concentrated on manual skill acquisitions. There is evidence for the present and the future that all levels of craft or manipulative skills are being rapidly obsoleted or automated and that an intellectualized base is the safest preparation for the productive citizen of tomorrow.

Here again, examples and experiences of the past are poor career predictors of the technological future. A recommended corrective step would be a considered campaign to rid ourselves, as educators, of the assembly line or the craft as the prevailing symbol of our productive society. Intergenerational advice predicated on intragenerational experience is not always good advice for career selection or for career value orientation. As educators, we must be concerned and continually aware that that we do not attempt to design educational programs for the next generation based solely on the experiences of the previous generation or the biases and limitations of the current teachers and school administrators.

Youngsters should be permitted an exploratory environment that is not confined to woods, metals, drafting or similar craft oriented interpretations of our productive society. At the Junior High School level, whether they know their career destinations or not; whether they be medical profession or para-technician oriented or endowed, they must recognize the impact of the various technologies, materials, processes and man technology confrontations.

A basic requirement is a technological oriented educational environment that provides a broad base of understanding of the multiplicity of careers available to both boys and girls in the scientific, professional and technical fields and in the inter-relationships of the technologies and careers as they function in our productive society. There is reliable support to indicate that the career opportunities of tomorrow require this understanding and appreciation of the various career requirements and technology applications.

The cult of efficiency has to be ascribed to educational administrators and just as frequently denounced. I suggest that this indictment is merited, in that administrators attempt to use highly sophisticated cost analysis, systems analysis, PERT and other models of organization and evaluation to already outmoded, ineffective and obsolete systems of education. The question has never been asked how can we provide each individual with more effective and efficient instruction. Rather, it has been ascribed to 'per-student-hour' costs or categorizing students in an already pre-determined and non-representative educational curriculum. "Cafeteria" type programs are offered under the guise that this will permit more individual selection and that educators should not structure the students thinking. What is wrong with the direction and structure? The academic disciplines and successful professions mandate extreme structure. Frequently educational administrators perpetuate the myth that they are in the process of educating when in fact they are engaged in the practice of training. The cult of efficiency ascribed to educators has been copied from business but neglected the fundamental premise that our productive institutions are most sensitive to the needs of their employees. [illegible]ically, employers provide employee needs at a cost that the customer can afford. All educators ask for is more buildings, more educational cafeteria offerings and more gimmicsk without the accountable performance evaluation. Is the educational product—the intellectualized student—more capable of coping with the cybernated demands of our society?

It is my contention that educators supposedly subscribe to practices inherent in our productive institutions as guidelines for curriculum construction, methods of teaching, and administrative practices. It is my further argument that most, if not all, fail to understand the changing nature of our productive institutions that are operating in a dynamic cybernated environment. This indictment is leveled specifically at our teacher education institutions that profess to be preparing teachers for high schools and post-high schools. Teacher preparation programs offer little understanding of the very segmented portion of our productive society and that is often a specific classification within an industry. Specifically, I am challenging all industrial arts, vocational, business education and technical teacher preparation centers.

We cannot ascribe this responsibility exclusively to the educational administrators of our secondary schools. However, I do condemn the administrators of secondary schools for failing to demand that teacher preparation centres provide them with the kind of teachers that will help to technologically acculturate our secondary school students so that they may cope with the problems that will confront them in a cybernated society. These technologically unacculturated students exist in cities, towns and all kinds of countries—industrialized or developing.

Despite the evidence of the technological revolution that surrounds each of us in our daily lives, we have only made minuscule advances in the use of teaching methods beyond Gutenberg's press and the dialogues of Socrates. These were admirable innovations in their time. The teacher of today must be a manager of a learning environment as well as a teacher or inevitably he will be replaced by a synchronized tape and film activated by a logic circuit. He then will only function as a cartridge replacer during coffee and lunch breaks instead of as an educator. Here again, we have professors with craft qualifications of the 1930's selecting prospective teacher candidates, preparing curricula and writing texts that fail to take into account the scenarios and paradigms so prevalent in the productive society of the 1970's.

There is no absolute nor discrete paradigm in productive society nor in any culture comparable to the models in the maths and sciences. However, some prominent trends do emerge that should engage the attentions of responsible secondary school educators.

My contention is that schools should be current in their programs. The interpretation of culture and technology cannot be that of twenty years ago if we are to meet the challenge of tomorrow.

Current prognosticators indicate in our ever shrinking world that the discrepancy between have and have-not nations will be intensified. I take exception to this from the standpoint of a citizen of the world and an educator. Their forecasts of doom will prevail only if we fail to recognize that a productive society, whether it be in this hemisphere or any other, is manifestly successful if the participants are properly educated. Regardless of the language, constant common objectives are represented in the technological limitations of the various processes, materials, equipment and man-technology relationships. We need not introduce blacksmithing to an emerging illiterate nation who proposes to be competitive in the cybernated society of the 90's. This is equally true of the minority groups on this continent or any other continent.

PRODUCTIVE SOCIETY

The term 'productive society' has been used frequently and will continue to be used throughout this text. Productive society is understood to consist of all institutions within our society that provide goods and services. It is accepted that within the productive institutions of our society, a large number of variables exist. These variables appear in various degrees as uses and abuses of science, technology, social sciences, human relationships: in fact, most of the basic academic disciplines that constitute the education available only for the elite.

With the multiplicity of variables, it would seem an impossible task to attem[illegible] formal categorization of the basic tasks and practices most prevalent in today's productive society and their cultural antecedents. Before any such discrimination is attempted, the reader is reminded of the fact, that a categorization is recommended only as a frame of reference sufficient for understanding productive society and therefore sufficient for interpretation, curriculum construction, evaluation and teaching students.

Since this is not an historical document—only an attempt to identify the basis and argumentation for the proposed educational program described in subsequent chapters, let us observe the predominant identifiable management practices in a leading industrial nation since 1900 to the present. In the early part of this century in the United States, the prominent organizational structure was focused upon a craft orientation. The leadership was predominently autocratic in nature, "robber baron" in character, and domineering in pattern. The human relationships between employer and employee are best described in Pareto's definition of "economic man," wherein man surrendered his time to the employer, which constituted specific craft oriented skills, for a remuneration. The employer was looked upon as omnipotent and with inalienable rights to assign, employ or fire at will. These assignments were generally categorized around definable skills or operations.

Under this type of organization, the operator or craftsman was responsible for the quality of the goods or services and could subsequently be held accountable for any lack of quality or credited with good quality. Credit in this respect meant continuation of employment. Downward communications were predominently orders and instructions from the superiors. The only viable feedback from the employee was the finished product. Did it work, or did it not work? Was it good or was it bad? This was also an era of high agricultural employment and large rural populations. The "Protestant Ethic" was very prominent during this era wherein the value of work was cherished, craftsmanship respected, skills could be handed down from master to apprentice in most of the productive institutions of the society of that day. Whoever was fortunate enough to be employed could easily assess the prospects for continued employment and could foresee for a decade or so the likely developments in his area of specialization. It must be remembered that while the governments on the North American continent subscribed to equal education opportunities for all citizens. in reality education was designed to accommodate the elite and career success was limited to a small number of high school graduates. Attendance at college and university was even more remote indicating that the productive career participants at that time could obtain their skills and subsequent employment through agencies other than a formal school.

Crises such as numerous depressions, the first world war, discontent with the leadership of the entrepreneur, resulted in concentrations of rebellious groups that were furthered by prominent studies such as Max Weber, Fredric Taylor and most notably, the Hawthorn studies. These findings were all stifled by an outstanding change in the economic pattern with the stock market crash and the depression of the thirties. Disillusioned with the apparent lack of effective leadership or leadership philosophies and stimulated by pragmatic economic and political theories, the pending second world war and other great revolutionary forces of the times throughout the world—value systems, philosophies, political ideologies and educational practices were subjected to great criticism. In the interim, technological advances were in evidence with the introduction of electricity, electronics, air travel, rapid communication, nuclear energy and many more.

With the impact of new technologies, articulation of human rights, increased political responsibilities and a need for economic stability, outmoded practices of producing goods and services were replaced. New materials were developed and new processes had tobe employed. A simultaneous emergence from a great depression combined with the demands of the second world war, emphasized the limitations of a craft oriented productive society. It was during this period that the most prominent declassification of the craft position occurred wherein crafts were divided into operations. The feedback principle was introduced to continuous lines of assembly and new processes. The emergence of a technological elite most representative in the transportation, communication and power industries, was also prominent in the manufacturing establishments. This was our first indicator that the productive environment was beginning to change radically, through the influence of new technologies, materials, processes and the emerging new role of the worker. This was the era of the greatest unionization in the history of mankind, giving evidence that the worker's disillusionment with managerial limitations was valid.

An increased need for goods and services, mandated that most former craft machines be redesigned in conjunction with the development of new materials, processes and equipment. This was one of the first indicators that there was a tremendous need for better trained and better educated unique specialists in our technological society. Schools of engineering were becoming recognized and received equal status with the 'pure' disciplines. The need for professional managerial capabilities stimulated the introduction of schools and faculties to prepare specialists in these areas.

The exigencies of World War II stimulated further technological development for the sake of self-preservation which culminated in the technological explosion most prevalent in our current productive society. It took the Sputnik for the schools to recognize that our students required an exposure to an expanded education. I hope it will not take a world calamity for the schools to recognize that all our secondary school students require a more comprehensive command of science, math and the humanities to cope with the new cybernated age.

This brief historical summary should give some indication that our productive institutions, in the persons of their managers and administrators, while they were delinquent in taking full advantage of the many social science discoveries, made amends and took advantage of these new found ideas to sustain them in a highly competitive world market. Yes, in fact, contributed substantially to world recovery after the second world war and still met the needs and demands of their own citizens. Granted, that there are ghettos and discrimination is prevalent, but this indictment cannot be assigned to the productive institutions with a fraction of the vehemence that it can be assigned to political, education, and religious institutions.

Let us observe some of the phenomena inherent in these new productive institutions. One of the outstanding characteristics is their resiliency from a highly autocratic managerial phase, to a professional management group that works with highly organized militant labor organizations, public and customer pressures, and federal and state legislation. Making all of these requisite policy, technical and career changes have resulted in numerous crises. Evidence indicates that these courageous decisions may evolve as a harbinger of better things to come.

The productive equipment resulted in highly automated operations or semi-automated operations, culminating in cybernated devices and processes. These were not accomplished by accident. More specifically, they were done by design and are most currently evidenced by the highly developed futuristic planning committees that have culminated in many service types of organizations and persons. This is not a 'by the seat of the pants' operation. No successful productive institution of the seventies is a 1940 counterpart, and is even more remote from its 1929 relative.

The nature of producing the required goods and services was achieved with the full realization that this is accomplished through the efforts of other people working in concert an eight hour day, five days a week and fifty-two weeks of the year. Current managers of productive institutions cannot revert to the cliche that the employee did not pass the course or that he was not bright. Instead they express serious community concerns and an accountable role in placing even the most mediocre products of our educational institutions and eventually train them to become productive members. They do this with objectivity predicated upon sound scientific realization that failing to improve is an indication of personal managerial failure and thereby loss of business and subsequent elemination from the competitive market.

The generally accepted framework for the guiding principles of this type of productive organization can be summarized in five steps:

1. Provide direction for the productive institution. These appear in the form of objectives, philosophy, policies, forecasts and procedures, to help sustain the present as well as the improved position of this institution among other competing institutions.

2. Establish responsible programs to achieve this direction. This constitutes one of the greatest breakthroughs of these productive institutions because it connotes flexibility and sensitivity to markets, human relationships, changing technologies and legislation.

3. Establish a meaningful standard of performance for every contributing member of the productive institution within each designated program that was established to achieve the original direction.

4. Hold each contributing member of the productive institution accountable for the established standard of performance to insure quality product or service and the acceptable conclusion of programs and ultimate attainment of direction.

5. Review the first four steps—that is, if direction changes then compatible programs must be developed, changing the standards of performance of each contributor thereby affecting his accountable role within the productive institution.

I like to refer to the above formula for successful management as G O P A R

GOALS
OBJECTIVES
PERFORMANCE
ACCOUNTABILITY
REVIEW

EDUCATIONAL RESPONSE

Any attempt to criticize education may not be warranted, however, let us accept the premise that education has made a substantial contribution in the past and is now subject to considerable amounts of criticism because it fails to meet the challenges of a cybernated society. It is not my intent to give a full analysis of the whole educational set of problems or give the complete answers, however, the program that will be subsequently described is intended to indicate in one subject area that as educators we have failed to take advantage of the known knowledge available to us and instead have resorted too frequently to inert or at best, gimmick approaches to our problems, and have neglected the scenarios and systems analysis approach to our problems represented in GOPAR.

History is replete with examples of industries of many countries that resorted to gimmicks, farce, and ignored employee criticisms and ideas. Governments fell, businesses failed and new political and economic ideologies were imposed. The productive institution managers of the North American continent were more receptive and ultimately more productive. It is this flexibility with direction and accountable productive performance that earned the North American productive institution manager the respect of his world wide colleagues. It is with this type of spirit that I present the following three samples of criticisms of education:

In the University of Alberta publication, The Gateway, January 16, 1970, issue, the following article appeared:

You see it's like this. Dan Carrol, the lanky, frizzy-haired freak who runs this rag, comes up and says he wants 110 lines on alienation. Perhaps I rank as some sort of expert because I wrote several weepy columns about alienation (really, that word is starting to make me sick) during the last few years. Back when those things were getting a log of ink, I used to fool myself into thinking they would actually accomplish something. They accomplished nothing.

It's not even like beating a dead horse anymore, because as I write this there seem to be maggots coming out of the roller. When I was writing the stuff, I actually thought there was someone listening, but just looking around this fluorescent prison of an office, it is obvious no one was. Sure there's soul, but it is so small and so far behind the skin that you'll never feel it, even in a crowd. You swim in it and never recognize it.

Are you separated from yourself? Are you depressed? Do you work with your mind turned off? Are you faking more and enjoying it less?

Don't ask what you've got.

What they do is simple. Just take a human being between the ages of five and six and insert it in a classroom with five rows of desks, with five (or maybe six) in each row. Add a blackboard, a ruler, a few pencils, paper, and an authority figure. The authority figure usually comes skirted and sexually frustrated at this stage. Later, there are variations; but even though some authority figures are human, there are others who ruin anything they do. Next, stuff the object in the desk with 12 years of education. Make sure that nothing is relevant to anything it is doing outside the school. Never respect any opinions it might have. It gets all its knowledge from the Authority Figure. Never teach it how to deal with its problems itself. Make it shuffle a lot. It should know how to step-and-fetch it. Turn it off. If it starts looking for an outlet where it can plug in, kick it, jail it, dispose of it. When it starts to grunt it is ready to be eaten. When it is ready it will look like other its. It will not look. It will be blank.

Now take the finished it and insert it in a job. It will work blankly eight hours a day, and *when the boss passes it will salute (if it's been properly trained). At night the it will watch television where other its who have been specially trained to look alive will look alive. Their skin will flex in alive ways on commercials, and it will go out and buy, hoping to look alive. It won't do any good —an it is an it is an it. With few outlets, and there are fewer every day, it may forget it has a plug. It may even join the social credit league. When the police pass it will shuffle, when a politician speaks it will say "sir," when an election happens it will grunt.*

What I've been trying to say is this. The schools produce fascists. The schools produce people who cannot think. The schools produce people who cannot read or write. The schools produce lobotomized dolts. The schools produce grist for the mill. The teachers ride the students into the ground. Most have no minds by the time they've finished grade twelve. Most of them never will have minds.

The system is designed to turn you off. The system has already turned the teachers off, and they, in their turn perpetuate the system. The system lives off itself. The system eats your mind. The first thing to do is burn the schools to the ground and start over again. That of course, is impossible. That will never happen.

The quality of education is clear. Teachers only strike for pay. They will not strike for better schools. Teachers will not strike for better libraries, better educational materials, more in-service training, more educational research. Teachers are pigs.

The Silent Majority is silent because all they ever learned to do is grunt. They will teach you to grunt too, if they haven't done it already.

That's about it. You have to live with it--I have to live with it. Someday we may come together and be alive. Maybe someday soon.

I'm not optimistic.

The Detroit Free Press had this to say in their October 29, 1968 issue:

Dr. Seymour L. Halleck, professor of psychiatry at the University of Wisconsin, has written a piece for Think Magazine, "Why They'd Rather Do Their Own Thing."

In case you are a bit out of touch with English as she is now spoken, to "do their own thing" translates to "go their own way" among young people. It is one of the key phrases in the so-called generation gap, responsible for much gnashing of the teeth and shaking of the head among us ancient gaffers.

One of the most aggravating of youthful tendencies is their insistence on the "now" of practically everything. They want the world to be on a string "now"- political reform "now," peace "now," brotherhood "now," love "now," Gene McCarthy "now."

To listen to them is to assume that they do not believe in tomorrow, and this is very disconcerting to elders who have spent lifetimes preparing for the future.

How do you explain this, Dr. Halleck? Listen . . .

Students today have little reverence for the past and little hope for the future. They are trying to live in the present.

The most important reason for this is the ever-increasing rate of change which characterizes our society. When no one can predict what the world will be like in 20, 10 or even five year, man must alter his psychological perspectives. The lessons of the past become less relevant; planning for the future appears futile. One is driven to gear his values systems toward enjoyment of the present . . .

* * * * * * * *

Yes, Doctor, but supposing the world doesn't go to Hades in a handbasket during this century? Supposing we come to some sort of an an "accommodation" with the Russians and the Chinese and there is no nuclear war. This is possible-- it is even probable. So what then? What are the young people going to do for the material things which are so highly important in our society?

Listen again . . .

. . . College students tend to downgrade the acquisition of property . . . they are unimpressed and sometimes even contemptuous of it. Recruiters for industrial firms on our campuses are learning that some of the best students are not interested in business careers. Few young people can view a life that is

dedicated to trade and acquisition of wealth as meaningful. Some conservative adults fear that this new devaluation of capitalistic enterprise represents a shift to communistic or socialistic philosophies.

This fear seems exaggerated. Acquisition of capital is a rational enterprise only when there is some reason to believe that it will have the same usefulness in the future as it does in the present. When this is not true the amount of self-expenditure involved in obtaining capital seems wasted . . .

All of this sort of grabs you, doesn't it?You go to the jute mill, Old Man, day in and day out, giving your all for the new car, the bigger home, the winter vacation, the fine clothes, the expensive college--and what does it get you in the eyes of your offspring?Deep down inside, while accepting the fruits of your toil and travail, they may be looking upon you as Mr. Robot of 1968--one of the last of the Steel Age Neanderthals. It is enough to make a man order a triple martini for lunch.

But is it all bad?Is the way we do business these days sacrosanct, or is there room for improvement? The latter would seem to be true. In fact, the changes within the commercial world these past 10 years have been amazing.

Today for example, some of our largest corporations are becoming deeply involved in our social problems, to the point where Ford and Chrysler (on the local scene) are going into housing, while others are committed to hiring those once considered unemployable.

There is a "profit motive" involved, of course, but what is wrong with that?Indeed, when the history of the "New South" is written, it may be determined that profit had more to do with social progress than any other factor.

Actually, the people of America, old and young, aren't as far apart as the pyrotechnics of campus revolt might lead us to believe. There will be "reform" on both sides of the generation gap–the nation will survive."

This is Ralph McGill's reaction, Detroit News, October 31, 1968:

There were no classrooms in the elementary school where I had gone for a visit.

There were large rooms, curving gently and lengthily with the architectural design. There were three groups in a room. Each group was clustered, in movable, desklike chairs, around a table.

The teacher could call them in close for instruction. For study or listening to lectures or being taught over television or by other means, they could move their chairs as they pleased.

Each of these clusters of youngsters was a class. The old methodology of teaching was not in use. I noted that most of the teachers were young.

The principal explained:

"It–this type of school–is new for me," he said. "I had to adjust. But there was a curious psychological reaction by many of the older teachers. Not being in a private classroom, with the door shut and with their own class captive before them, made some teachers very nervous.

"Some simply couldn't take it. One actually cracked up. So we worked out transfers."

"The young ones like it?

"Yes they do. We find, of course, some parts of our new techniques don't work as planned. So we make changes. We improvise."

"The pupils are pleased?"Yes. They like it much better."

(The school is in an area where former residents of an old-time slum had been provided new urban renewal, low-cost housing. A high percentage of the pupils are in homes where the father is absent because of death, divorce or desertion. This is a familiar pattern. Such conditions often make for disorder–running in the halls, fighting and so on.)

"How about behavior?

"Better than in the old school. There are, of course, some youngsters not well disciplined. But somehow the newness of the school, the absence of long corridors, seem to make for better behavior."

Change is picking up momentum in education.

The big revolution is ahead. The older teachers, themselves the products of middle-class schools designed to teach middle-class attitudes and values, with subjects selected for the proper upbringing of middle-class youngsters, are going to be more *and more uncomfortable . Unless, of course, they can adjust.*

It now is estimated that by 1975, a mere seven years from now, the teacher shortage will be relieved substantially. More and more young men and women, especially the former, are going into teaching.

These new teachers are out of sympathy with the old methodology. They are right to be annoyed.

It is quite likely that many adults in education and parents who send children to be educated are going to find their names in the black book when the final trumpet sounds.

It is unpardonable that our system allowed educators to classify children as "backward," as "slow learners," as "problem children unable to learn." God alone knows how many children out of illiterate, deprived slum homes have gone to the first grade with a vocabulary so limited they could not understand what the teacher was talking about and–therefore–been labeled "unteachable."

For a generation we applauded such divisions–the lumping of confused, frightened, sometimes hungry, half sick children into categories that really retarded them.

Throughout all our history–and maybe that of other nations as well–the children from deprived backgrounds and homes have, in general, become the poor and deprived of each new generation.

To the question, "Who can be educated?" the new breed of teacher is answering, "Everyone–anyone."

I may be criticized for including the above comments, but I feel we–all educators, must go to the students, the taxpayers, parents, the press and other interested publics to ascertain how they view education.

PROCESSES FOR CONSIDERATION

Argumentation is abundant in discussing what kinds of value systems secondary schools should be transmitting. Besides the inquiry what is wrong with middle-class values? Suffice to say that a whole host of values, habits and attitudes imposed by a demanding technological society are being transmitted almost without question and certainly without any serious intellectual involvement on the part of the students or educators as to whether these values are legitimate and good for society by any classification of top, middle or lower class. This is further argumentation that a program of education at the secondary school level must transmit the technological effects and demands made upon all strata of society.

Let us observe some of these technological influences. Look at the impact of automotive travel or jet air travel upon all strata of society. Observe your own reaction to the often in bold type direction–'Do not spindle, fold, mutilate or staple.' Labor saving devices are not exclusive products of a manufacturing plant. They are in evidence in the home, in the office, the church, the school. Observe the impact of technology upon our mental health, surgery, pharmacy, dentistry and ecological imbalance. Chemical preparations that affect our food products, our sports life, our air, our water–are these, in effect, to be ignored, or are they to be recognized that the effect of a dynamic technological explosion has had an impact on all levels of our society with only an occasional effort to learn to understand it and to master it.

It is proposed that there are four common processes predominant in all institutions in our productive society that must be carefully observed and understood before any curriculum, building, administrative structure or request for funding be responded to. The four processes in question are listed in the recommended rank order of consideration–authority, decision making, communications and organization.

Authority:

There are many definitions of authority that explain authority as emanating from the masses as described in a true democracy or from a duly constituted organization, as in the military. Let us observe authority as the power to act as it influences the productive institutions of our society, the schools and their curricular content, and the students' individual lives.

In a highly authoritarian society, authority can be ascribed to size, to military power, to control of the public funds. In other instances, we ascribe authority to a knowledgeable person, a degreed person, historical precedence, age. There are other sources of authority that deserve some consideration . . . the duly constituted laws of the land that govern the functioning of institutions and individuals, the policies of a business or industry.

It is my recommendation that one of the reasons for difficulty within the schools is that too frequently we have become preoccupied with the ephemeral vacillations of our society which result in word games, myths or temporary solutions to educational activities without authoritative merit.

Let us observe that very few critics question the authoritative base for science, mathematics, English, the arts, but extensive effort is expended and criticism is levied upon the methods used in transmitting this basic knowledge within our schools.

The question of the value system of meritocracy has been leveled at schools and in response to this indictment, rather than evaluate the educational value of merit in our schools, educators have taken cover in mediocrity which resulted in temporal solutions and neglected its real responsibility to first transmit knowledge to all students at all levels, including the impact of the technological environment.

It has often been stated that productive institutions exercise their authoritative positions to earn a profit, therefore they have fulfilled their responsibilities to the representative bodies that have delegated this authority and did this in a measurable quantity. Study of the history of business and industry indicates that this progress has not been devoid of serious consideration of psychological and sociological implications upon all levels of the productive institution and subsequently upon profits. Productive institutions are held in check by legislation, by unions and similar organizations, by customer demands and by public pressures.

When training an employee a supervisor's capabilities are measured by that employee's performance and he therefore is subsequently evaluated by the cumulative performance of all employees which reflects upon his productivity. The impact of this geometrical productive assessment is the result of a highly advancing technological society and spells the difference between success and failure in productive institutions.

A supervisor understands that he must live with his employees eight hours a day, five days a week, fifty-two weeks of the year and that the requisite skills for these work classifications have not been transmitted by the public schools of this nation. A supervisor does not have unlimited selection of employees, particularly in a high employment market. A supervisor cannot fail or pass employees and attribute failure to an employee and take credit for their successes. The supervisor needs bodies, hands, skills—manual and intellectual and productivity. His authority for all of these variable functions emanates from the basic policies and philosophy of the productive institution that recognizes that all employees, regardless of status, are human beings, citizens of this country, taxpayers and ultimately ul consumers. The supervisor needs the employee as much as the employee needs him. Therefore, if he abdicates his authoritative position, his responsibility to a superior body to produce at a profit within the limitations of funds, personnel and capital equipment, he cannot realize the ultimate evaluation of his worth, productivity at a profit.

Now let us observe the educational process and its function in our society—to educate the youth of the society. Without delving too deeply into the legal authoritative base for the formation of schools, which evidence is legion, let us discuss the more intangible basis for authority in educational institutions. Historically, parents have transmitted this responsibility to public institutions with the full expectation that they would obtain a fair dollar value in return.

Therefore, one of the first recommendations for educators in assuming a responsible, authoritative position, is that teachers can be most successful and satisfy social needs by assuming the authoritative position of disseminating that knowledge which they are prepared to teach. For instance, physics teachers may be well versed in contemporary physics and math teachers in math, English teachers in English, history teachers in history, and industrial arts teachers in the impact of technology within our industrial institutions. This implies the transmission of all this knowledge to all students and not to a select few. This does not mean that because of an intellectual variable—a highly questionable quotient—that students with variable intellectual levels can be subjected to a modified or "dumbed-down" version of the subject matter. A stretch-out of any subject is recommended or new methods devised to impart this knowledge rather than an indictment of a student's ability or the arbitrary decision of failing or the current practice of passing students on seniority, maturity and in some cases, good conduct.

Too frequently the teacher or the educator subscribes to the premise that the taxpayer or parent usurps the teachers' authoritative base. They don't do this with doctors, lawyers, or other professions because these professional people function in their area of specialization. I contend that every teacher does not have his basic authority usurped. In fact, teachers abdicate rather than assume the authoritative base to teach their subject specialty. They get involved with foreign fields of psychology, sociology, and their personal, biased interpretations of these phenomena rather than concentrate and prepare themselves adequately in their field. The teacher is no more qualified as a psychologist than the supervisor, doctor or lawyer. He cannot interpret or transmit the ills of our society—it is not his responsibility or his authority to do so.

Teachers professing to interpret industry or the recommended productive society must be well versed and properly prepared in the variety of phenomena that permeates our productive society. If physics teachers must be alert to the most current laws of physics, therefore, industrial arts teachers, vocational and technical teachers must be equally well versed in their areas of specialization.

Decision Making

Historically, decision makers depended to a large extent upon intuition and in many cases, the devil theory, to arrive at their solutions. Rugged individualists operated on hunches or inspirations.

With the rapid expansion of knowledge and the applicative use of this knowledge as it appears in technology, operations, products and services; governments and educational enterprises must rely more extensively on the scientific process of decision making rather than historical precedents or intuition. Therefore, decisions affecting curricula at any educational level must be approached as scientifically and objectively as possible; just as decisions involved in productive institutions.

Many social scientists aver that the application of scientific methods to decision making is inappropriate. Thus one cannot use physical science logic as a foundation for social science. Therefore, economic theory cannot be modeled after physics since the variables are of a social and human nature. However, evidence of the success of economic planners implies that these previous assertions may be premature.

The very nature of economics impedes mathematical solutions. The theoretical framework is difficult to apply in a reality-based situation. Another problem is the vagueness of terminaology and the difficulty in describing social situations precisely. Consequently, the intital task is the clarification of the problems by further careful descriptive work.

The decisive break which came in physics in the seventeenth century, specifically in the field of mechanics, was possible only because of previous developments in astronomy . . . the gradual development of a theory, based on a careful analysis of ordinary everyday interpretation of facts. Thus the contribution of astronomy, which was integral to physics, can be paralleled to the importance of economic theory in the development of decision making theory.

The first stage in the theory of decision making development is recognition and acceptance of basic foundations about which there is no doubt. The second stage is the application of the basic foundation to somewhat more complicated situations; if the application is successful, it is utilized, if it is unsuccessful, other alternatives are considered. Thus the ultimate goal of decision making theory (like economic theory) is the ability to predict or anticipate outcomes.

Content for curricular decision making has ample precedence and authority because of their antecedent evidence in the various disciplines. However, when it comes to decision making in industrial arts curricula, educators have been remiss in looking at the full picture. Some wish to interpret technology. It is my contention that we must interpret the scenario prevalent in the productive institutions of our society and not any one craft, material, technology or process, but more specifically, their interrelationships as they are described at greater length in subsequent chapters.

Communications:

Assuming that an authoritative base for curricular content has been identified and that the decisions pertinent to curriculum have been predicated upon this authority, then the next process to be considered is communications.

It is recommended that the communication process, whether in productive institutions or in educational enterprises, be viewed in its totality and as it influences or is influenced by the functioning structure of that organization. It is further recommended that the communications process be observed as constantly existing and is more responsive to the way the organization actually functions rather than to the way the professional organization verbally articulates its role.

The role of semantics, proper reproduction, good English usage, or other communication skills cannot be denied, but evidence indicates that communication is successful and creditable only when messages, oral or written, are reinforced by actions.

Paul Pigors best summarizes this when he says:

Effective communications is difficult to achieve, because understanding is more than a grasp of facts. Meaning, if any, is conveyed (1) by words spoken and written, (2) by interpretations of words or silence, action or inaction, and (3) by insight into situations. Moreover, all communications is part of a continuing process which, in every human relationship is a joint task.

In support of the belief that communication in industry is more than technique centered, many authors contend that effective communications in any enterprise relies upon a continuous interacting and effective information flow. In an institution where success is dependent upon the coordination of all the members, the communications process cannot be placed in a supplemental role. The managers and administrators depend upon accurate information to effectuate decisions. The contributors depend upon the efficiency with which the managers and administrators deal with this information in reaching conclusions. In this respect, the organizational activity, its goals, success or failure relies upon a continuous interacting and effective information flow.

Effort spent on communicating some kinds of information to students is largely effort down the drain. Students pay scant attention to communications in which they are not interested. The use of color, glossy paper and attention-getting devices, is secondary to the questions, "Does the student really care anything about the information you plan to give him?'

In general, studies indicated that students were interested in information that school was "them" oriented. Such information grants the student an opportunity to influence his future with the organization and indicates the organization's sincere desire to educate him.

These findings help support George Homan's hypothesis that informal communication, which is social in character, develops side by side with task oriented formal communication. The use of the channel for either kind of communication tends to reinforce its use for the other.

Back in 1955 G. Edward Pendray stated:

1. People are interested first in people, then in things, last in ideas. If an abstract idea—or thing—is what you have to exploit, you will fare best if you state your case in terms of people.

2. People can be counted on to act only when they expect to gain something by it. Appeals to ideas or altruisms sometimes work, but for sure-fire results spell it out in terms of "What's in it for me."

This means to me that every student wants to learn and have an opportunity to speak, to ask questions, not to be lectured to as one of a mass. A subsequent chapter on methods and evaluation will deal with this topic thoroughly. Suffice to say that every teacher, professor and administrator is lost without a sound communications system, and I don't mean audio or visual electronic devices—I mean that he must communicate his ideas, his feelings, his purposes, his goals, his whole personality with the opportunity for feedback. Otherwise he, his school, the community and most important, the students, pay a heavy penalty. Good communications gives Authority an acceptable place in the school and makes decisions meaningful.

Organization:

This process better than the previously enumerated, Authority, Decision Making and Communicating, indicates that teaching is more than a person with a font of information. The teacher cannot rely upon a textbook as his main resource. This is particularly true of teachers who deal with concepts and theories or teachers who teach laboratory type programs. The reason is that there are a large number of resources available to the teacher of today and he must not only teach but manage the many resources available to him for any lesson, unit or curriculum—therefore, he must be well organized.

Granted that there are a large number of different types of teachers, teachers with different backgrounds, different philosophies, different training, attitudes and beliefs. Let us concentrate upon the performance centered teacher that may subscribe to the perfomance centered type of teaching-managing previously described in this text. Note that I said teach-manage, not only teach. The long touted lecture method is as obsolete as the horse and buggy—more methods of evaluation and method will be described in Chapter VII. What is of concern here is that any educator at any level who fails students is first a failure himself. I do not propose that students just automatically get promoted to get rid of them, but teaching authentically is more than dissemination of information—this can be accomplished much more effectively and cheaply by employing proven technological methods. Yes, even to the degree that the teacher may become the service man during student coffee breaks or lunch period to make certain that the equipment functions. I believe teaching is more than this—it is the reaction or no reaction that I perceive as I teach—this means a new approach—flexibility—different words—additional models—a different approach. This then implies that I must be well organized, organized in terms of the school and subject area goals: that I understand how my subject matter field interfaces with the other subjects, that I know the type of student behavior and can anticipate and then hold them accountable in terms of the subject matter I am directly responsible for. This means I must not only be knowledgeable in the field but also up to date—that I know all the resources available to me to accomplish this effect and that if there is any failure, then I have failed and not the student. This presupposes that I, as teacher or professor, understand my functions as they are related to educational objectives of the institution and the resources available to achieve these objectives. This process is accomplished by a command of a wide variety of methods and the quality of information I have available in my area of specialization. To accomplish this it would be my responsibility to plan—short range and long range—how best to motivate the student body so that I can direct their attention toward the subject matter without threat or coercion—and most important, I would observe how best I can manage the learning environment wherein students and I will be required to function. These are not impossible standards of performance, in fact, they are in evidence wherever good teaching is taking place. If all my appeals fail, then let us ask ourselves a selfish question. What is there in it for me? These students invest a big portion of their time and their ultimate actions as adults can rightfully be laid at our doors—whether we deserve this or not is academic—that's where the liability will be placed. In fact, current evidence today throughout the world indicates this.

The student, parent, taxpayer, industrialist and politicain are all keenly interested in education—they see mediocre results with the ultimate mediocre citizenry. Taxes are rising, costs are rising—and educational quality cannot claim commensurate improvement. The crisis is here—we must confront it. Maybe we do need professional general managers to replace our school superintendents. I don't recommend that we revert to the one room school house, but I do recommend that the one room school house teacher had a better conception of how all the subjects would interface with the various graded students than most administrators or curriculum experts do today.

The program described in the following chapters attempts to indicate that this is possible, in fact, it is functioning.

CHAPTER II

THE FOUR PHASE PROGRAM

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DESCRIPTION

PHASE I

PHASE II

PHASE II

PHASE III

PHASE IV

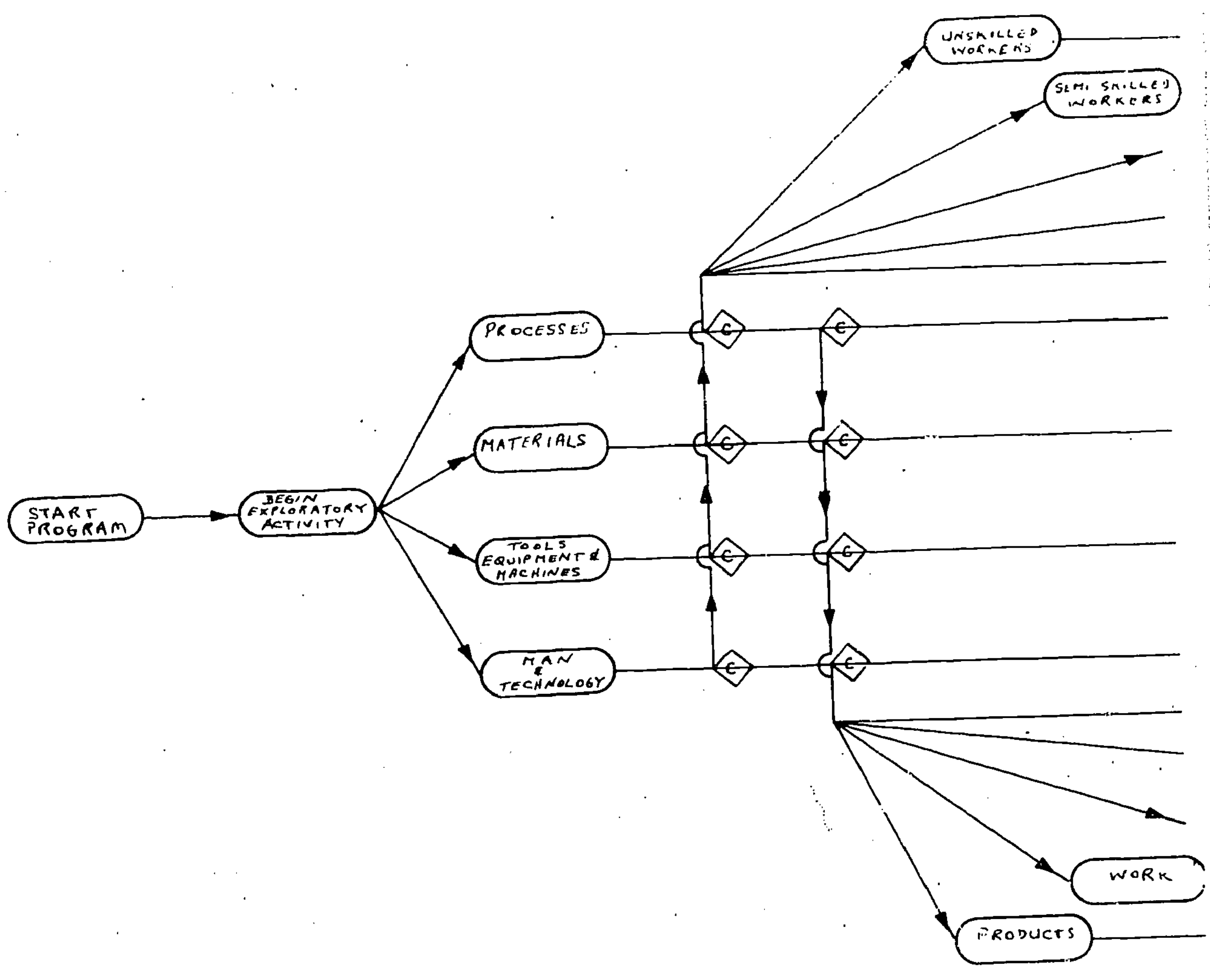
METHODS

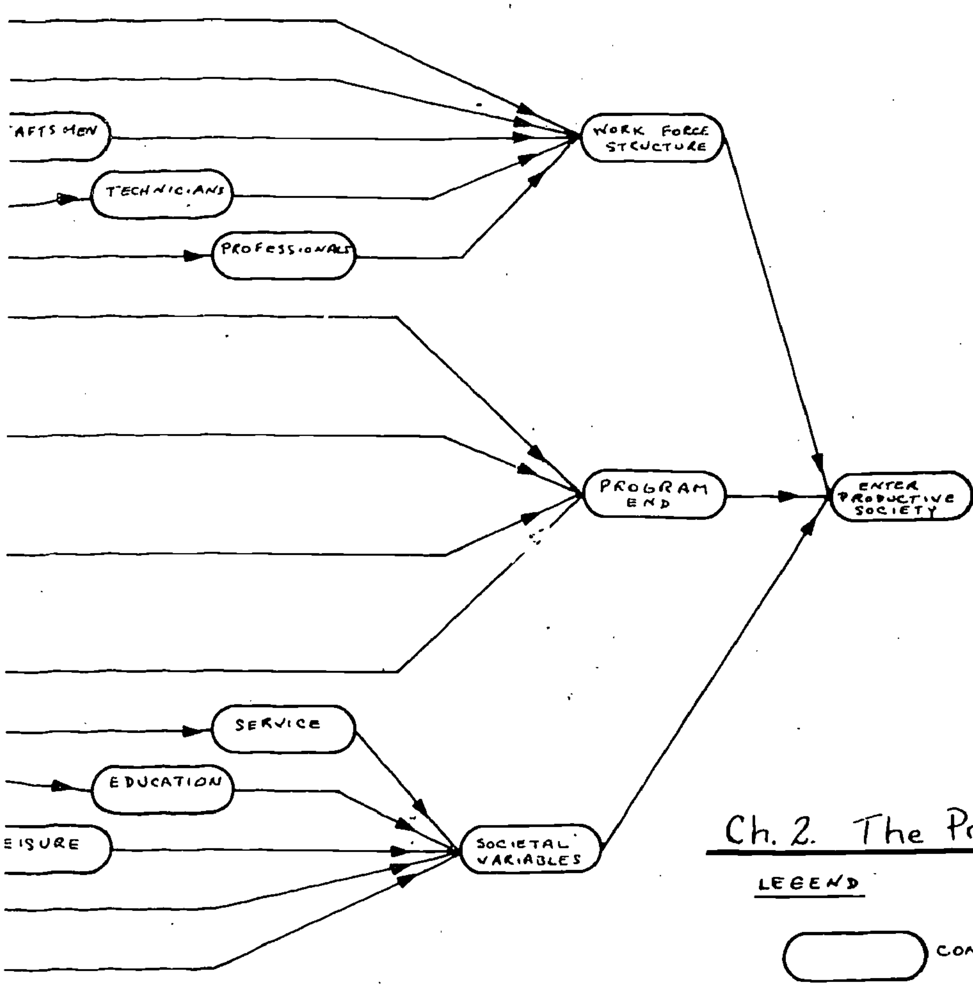
EVALUATION

MATRIX

INSTRUCTIONAL TECHNOLOGIES

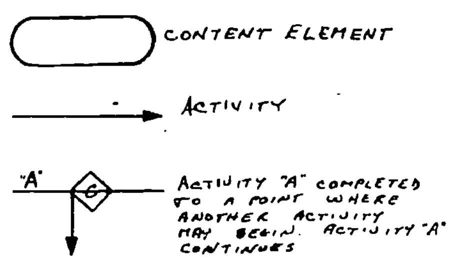
ORGANIZATION


UNSKILLED WORKERS
SEMI SKILLED WORKERS
PROCESSES
MATERIALS
START PROGRAM
BEGIN EXPLORATORY ACTIVITY
TOOLS EQUIPMENT & MACHINES
MAN & TECHNOLOGY
WORK
PRODUCTS



Ch. 2. The Program

LEGEND



CHAPTER II

THE FOUR PHASE PROGRAM

INTRODUCTION

One of the outstanding problems confronting all of society today and unquestionably will confront society tomorrow. is the rapid change and introduction of technological developments. An observation by Dr. John Platt of the University of Michigan indicates that in the last century we have increased our speed of travel by 100, our energy resources by 1,000. our speed of data handling and the power of our weapons by 1,000,000 and our speed of communication by 10 million.

We have had to abandon many of our basic truths in physics, geometry, chemistry so much that it becomes impossible to understand at what point in time these basic truths become obsolete.

Scientists and professional people often state that they become obsolete five years after they have left college if they do not constantly stay abreast of the recent articles in their respective journals, seminars or conferences. If this be true, is the gap ever widening for the average citizen who must vote on large expenditures because of technological innovations and discriminate between biased public officials. Must citizens decide to purchase or not to purchase, to use or not to use, or to invest valuable personal time for further education in any one of the fast developing technological innovations that affect him directly or indirectly? Yes, it is a confrontation of man and technology and the ultimate consequences will be determined whether man shall rule technology or technology rule man.

It is therefore my premise that a program of study is needed that will, through directed discovery and other methods, meet the often expressed needs of problem solving, individualized instruction, discovering one's own capabilities, and progressing at one's own speed. It is the intent of this program that students very rapidly recognize nomenclature scientific and mathematical concepts, the cumulative impact and subsequent effects of technological innovations upon their lives as they study, as they attempt to select a career goal and how they may function in our productive society.

The proposed program is designed, and substantiated by research evidence, for grades seven through twelve. Evidence indicates that it has merit to be introduced to grades kindergarten through six, post high school and adult education. The basic challenge is that our society is technologically unacculturated so that students in New York City ghettos or the suburbs of Detroit, or the Western Indian reservations neglect to acquaint themselves with the dynamic effects of scientific discovery that result in technological innovations and the impact upon their lives.

It is my recommendation that this program represents in addition to secondary school objectives, the following four objectives:

1. Whatever educational experiences this program offers, it must of necessity reinforce, complement, give meaning to the other courses offered at the secondary school.

2. This program environment must also include a course organization that will help to synthesize other secondary school course offerings, show the interrelationship of technologies at work and the relationships of man and technology and the relevance of science, math, humanities and social sciences.

3. Through these offerings, the student should, by experiences, be given opportunities to work by himself, obtain confidence in solving problems, identify questions and concepts and ultimately, select some *general* pattern for his or her career.

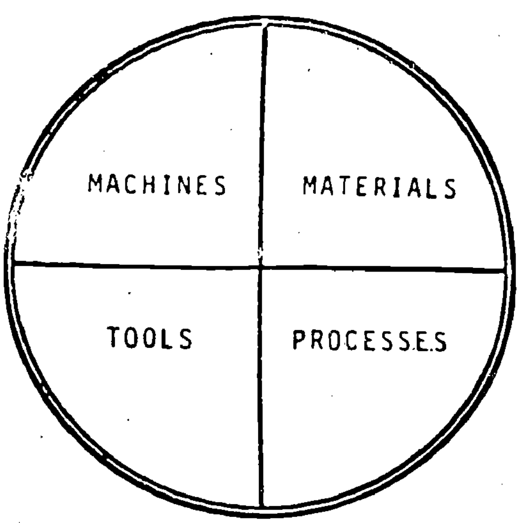
4. The guidance aspect of this program is more devoted now to the interpretation of our productive aspects of our society as it functions now and is likely to function when the student becomes a productive citizen.

It is not sufficient to propose objectives. The essence is to establish laboratory experiences that utilize known technologies, and to enable the teachers to implement this type of program.

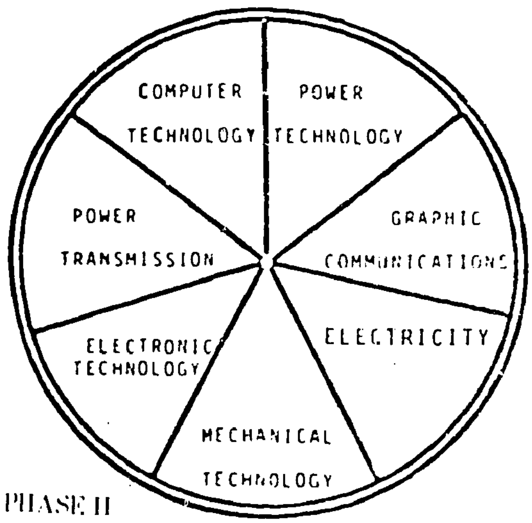
Further, the program is designed and objectives cited in this chapter by establishing meaninful learning experiences to upgrade ninety to one hundred percent participant advancement in other secondary school courses. If the student understands the application of math or physics or chemistry as it appears in a technology, then formulas and principles quoted in his other courses will retain significance.

DESCRIPTION OF PROGRAM

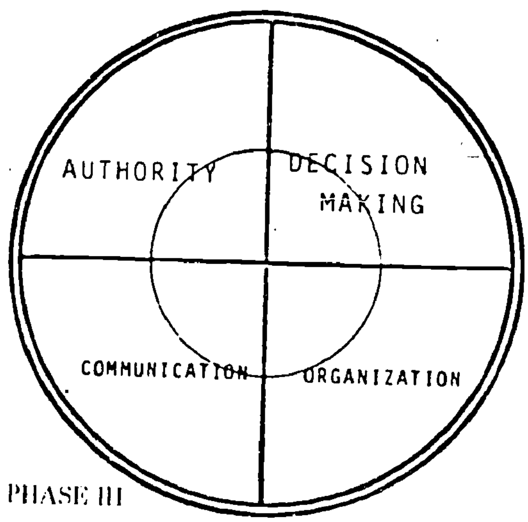
As with any educational recommendations, the following industrial arts program and its subsequent sub-headings are described in greater details in following chapters.



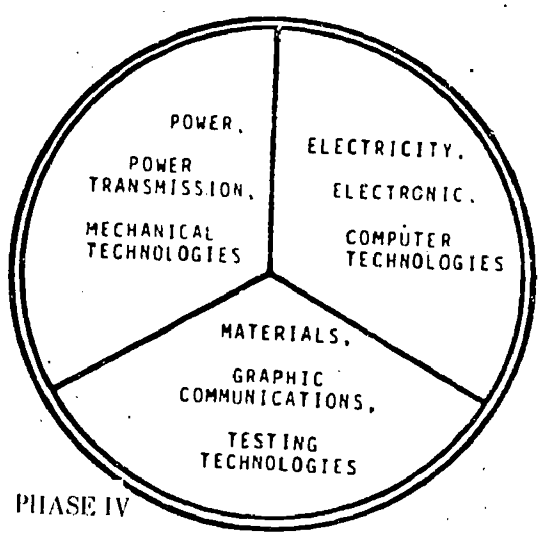
PHASE I



PHASE II



PHASE III



PHASE IV

This program is distinguished from vocational education in the same sense as any other academic course offerings are from vocational education, technical education or professional education.

The recommendations for this program do not profess to replace any current academic offerings. Instead, its viability must be substantiated by its unique contributions to secondary education, to boys and girls, regardless of their ultimate career destination.

Historically and very accurately, industrial arts offerings were predicated upon a craft-oriented industrial society. With a dynamic introduction of technology into all facets of our productive society, whether they be scientific, professional or technical or a delineation of each of these, it is imperative that we transmit the technological climate of our current society, which includes all of society's institutions and not just "industry." Industry is not an adequate sample of our productive society.

Electronics is not the exclusive province of the TV repairman or the electronics technician or the electronics engineer. Electronics is also very gravely the concern of the medical doctor who is increasingly concerned over the technician's interpretations of electronic metering device readings which may in essence have one set of parameters for the technician but constitute an entirely different set for diagnostic purposes of the medical professional.

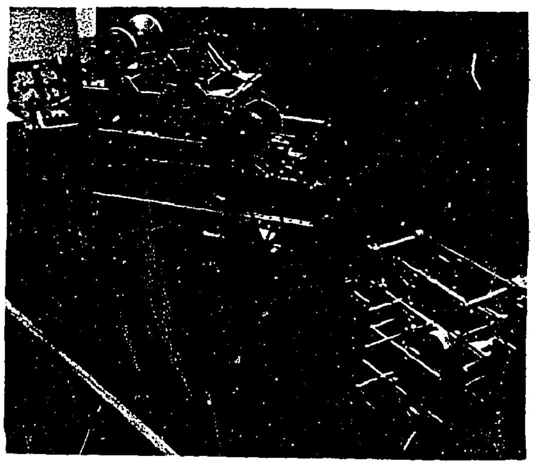
Electronic data processing and retrieval is in abundance in every productive institution in our society. They are not the exclusive province of an accounting department. They are equally prominent as retrieval systems, in hospital drug administration, legal case histories, yes, even biblical texts (don't forget the moon shot, libraries,government, rapid information for decision making and variable usages).

There is a failure to recognize that even if industrial arts should wish to limit itself to the rapidly diminishing crafts as representative of our industrial enterprise; current practices within the schools indicate that even this inadequate sampling has no tangible right to occupy the time of any student regardless of categorization as a high achiever or low achiever. These current industrial arts practices make little or no contribution to the educational process at the secondary school level.

The typical carpenter no longer pursues his craft according to the archiac craft practices. The plumber of today is equally concerned with plastics and their extruded forms for transmission of liquids, semi-solids, and solids. The tool and die maker is rapidly being maneuvered and ultimately declassified by numerically controlled machines, electric discharge machines and pneumatic profiling devices. It is not only that the producing machines have changed, but the processes involved in providing these goods or services have been radically changed due to the development of new materials, to the point that the linotype and hot lead printer is rapidly being replaced by a numerically controlled offset printing process and a short run printer by the equally dynamic electrostatic processes.

What role then can we ascribe to the typical industrial arts birdhouse, pump lamp, soldering iron, bench vice or the drawing of such. When in fact, the technologocal environment about us is so complex that it employes a variety of technologies and very rapidly obsoletes the old craft orientation. There is ample evidence to indicate that routine, manual functions can be most easily automated and that craftsmen may become technicians or para-technicians or skilled obsoletes. (These also extend to professional

and scientific areas). Cybernation is more than a series of new machines and more fundamental than any hardware. It is a way of thinking as much as it's a way of doing.



What justification is there in having students carving wood bowls, or plastic blocks when in fact, extrusion, lamination, injection processes in many material forms are perfected and practiced. In fact, many toys are more current representatives of our cybernated society than the practices carried on in the name of industrial arts.

I take full responsibility for condemning current industrial arts practices. However, I also advocate that industrial arts can become a most imperative academic offering in secondary school education. Yes, coalescing or synthesizing academic subject matter in an environment that no other course offering is currently accomplishing. I offer the following industrial arts program in support of this argument.

The four main objectives of this program that every student needs and only this proposed program can offer are:

1. Reinforce academic disciplines

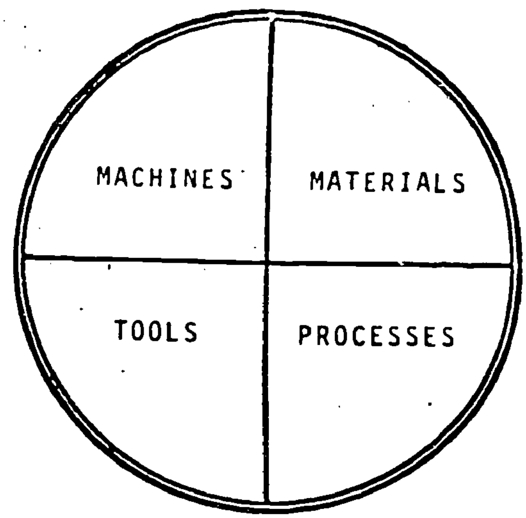
2. Provide a synthesizing educational environment

3. Interpret productive society

4. Provide exploratory experiences for guidance in career pursuits.

To achieve these objectives, it is recommended that the program constitute four phases offered to all boys and girls in the following manner prescribed.

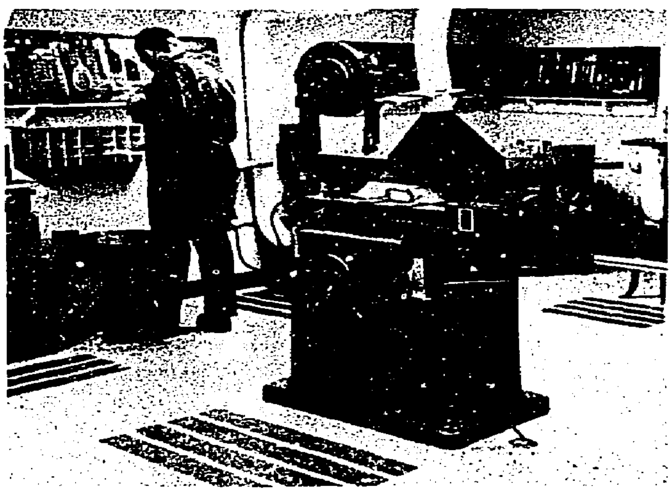
PHASE I



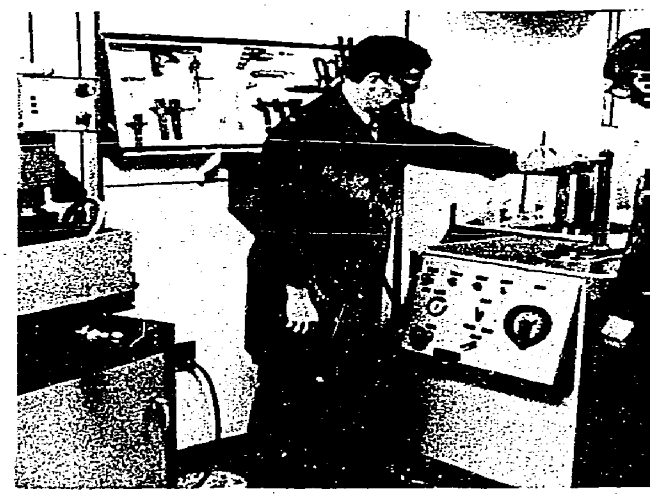
Exploratory experiences are provided in a multiple-activities laboratory which exposes grade 7 students to a representative sampling of the tools, materials, and processes inherent in our productive society.

It is recommended that a representative sampling of this Phase I laboratory experience would consist of the following sample six activitie s

1. Woods

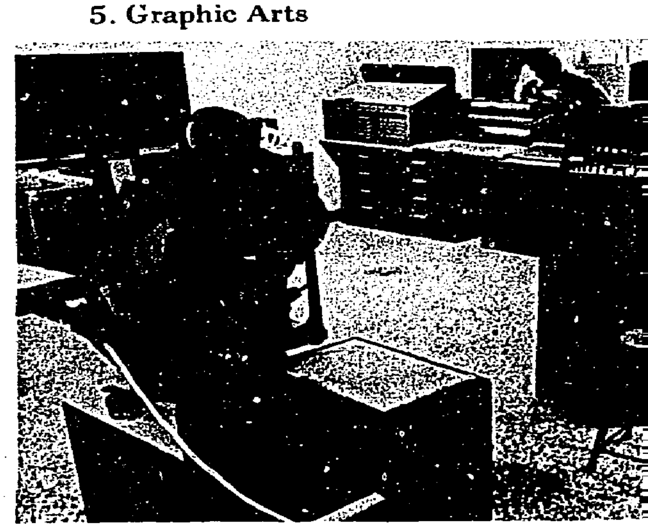


2. Plastics



4 Ceramics

5. Graphic Arts

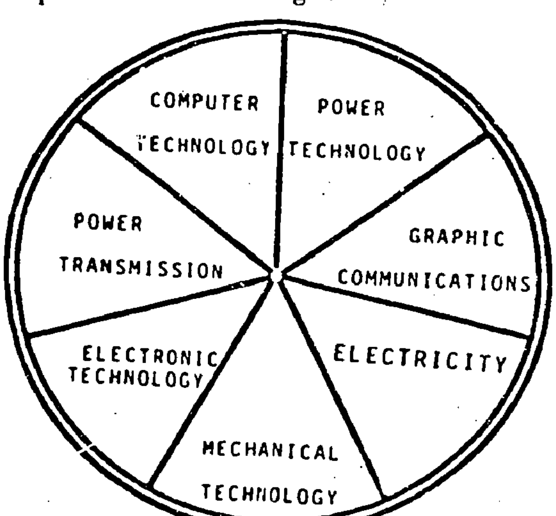


6. Materials Testing

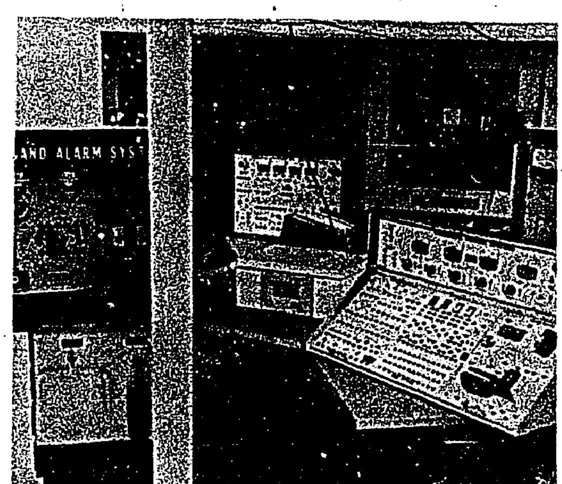
Regardless of the students ultimate career destination, these six activities, while they may not be all-inclusive, are a sample of a fairly large representation of involvement of the productive institutions of our cybernated society. Extrusion is compatible whether it be plastic, steel, pills or cookie dough. What is significant is that the relative understanding of the material and process be appreciated. The specifics are assigned to those vocational education or productive institutions more proficient in this area.

Technologies are inherent in many of the processes and materials described in Phase I, however, the terminology and classification in this phase is representative of the most prominent sampling of technology in our cybernated society. The uniqueness of this combination is that it is again presented to grades eight and nine in the multiple activities type laboratory where students will sample the following technologies:

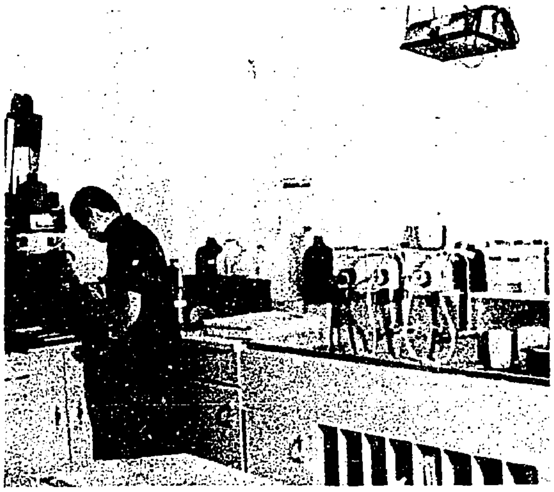
PHASE II:
Exploration of Technologies



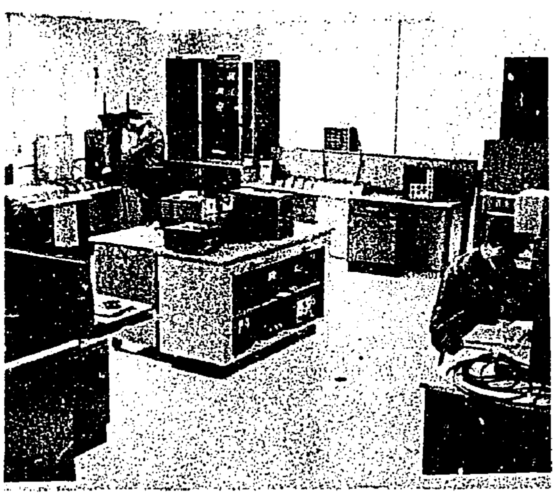
1. Electricity



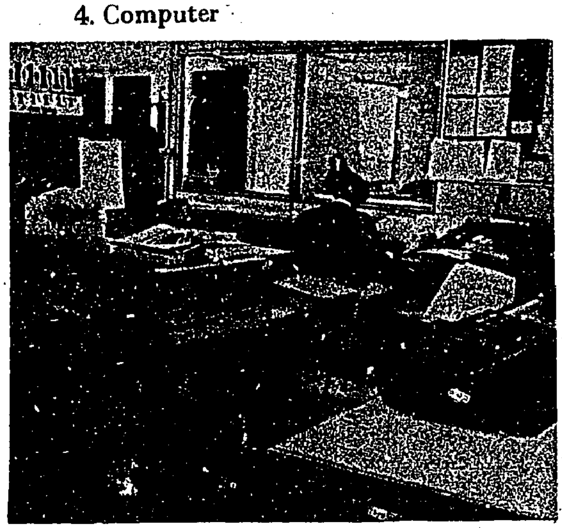
2. Graphic Communications



3. Electronics

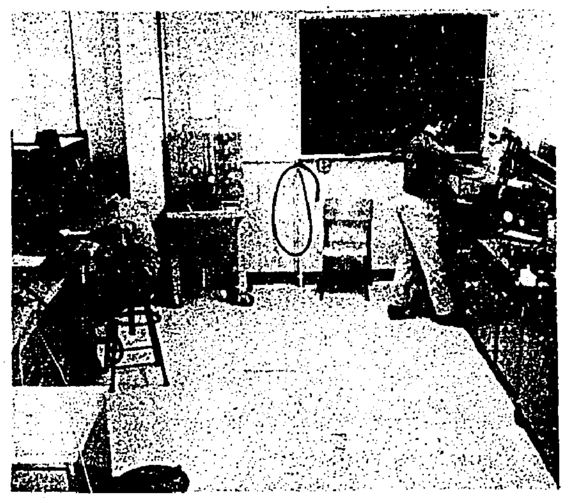


4. Computer

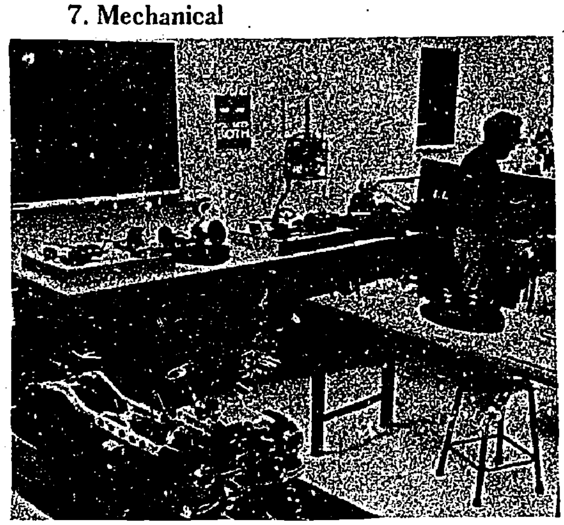


5. Power

6. Power transmission

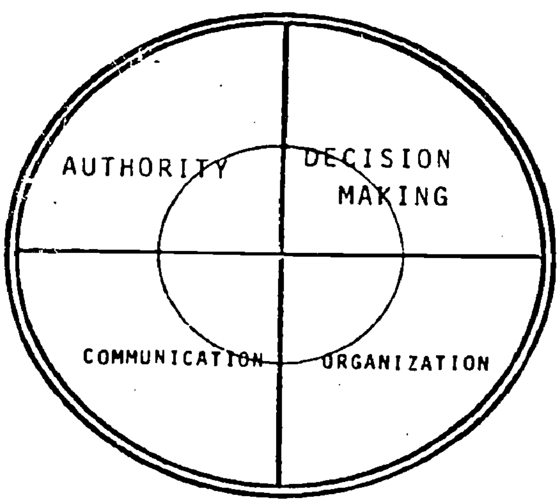


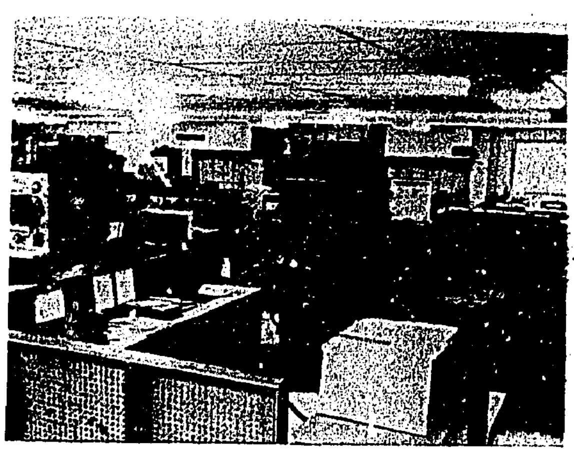
7. Mechanical



It can be readily observed that a product was a vehicle of instruction in Phase I. The experiment becomes the vehicle of instruction in Phase II. This uniqueness of instruction transmits the unusual environment inherent in technologies, but also the requisite disciplines, attitudes and habits that identify these specific technologies and activities. More readily it can be seen that both Phase I and Phase II are designed to support the academic pursuits of the junior high school curricula.

PHASE III:

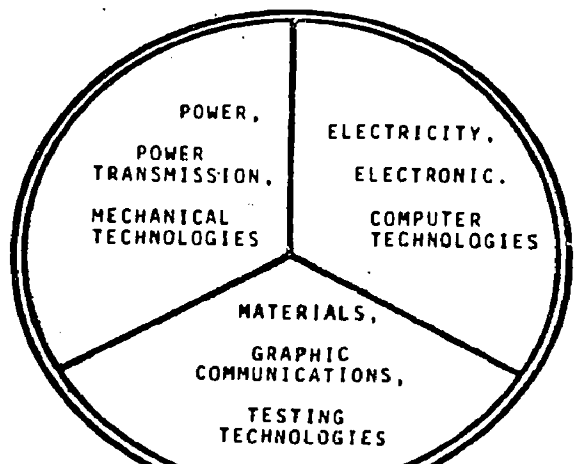


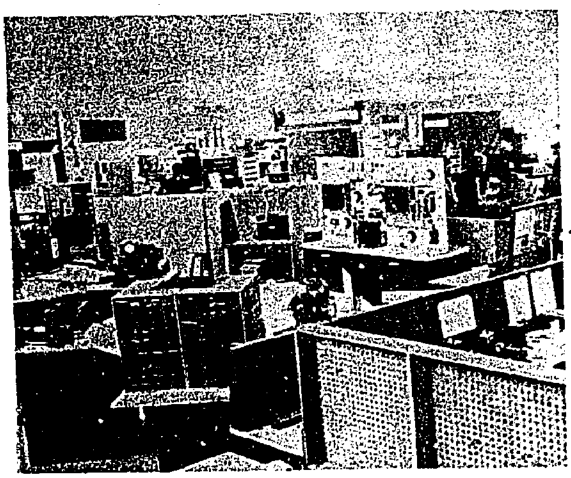


So far we have dealt with tools, materials, processes and technologies so prevalent in our productive society and pragmatically discernable. What about man and technology? What are the outstanding value systems that govern the introduction of atomic energy for constructive or destructive purposes? Shall man sit in judgment and through his other institutions such as political, religious, economic, etc., circumscribe or proscribe the ultimate use of these technologies? Does man understand that when he functions in any institution of our productive society that a multiplicity of technical innovations are in evidence and their concomitant specialists and biases.

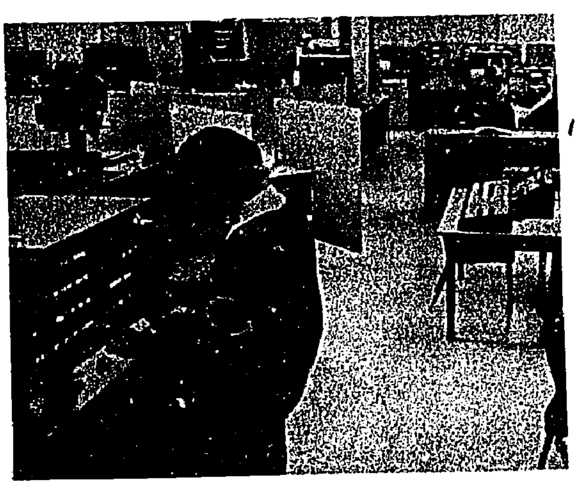
Therefore, Phase III is designed to give laboratory experiences to tenth grade students based upon the processes of authority, communication, decision making and organization that are inherent in each technology, each institution employing this technology and the various levels of the hierarchy as productive citizens function within these institutions, whether it be cybernated, automated, semi-automated or any combination of the afore-mentioned for whatever purpose of supplying goods and services, not always necessarily for profit.

PHASE IV:



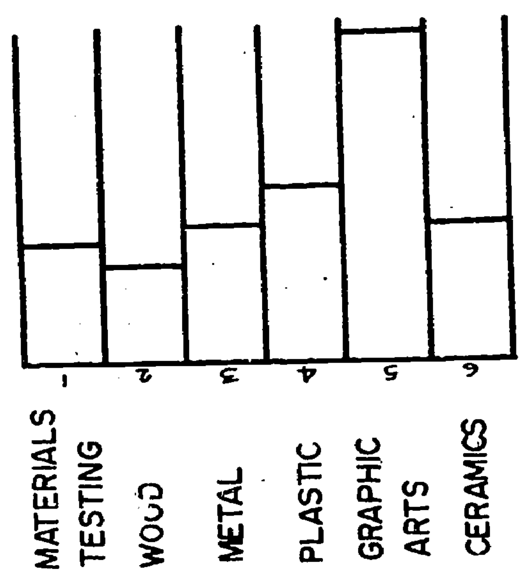


The best way to envision Phase IV is to appreciate that students—boys and girls— will have experiences in Phases I, II and III and would culminate in Phase IV based on their interests and abilities graphically illustrated in the previous phases very much like junior high school general science starts to become more specific and appears as physics, chemistry, biology and zoology.

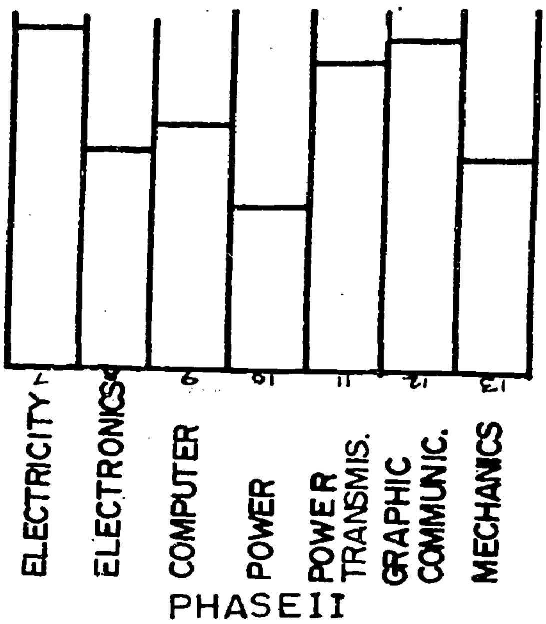


Here then the previously enumerated four institutional processes experienced in Phase III—the seven technologies experienced in Phase II and the six materials activities described in Phase I culminate in one large laboratory that permits the students advanced experiences in no less than two and no more than three of the previously enumerated areas in grades eleven and more depth in grade twelve or preferably two or three areas in grade eleven and two or three areas in grade twelve.

This would support the initially enumerated objectives for this program as well as the other academic offerings at the high school level. For example, a student may elect because of shown ability and interest, a combination of electricity, electronics and computers, or power, power transmission and mechanical, or materials, mechanical and electricity. Based on his previous exposure to the academic subjects in Phase I, II, and III, this would reinforce his current involvement in a variety of academic pursuits and industrial arts in a more intensified and supportive manner.

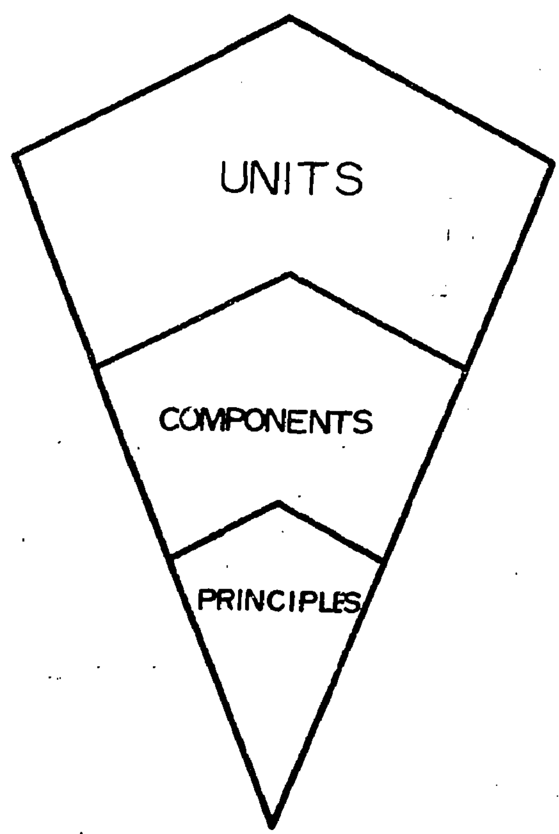


PHASE I



It is my contention, supported by evidence, that it is this traditional process that discourages students from acquiring a whole host of specifics before a system becomes meaningful. It is this very process that emphasizes and puts a premium upon rote learning and memorization rather than understanding and comprehension. It is my recommendation that for this program, taking into account the previously enumerated arguments that the student be exposed to a system such as a record player, or a radio receiver and then to the units that comprise this system such as the power supply, amplifier, etc. Then and only then at the high school level, do the components and scientific or mathematical principles that comprise the system and their understanding, lend themselves to the analysis of malfunction and design.

SYSTEMS



METHODS:

One of the first recommendations novel to this program is the employment of methods of productive society that help achieve the stated objectives. There is no evidence to indicate that our conventional approach of laboriously studying the minute aspects of technology and then building up to the whole system, stimulates learning, motivates discovery or in fact, results in any real educational learning. Granted this is a method that has been used with the more elite students. It is my recommendation that if we are to make learning more meaningful, and to reach 100% of our secondary school population, we must approach this type of learning problem from the general to the specific. There are many outstanding examples, but one of the most prominent is an observation of the current electronics textbooks. They almost universally approach the laborious process of acquiring the specifics such as laws of electricity, the workings of amplifiers and other components and circuits.

This is no different than what is currently employed in a junior high school general science program where it is fairly broad in concept at the seventh, eighth and ninth grade level and ultimately becomes more specific at the high school level and more so at the college or university level.

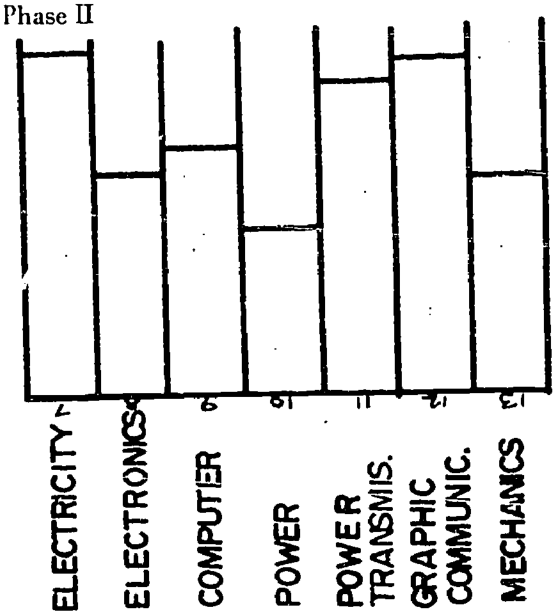
Other methods to be employed in addition to the conventional demonstration and lecture, would be JIT, the conference method, role playing, case studies, Pert and critical incident, all of which will be described in greater detail in chapter VII.

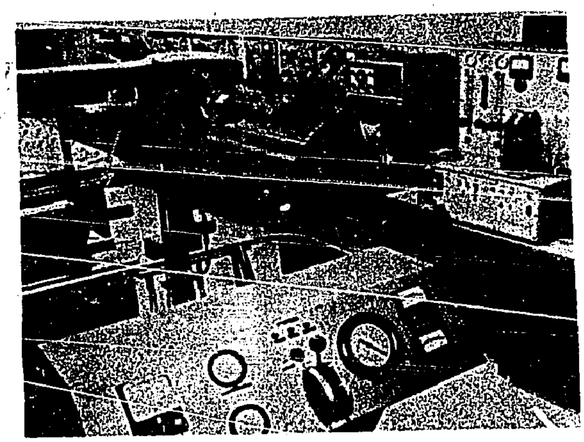
EVALUATION

Educators, parents, et al. have rankled at the conventional educator's grade of 70%, 80% or A, B, C or the myriad of combinations. It is my recommendation that one of the chief evaluating instruments to be employed would be the ever-present critical incident prominent in productive society. This would result in a profile and not in a grade . . . in a trend, not a category . . . in potential, not indictment . . . in objectivity, rather than subjectivity.

Who is to say that a youngster's progression through seven technologies at the junior high school level would not result in the following profile?

Phase II





His explorations of these technologies does indicate with a greater force that his lack of completion or failure to finish a prescribed matrix of activities in any technology is destined to stimulate further interest or comprehension in the underlying academic subject that is manifest ~~in the technology~~.

The teacher's evaluation of the various units of study designed for students and its applicability to the course and to the full program should be subjected to a PERT analysis. This in effect means, since it is PERT there is constant evaluation of student involvement in the design unit sequence and activities and is always subjected to the challenging question, "Is this the most optimal sequence of learning to obtain the optimal required behavior with this type of student?" This lends itself to statistical analysis, assistance and consultation with other course teachers, and with experts of productive society.

Laboratory Phase ________________	Year ______________
Network code ________ Event No. ______________	
Subject ________________________	Number of lessons _____
Objectives to be achieved ______________________	
Specific content area	Remarks
	Methods
References	Audio-visual aids

Development Worksheet

This eliminates again the individual subjectivity or bias or limitations of teacher, administrator and local school district. It must be recognized that productive society extolls performance not mediocrity and that communication is most prominent through action or inaction, and not confinement to verbal or oral communications. Therefore, the students and parents rapidly recognize that the school and the teacher are continually alert to a check on the school's performance as it relates to the student's achievement and that students are not subjected to the indictment that if they have not succeeded in a rigidly prescribed course of study that they have failed. The reverse is true. It is the teacher and the administrators who have failed to teach the student—not the student who has failed to learn.

For example: Schools have repeatedly offered mechanical drawing for junior high school boys with various substantiating reasons and rationale. Productive society conversely demands that males and females be capable of using the graphic symbolism in society and instruments that produce this graphic symbolism such as blueprints, teleprinters and halography, which means in essence, that less time be devoted to the mechanical drawing activity and more time concentrated on various aspects of blueprint and schematic reading and recognition of a typewriter keyboard for computer communication rather than concentrate on the drawings that more logically belong in a vocational and technical skill preparation program.

PERT application to the drafting and other similar industrial arts activities would have very rapidly indicated to curriculum makers, teachers and administrators that this activity is not only not representative of industry, but it is definitely not representative of productive society.

MATRIX:

Much has been written and almost all educators subscribe to the need for recognizing and designing courses of study to satisfy individual differences. Careful perusal through the literature and research reports indicates that this objective has yet to be achieved.

In support of this program and to the further recognition of individual differences, it is my recommendation that every activity whether it appears as an experiment or as a product, as it occurs in the curriculum of industrial arts and subject to PERT analysis and critical incident evaluation must appear in a matrix within each material or technological activity that will be representative of that activity. The design of products and experiments must be adaptable for the slow, non-motivated learner as well as the highly disciplined rote learner and retainer of basic facts and concepts. It must be remembered that the matrix is basic to the organization and evaluation of the course offerings and provides direction for the student, the teachers, and the administrators.

MATERIALS TESTING AREA

SAMPLE TESTING PROPERTIES	USES OF TESTING IN SOCIETY	1		2		3	
CHEMICAL	SOCIETAL — HOME; PERSONAL — CULTURAL; INDUSTRIAL — SCHOOL	A_1	A_2	A_5	A_6	A_9	A_{10}
		A_3	A_4	A_7	A_8	A_{11}	A_{12}
THERMAL		B_1	B_2	B_5	B_6	B_9	B_{10}
		B_3	B_4	B_7	B_8	B_{11}	B_{12}
ELECTRICAL		C_1	C_2	C_5	C_6	C_9	C_{10}
		C_3	C_4	C_7	C_8	C_{11}	C_{12}
PHYSICAL		D_1	D_2	D_5	D_6	D_9	D_{10}
		D_3	D_4	D_7	D_8	D_{11}	D_{12}
MECHANICAL		E_1	E_2	E_5	E_6	E_9	E_{10}
		E_3	E_4	E_7	E_8	E_{11}	E_{12}
RADIANT		F_1	F_2	F_5	F_6	F_9	F_{10}
		F_3	F_4	F_7	F_8	F_{11}	F_{12}

MATERIALS TESTING MATRIX PARADIGM

Some of the most important considerations in the construction of this matrix constitute the following:

1. The experiments or products be representative of each activity or technology so that an accurate sampling through involvement is in evidence.

2. These products or experiments be established at three levels of learning so that conceivably all students may elect to start in column A and based on their ability, interests, desires, may continue on column A or progress on to column B or C. It would also be advisable that within each column a combination be representative of each experimentation or project, that several additional products or experiments be incorporated that would include the same principles inherent in Crowder's branching recommendations and for the same reasons.

INSTRUCTIONAL TECHNOLOGIES:

If this program is to be representative of ~~the impact~~ of technologies within our productive society, then of necessity, it must be one of the most competent utilizers of technologies that will aid the learning process. Chapter 7 will devote itself in greater detail to the individual methods enumerated but a brief introduction is required at this time to give the relative position of this section of the program.

Too frequently in the past, instructional technology in industrial arts has confined itself to cut-away models, 16 mm gang films, strip films and large illustrations which in many cases are presented in the wrong sequence in the learning process or have been obtained from industrial sources out of date and obsolete.

Observe the recent newspaper article when first graders attempted to explain to adults the recent moon shot and extended moon walk. Regardless of whether they understood all the intricate planning, controls, techniques, inherent in this moon landing, they were making explanations to adults, often in an exasperated manner, of the complexities of the trip and the walk.

By the time a film is made by educators for educational purposes, landing on Mars will have been achieved, and this preliminary research and development will have become historical. Therefore, selection of any visual materials should be carefully analyzed and very frequently instant television transmission can be used to greater advantage, supplemented by video tape for the duration of its creditability and/or stored for its historical significance. Therefore, one of the recommended technologies in this program, obtainable at reasonable cost, are television receivers, video tape pick-up receiving and transmitting.

Tremendous advances and developments permit the use of recording instructions and information on tape decks that can be utilized repeatedly within a looped area by students whenever the need presents itself. One particular case in point, our research indicated, was that students in the research program were very poor readers. Special tapes were prepared to be used on portable transmitters with an ear plug-in. This experience indicated that as long as a student did not have a hearing impairment, he was able to conceptualize as rapidly and without the handicap of reading. It further indicated to the student that the need for written material was very prominent than written material received considerable attention. Therefore, books, journals, pamphlets, written instruction, etc. still play a very vital role in this program with the proviso that they be housed within their relative activity area and for immediate loan to students when the interest or desire is expressed without the restrictive or prohibitive practice of attempting to withdraw said material from a proscriptive library.

Research evidence indicated that success with auditory technology stimulated further interests in the illustrated and written explanations coupled with the immediate availability of books and pamphlets, improved the student's reading capability as compared with the control group who were exposed to the conventional learning environment. (Don't forget sound, computing assisted instruction, single concept films, teaching machines, programmed instruction, computer terminals and pictorial programmed instruction).

ORGANIZATION:

At first reading, the realistic implementation of this program seems an insurmountable obstacle for one teacher. It goes without saying that every activity area must be complete with requisite hand tools, equipment and supportive teaching technologies and software. If PERT, critical incident, and the many other suggestions peviously enumerated are used, it is evident that the problems of inventory control, student discipline, safety etc. must be well organized if a good learning environment is to ensue. However, if we are to interpret productive society, we must pattern organizational practices after those of the productive institutions within that society. Reference now is made to the enumerated steps in Chapter I which indicate immediately that direction of this program is essential before any layout, equipment, course of studies, etc. may be engaged in. It can be observed at this point, that the program was designed on the systems approach, so that involvement in all four phases will result in the previously stated objectives.

CHAPTER III

PHASE I—INTRODUCTION TO TOOLS, MATERIALS AND PROCESSES

INTRODUCTION

METALS
- Authority
- Decision
- Communications
- Organization

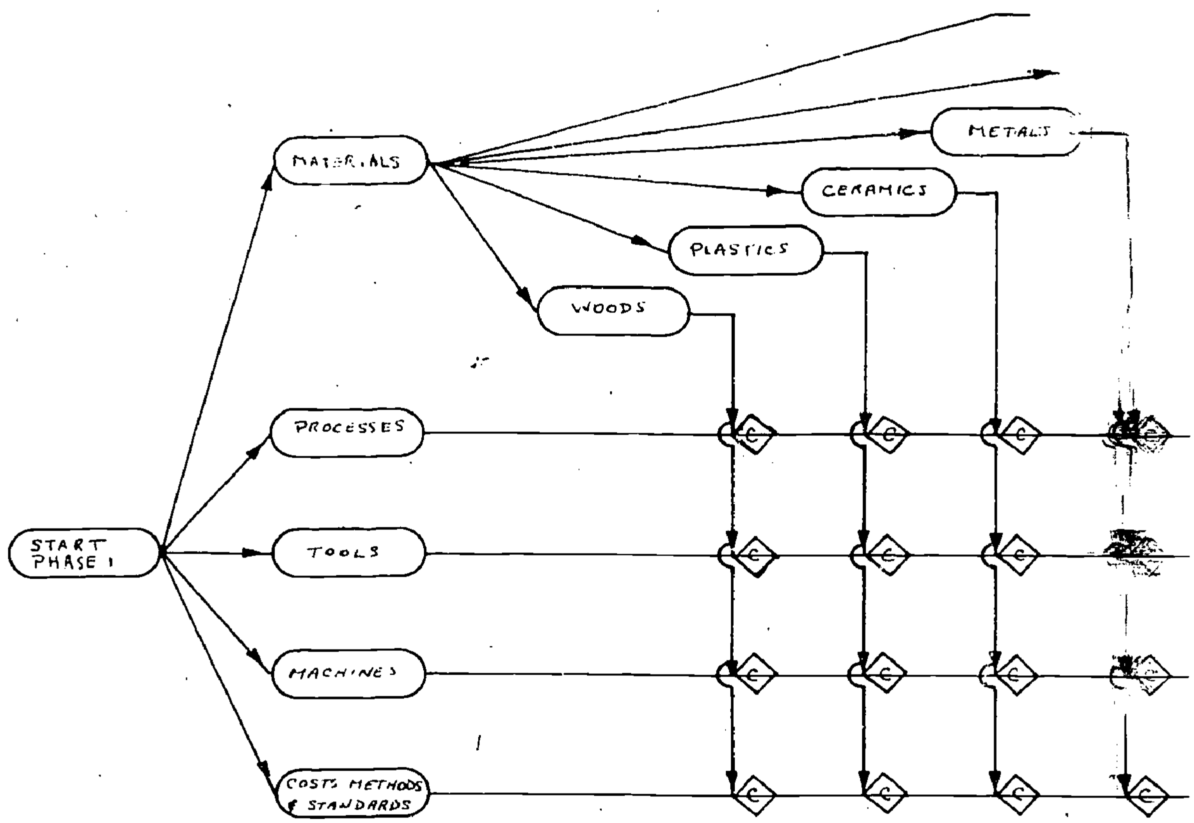
PLASTICS
- Authority
- Decisions
- Communications
- Organization

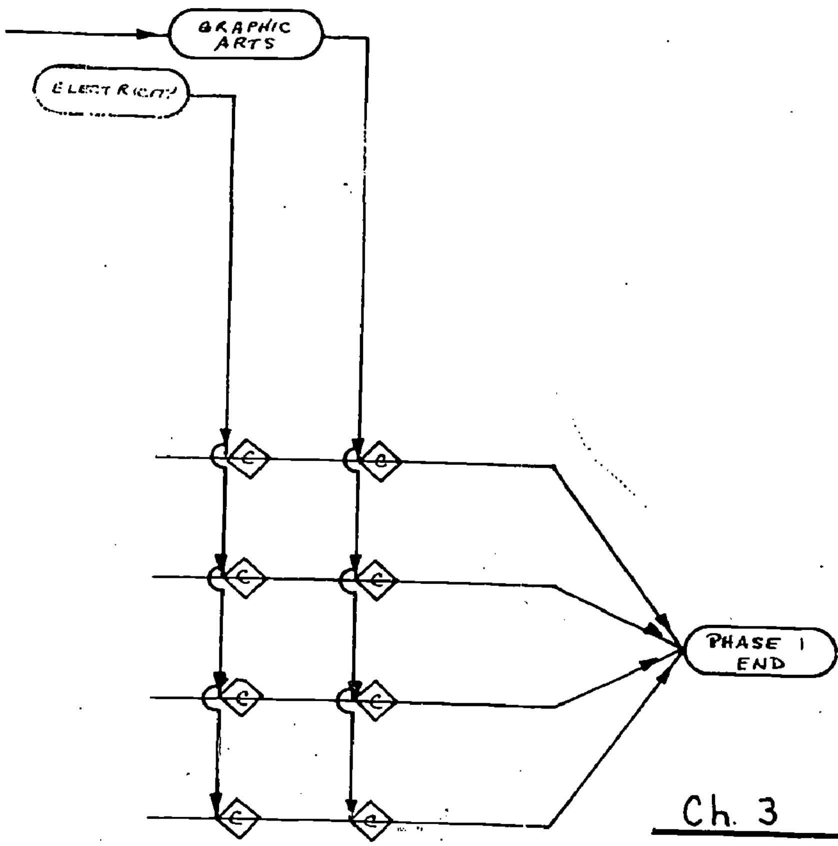
WOOD:
- Authority
- Decision
- Communications
- Organization

CERAMICS
- Authority
- Decisions
- Communications
- Organization

GRAPHIC ARTS
- Authority
- Decision
- Communications
- Organization

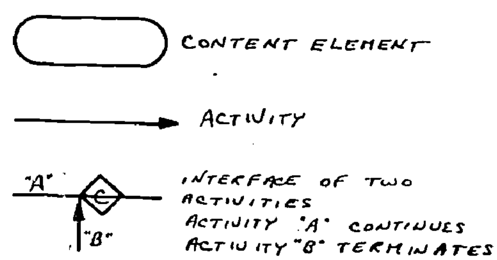
MATERIALS TESTING
- Authority
- Decisions
- Communications
- Organization


START PHASE I
MATERIALS
PROCESSES
TOOLS
MACHINES
COSTS METHODS & STANDARDS
WOODS
PLASTICS
CERAMICS
METALS



Ch. 3 Phase 1

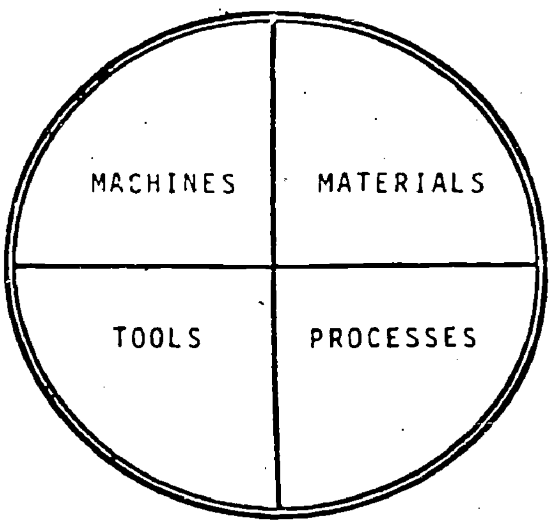
LEGEND



CHAPTER III

PHASE I–INTRODUCTION TO TOOLS, MATERIALS AND PROCESSES

INTRODUCTION



This phase of the proposed industrial arts program, to interpret the impact of cybernation upon boys and girls of the seventh grade level, is categorized as an introduction to tools, materials and processes. The assumption here is not that students have never been introduced to any tools or any materials or any processes or that they will not at some future date become familiar with more advanced combinations of these. However, it is the intent to bring together a manageable number of tools, materials and processes that would be representative of a viable sampling of our productive institutions, and as a preliminary and corollary to the other three phases of the proposed program.

The six areas selected and the methods employed to teach and organize this phase will be described in greater detail. However, the four objectives, as previously stated, must be met and the maturation level of the probable students must be seriously considered. When the term 'probable students' is used, the reference is made to all seventh grade students regardless of their profile on any intelligence, interest or ability instrument or adults–or any age group that is technologically unaculturated. The most important function of this phase is to:

1. Reinforce academic learning.
2. Synthesize the educational environment.
3. Interpret productive society.
4. Provide exploration and experiences to guide future career selection.

The six areas selected which will provide a multiple activity learning environment to give students an understanding in tools, materials and processes are: woods, metals, plastics, ceramics, graphic arts, and materials testing.

There can be no hard and fast delineation of the material areas any more than such a discrete delineation is possible as representing all the productive institutions within our cybernated society. Careful observation of all six areas of study would indicate that tool and machine design, materials development, methods alteration and materials process evolution are all based on the fundamental sciences. Further evidence in the multiple activity recommended organization of these six material areas, by exposure alone, transmits to students an understanding that no tool, process, or material is independent or isolated from the others. However, it must be remembered that no area of study is predicated upon the old craft system representative of industry of thirty years ago. This is not six small "unit shops." Instead, the areas of study are envisioned as a host of learning experiences based upon methods evident in the handling of materials and the use of tools to produce goods and services in our productive society. Therefore, it is not significant that a student know how to sharpen a drill, or construct a die, but that he recognize the optimal condition of the tools and equipment necessary for the ultimate conclusion of his operation as he changes the shape of the material.

It must be understood that the sample tools and operations offered in this text are far in excess of those required in a typical junior high school laboratory, but they do present a viable sampling which can be modified according to each school district's ability to purchase the requisite equipment, availability of qualified personnel, and readiness of the students.

The following two photos illustrate an overall picture of the University's Phase I Laboratory:

METALS:

The materials area of metals has been exposed to dynamic technological changes. Powdered metallurgy has had a drastic impact upon the forming of unique shapes required in the multiplicity of products and services in every facet of our productive institutions. It would be impossible to machine the unique configuration of these parts and the cost would be prohibitive. In the area of machining metals, equally dramatic developments have occurred where man's former sense, feel, and judgment has now been replaced by numerical control and hydraulically and pneumatically sensitive profiling equipment. Yes, to the point that this equipment not only duplicates man's unique dexterity, but it also perfects it. The development of metals and metal alloys has drastically changed our way of life, permitting space travel and enabling us to harness nuclear energy. It provides products, previously too costly for the average consumer, but now available to almost every home-own.r, reducing tedious tasks and enriching life.

Shaping and forming of metal products is virtually impracticable by the hand method, not only because of the cost involved, but because of the unique characteristics of the many alloys that have been developed to fulfill unique functions in our cybernated society.

Therefore, it is no longer valid in Industrial Arts to require a student to spend extensive and valuable learning time in how to properly file a metal surface or thread on a lathe, when all of these operations, because of quantities and price and the requisite use of unique turning tools and close tolerances, are better performed on screw machines, electric discharge machines or equally sophisticated metal shaping and forming equipment. The tedious process of hand tamping a sand mold or the making of a wood pattern becomes an indefensible learning experience except in vocational or technical education and then only in limited areas.

productive capability. Countries that used to be prime producers of steel find themselves constantly challenged by countries that lack the basic raw materials. Improved transportation and the introduction of the oxygen process in steel making permits business men to import steel shipped thousands of miles, of equal quality at a lesser price per ton, than could be purchased within their own country. The implications for changing political structures, international economic systems and opportunities for developing countries is obvious.

Authority

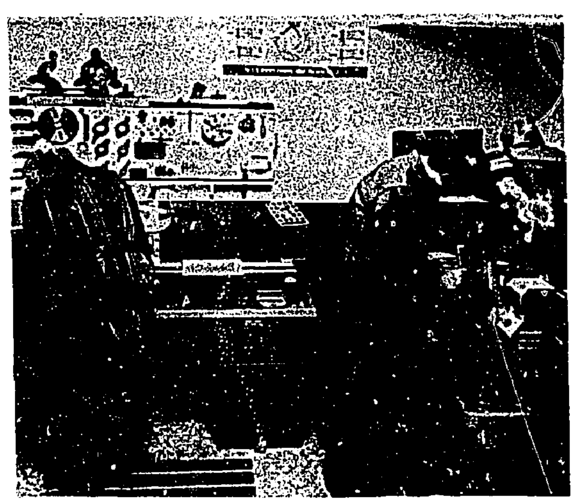
The shaping, forming and processing of metals has reached a fairly sophisticated level in all aspects of our productive institutions within our cybernated society. Just a casual observation of the multiplicity of products that appear in the home, in the office, on the streets, in the air, the surgical rooms, or our current modes of transportation, gives ample evidence that the material area of metals is a most serious area of educational concern whether a student must make decisions pertinent to using these materials or purchasing them as a consumer or paying for them as a taxpayer, or using them in leisure time activities. Metals affect all our lives and will continue to do so increasingly, despite the introduction of new material areas. Whether as a user, designer, or shaper of this material, it must be recognized that the basic changes that occurred in this material have emanated from fundamental art, physics, chemistry, and mathematics and that subsequent productive institutions, providing goods or services, have re-organized the man—material relationships and a whole host of new technologies and language uses have been introduced into our culture.

The impact of changes in this materials area has been so dynamic that it has affected the international marketing, economic and

Decision

Here again the decision to enable a student to acquire learning experiences in the unique qualities of metals, metal characteristics and the processing of metals, will determine the metals material product matrix paradigm.

As illustrated in the product matrix paradigm, the decisions for a representative sampling of experiences will be focused more upon the forming of parts by compression and heat as in powdered metallurgy and the advantages and uniqueness of this operation as contrasted with the foundry operation.



METAL MATERIALS AREA

SAMPLE PROCESSES	USE OF MATERIALS IN SOCIETY	1		2		3	
MACHINE SHAPING LATHE MILL	SOCIETAL – HOME; PERSONAL – CULTURAL; INDUSTRIAL – SCHOOL	A_1	A_2	A_7	A_8	A_{13}	A_{14}
		A_3	A_4	A_9	A_{10}	A_{15}	A_{16}
		A_5	A_6	A_{11}	A_{12}	A_{17}	A_{18}
HOT METALS		B_1	B_2	B_5	B_6	B_9	B_{10}
		B_3	B_4	B_7	B_8	B_{11}	B_{12}
POWDERED METAL		C_1	C_2	C_5	C_6	C_9	C_{10}
		C_3	C_4	C_7	C_8	C_{11}	C_{12}
ELECTRICAL DISCHARGE		D_1	D_2	D_5	D_6	D_9	D_{10}
		D_3	D_4	D_7	D_8	D_{11}	D_{12}
SHEET METAL		E_1	E_2	E_5	E_6	E_9	E_{10}
		E_3	E_4	E_7	E_8	E_{11}	E_{12}
WELDING		F_1	F_2	F_5	F_6	F_9	F_{10}
		F_3	F'_4	F_7	F_8	F_{11}	F_{12}
SAMPLE TEST PIECES		G_1	G_2	G_5	G_6	G_9	G_{10}
		G_3	G_4	G_7	G_8	G_{11}	G_{12}

METALS PRODUCT MATRIX PARADIGM

Machine operations are mandated by the unique alloys so that many pieces cannot be sawed by the conventional hack-saw but now must be consigned to the continuous band-saw or abrasive belt or the electric discharge method. The ultimate finish of a metal need not be confined to the physical application of paints but now incorporates the use of chemicals, electrolitic processes and unique high fire glazes. The usual temperature differentials of heat and cold have been extended considerably. Current processes have extended metal product utilization and durability.

Considering the impact of the dynamic changes in the metals area, the need for material product matrix flexibility, student individual differences as well as the enlarged learning opportunities, obviate the former laborious task of producing metal products by the almost exclusive concentration on the lathe, milling machine, shaper and drill press, supplemented by hand operations.

Here as in every materials area, the learning experiences must be representative of the highly sophisticated characteristics of metals as they manifest themselves in products and services in our productive society. The four foot break and shear can be easily replaced by a much smaller version or a hydraulic press to provide the requisite experience of primary sheet metal operations.

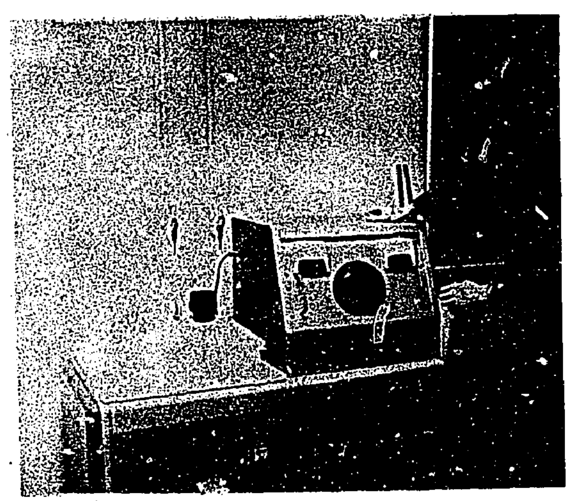
The differences in price and space can now be reassigned to the more sophisticated treatments described earlier. Here, as in every material area, test samples of the various metals and metal treatments are created and subjected to standard destructive testing in the materials testing area of the Phase I industrial arts laboratory. It should be emphasized that in all technologies, operations and materials development, the student's attitude towards established materials standards is very critical.

Communications

In the metals area, as well as in all areas of industrial arts activities, one of the most outstanding communications methods recommended is the actual student performance. It is through the actual performance of making the product that the student learns the various characteristics of the metals used; their limitations and peculiarities. The student also acquires the added knowledge and understanding of the currently developed equipment to shape or form the requisite metal product as well as the metal's adaptability to surface treatment.

It is further re-emphasized that the product is the means by which the student acquires the appreciation for the fact that materials, machines and processes are a result of efforts in the other academic disciplines and follows the recommended pattern of learning from the general to the specific (systems, units, components). The surrogate industrial experiences provide the added learning dimension of the actual application of basic scientific discoveries, in the applicative state. In this area, as in other material areas, the teacher demonstration method helps to communicate to the students, the requisite knowledge in making the product. The basic concepts of effective demonstration should be used, and more importantly, the JIT, JRT method should be employed where the instruction is designed to be succinct, timely, and reinforced by follow-up.

The metal materials area lends itself to the use of models and cut-away teaching devices. There is no easy illustration to show poured castings with the many undercuts which affect the limitations of this process and ultimately its design. This basic process is most difficult to transmit, as many others are, and is related not only to basic pattern and core design and powdered metallurgy dies, but is also directly related to the principles of die design employed in plastic injection, extrusion and rotational molding. It is equally applicable to other materials, such as ceramics and woods. A new plastic cut-away using wax as a molten material very quickly accomplishes this task.



The high frequency of unique terminology and concepts, encourages the use of cartridge tapes and portable recorders with an ear plug-in in the materials area. Use of this audio media permits students who have difficulty in reading complex terms or conceptualizing from a printed page, an added advantage. This use is validated by research evidence. Students whose reading capabilities were determined to be considerably lower than the average student at their grade level, could comprehend and conceptualize by the use of sound. This method is further reinforced by the pictorial programmed instructions previously mentioned and to home-work assignments from text material printed in pamphlet form or paragraph sections of the conventional text. The use of a combination of methods has the added advantage that the student is not denied the opportunity to make the product, which was designed to teach him the unique aspects of metals, because of a reading deficiency. Highly rated students with good reading abilitiy were having difficulty conceptualizing the unique characteristics of metals from the printed page. However, by working with the metal and using taped audio and visual instructional materials, this added to their technological acculturation in a shorter period of time with a greater depth of understanding.

It will be repeatedly emphasized that the prime concern of the teacher is to communicate a valid sampling of the unique characteristics of the metals area to optimize the learning sequence expressed through the metals matrix paradigm previously illustrated.

Organization

Just as in any materials area, the metals area organization must consider very seriously, not only the learning requisite for this area, but also the safety of the student as he uses the equipment. High speeds, temperatures and sharp edges in metals operations mandate ample space and careful placement. Illustrations in this chapter show the recommended organizational structure that permits the housing of all equipment, tools, supplies within the learning environment designed for every student in the metals area. Therefore, minimizing traffic, optimizing learning time and cutting down on accident probability.

Uses of color, non-skid applicators, guards, eliminating reaching past turning spindles, or other dangerous operations must be representative of the same practices in productive society. This organizational concern contributes to more effective learning and minimizes exposure to accidents. Please note the unique tool panels, material racks and diagonal taped text for quick inventory purposes. Name identification under each tool continues to reinforce the unique nomenclature for the operation of the metals area and adds an additional dimension for learning.

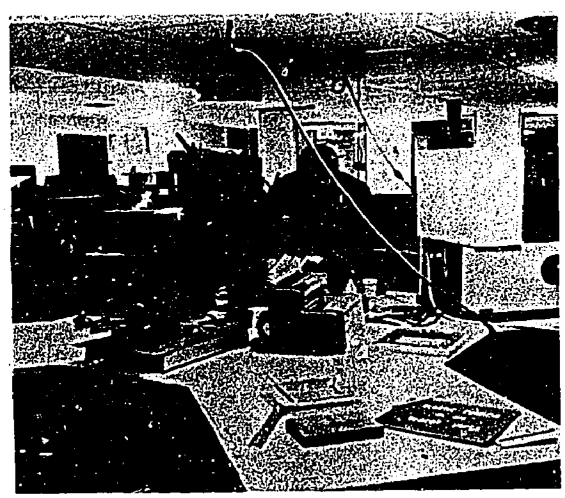
PLASTICS

Plastics materials and plastic products have had an unceremonious introduction into productive society in the form of celluloid and its alternatives. Today, no one can deny the unique contribution of plastic products and materials to our productive society. Many products prohibitive to a multiplicity of applications because of the higher cost of metals or other conventional materials are now made possible through the development of a number of chemical combinations that resulted in the basic plastics materials. The man-made and synthetic fibers are subjected to extrusion, injection, compression, lamination, molding, impregnation and many other applications. It is rapidly becoming a very durable material with wide application for easy disposal. In many cases, frequently reconstitutable. These characteristics satisfy sanitation requirements, weight limitations, esthetic qualities and substitutions where such qualities are mandated of this material and its product. The plastic material area is a very good example of the development of a large number of industries and operations requiring very few skilled operators. People involved in research and development of the raw materials, products and applications need skill. The model makers, tool designers and machine designers are skilled. This group represents only a small number of this sample of productive society.

Outside of the consumer, the largest number of people involved in the plastics industry are para-technicians and semi-skilled operators that produce the products utilized in such abundance in our society.

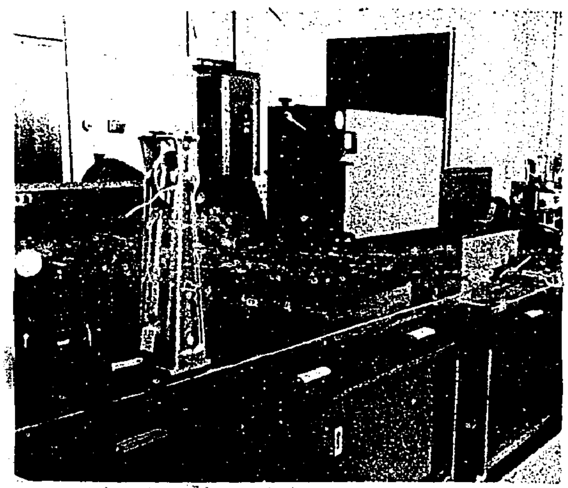
Authority

The uses of plastics and plastic products are legend. It is a legitimately accepted and recognized material. It is rapidly invading other material areas. It lends itself to a multiplicity of operations and treatment and in many instances, rapid obsolescence replaced by newer developments and applications. Products formerly prohibitive because of cost are now a bane on the market. Very rapid observation of containers, utensils, safety devices, vehicles, appliances and toys, indicates the versatility of this material; from the aero space industry to toys its application is very prominent and its understanding pathetically meager. Observe the simulation of leather with corfam, the use of plastics materials in textiles, the replacement of corrosive metal pipes with plastic pipes, virtually eliminating old craft skills and surmounting unique configuration requirements with flexible tubing in a variety of sizes and application for the use of a wide variety of



corrosive fluids. Observe the application of injection molded doors replacing wooden doors in mobile homes where plastic has greater resistance and flexibility to temperature changes, humidity variations and shocks, resulting from road travel.

The application of fluid plastics for long wear on walls and floors, the development of large numbers of plastic fibres used in floor coverings and textiles resistant to wear, stains and other injurious treatment limits, and in some instances obsolets the use of plant and animal fibres.



The whole field of plastic laminates and impregnation is just beginning to expand. The unique applications of plastic materials finds unlimited use from extreme temperature abuses in aero-space travel to sanitary application in surgery to the simple laminates of private papers to extend their utilitarian value. Plastic materials have established a significant place for themselves in productive society in a multiplicity of products and services.

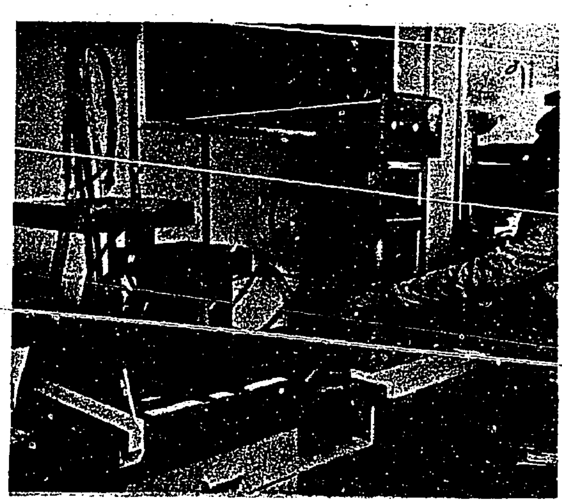
Decisions

Plastics is a viable materials area in industrial arts. Industrial arts can best reflect the uniqueness of this material by adopting the technological processes of shaping this material as a basic categorization for the learning sequences.

Observe the plastics product matrix paradigm and note the left hand column which breaks itself down into: injection molding, extrusion, compression, centrifical force molding, lamination and heat bonding as representative processes and recommended learning sequences.

This materials area and its former applications in industrial arts serves to illustrate the basic indictment previously leveled at industrial arts. The teaching material content in industrial arts is all too frequently identified with the craft applications of the material and evidence abounds that plastics have been introduced into industrial arts in block form and the craft application of carving and shape assembly of flat sheet stock has been an almost exclusive preoccupation with this material. Admittedly, the characterisitcs of the plastics materials, a few years ago, was very limited, and therefore, its uses were limited. This helps to explain that industrial arts has no authoritative position in introducing a material for its novelty.

It should be introduced only if it has a viable position as a representative area of our productive society. This material and its rapid technological changes is further evidence that while the craft orientation to materials shaping as a basis for curriculum analysis and a defense for optimum learning experience may have been valid in 1930, it is no longer valid in the latter part of the twentieth century.



PLASTIC MATERIALS AREA

SAMPLE PROCESSES	USE OF MATERIALS IN SOCIETY	1		2		3	
INJECTION	SOCIETAL — HOME PERSONAL — CULTURAL INDUSTRIAL — SCHOOL	A_1	A_2	A_5	A_6	A_9	A_{10}
		A_3	A_4	A_7	A_8	A_{11}	A_{12}
EXTRUSION		B_1	B_2	B_5	B_6	B_9	B_{10}
		B_3	B_4	B_7	B_8	B_{11}	B_{12}
CENTRIFUGAL		C_1	C_2	C_5	C_6	C_9	C_{10}
		C_3	C_4	C_7	C_8	C_{11}	C_{12}
HEAT AND PRESSURE		D_1	D_2	D_5	D_6	D_9	D_{10}
		D_3	D_4	D_7	D_8	D_{11}	D_{12}
BLOW AND VACUUM FORM		E_1	E_2	E_5	E_6	E_9	E_{10}
		E_3	E_4	E_7	E_8	E_{11}	E_{12}
CELLULAR		F_1	F_2	F_5	F_6	F_9	F_{10}
		F_3	F_4	F_7	F_8	F_{11}	F_{12}
TEST SAMPLES		G_1	G_2	G_5	G_6	G_9	G_{10}
		G_3	G_4	G_7	G_8	G_{11}	G_{12}

PLASTIC PRODUCTS MATRIX PARADIGM

Using this material is a good opportunity to minimize the mystery so prevalent in chemical formulae. The learning is accomplished by application and experimentation without serious threat to the student, equipment or material. The unique characteristics and fine balance of chemical and physical factors will very rapidly indicate to students the command of the plastics material area is basically housed in the chemistry and allied discipline areas.

The student produced products for the plastics materials area are limited to the availability of dies and equipment in the respective processes previously enumerated. Sample test pieces are designed to expose the student to the standards destructive testing area recommended for Phase I of this industrial arts program.

Admittedly, the products resulting in this area can be easily manufactured. That is the uniqueness of this material and helps validate this previously stated example. What can be re-emphasized is the close scrutiny required for the proper mix of the raw material to obtain a product with specified characteristics. The data are recorded in much the same manner that the treatment of other chemical experimentation data are recorded. This learning experience gives further reinforcement of the stated industrial arts objectives and an awareness, through practice, that a logical discipline of careful measurement is mandated if certain prescribed product qualities are to be achieved. An additional reinforcement of learning experiences and cross materials area similarities is the use of dies in the plastics area which are in evidence in metals, ceramics and woods. The basic equipment availability and materials limitations present the learning parameters for this material area as well as for the technological areas.

One basic change in the product matrix paradigm is evident. The three columns for products are still present but are dominated by the cost of the basic product which is proscribed by the process, die and mix. A sampling of the processes is equally applicable to high achievers as well as low achievers. The learning variable occurs to the degree which the various levels of students comprehend concepts that result from the interaction of properties of raw material, within physical treatment limitations. Product design makes further demands upon this interaction.

Communications

Basic responsibility in this area is to teach the uniqueness of this material which incorporates not only a multiplicity of concepts processes and equipment but also a large

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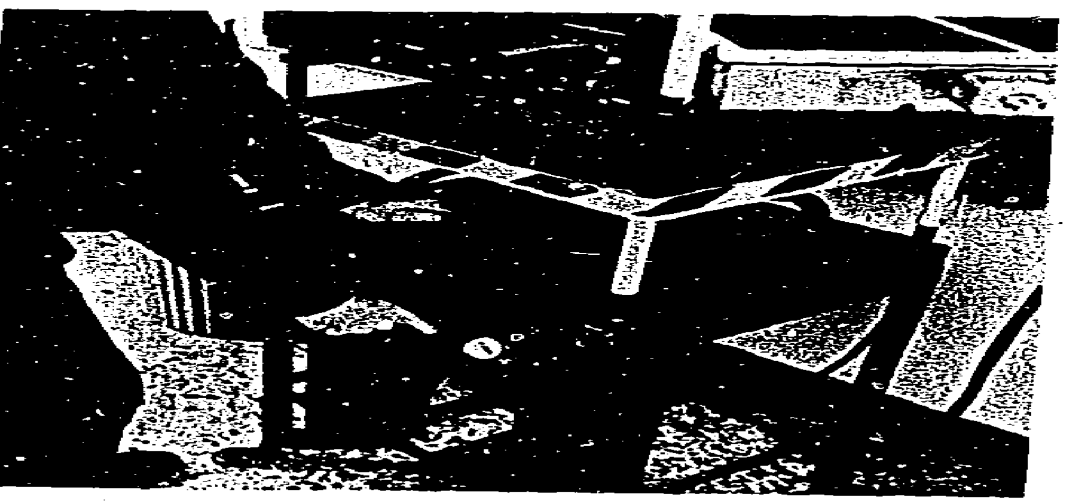
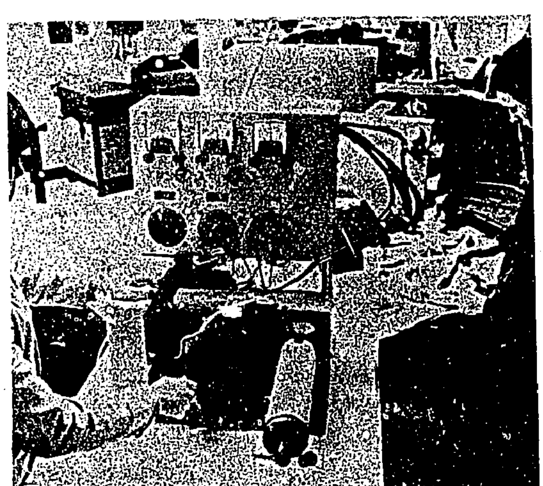
mber of unique terms. Therefore, this
iterials area of plastics lends itself to an
istration of two additional methods of
mmunicating the authoritative learning
juences previously decided upon, in a more
timal manner . . . specifically the methods of
entation and induction. It is suggested that
ientation and induction are methods
resentative of our productive society and are
plicable to every area of industrial arts. This
plication of these metho' s described in this
tion because plastics as a material lends itself
the unique and challenging nature of the
r-growing plastic institutions within our
ductive society.



These are two terms and they are not
nmended to be used interchangeably. To
t, is understood to be the introduction to
udents entering any area to the totality of
ities that are subsumed in that area.
efore, using the previously described
idge tape, the four or six students assigned
his area would, for orientation purposes,
listen to the tape as they walk about the
The work stations, equipment and its uses
applications would be explained. Students
d be required to acquaint themselves, using
artridge tape or other audio-visual medium
the area learning possibilities, safety rules
codes, inventory controls in evidence,
ict matrix, where to find the raw
ia' and where to store their products.

The instructional medium used would then lead the students within this area into the induction phase which would introduce each student to an activity predicated upon a pre-determined product schedule, to optimize learning and equipment utilization. This introduction would explain the specific activity and the subsequently designed learning materials, product material and equipment related to that activity. The methods employed for this supplemental information can incorporate the many described in Chapter VII, and would depend upon the equipment available, the capability of the teacher and the maturation level of the student.

Induction, more specifically, would be designed for one student at a time as he approaches a specific machine that performs a peculiar operation. It would inform the student how to operate that equipment, its limitations, and the danger points and where to obtain the requisite raw materials and in what proportions. This would result in the requisite product identified on the product matrix paradigm.



Organization

This area is a good example of the rapid advance in a materials technology and particularly in the willingness and ability of suppliers to provide equipment that is suitable, financially and educationally, for the junior and senior high school level. Any attempts to offer surrogate experiences in plastics materials and processes and the use of tools, would have been prohibitive in the early 1960's. Today very complex extrusion, injection, laminations, centrifugal force forming and a shelf life of plastics has been perfected sufficiently to permit the teacher or administrator to provide a very extensive sampling of the impact of plastics materials within our productive society.

Care must be exercised in the storage of materials and in the placement of equipment for optimum utilization. The decorative aspects applied to the finished product can be referred to many of the applications recommended for woods, metals, graphic arts, or ceramics. The hand tool operation for decoration purposes, formally so prominent in industrial arts, must be relegated to the same position as wood carving and metal chasing.

The learning experiences will govern decisions regarding organization of this area. Therefore, any hand tools required should all be located in this specific materials area. Please note the photographs which emphasize the use of the "X" bench, lazy susans, and sealed containers and their accessibility for student use.

In organization of this area, care must be observed in the layout to accommodate a minimum of four students and a maximum of seven in order that the individual differences aspect of this program described in Chapter I will be available. This individual difference consideration is not peculiar to this area, but must also be considered when organizing each of the six areas recommended for Phase I of industrial arts.

WOOD:

The predominance of wood as a material or wood products in our productive society is very evident. However, it must be appreciated that wood and wood products are not the exclusive province of the fast disappearing cabinetmaker or carpenter.

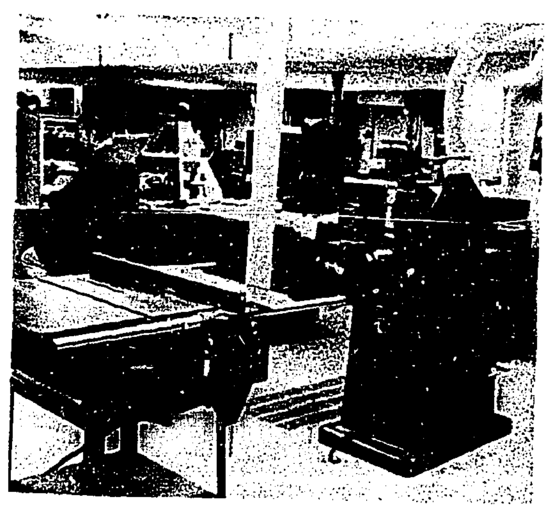
Wood and wood products will continue, as evidence indicates, to be a vital material in our productive society as long as the raw materials exist. However, wood and wood products are changing drastically in appearance, use and specifications. The whole field of wood composition, boards, plastic impregnation of wood fibres and other treatments of the basic wood materials should be considered.

Authority

The design of learning experiences around cabinet making or carpenter skills is highly questionable. Therefore, this materials area, should not only introduce students to the hand and machine operations typical of the common treatment of wood as evidenced in most homes and furnishings, but should incorporate the other chemical and physical treatment of wood products in combination with other materials in the producing of good and providing services.

The subsequent product matrix paradigm for this area is a sample illustration of the kinds of activities that a student can become engaged in, not for the purpose of learning to make a joint, which is a vocational skill, but for the express purpose of learning the various characteristics of wood and wood products and the limitations of the material in constructing these products.

Since the product becomes the prominent vehicle for learning, the various uses of tools to shape this material are indicated because they are also utilized with some modification in other material areas. It is recommended that hand power tools should be utilized instead of hand tools. This educational decision is dictated by the predominance of power tool utilization in our productive society. The requisite attitudes for the use of this equipment, its relative cost, speed and requisite maintenance, has much more significance than to have a student perform a similar operation using hand tools.



Decisions

Having established a reasonably authoritative position to include woods as a defensible material area in the industrial arts curriculum, the next recommended step for consideration is the decisions that must be made to identify the learning experiences in an effort to optimize the previously stated industrial arts objectives. The product or project at this moment becomes a vehicle to illustrate to students the various applications and limitations of wood or wood products. This material application may need to change the

WOOD MATERIALS AREA

SAMPLE PROCESSES	USES OF PROCESSES IN SOCIETY	1		2		3	
WOOD SHAPING		A_1	A_2	A_{11}	A_{12}	A_{21}	A_{22}
BANDSAW		A_3	A_4	A_{13}	A_{14}	[illegible]	A_{24}
LATHE		A_5	A_6	[illegible]	A_{16}	[illegible]	A_{26}
JIGSAW		A_7	A_8	[illegible]	A_{18}	[illegible]	[illegible]
		A_9	A_{10}	A_{19}	A_{20}	[illegible]	[illegible]
VACUUM PRESS		B_1	B_2	B_5	B_6	B_9	B_{10}
		B_3	B_4	B_7	B_8	B_{11}	B_{12}
CHEMICAL IMPREGNATION	SOCIETAL — HOME	C_1	C_2	C_5	C_6	C_9	C_{10}
	PERSONAL — CULTURAL	C_3	C_4	C_7	C_8	C_{11}	C_{12}
LAMINATES	INDUSTRIAL — SCHOOL	D_1	D_2	D_5	D_6	D_9	D_{10}
		D_3	D_4	D_7	D_8	D_{11}	D_{12}
COMPRESSION		E_1	E_2	E_5	E_6	E_9	E_{10}
		E_3	E_4	E_7	E_8	E_{11}	E_{12}
TEST SAMPLES		F_1	F_2	F_5	F_6	F_9	F_{10}
		F_3	F_4	F_7	F_8	F_{11}	F_{12}

WOOD PRODUCT MATRIX PARADIGM

(PULP PROCESS LEFT FOR PHASE III)

shape or form as well as to modify or adulterate the basic specifications such as impregnation with chemicals or plastics or decomposition into pulp or slurry to be formed into paper, paper products or composition board. One of the first activities that this type of materials learning environment mandates is that whatever product or project is selected, the processing or maniplulation of wood must subscribe to predetermined standards whether they be standards imposed by the logic of the sciences or standards imposed for effective and safe utilization of tools and equipment. Therefore, careful observation of the matrix paradigm will reveal that at the very end there are sample test pieces exposing wood to a variety of treatments that will be taken to the materials testing seciton of the laboratory, and exposed to various pre-determined destructive tests. Another serious decision that must be determined in the creation of the paradigm of products is that the products must provide learning experiences, as in any academic subject field, designed for youngsters at every intellectual level an adequate sampling of a defensible unit of study. This puts greater emphasis on pre-designed products, a more highly structured product matrix to provide a valid sample of learning experience. This concern takes precedence over the previous industrial arts practices that youngsters should design their own products. The recommended product designs would incorporate not only a pleasing esthetic quality but should also incorporate sound engineering principles and include operations and processes that would expose the student to the various characteristics of wood and wood products and tools. This assumes again the basic premise that the general educational format is to teach from the general to the specific and the student acquires appreciation for good design, respect for equipment utilization and limitations and an understanding of the unique qualities of wood and wood products.

The next serious consideration which has resulted in many previous indictments of industrial arts is to incorporate an opportunity for individual study and individual differences, whether they be evidenced as taste, interest or ability. The matrix paradigm will reflect that the left hand column designates a sampling of processes and experiences recommended for the wood material area. Column 1 should designate a sampling of the products that will emphasize requisite learning experiences designed for the most basic level of student. This should not be predicated upon a student's IQ level. It is entirely possible that a student with a high IQ has never had any opportunity to work with wood as a material and therefore the selection of the products in Column 1 should be basic enough to permit this introduction to the material as well as the processing of this material to result in a final product. Therefore, product sequence incorporates the use of tools, the use of academic disciplines in measurement and treatment of the material and the requisite problem solving and logic which culminates in a final product. Careful observation of the matrix paradigm will indicate further that Columns 2 and 3 should represent products that demand a more advanced degree of ability and understanding. However, products in any column are representative of the previously delineated requisite learning experiences which were determined to be valid and representative of the wood material area.

The above material does not imply that other decisions pertinent to this materials area are not required. It is intended to indicate that these are the most primary decisions to be considered. That is, that the requisite learning experiences are designed to adequately represent the material wood and that decisions such as how to teach, the equipment to be purchased and other materialistic decisions can be better relegated to a secondary role and should more properly be categorized as recommended in the organization section of this chapter.

Communications

Now that we have authoritatively determined that the material wood is a viable unit to be taught and made the primary decisions on the kinds of learning experiences and the vehicles that we will use to achieve these learning experiences, we can then more properly be concerned with the methods that we will employ to achieve this learning. In other words, how shall we communicate to every student boy or girl, the impact of wood as a material and its many uses as it appears in our technological society? Having determined the experiences we desire to expose the student to, this will then lend itself to the utilization of PERT as a method of evaluating whether the sequence of learning experiences, we have recommended, are valid recommendations and follow an optimum sequence to result in successful student learning. This method takes learning experiences provided in industrial arts from the "arm chair" realm of decision making to a more viable area and makes learning or change in behavior measurement defensible. It further aids the industrial arts teachers, administrators and subscribers to assess whether further expenditures of time, funds and effort are valid. The PERT method permits industrial arts to be evaluated in the same frame of reference as the other academic subject matter fields.

In the area of methods, more fully described in Chapter VII, it can be recognized that a large sampling of teaching methods are applicable. It is not the intent to make a list of recommended methods so prescriptive that it would deny industrial arts teachers an opportunity to reflect individual differences or to reject individual student's interests or abilities as they explore the industrial arts multiple activity materials laboratory experiences. A few samples will be illustrated of teaching methods used and different examples will be used in different materials areas of this laboratory. The recommended methods are only a sample and not prescriptions any more than the product matrix paradigm is a prescription. The product matrix is a paradigm of probable product vehicles to enhance learning. This gives the industrial arts teacher a unique opportunity to recognize individual differences and provide a meaningful learning environment. This opportunity is not always available to the science, math and other teachers who, in fact, must and do subscribe to the basic laws and logic of that science and have very little opportunity for educational synthesis and productive society extropolation.
extropolation.

One of the methods used in the wood materials area is the pictorial program instruction method which is very adaptable to the initial introduction of students to any product and equipment usage in this area or in any of the other material areas described. Careful review of the samples provided in Chapter VII will indicate that the pictorial representation of the requisite steps are reinforced by simple succinct, written instructions in a tested and proven sequence. In the event that a student arrives at some unknown area such as the operation of a piece of equipment, or the finishing of the product, this can be supplemented by an audio single concept film or by a taped cartridge inserted into a portable recorder available to the student in the wood materials area. This leads into the next categorization for effective learning of the wood materials area of the Phase I activity of the industrial arts program. That is organization.

Organization

It becomes very obvious that organization plays a very prominent role in industrial arts. Otherwise, the laboratory learning experiences become frustrating to the teacher and traumatic and discouraging to the students. Only after learning has been delineated and determined can we viably submit a budget and a purchase requisition for tools, supplies and equipment.

The tools and equipment should be adequate for the representative learning experiences as previously enumerated in the wood products matrix paradigm. Sample equipment lists of hand tools and equipment can be obtained from suppliers. The most important thing to recognize is that all tools and materials requisite to learning about wood and wood products must be housed in this one material area so that students are not required to make extensive excursions to bring out a fourteen-foot board from a lumber supply room to cut off eighteen inches for a product. Time wasted in this type of activity is educationally indefensible. Therefore, materials, hand tools, stationary equipment, books and other learning materials must be housed in the prescribed materials area. Observation of the photographs illustrating such organization will illustrate the point.

It must be recognized that placement and utilization of tools and equipment mandate certain space requirements for effective and safe use. These requirements are prescribed by sample practices in our productive society and also mandated by law. Organization should further consider that the convenience, safety and comfort of students is of prime importance so that learning is optimized. This same consideration is equally applicable to the teaching environment. Reference to human factors engineering principles would be valuable. Establishing an authoritative

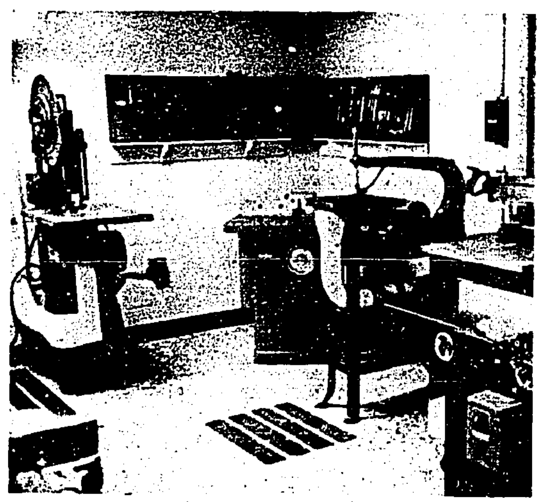
base for teaching wood as a viable material area, making decisions affecting optimal learning, communicating a meaningful learning environment supported by well organized and safe learning experiences provides the industrial arts teacher with a defensible educational claim upon students' time, educational funds and educational facilities. Industrial arts content can no longer be subjected to the pressure of a supplier, or the whims of an administrator and become a victim of subsequent cut-backs in funds or space. The institutional responsibility of cut-backs in space and funds is accompanied by a commensurate cut-back in learning experiences. Can we say that a major responsibility of secondary schools is to guarantee that future society will not be technologically unacculturated?

CERAMICS:

Ceramics is the world's oldest material and craft, but it also must be recognized that it is one of the most unique and rapidly expanding materials areas in our current productive society. The unique applications of ceramic materials in combination with other elements, lends itself to a unique number of applications for bonding purposes, decorative applications and high temperature differential applications. The most common in evidence is the movement of a frozen dish from the refrigerator and brought to a boiling point on the household range. This same application to a greater extent is in evidence in many of the other institutions in our society—most dramatically in the aero-space industry in the covering of metals exposed to frictional heat.

Authority

Extreme care must be exercised in determining the authoritative base of learning experiences representative of ceramic tools, materials and processes. The conventional kitchen craft application of slip casting, coil molding and low temperature firing are poor representative samples, and therefore, poor exploratory experiences of this materials area as it is represented in our productive society.

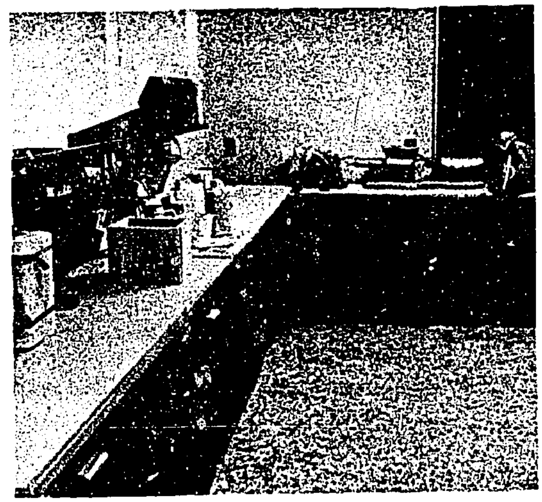


Granted that extrusion and other processes and applications are equally useful in ceramics. What needs to be stressed in this material area are the unique chemical and physical properties of ceramics and their subsequent reaction to heat and pressure which distinguishes a conventional container from that of one capable of extensive wear, heavy usage and extreme temperatures. The basic forming operations may be very similar, but the intensity of heat, the base material, chemical mix and the ultimate application and mix of the finished raw material, vitally affects our use of this oldest of man's building materials.

Application of cloisonne to a household article is an artisan type of skill, whereas a high fire application of a different mix that will absorb shock and resist extreme heat upon earth re-entering, poses a whole new set of parameters for study and ultimately affects the design of learning experiences in this area.

Decision

Observing the product matrix paradigm in this area will indicate that a healthy respect must be obtained for the uniqueness and characteristics of the materials most prominent in this area. This represents a careful mixture of raw materials and their glazes and comparisons of finished products characteristics which can be verified in the test samples so prominent in this area. While other material areas in industrial arts lend themselves to observable manipulative processing of the materials, the unique chemical and physical combinations inherent in ceramic products are more susceptible to a data-gathering and testing



because the basic forming processes are very similar whether it be a slurry or a semi-solid, the ultimate differential occurs in the finished product which is characterized by its unique qualities of breakage, heat resistance, shrinkage and elasticity. Qualities that distinguish the new ceramics technology from the centuries old craft.

Creativity has always been stressed in this area of material study in an artistic sense. This should continue to be so, but design creativity must remain the province of the fine arts classes. The justification of ceramics as a material in industrial arts is the unique combination of chemical and physical properties. Therefore, a creative logic of the sciences as it affects product characteristics is justifiable in this materials area of study in industrial arts.

One of the decisions that confronts future curriculum content development of this materials area is the use of other earth elements, such as bauxite, that have found their way into the metals area of industrial arts. If we can justifiably introduce the silicones because of its glass characteristics, we should seriously consider the introduction of bauxite and similar materials singularly and in various combinations. We should also reconsider the nomenclature of this materials area and instead of ceramics, this materials area could be referred to as the earth elements area.

CERAMIC MATERIALS AREA

SAMPLE PROCESSES	USE OF MATERIALS IN SOCIETY	1		2		3	
EXTRUSION	SOCIETAL — HOME; PERSONAL — CULTURAL; INDUSTRIAL — SCHOOL	A_1	A_2	A_5	A_6	A_9	A_{10}
		A_3	A_4	A_7	A_8	A_{11}	A_{12}
HAND FORMING		B_1	B_2	B_5	B_6	B_9	B_{10}
		B_3	B_4	B_7	B_8	B_{11}	B_{12}
SLIP CASTING		C_1	C_2	C_5	C_6	C_9	C_{10}
		C_3	C_4	C_7	C_8	C_{11}	C_{12}
COMPRESSION		D_1	D_2	D_5	D_6	D_9	D_{10}
		D_3	D_4	D_7	D_8	D_{11}	D_{12}
GLAZING		E_1	E_2	E_5	E_6	E_9	E_{10}
		E_3	E_4	E_7	E_8	E_{11}	E_{12}
GLASS MAKING		F_1	F_2	F_5	F_6	F_9	F_{10}
		F_3	F_4	F_7	F_8	F_{11}	F_{12}
FIRING		G_1	G_2	G_5	G_6	G_9	G_{10}
		G_3	G_4	G_7	G_8	G_{11}	G_{12}
GLAZE & CLAY MIX		H_1	H_2	H_5	H_6	H_9	H_{10}
		H_3	H_4	H_7	H_8	H_{11}	H_{12}
TEST SAMPLES		I_1	I_2	I_5	I_6	I_9	I_{10}
		I_3	I_4	I_7	I_8	I_{11}	I_{12}

CERAMIC PRODUCTS MATRIX PARADIGM

Communications

Because of the unique nature of this materials area, a large variety of product samples must be in evidence, as they would be in any typical test laboratory. Wherever possible, before and after, the liquid and solid state characteristics and their chemical equivalents must be profusely illustrated.

This is the industrial arts teacher's best opportunity to bridge the mysticism inherent in scientific symbols and translate them into meaningful application, thereby further reinforcing the need for careful measurement and data collecting. This is a unique discipline, inherently required of all aspects of our highly cybernated society.

At the risk of redundancy, I remind the reader that industrial arts is designed not only to reach the twenty percent of our school population that learns despite out efforts, but the greater challenge is that of reaching the remaining eighty percent and making the mysterious technological symbols and concepts meaningful as they culminate in a finished product.

A profusion of chemical formulae with their raw mix samples and the finished solid product helps to bridge this gap. Emphasis on careful data collection is not only required in other material areas but requires the same type of attitude in students of other academic studies. Therefore, forms, report writing, accurate observation, weights and measures, are equally prominent attitude characteristics to be transmitted in this materials area. Granted that the pictorial programmed instructions, single concept films and similar methods may be used to transmit the unique processes and operations. The change in behavior as a result of acceptable learning experiences include observation, confirmation and data collection.

Organization

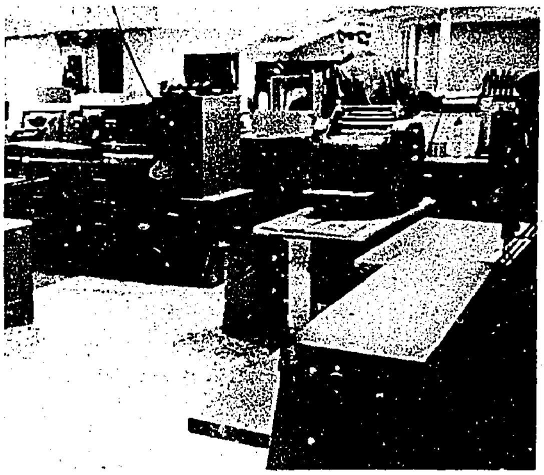
Organization of this materials area lends itself to the units of study previously described. Physical equipment does not require extensive space, but unique air, gas and other utility requirements must be met. High firing chambers and their basic fuel and exhaust systems must be established. The chamber capacity is determined by the size of the products and this is a serious consideration since chamber size drastically changes the cost of the initial installation (such as powdered metallurgy, bauxite compression and reduction and glass making).

GRAPHIC ARTS:

The graphic arts industry is one of the oldest crafts in evidence in our productive society. It is also one of the most outstanding current examples of the impact of technology upon the practices, habits and attitudes of a historically well-established craft. The old letter-press method is virtually obsolete. The offset press, electrostatic processes and unique chemical combinations and chemical sensitivity processes have radically changed the materials, processes and tools that are representative of this aspect of our productive society. Book binding has been moved into the realm of the artisan and substitute methods of rapid accumulation of pages and fixing them into a design configuration have been radically changed.

This is a very rapidly expanding aspect of our productive society, and therefore, cannot be treated entirely in the beginning phases of industrial arts. The elementary processes and the more sophisticated electrostatic, mass reproduction, photography, holography, etc., are introduced as an aspect of the communications materials and processes in Phase II, under graphic communications.

The probable maturity level of seventh graders, mandates that the requisite disciplines of offset, embossing, sign printing, plastics lettering, collating, etc., require a routine of discipline to optimize utilization of graphic arts, processes and equipment.



Ample evidence indicates that whether it be a medical report, a legal brief, a political white paper, a scientific thesis or an educational dissertation the basic processes in communication are fairly standardized throughout our productive institutions. Therefore, speed and quality are demanded at a

minimal cost whether it be a military battlefield, manufacturing production line or a sophisticated business board room. The material to be communicated must be accurately reproduced, so that it is legible and acceptable to the reader.

Authority

A number of authors have indicated that more scientists are alive today than all the previously known scientists recorded in the history of our civilization. Doctor Isaac Asimov made the observation that of all scientific publications that occurred since 3100 B.C., half of them occurred between 1950 and 1960. This is but one small example of the exponential explosion evident in the graphic arts industry. The progress of civilized man depends upon his ability to impart information to others by means of the recognized symbol or image. In an age when visual literacy is becoming more important and a good proportion of the world's population is illiterate in the use and implications of graphic materials and processes, people need to be taught to see and understand what they see to the same degree that they were taught to read and write.

The greatest asset to the graphic arts productive institutions was the introduction of the printing press, but it must be understood that the press was not significant only in the aspect that further developments in the paper industries--inks and allied techniques became perfected so that the use of the press and the development of the printing craft was assured.

Admittedly electronics and the advancement of electricity have affected the communications aspect of our productive society. These are stressed with greater emphasis and specificity in the electricity and electronics activities of the various phases of the proposed industrial arts program. This is additional argumentation that no materials area or technology functions in isolation from others. Marshall McLuhan and others have indicated the impact of visual technology upon the graphic arts industries in our productive society, and therefore, upon all citizens in society.

Because of this dynamic explosion, the inclusion of graphic arts in the Phase I aspect of this industrial arts program is to introduce the student to the variety of systems and processes most prominent in the graphic transmission of information in our productive society. Therefore, the variety of communication processes and materials is represented as graphic arts in Phase I, graphic communications in Phase II, and its ultimate appearance in Phase IV. The proliferation of graphic communications practices and methods nullifies the age-old practice of exposing Junior High School industrial arts students to mechanical drawing. Mechanical drawing represents a small insignificant graphic method of communication at the expense of exposing students to a wider variety of systems and methods most prominently utilized in our productive society. Students can postpone the specific acquisition of drafting skills to vocational and technical

Regardless of how updated each specific area may be, the purpose of industrial arts is a broad sampling of these specific craft areas, their influence upon each other and their combined influence upon our society. One only needs to pick up the daily newspaper to see the impact of color in the use of daily newsprint . . . a process prohibitive to the industry a decade ago. The compilation and the make-up of masters, their reproductive capabilities, the uniqueness of inks and papers with the use of modern headliners and varitypers, all lend themselves to the introduction of a wide variety of reproduction tools, materials, and processes that are evident in the home, office, and every productive institution in our cybernated society.

schools. Concentration should be on the utilization of blueprints and other graphic reproduction media. This is additional justification for defining an authoritative base for industrial arts content before any curriculum decisions are made and equipment purchased. Exposing students to obsolete or minute representations of our productive society is indefenisble.

Industrial arts is designed to be general education through an exploratory representation of the productive institutions in our society. Industrial arts is not vocational preparation in the printing trade, as draftsmen or photographers.

Decisions

Having determined that this is an authoritative area of study, decisions have to be reached which would expedite an exploratory experience with the various communication processes and materials most commonly in evidence in our productive society. The use of hand set type is rapidly disappearing. However, it is in evidence in a variety of small applications as rubber stamping, embossing or sign making. These applications can be used in plastics, on paper, following a template or the

GRAPHIC ARTS MATERIALS AREA

SAMPLE PROCESSES	USE OF MATERIALS IN SOCIETY	1		2		3	
HAND PRESS	SOCIETAL — HOME; PERSONAL — CULTURAL; INDUSTRIAL — SCHOOL	A_1	A_2	A_5	A_6	A_9	A_{10}
		A_3	A_4	A_7	A_8	A_{11}	A_{12}
OFFSET		B_1	B_2	B_5	B_6	B_9	B_{10}
		B_3	B_4	B_7	B_8	B_{11}	B_{12}
RUBBER STAMP		C_1	C_2	C_5	C_6	C_9	C_{10}
		C_3	C_4	C_7	C_8	C_{11}	C_{12}
EMBOSSOGRAPH		D_1	D_2	D_5	D_6	D_9	D_{10}
		D_3	D_4	D_7	D_8	D_{11}	D_{12}
DECAL		E_1	E_2	E_5	E_6	E_9	E_{10}
		E_3	E_4	E_7	E_8	E_{11}	E_{12}
ENGRAVING		F_1	F_2	F_5	F_6	F_9	F_{10}
		F_3	F_4	F_7	F_8	F_{11}	F_{12}
BLOCK SIGN PRESS		G_1	G_2	G_5	G_6	G_9	G_{10}
		G_3	G_4	G_7	G_8	G_{11}	G_{12}
SAMPLE TEST PIECES		H_1	H_2	H_6	H_6	H_9	H_{10}
		H_3	H_4	H_7	H_8	H_{11}	H_{12}

GRAPHIC ARTS MATRIX PARADIGM

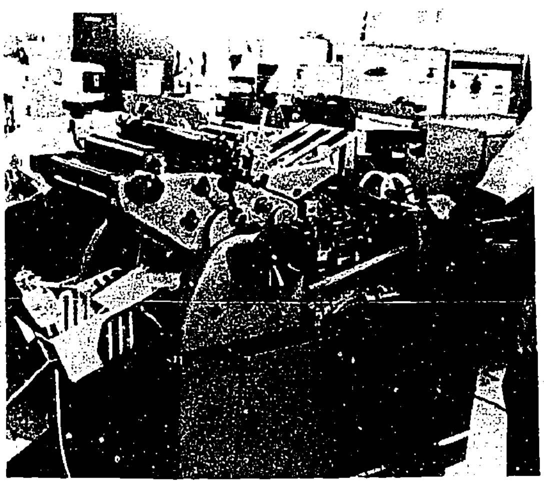
use of the original lead slug. Whatever the materials, a specific set of disciplines, attitudes and respect for materials and understanding of processes must be transmitted. It is therefore recommended that a careful observation of the

following matrix paradigm will indicate products and experiences involving a hand letterpress, an offset press and embossed name plates, printed signs and the duplicating capability and manufacture of a rubber or plastic stamp.

A portion of this activity can be devoted to blueprint reading and simple free-hand sketching using coordinate paper. Use of models help to expedite this activity thus minimizing the need for group instruction.

Communications

In this material area, as well as the others, a careful orientation and induction is preliminary to any learning activity involving students. An example of the multiplicity of methods used should be well illustrated in this area. A pictorial program instruction booklet is very applicable for the embossograph and sign printing areas of study. There are a number of good blueprint reading program instructions available in this area. The operation of the offset printing operation poses a number of problems.



However, a single concept film viewed prior to operation of an offset machine is available from many equipment manufacturers and explains the basic processes. This is followed by a planned assessment of a student's understanding before operation of the equipment is permitted. The instructors assessment may necessitate a demonstration followed by the use of tapes describing step by step performance of this process for further reinforcement. Fail safe steps in instruction must be incorporated to optimize learning and minimize equipment maintenance. After this exploratory experience, a student can be exposed to 16mm films summarizing the graphic arts area. Final examination in conjunction with the critical incident evaluation of the student's performance in this area, is now subject to placement on a graphic performance profile.

Organization

This area is very similar to plastics and has an abundance of equipment that lends itself to the teaching of a prescribed unit. Once the determination of units to be taught has been made, the greatest caution to be employed is that a careful analysis of equipment capacity and durability is determined. Many of the graphic arts products currently available on the market are satisfactory for home use but cannot survive an eight period day full utilization by students. Therefore, size determination effects costs. Variety of processes and systems to be learned as well as the validity of these systems determines the equipment.

The one single major expense in this area is paper. Organization should be such, that tight inventory controls are established permitting a multiplicity of materials and processes explorations available for students, but also, that finished products, paper, ink samples and other materials are made available as destructive test pieces in the previously mentioned materials testing section of the Phase I program.

Because of the requisite feeding, collating and similar operations required of this activity, organization should take into account the lineal feet of bench top space required without interfering with on-going graphic arts experiences.

MATERIALS TESTING

One of the rapidly emerging technologies is the Standards Technology. This has been necessitated by the fast developing new technologies and the unique roles of technicians employed in the various productive institutions of our cybernated society.

The frequent duplication of product or service and the need to maintain a high quality of product or service demands careful calibration or evaluation of consistency of process or material. Any deviation from the established and proven standard adversely affects the quality of the product or service. It would not be possible to utilize technicians as para-professionals unless the more repetitive tasks of the professional could be analyzed and standardized for delegation to a technician. This same process is in evidence whether it is the manufacture of a simple appliance or a complex solar vehicle. It differs only in degree. In order to continue and improve products or services, careful assessment of applied standards for measuring consistent quality or unique characteristics must be studied. Any changes introduced have a vital impact upon parts replacement, obsolescence and the ultimate economy.

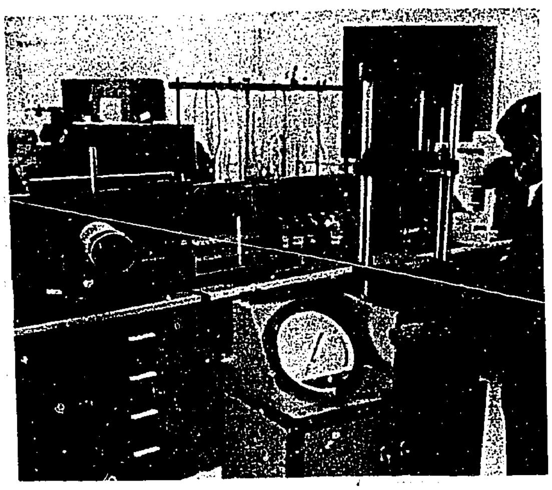
Many of tests performed are conducted in laboratory environments using laboratory analysis and extropolation. It is imperative that consumers and professionals have a comprehension of the standards techniques employed to give the techniques creditability. Participants in the testing laboratories adhere to rigid standards procedures in order to maintain creditability. It takes on an aura that the reputation of the personnel and/or the laboratory is maintained because of adherence to consistent standards which ultimately is reflected as reliability.

Authority

Whether these standards are applied in quality control situations in manufacturing or analytical tests performed in hospital laboratories, all of society subscribes to this technology. It aids in the process of technological acculturation to understand and appreciate this basic technology so that the testing services performed have a creditable role in our productive society.

Many standards technology situations are identified as destructive materials testing but others with equal importance are tests of prognostication. Therefore, the test pieces recommended in the various materials areas described for Phase I are the student's first introduction to this technology as subscribers. Performance in this technological area in Phase I is identified as analysis and data recording.

Exploratory experiences as they function accordingly are focused upon the test pieces exposed to a prescribed destructive test pattern. Students observe and record the unusual phenomena. This total process requires not only a unique understanding of the various testing and calibrating pieces of equipment but assists in the careful observation and recording of the results which are not too different from the laboratory experiences required in the other science areas of study in secondary education.



The one big significant attitude and appreciation that can be transmitted is that any controlled change in expected characteristics ultimately affects duplication of quality products or services as they appear in our productive society.

Decision Making

The materials to be tested established by Phase I provides an abundance of test pieces for the testing area. Observing the matrix paradigm the three columns of 'test' experiments identified as 1, 2, and 3 can be so that a simple test of chemical corrosion is A1 and electrical conductivity could be C12.

The learning sequences are governed by the test samples available which incorporate not only the materials utilized in Phase I but also those materials and processes that are utilized in introducing technologies in Phase II such as fuels, lubricants, photgraphic paper, hydraulic fluids, and continue on into Phases III and IV of the proposed industrial arts program.

MATERIALS TESTING AREA

SAMPLE TESTING PROPERTIES	USES OF TESTING IN SOCIETY	1		2		3	
CHEMICAL	SOCIETAL — HOME PERSONAL — CULTURAL INDUSTRIAL — SCHOOL	A_1	A_2	A_5	A_6	A_9	A_{10}
		A_3	A_4	A_7	A_8	A_{11}	A_{12}
THERMAL		B_1	B_2	B_5	B_6	B_9	B_{10}
		B_3	B_4	B_7	B_8	B_{11}	B_{12}
ELECTRICAL		C_1	C_2	C_5	C_6	C_9	C_{10}
		C_3	C_4	C_7	C_8	C_{11}	C_{12}
PHYSICAL		D_1	D_2	D_6	D_6	D_9	D_{10}
		D_3	D_4	D_7	D_8	D_{11}	D_{12}
MECHANICAL		E_1	E_2	E_5	E_6	E_9	E_{10}
		E_3	E_4	E_7	E_8	E_{11}	E_{12}
RADIANT		F_1	F_2	F_5	F_6	F_9	F_{10}
		F_3	F_4	F_7	F_8	F_{11}	F_{12}

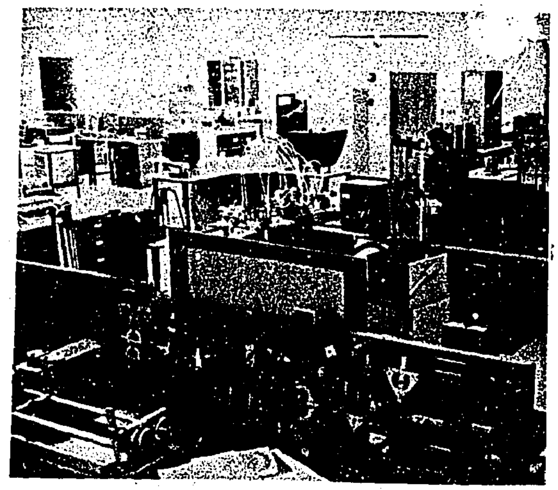
MATERIALS TESTING MATRIX PARADIGM

Communications

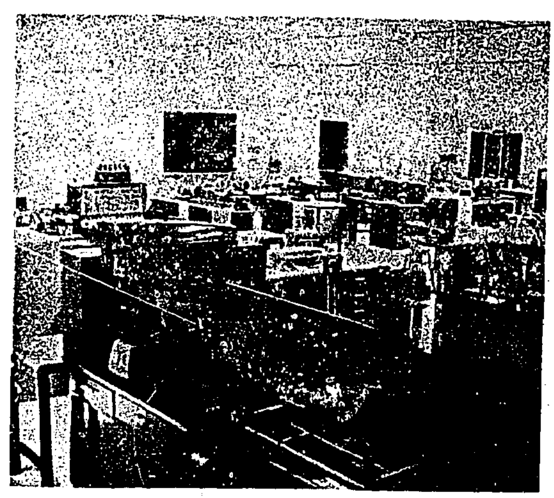
As in all other areas this area of Phase I industrial arts also places extensive demands upon the communication process. The previously designated material matrix test piece or special test pieces will determine the learning that takes place in this area. The real problem is that in the other material areas the student could conceptualize by doing. In this activity the student will observe the destruction or flash point of the material in a matter of seconds. It may be advisable to have several similar test pieces and a preview of what learning is designed illustrated on a closed loop sound film. A reading assignment or "take home" audio tape before the actual tests take place encourages success. It is my further recommendation that in this area as in other material areas, that scientific and mathematical formulae that are used in other classes be conspicuously displayed. This also is one time when all students may be brought together and shown a film on testing and standards that may further stimulate understanding and comprehension. We must constantly be aware that this is an industrial arts laboratory and not a science classroom. We are users and manipulators of the materials, proccsses and technologies emanating from science and not teachers of science.

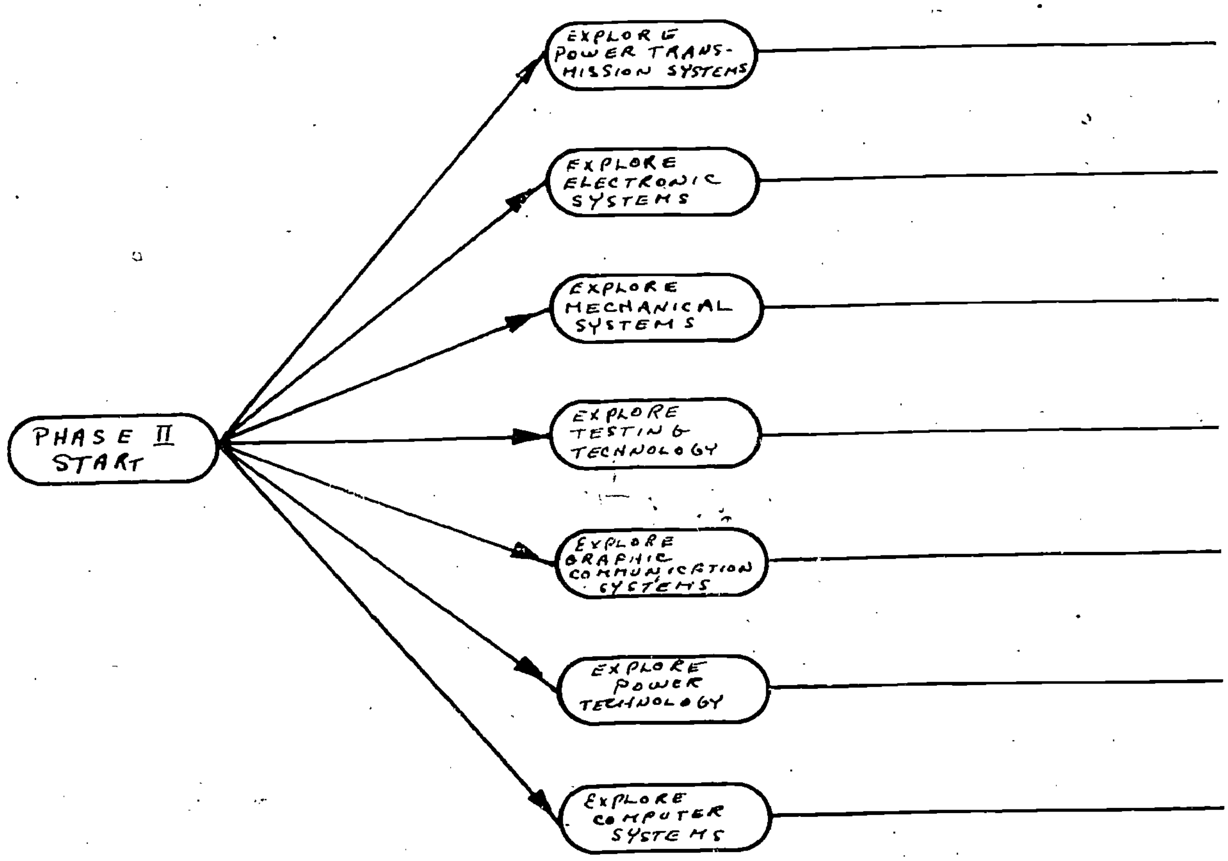
Organization

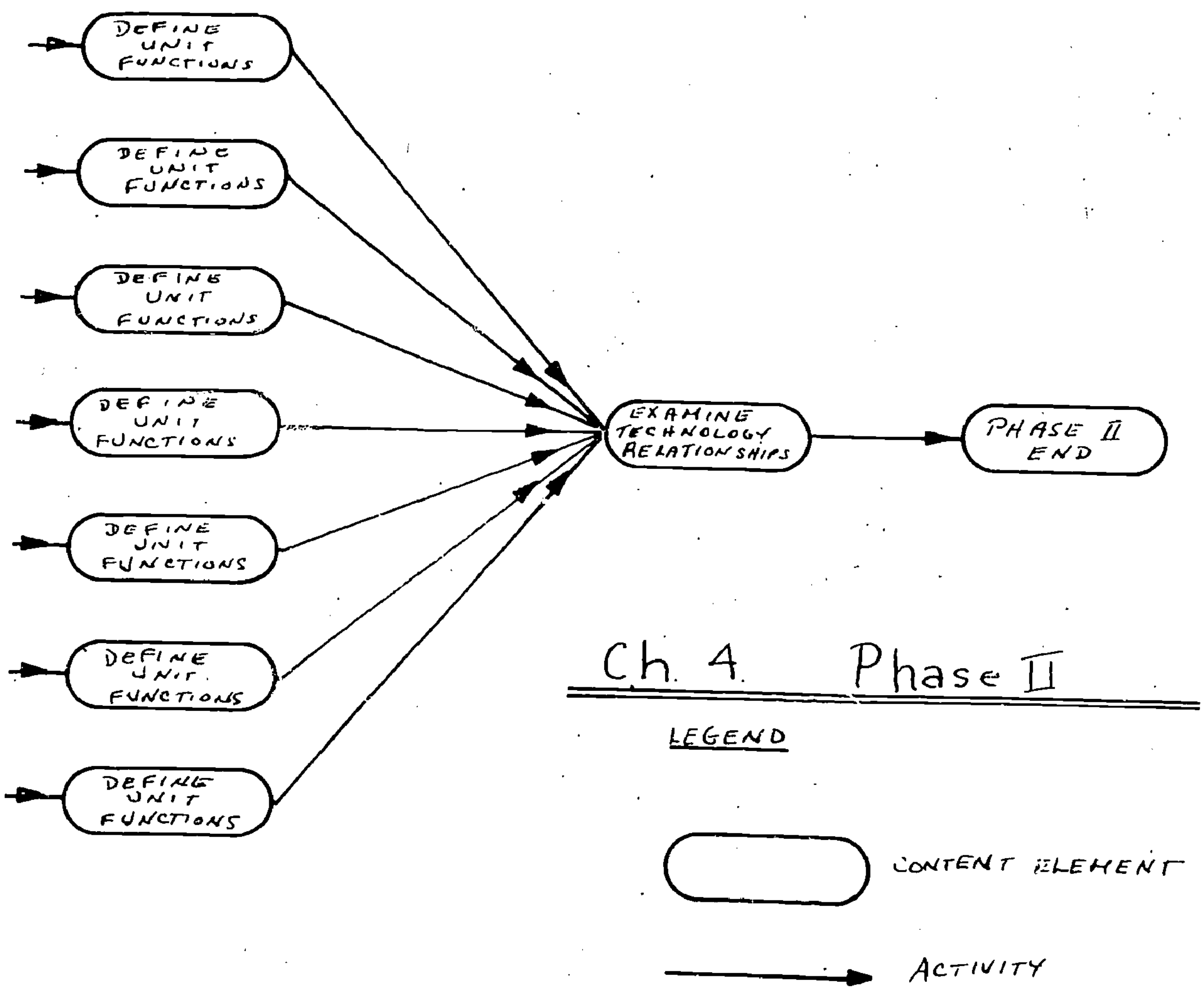
The utilization of this section of the proposed Phase I industrial arts program cannot be utilized as the other enumerated material areas. It is the author's recommendation that the time to perform a test or a series of tests as the instructors matrix paradigm demands must be accomplished immediately after the student has completed his test piece or pieces in any materials area. Therefore, this area is continually being used by all students throughout the year and must be supplied with sufficient orientation and induction information and equipment to permit the most optimal use of this area. It is my recommendation that pictorial programmed instructions, audio tapes and closed looped audio films be used before any tests are performed on any equipment. Minimal and maximal tolerances should be clearly stated and all forms and reference tables easily accessible.



The accompanying photos show that all necessary adapters and equipment is available and ready for student use. As in other material areas extreme caution should be exercised. A shear or torque destructive test—toxic fumes, splashing liquids or chemicals could expose students to serious accidents. This condition is also present in our productive society. Therefore, the same monitoring practices and devices must be incorporated.




PHASE II START
EXPLORE POWER TRANSMISSION SYSTEMS
EXPLORE ELECTRONIC SYSTEMS
EXPLORE MECHANICAL SYSTEMS
EXPLORE TESTING TECHNOLOGY
EXPLORE GRAPHIC COMMUNICATION SYSTEMS
EXPLORE POWER TECHNOLOGY
EXPLORE COMPUTER SYSTEMS


DEFINE UNIT FUNCTIONS
DEFINE UNIT FUNCTIONS
DEFINE UNIT FUNCTIONS
DEFINE UNIT FUNCTIONS
DEFINE UNIT FUNCTIONS
DEFINE UNIT FUNCTIONS
DEFINE UNIT FUNCTIONS
EXAMINE TECHNOLOGY RELATIONSHIPS
PHASE II END
LEGEND
CONTENT ELEMENT
ACTIVITY

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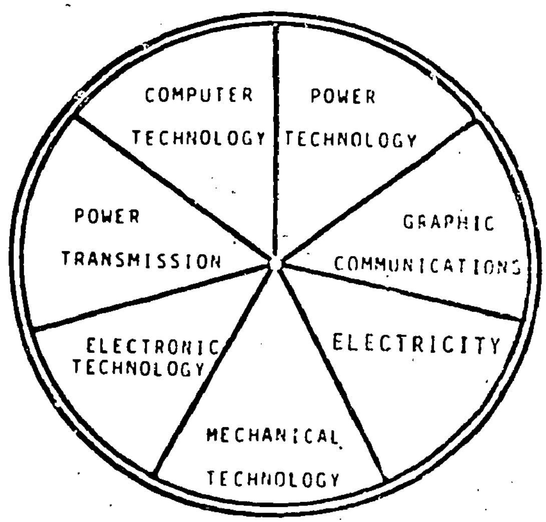
CHAPTER IV

TECHNOLOGIES

INTRODUCTION



Technology is neither a new term nor an unusual phenomena. It has its roots in antiquity, long before the introduction of the compass in maritime travel. The uniqueness of technology in modern day society has emerged because of the rate of rapid development in many technologies and the relative position of technology to science. This has resulted in many of the current productive aspects commonly referred to as cybernation or automation or rate of change . . . each in its own right worthy of extensive study. These terms have been described in some detail in previous chapters.

What is significant is that technology is a justifiable area of study for industrial arts. Many technologies and their unique phenomena are not being transmitted to secondary school students nor is technological relevance to the basic scientific area of study sufficiently emphasized. It is safe to assume that our educational programs are very delinquent in transmitting the impact of technology. This deficiency is so apparent that secondary school students, technical school institute graduates or college degree candidates may be classified as technologically barbaric or at best unacculturated.

The other indictment that confronts educators is the typical assignment of any technological study as vocational. Therefore, the total relevance of technological systems—their scientific origins and interdependence, their social and economic implications are neither studied nor acknowledged. If any effort at study is presumed, it usually is assigned to the very narrow vocational pursuits as technicians in the specific fields of electronics, radar, instrumentation or communications. So much so that professionally prepared scientists, because of their interest in computer science, function as technicians rather than scientists so that they can use computer technology as a tool in the interests of their basic specialty, "science."

The unique applications of technologies result in automated and semi-automated systems in the various productive institutions of our society; in hospitals, in military strategies, in manufacturing, in transportation and in large business offices.

Without recognizing the impact of the various technologies upon our productive society, students may elect to pursue a career classification that is much too narrow, and in many instances, obsolete in practice and in theory by the time they become available to the productive society. One of the fastest changing technologies and most assuredly destined to be obsolete in its current educational interpretations, is electronics. Observe the number of laboratories, even in technical institutes, that still pursue and defend the vacuum tube as a viable area of study, when micro-miniturization has rapidly changed the electronics design, assembly and application concepts and is moving toward chemical crystal circuitry.

The depth of any technology study should continue to be relegated to technical and vocational programs. The general area of study of a technology and its application to the many processes and uses in our society, mandates that all students, regardless of their career pursuits, must recognize the impact, not only of one technology, but the interrelationships of technologies upon their selected careers. The medical profession is in danger of losing its diagnostic responsibilities if they abdicate to an electronic technician the interpretation of electronic calibration devices. Placing a terminal on a specific circuit in a communication system for calibration is easily predictable. However, placing the same terminal for comparable calibration on the anatomy of a person is a fundamental responsibility of the medical man if meaningful readings are to be obtained and relate to accurate diagnosis. Similar type examples are available in every professional field. Therefore, whether a student ultimately becomes a para-professional or a professional, it is mandatory that he understand the multiplicity of technologies. A student should not be limited to the singular technological applications in daily life or the specific limited applications inherent in a vocational career. The interrelationships of technological systems and how they influence all our lives is an area of study that should command an educator's attention.

If the broader applications of technological interdependence and interrelationships are understood, the more simplified specific applications can be appreciated and form a good base for vocational career selection and preparation for future vocational career changes.

PHASE II

Technology affects our society, our economy, our government, our relationships with other governments and societies. Yes, our very lives are affected by technology. Observe the dilemma of the cities, our shortened and extended life, massive and immediate communication, our basic bodily functions, all are affected by the rapid expansion of technology. Whether it be a trip to the moon, a transplanted human organ, polluted air, paying a bill, or seeking leisure time activity, basic technologies are vital in all of these pursuits. Technologies will continue to be used to advance our society and they are likely harbingers of a better understanding of human beings and their problems, or how human beings learn. Hopefully the use of techologies will eliminate the scourge of war, pestilence and ignorance, put this must be accomplished by design and not by accident. The sooner we can introduce technology into the study of our secondary school curriculum the sooner man will become the master of technological innovations and applications, rather than its slave.

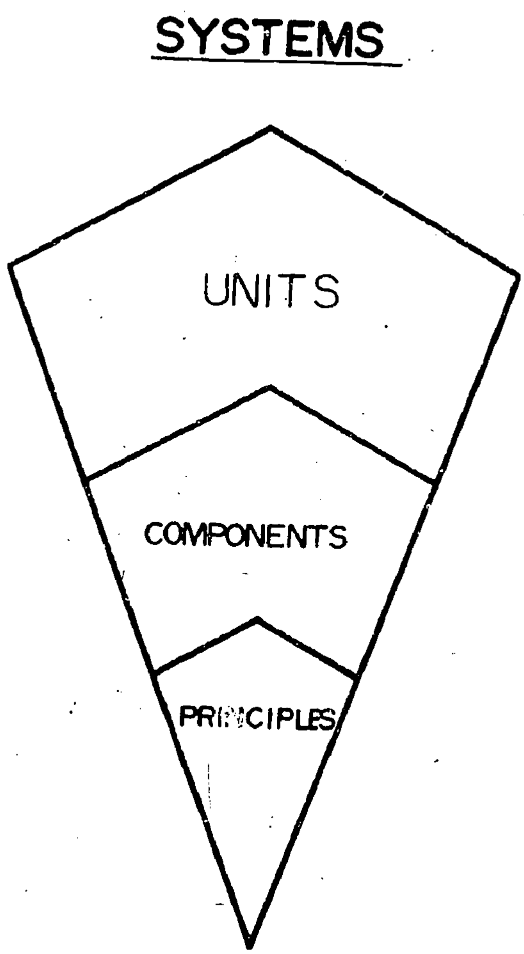
The computer technology is constant in the United States, Russia, or the emerging African nations. Computer applications are constant in the numerical control applications in industry, in accounting in hospital applications or planning strategies in government, industry or the military.

Since there is no other qualified subject area of study in the secondary school, and because of the unique qualifications of the industrial arts teacher, industrial arts has the environment and must be permitted to interpret technologies to all secondary school students. This interpretation will not only reinforce the student's academic studies, but it will also provide an exploration and an understanding of technologies to aid in career planning and interpretation of the pact of technology upon our society. Th es that industrial arts teachers and other subject teachers in a secondary school will work in concert to optimize learning.

The intent is not to transmit the understanding of technology alone. The reader is reminded of an earlier indictment levied against education wherein less than twenty percent of our secondary school students excel in the sciences and the mathematics. One of the objectives of this program is that we increase this percentage to at least 80% of the school population. It is no credit to educators that we are able to teach the upper intellectual levels of our secondary school population the various mysteries of the sciences, the maths, and the applications of language. The real challenge is to reach the remaining 80%. There is abundant evidence that a careful evaluation of our former methods of teaching the majority of students is the real challenge of education and may result in the ultimate salvation of this world.

The goal of public education should not be the preparation of an exclusive segment of society whether it be the intellectual elite, preparation for vocational careers, or professionals. This is educational apartheid . . . snobbishness that should not be tolerated or condoned by taxpayers, parents, or students. Educators should be alert to the possibility that if we continue our current educational practices and if there is any viability in the professional forecasts of our society for the future and if we are fortunate enough to avoid a military catastrophe, portends in today's society indicate that the educationally neglected of today, may reasonably become the most vocal majority of tomorrow. The lack of employment, the logical pursuits of the least educated masses will be concentrated on politics and governmental activities which would affect their subsistance policies, thereby subjugating those educated in the elite pattern to the role of serfs and the abundance of goods and services of the qualified will be subjected to the whims and exigencies of the less educated. If this is not sufficient incentive for educators to update their education and educational policies, eliminate their snobbish attitudes and recognize the need for all educators to work in concert, then programmed learning, automated teaching can very easily be assigned the teaching task. This would eliminate the need for the human teacher involvement since teachers are not fulfilling their total educational obligations anyway, as has been identified in many of the educational institutions of our society.

It is therefore recommended that the Phase II aspect of the proposed industrial arts program, incorporate the study of technologies. It is not recommended that these technologies

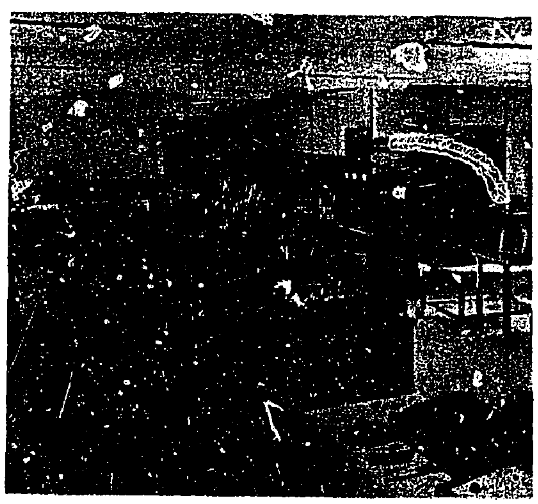


be studies in the typical manner subscribed to by vocational educators. Instead it is strongly recommended that the approach to the study of technology be from general to specific, systems to principles, and that the broader aspects of society and technology, technology and technology, and the academic disciplines within technology be understood and stressed.

Seven technologies have been selected as representative of our productive society equally applicable to the Eskimo of the North, to the Indian of the South, to the Inner City youth or to the urban youth, regardless of their career aspirations.

The seven technologies are:

1. Computer
2. Electronics
3. Power
4. Power Transmission
5. Graphic Communications
6. Mechanical
7. Electricity



One of the unique contributions of the institutions of productive society can be discerned in observing the categorization of the Phase I and Phase II industrial arts program.

It is admitted that materials, processes and tools interrelate with technologies and vice-versa in many of our productive institutions in a cybernated society. However, observing the concentration of study on materials, processes and tools, prepares the student for the more complex study of the uniqueness of technologies and culminates in the study of man and technologies in Phase III.

Working with technologies as well as working with any science or other subject area of study mandates a certain discipline of the student. However, this discipline is not voiced by the teacher. This discipline is voiced by the technology itself as the students in their practical discovery of working with unknowns, begin to recognize the demands of the technology. There are definite limits to any material or process as well as there are to technologies or to human beings. The great hope is the human beings adaptability and flexibility and the inexorable static characteristics of the technology. What appears as a mystical formula in junior high school science is equally mystical when it appears as a decision-making paradigm for the educator. However, the secret is that as educators make decisions and realize the consequences of these decisions, so do junior high school students begin to realize the value of scientific formulae as they study the applications of the technologies and their consequences.

Observation of the photographs and the diagrams will indicate the organizational pattern for the Phase II industrial arts program. Physical placement of technology areas immediately indicates to the casual observer, the interrelationships of the technological areas of study, Research indicates that this type of organization not only possesses a synthesizing influence upon students as well as positively reinforcing their study of the sciences and mathematics. The organization of the units of study and the teaching methods employed, previously described in Chapter III, made an unusual contribution to the student's comprehension and improvement in the area of reading and comprehension.

It is recommended that this phase of industrial arts study be assigned to grades 8 and 9, boys and girls. Phase I industrial arts is recommended to precede Phase II because the teaching of junior high school science and mathematics because of current curricular practices is more adequately reinforced. Since junior high school curriculum policies recommend the study of general science and math and appear as more specific concentration in the senior high school as physics, chemistry or biology, so the study of technology in Phase II is the general approach synonymous with junior high school study of science and mathematics. Phase IV industrial arts is clustered and synonymous with the administrative practice of studying in depth, the other academic subject areas in senior high school.

The four recommended processes, that is, (A) establishing the authoritative base for an area of study in this phase of industrial arts, (B) making the most optimal decisions in identifying the units of study to optimize learning about the specific technology, (C) communicating most effectively the determined units of study, utilizing previously enumerated methods, and (D) organizing a technology in an optimal manner to expedite A, B, and C above, to ensure that the greatest amount of learning takes place, is followed in this chapter as it has been exemplified in Chapter III. The four processes will be incorporated in the descriptions of the technologies. Special applications unique to a technology will be identified to assist in communicating and organizing this phase of the industrial arts program.

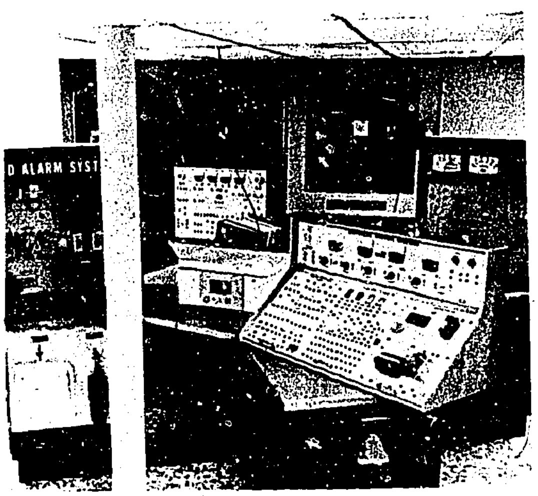
ELECTRICITY

All one needs to experience and appreciate the viability of electricity as an authoritative base of study for industrial arts, would be to have been caught between floors in an electrically operated elevator during the recent United States "brown outs." The extent of inconvenience and in many instances, jeopardy to affected citizens and its impact upon their lives during this shut-down is legend. This example may also help to illustrate the difference between industrial arts and vocational education. It would avail no citizen any opportunity for correcting the situation other than the vocationally or technically trained personnel employed to rectify the dilemma. However, this incident does indicate the extent of the use of electricity in our current productive society and therefore understanding of this unique technology would aid in its ultimate control by man. A control that is exercised by legislation and licensing of the power producing segments of our society.

Whether the student ultimately becomes a scientist, a professional person, a technician, or a semi-skilled producer in our society, it is inevitable that his country, or any other highly industrialized country of the world, will be a consumer of electrical power produced by a hydro or diesel fueled generator system, a steam or coal fueled generator or subscribe to electrical power generated by nuclear energy. Statistics indicate that electrical power affects all our lives and a reasonable appreciation and understanding of this technology must be transmitted to the whole population. The mysticism of electricity must be eliminated for the masses whether it is applicable to actions of citizens, consumers, or career area specialization as producers in our cybernated society.

Authority

Our current standard of living mandates the continuing use of electricity as a basic technology in the future. All scenerios of the future, forecast increased uses of electricity. Electricity appears as instrumentation and controls for all basic human needs, in fact, it is physically impossible to move any distance on this continent without the impact of electricity.

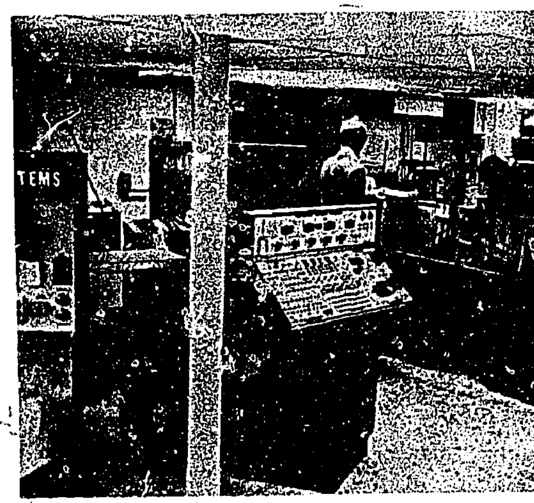


Such a vital technology must be understood and appreciated so all citizens may make more intelligent decisions regarding its uses, and consumers may obtain a more advantageous output of this increasing technology.

Electricity and its applications in our society must be studied, not in its scientific formulation alone, nor its vocational maintenance and installation, but in its broader aspects as a dynamic technology that combines with other technologies and processes to provide the goods and services inherent in productive society.

Decisions

It can be observed from the electrical technology matrix paradigm that the units of study differ very radically from those commonly designed for vocational preparation. The designation of units are principally to emphasize the distribution of energy, its limitations and unique characteristics that contribute to more effective systems uses. It can be further observed, that the learning experiences now constitute a series of experiments with prewired and preassembled alarms, lights and controls, whose chief responsibility is to acquaint the students with the unique applications of these electrical systems to daily life and reinforce the basic scientific concepts that inspired these applications. Every attempt is made so that the units of study help to clarify the mysteries of the uses of electricity and the age old analogy of the water supply system is not recommended.



The electricity technology area of study provides an excellent opportunity of learning from the general to the specific. Most electrical textbooks and equipment suppliers have imposed the method of learning electricity and its mysteries by offering minute specific information and working up to the system. It is my recommendation that industrial arts should offer students an understanding of the varied applications of electricity so that it can give meaning to the many roles that electrical systems fulfill in the multi-faceted applications within our productive society. Studying electricity in industrial arts should add

ELECTRICAL TECHNOLOGY

SAMPLE EXPERIMENTAL SITUATIONS	ORIENTATION: USES IN SOCIETY	INDUCTION: SYSTEMS		INDUCTION: UNITS	
SIMPLE LIGHTING	SOCIETAL – HOME – INDUSTRIAL / CULTURAL – SCHOOL – PERSONAL	S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
COMPLEX LIGHTING		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
SIMPLE ALARMS		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
COMPLEX ALARMS		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
GENERAL CONTROLS		S_1	S_2	U_1	U
		S_3	S_4	U_3	U_4
SIMPLE INDUSTRIAL CONTROLS		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
MOTOR CONTROL		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4

ELECTRICAL TECHNOLOGY MATRIX PARADIGM

significance to mathematics and the sciences and electrical system impact on the social structure of this universe. It is strongly recommended, and supported by research evidence, that to accomplish the above objectives, industrial arts should present electricity to all of the students proceeding from the known to the unknown– from the general to the [illegible]ific.

In order t[illegible] [illegible]eciate the application [illegible] the ultimate value of electrical technology, [illegible] recommended that a [illegible] amount of effort be expended to the former pre-occupation with skills required to solder, to install wires or to rewind motors. Instead let us start with the most common known application of electricity–lights, buzzers, alarms and controls within electrical appliances.

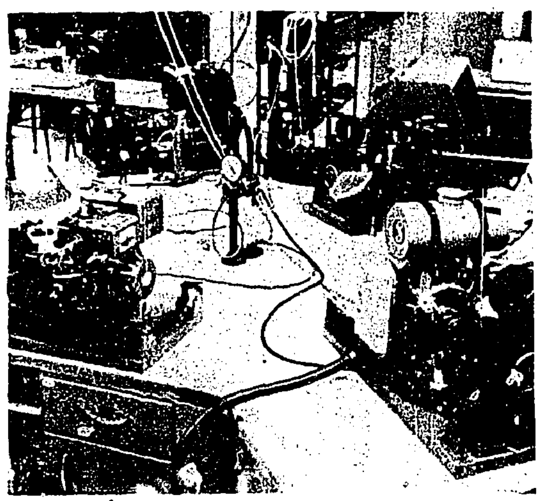
POWER TECHNOLOGY

From the frigid tundras of the north to the steaming jungles of the south, power is in evidence wherever man elects to settle. Originally, power was confined to that exercised by man's physical limitations or supplemented by domesticated animals. The uniqueness of power as a study and as a technology in industrial arts is supported by the rapidity with which power systems are utilized to satisfy the variety of man's excursions. No longer must we rely upon the combustion of hydro-carbons or the availability of water power. Nuclear energy, solar energy, the use of chemicals in fuel cells, and the current resurgence of steam as a viable power system is changing man's living habits, his battle with the elements and his mode of transportation and production.

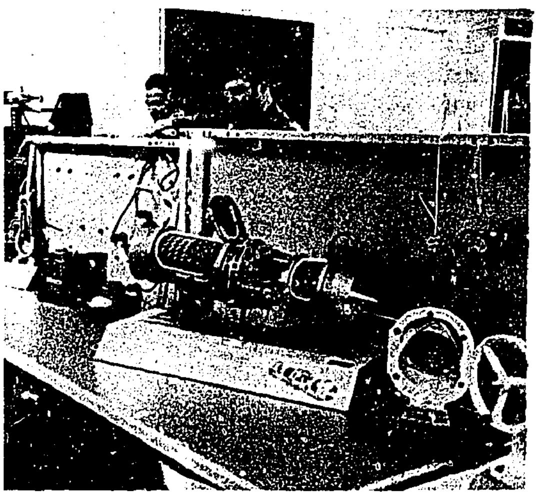
In industrialized countries power systems are in evidence everywhere. They may be highly centralized sources for the production of electrical power, mobile units for transportation or a variety of applications in the homes, the apartment, manufacturing plant or hospital. Power systems are in ample evidence throughout our productive society. They are increasingly becoming more dominant in our daily productive lives and in our leisure activities. Therefore, power and its systems as a unique technology becomes a viable area of study for industrial arts for the previously enumerated reasons.

Authority

Just a casual observation in our daily lives, in our working environment, in our study environment or in our leisure time activities will reveal the variety and profusion of power systems that abound in our society. Whether they be two cycle gasoline powered engines or a highly sophisticated super-sonic jet they affect our lives as citizens, individuals and as productive members of a society.

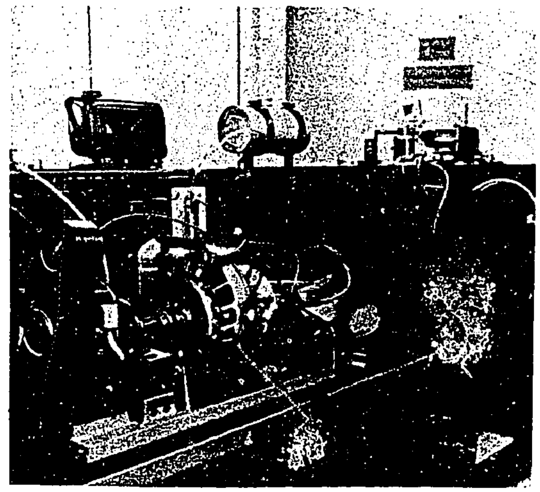


The previous industrial arts pre-occupation with the introduction of automotives or the repair of engines took on the flavor of vocational preparation and neglected the introduction of other power systems as a general education contribution. How many industrial arts laboratories can claim the Wankel system of power or a pulse jet or a solar energysystem? Here is an excellent opportunity to observe that while the training of automotive mechanics is vital to our productive society, this responsibility should be assigned to vocational schools preparing such mechanics and that industrial arts should introduce boys and girls to a variety of systems of power as these systems are employed throughout our productive society. A study that could assist the student more realistically to select a career pattern, understand the impact of a power system upon his career selection as well as the role of power systems within our society.



Would man have originally subscribed to the use and development of the hydro-carbon burning systems used in our automobiles if he could have perceived the polluting impact of this type of power system? How many educators recognize that a similar threat confronts us in disposition of the nuclear power systems wastes? Unless we, all of us, appreciate and understand these consequences nuclear waste could be more devastating to the lives of men than the hydro-carbon pollutants of today.

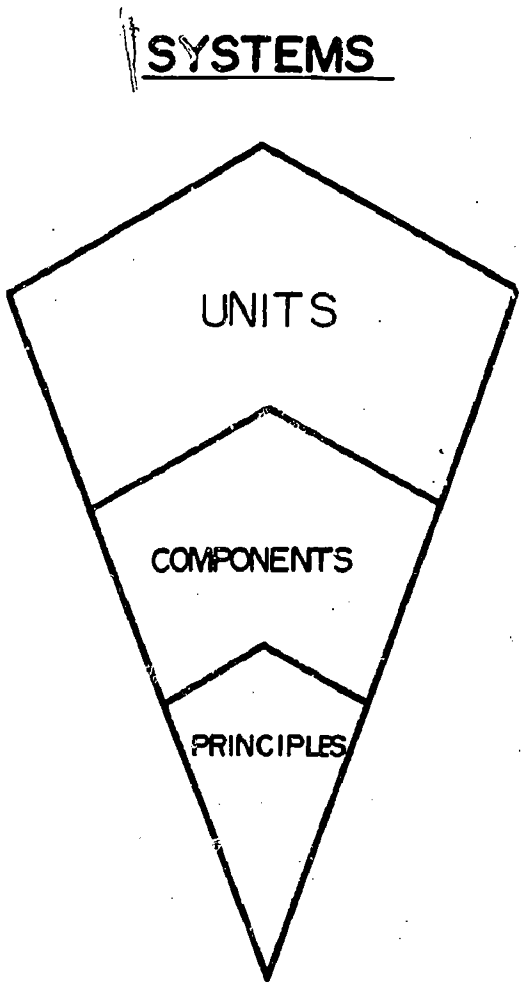
The mass population explosion and the mass uses of these hydro-carbon power systems produce astronomical effects. Military devastation becomes insignificant compared to the potential hazards of hydro-carbon power systems. This is not to [illegible] their use, but it does emphasize the need to understand these power systems, the fuels they employ, the wastes they exude in return for the power obtained.



The power systems recommended for study are based on the preponderance of these systems evident in our productive society. As a recommended sampling of power systems for the study of power as a technology in Phase II of the industrial arts program, the following are submitted: two cycle and four cycle gasoline engines, four cycle diesel, the Wankel engine, pulse jet and the electric motor.

Decisions

Having established that there is a proliferation of power systems in our society and that no citizen, male or female, is isolated from the influence of power systems, the requisite decisions for defining the areas of study for this technology can be delineated.



The above figure will suggest that in the Phase II industrial arts study of power technology, the basic format used is to direct the student's learning from the system to the components concept, from general to the specific. Observing the photographs and the following power technology matrix paradigm, it can be readily identified that no disassembly of these power systems is recommended nor organizationally provided for.

It is recommended that introduction of the power technology or any other technology as a viable learning activity in industrial arts is not how to repair a carburetor, but that a carburetor is in fact, one of the units in a gasoline engine as differentiated from a fuel injection system in diesel engines. That the ratio of power at the power take-off differs and is important. Fuel costs and the appearance of these power systems in various other complex systems within our society are mandated by fuel availability, ecology, cost and work to be performed. These are the general education industrial arts concepts that affect our society, that interpret the impact of technology on society, not the specific understanding and skill of being able to repair and adjust a carburetor. This skill should be assigned to the specific training responsibility of mechanics within our productive society. Industrial arts is not a subject matter field that is to prepare mechanics or any other specialists. Therefore, in power technology, industrial arts' chief responsibility is to provide a learning environment so that students can understand the differences among the enumerated power systems and the result of applications of power systems to more complicated systems that appear in our productive society

The next sequence of study is to identify the units comprising each power system and the

POWER TECHNOLOGIES

SAMPLE EXPERIMENTAL SITUATIONS	ORIENTATION	INDUCTION			
	USES IN SOCIETY	SYSTEMS		UNITS	
2 CYCLE ENGINE	SOCIETAL - HOME - INDUSTRIAL CULTURAL - SCHOOL - PERSONAL	S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
4 CYCLE ENGINE		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
DIESEL		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
WANKEL		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
PULSE JET		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
ELECTRIC MOTOR		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
FUEL CELL		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
SOLAR CELL		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4

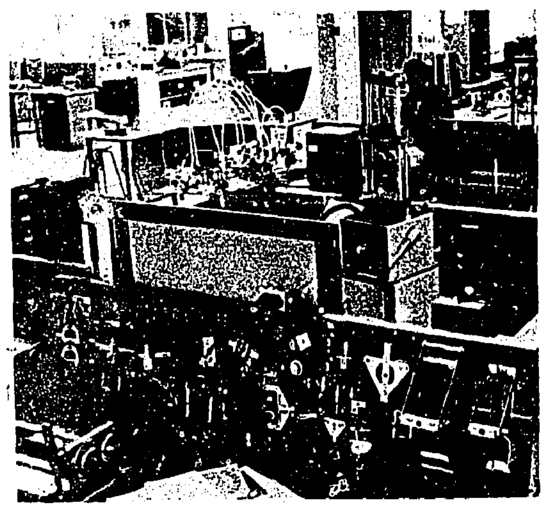
POWER TECHNOLOGY MATRIX PARADIGM

interdependence of these units to produce the ultimate power system for which it was designed. Following this the student should pursue the comparison of similar units in different power systems to recognize similarities of differences of function, results, design, performance and calibration variables.

The variety and individual differences of students may necessitate that each unit incorporate the further identification of the various components comprising each unit.

All of these activities in the study of power technology are test-stand activities . . . therefore, most of the results obtained is through calibration and data collecting. What does happen when the fuel mixes change? What is the difference between a two cycle and a four cycle engine? How does its application affect our productive society? Can we transfer the horizontal thrust of a pulse jet system to a rotary motion? Can we change a rotary motion in a four cycle engine to a lateral motion?

These concepts are introduced as diagrams and conceptually described in general science. The interpretative aspects of industrial arts in the actual use of these power systems and the realization and physical articulation of the science concepts, emphasizes the unique contribution that the power technology and other [illegible] technologies, identified in the recommended industrial arts program, can make to the secondary curriculum. Therefore, defining the ultimate value and unique role of industrial arts.

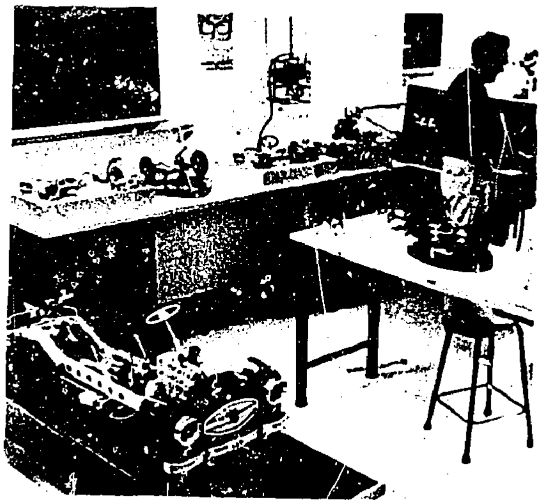


The pictures of the industrial arts laboratories readily illustrate that automobiles, airplane engines or lawn mowers are not in evidence. It is re-emphasized that a two cycle engine is not limited to lawn mower applications, in fact, lawn mowers use other power systems. The supplementary photographs indicate that small size power systems are available at minimal cost. The savings generated in the initial cost of the smaller power systems, supplemented by the use of cutaway models, permits a tremendous saving of square foot learning space and its attendant costs. Cutaway models are available to further minimize any tear-down operations, therefore optimizing and reinforcing learning without the needless and tedious tear-down activities which often detract from industrial arts objectives.

MECHANICAL TECHNOLOGY

Since man used a lever and a fulcrum to move extremely heavy objects, the principles of mechanics have permeated our society. With the use of activating forces such as pneumatics and hydraulics and the introduction of unique gearing combinations excited by fluid power or electrically stimulated power units, man's command of the mechanical technology has increased exponentially.

Basic physical laws have not altered appreciably and the concepts transmitted by the study of science and physics appear as unique, often mystical phenomena. The introduction of automation, cybernation and

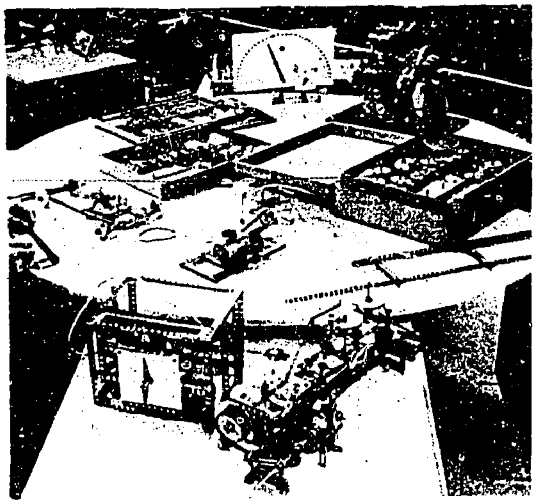


the simple household appliances illustrate that mechanical technology permeates every activity of our society. Mechanical technology is introduced as a general e[illegible]n study reinforcing science and mathema[illegible]he study of this technology in industrial arts is differentiated from the vocational practices of the mechanic, machinist or industrial technician. The engineer must be very cognizant of mechanical principles and their consequences as he designs a bridge, a machine, or a sophisticated system. The often repeated adage "for the want of a shoe the war is lost" is equally appropriate here, "for the want of a physical advantage, the optimum efficiency of a system is greatly diminished." Admittedly,

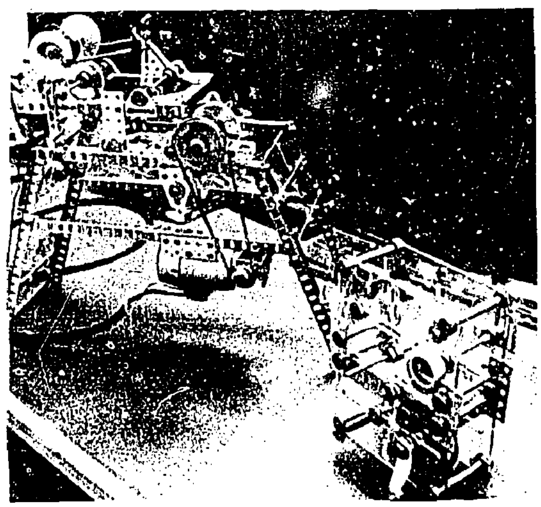
many of the physical theories and concepts can be tried and tested through the use of computers. However, man's continued insistance upon development of prototypes or models makes it a worthwhile investment to assess the human input, which affects computerized calculations, validated by models and prototypes.

Authority

There are definite limits to the combinations and the extent of power transmitted by a variety of gearing configurations. Mechanical technology can increase student understanding of the complex conceptualization transmitted by science that gears or gear pitch can improve power, increase speeds, and change direction. These mechanical concepts become confusing to most students but can become readily discernable, and easily learned when mechanical prototypes are assembled in some of the combinations illustrated by the photograph. Most of the prototypes are related to the equipment most prominent in the recommended industrial arts laboratory.

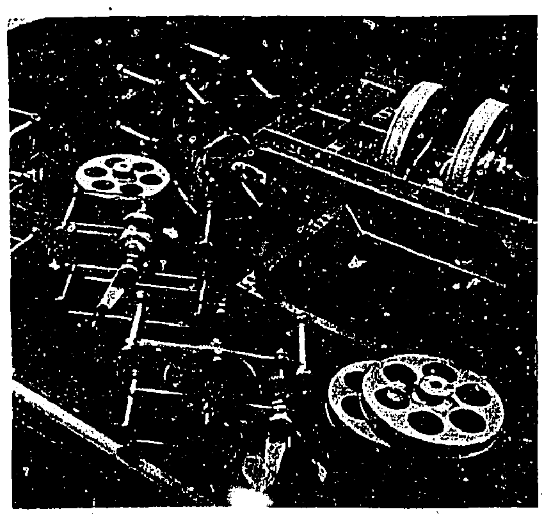


The increased automation and semi-automation of extensive production lines and the application and increase of services indicates many of these operations rely upon basic physical principles that historically predate the automobile. It is the application that varies. What used to be a craftsman operated milling machine is now a numerically controlled milling operation by introducing the new computer technology and the adaptation of hydraulic, pneumatic or electric sensing motors. These combinations of technologies extend the old physical applications of basic machines and result in sophisticated systems, previously unanticipated because of man's physical and intellectual limitations.



Many unique die configurations or air vehicles would not be possible unless the basic machine, previously designed by man and limited to man's manual dexterity, can be greatly extended by placing design decision on a tape that actuates hydraulically operated motors which govern the resulting performance of the machine. This performance can be combined in a three axis operation, impossible to accomplish using man's limited manual dexterity.

The predetermined operations can be studied, and if necessary, improved upon to optimize production, quality, design and overcome unforseen affects.



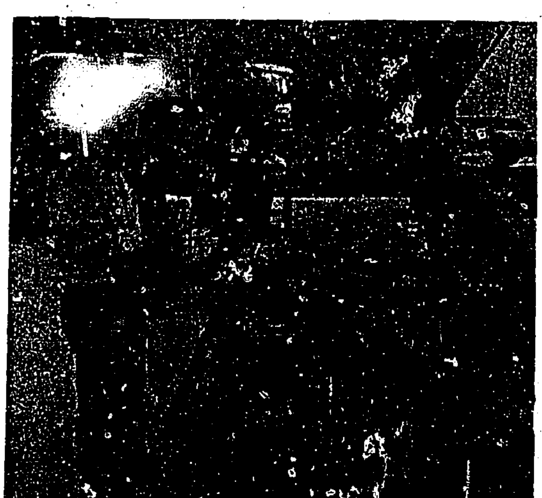
MECHANICAL TECHNOLOGY

SAMPLE EXPERIMENTAL SITUATIONS	ORIENTATION	INDUCTION			
	USES OF SYS- -TEMS IN SOCIETY	SYSTEMS		UNITS	
SIMPLE GEARING	SOCIETAL - HOME PERSONAL - CULTURAL INDUSTRIAL - SCHOOL	S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
SIMPLE ROTATION		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
CHANGE IN ROTATION		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
COMPLEX GEARING		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
SIMPLE COMBINATIONS OF GEAR PROBLEMS - OBSERVE COMPLETE SYSTEM CUTAWAY		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
SIMPLE MACHINES		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
COMPLEX MACHINES		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4

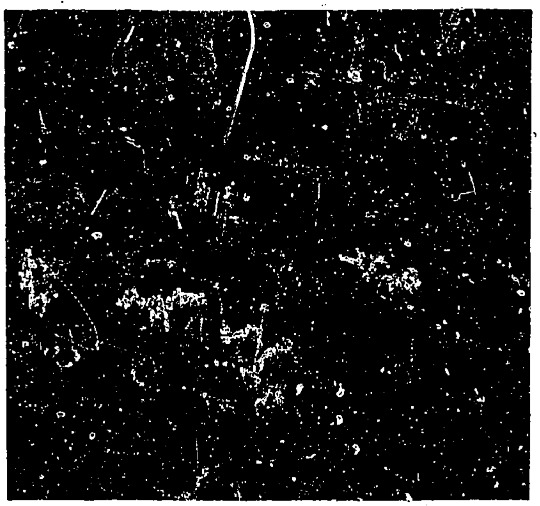
MECHANICAL TECHNOLOGY MATRIX PARADIGM

Decisions

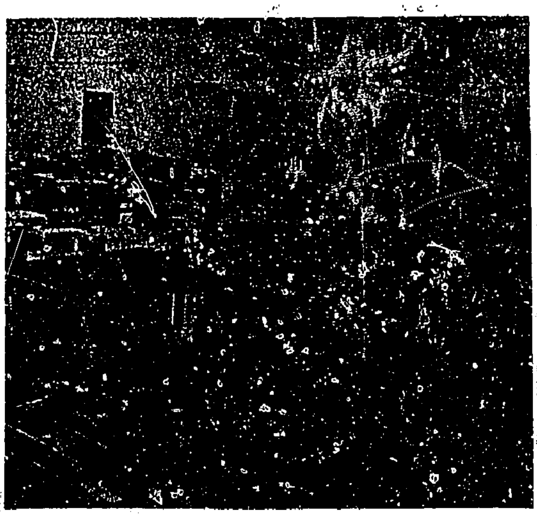
Observation of the mechanical technology matrix will indicate the previously recommended systems, units, components pattern of study. Admittedly, the systems selected for study are simple and would appear, and do appear, as units in a more complicated system in the Phase IV industrial arts program. However, the main objective is to recognize



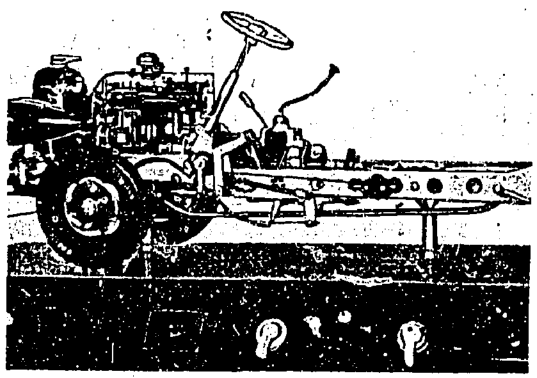
that the variety of mechanical systems do perform specific functions and as is true of many sophisticated systems, this sophistication is a result of a combination of simpler mechanical systems and technologies.

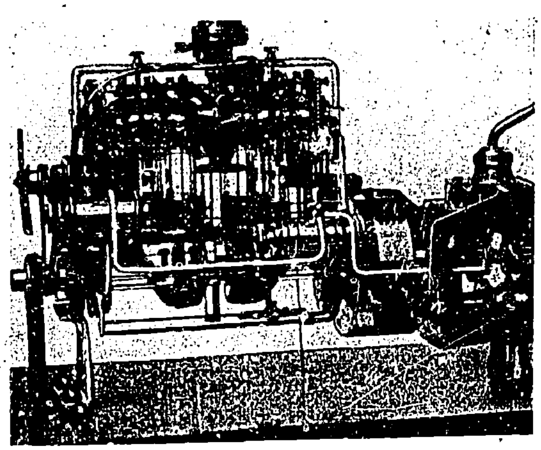


It is imperative that cutaway models as in the illustrated complete auto chassis or plastic engine models be made available for constant reference of a simple mechanical system to a more complex system. The whole system illustrates the complex interrelationships of technologies and mechanical systems. It is recommended in the mechanical technology area as in the other technology areas,



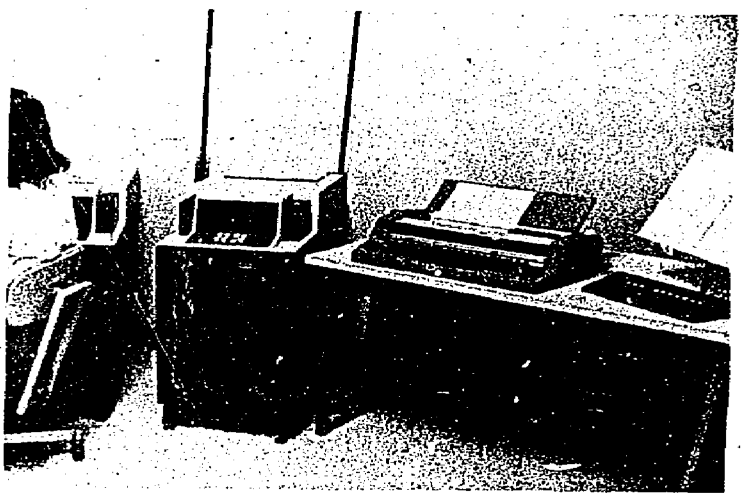
that—hands on operations or feasibility—development through experimentation be accepted as the most successful methodology—this does not mean that teaching methods described in chapter VII were ignored.





GRAPHIC COMMUNICATION

A casual observation confirms the variety of media and methods used in communicating symbols in every aspect of our society. Every institution and every facet of our society receives a profusion of messages transmitted by a number of communication methods and media. Admittedly, the offset press is very prominent but the immediate reproduction of a few copies or micro-miniaturization of large copies for storage and retrieval, enable a variety of combinations of these media to produce and store information previously undreamed of.



It is safe to state that no career pattern is immune to the thrust of the graphic communication's technology. No citizen is isolated from its impact. Therefore recognition of the various graphic communications media and their potential is a viable area of study for industrial arts. Observe the rapid and radical transformation of photography, instant copying, sound recordings, the voice typewriter, and the identification, recording and confirmation systems.

Authority

One needs only to appreciate the volume of legitimately produced and sponsored information that proliferates all aspects of our society to recognize that this is an exponentially expanding technology. It behooves the experts in reading comprehension, if man is to take these technological innovations in that aid and abet the ba communicating, that is, "the comm ideas," to recognize and utilize the

The relevance of these me communications alone has been r recent journal of psychology. T intermittent illumination on subliminal perception paint chara discernability, road signs as cor color coding, cigarette images and of smokers, and letter di profoundly effects perception and cornerstone of knowledge in our u of this technology.

ing and reading
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in combinations
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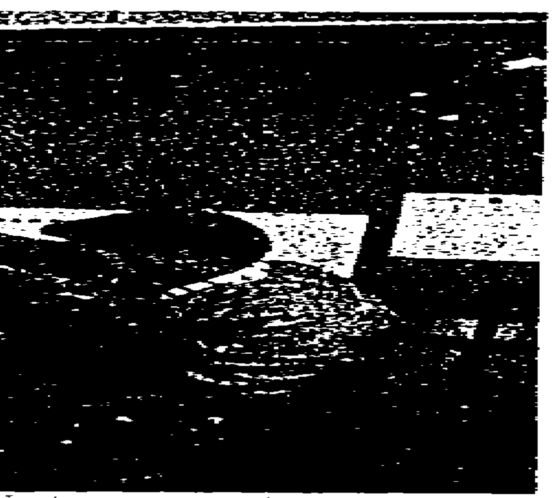
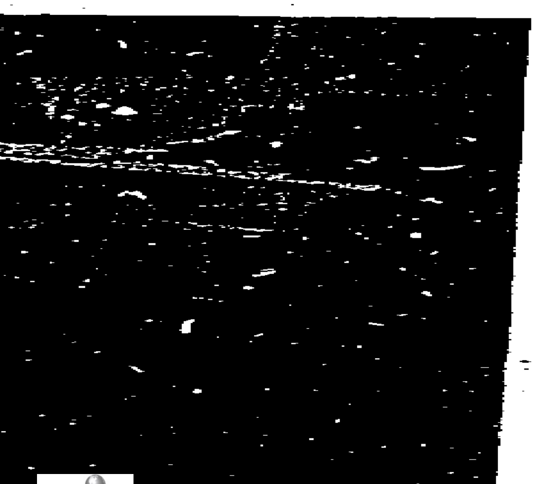
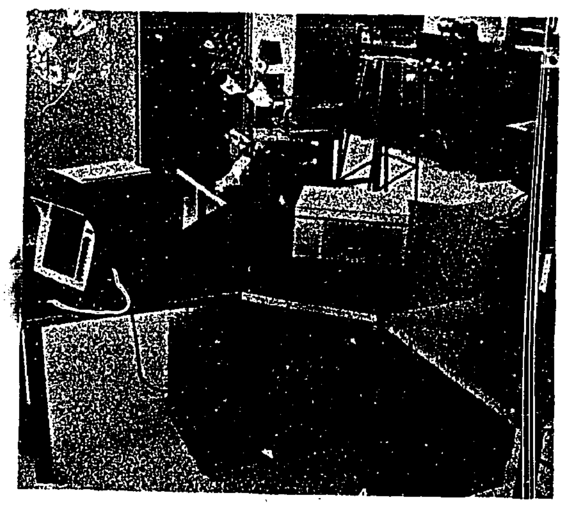


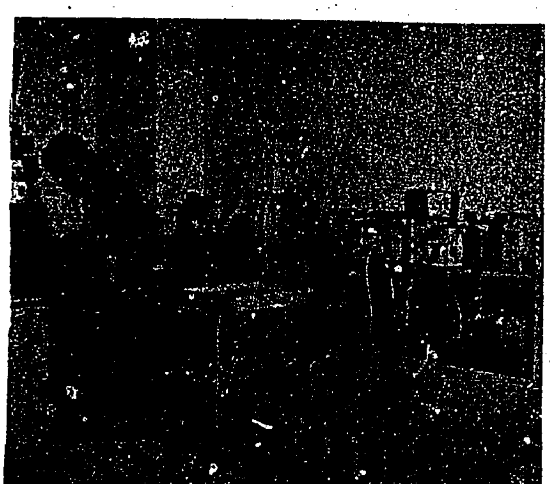


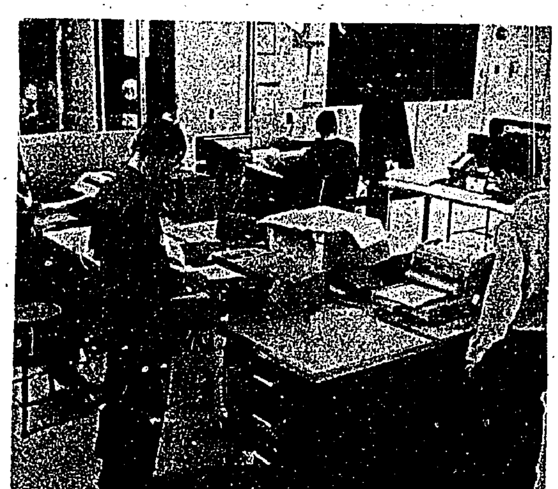
Industrial arts preoccupation with mechanical drawing and in some instances printing and very rarely photography fails to interpret adequately this dynamically expanding technology. The expanding nature of chemically sensitive pape and their solutions, the large variety of electro-sensitive developing processes in combination with the physics improvement in lens and lens combinations makes possible immediate reproductions of still or motion pictures. It is recommended that all students be exposed to a multiplicity of these graphic communications reproductive processes and media. Any good office supply house in combination with a photography supply house has a variety of equipment and supplies that will provide an adequate sampling of these media.

Decisions

Observing the matrix paradigm, it can be ascertained that a dummy copy which is used for making of the master and ultimately printed on an offset, still subscribes to the systems, units, components or general to specific format. Therefore, the subsystem or units whether it be photostatic copy, letter assemblies or glossy photographs require not only legibility but the requisite appeal to the reader. The ultimate objective of transmitting ideas and meanings emphasizes the need for understanding the systems and units of graphic communication technology to include photography, paste-ups, headliners, varitypers, and process cameras. These processes, in combination with the use of color, symbolic graphic illustrations or other







GRAPHIC COMMUNICATIONS

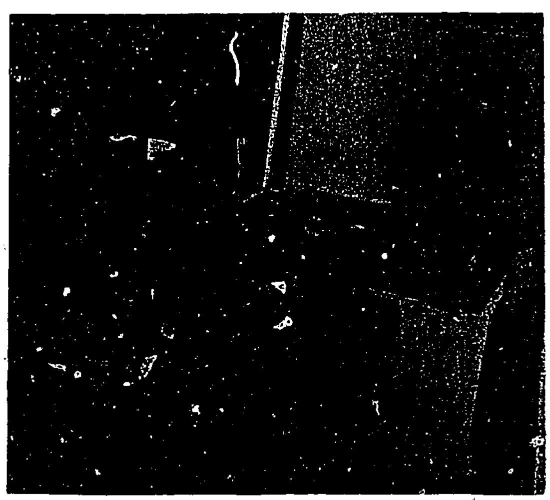
SAMPLE EXPERIMENTAL SITUATIONS	ORIENTATION	INDUCTION			
	USES OF SYS – TEMS IN SOCIETY	SYSTEMS		UNITS	
SIMPLE MECHANICAL DRAWING	SOCIETAL – HOME PERSONAL – CULTURAL INDUSTRIAL – SCHOOL	S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
SIMPLE LAYOUTS		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
USES OF CHEMICAL AND ELECTROSTATIC COPIERS		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
SIMPLE STILL PHOTOGRAPHY		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
COMPLEX MOTION PHOTOGRAPHY		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
VIDEO TAPE		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
SIMPLE DUMMY LAYOUT		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
COMPLEX DUMMY LAYOUT		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4

GRAPHIC COMMUNICATIONS MATRIX PARADIGM

commercially available prepared media can result in a one-page dummy, a four-page booklet or a sixteen-page brochure.

The ultimate obligation of the finished product is to transmit a message, acceptable to a specific range of readers and hopefully retained, for future reference whether it be an advertising flyer, a local newspaper advertisement, an instructional sheet, a government pronouncement or a scientific paper.

The addition of sound is not only an advisable adjunct as a teaching medium but is used very extensively in sales and sales promotion, news information, propaganda purposes, and explanation of complex scientific concepts. The audio medium in combination with the previously enumerated graphic reproduction processes can result in sound moving pictures as 8mm or single concept film products. The unique combinations utilizing sound and strip film as in the DuKane process



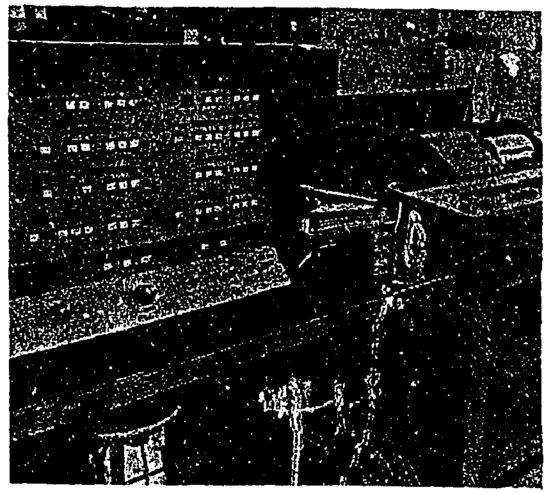
and others are appearing with greater frequency in advertising and education. Education is not confined to the formal school, but is considered a prerequisite to effective sales. To educate the consumer, to assure him that purchase of a product is within his capability to pay, use and often install is a salesman's credo using either graphic, audio or a combination of techniques.

As a reminder, the student already has had graphic arts and blueprint reading in Phase I industrial arts. He now needs exposure to the various methods, machines and combinations of equipment that result in a dummy copy. This dummy copy could employ still graphics, symbols and color for an advertising layout or a more complex dummy; script, run through, check out and equipment for a video run. The use of a holographic camera, accompanied by a typed spec sheet gives the following statement more meaning. Cybernation is more than a series of new machines and methods and more basic than any hardware. It's a way of thinking as much as it is a way of doing. The use of a holographic camera that takes a three dimensional photograph, accompanied by a spec sheet does away with the laborious drafting. Therefore, time spent on a typewriter keyboard is much more defensible.

COMPUTER TECHNOLOGY

One of the most dynamic technological impacts imposed upon our productive society in the last decade, and with projected geometrical impact on the future, are logic circuits in combinations that result in computer devices previously unheard of. As a technology, computers are no innovation. A mechanical computer was devised in the latter part of the nineteenth century to record tides. Neither are computer functions confined to electronic impulses. They also take the form of fluidics, a rapidly developing method of creating logic circuits in combinations with other technologies.

The impact of the computer technology upon our society can be an asset or it can be devastating. It will be a harbinger of



contributory developments towards improvement of society or result in a hoard of slaves to the computer technology. Note the often repeated admonition on a bill—do not fold, spindle, staple. This simple instruction indicates the demands this technology imposes upon its subscribers. It has further demands, many productive institutions have resisted the logical reasoning before the introduction of computerized data collection and retrieval system. With the introduction of computerized information storage and retrieval systems and its demanding organization and compilation to make use of the machine's capabilities has upgraded managerial, administrative, and accurate information transmission practices previously considered impossible and with a rapidity beyond the human capability. Computers therefore cannot be observed in only a negative aspect. They have very positive influence upon our society. The future of the computer may well be determined in the use of social science research which will enable the treatment of human variables previously considered impossible.

Authority

The current statistical application of computers is being greatly enlarged and improved. The storage facilities and immediate retrieval of information for decision making or in fact an extension of use to actual projected and simulated decisions based on stored

information gives the con
potential. The decreasing co
these complex devices and
has enabled the introductio
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impossible to copy wi
multiplicity of accounts
banking institutions, en
forecasting, expedite space
plan military strategies. Re
rely heavily on the use c
technology. As all new techn
abused. So much so that s
utilized as technicians an
usurping the decision maki
top administrators, managers

Computer technology
mathematics and physics. H
computer science is emerging
and anticipatory uses of mat
in the design of new logic sy
statistics, and programs to e
capability. As a new technolo
example wherein the comput
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What is significant is that a
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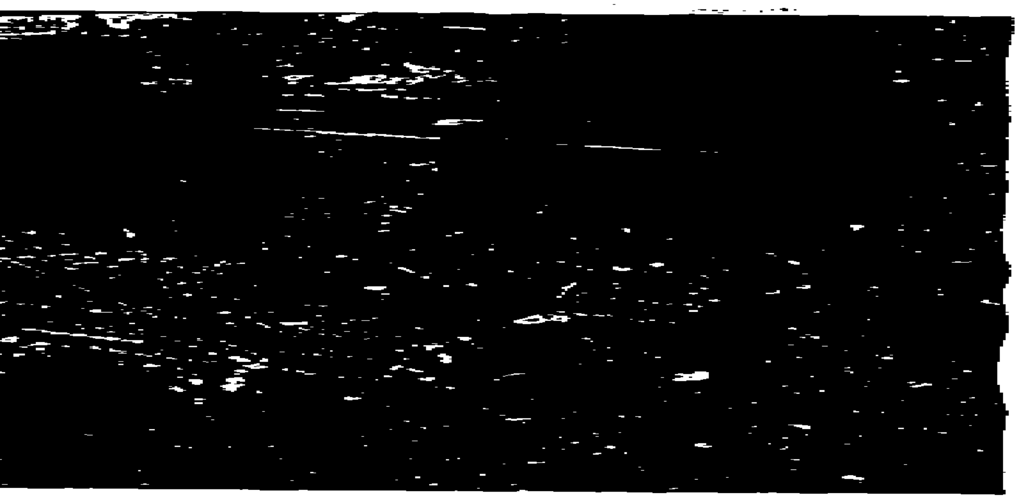

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However, a unique
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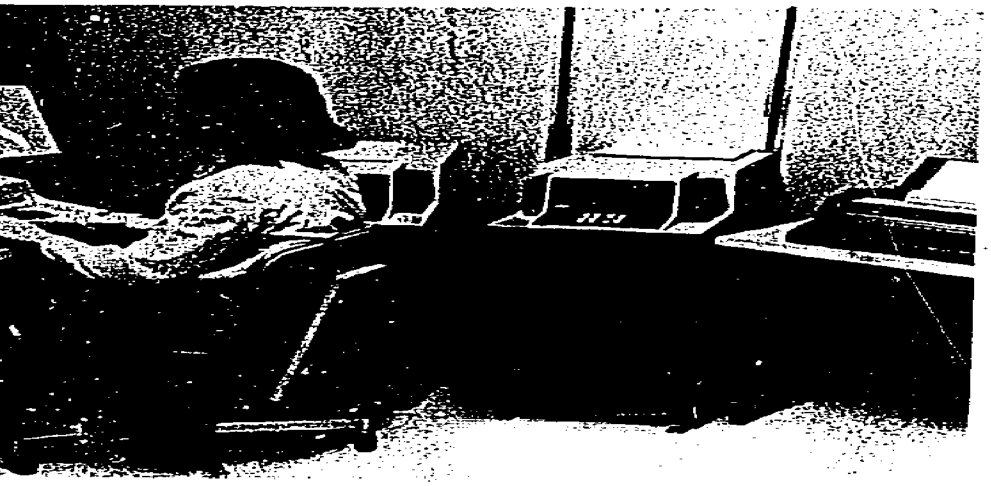
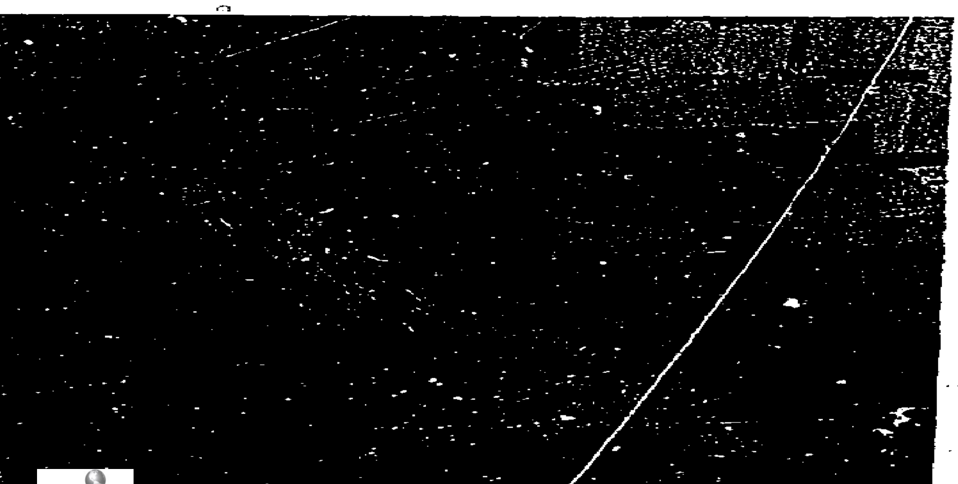


Introduction of computer technology to h and ninth grade students validated the strial arts objective that working with a nology made meaningful and therefore orced often mysterious academic subject cepts. A complete understanding of ematics was not a prerequisite to an tive utilization and appreciation of the puter technology. This is equally true of rchers that engage in tedious statistical ses which can now be assigned to the erly programmed computer.



COMPUTER TECHNOLOGY

SAMPLE EXPERIMENTAL SYSTEMS	ORIENTATION: USES OF SYSTEMS IN SOCIETY	INDUCTION: SYSTEMS		LANGUAGE		UNITS	
MINOX	SOCIETAL - HOME; PERSONAL - CULTURAL; INDUSTRIAL — SCHOOL	S_1	S_2	L_1	L_2	U_1	U_2
		S_3	S_4	L_3	L_4	U_3	U_4
ARKAY		S_1	S_2	L_1	L_2	U_1	U_2
		S_3	S_4	L_3	L_4	U_2	U_4
BITRAN 6		S_1	S_2	L_1	L_2	U_1	U_2
		S_3	S_4	L_3	L_4	U_3	U_4
P.D.P. 8		S_1	S_2	L_1	L_2	U_1	U_2
		S_3	S_4	L_3	L_4	U_3	U_4
360 TERMINAL		S_1	S_2	L_1	L_2	U_1	U_2
		S_3	S_4	L_3	L_4	U_3	U_4
C.A.D. INSTRUCTION		S_1	S_2	L_1	L_2	U_1	U_2
		S_3	S_4	L_3	L_4	U_2	U_4

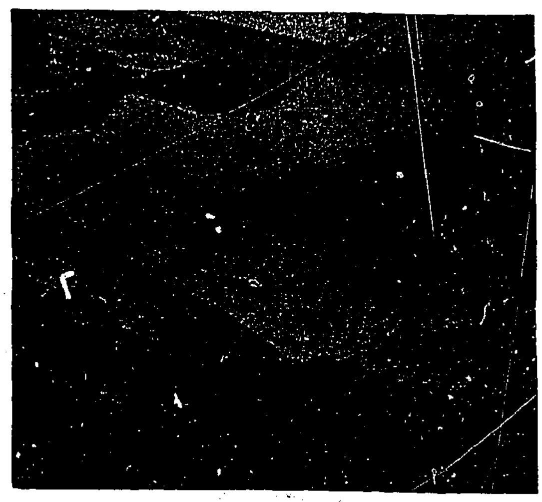
COMPUTER TECHNOLOGY MATRIX PARADIGM

One of the greatest criticisms, when this technology was recommended as a viable instructional area in industrial arts, was the cost of equipment. The expanding nature of this technology has greatly reduced the cost of equipment thus making it available at the junior high school level.

Decisions

The illustrated matrix and the accompanying photographs will help describe the design of learning activities recommended for this technology. There is a rapid development and introduction of new models and manufacturers of this type of equipment. Educators must be constantly alert to the current availability of computer models and sizes available to fulfill their requisite educational needs.

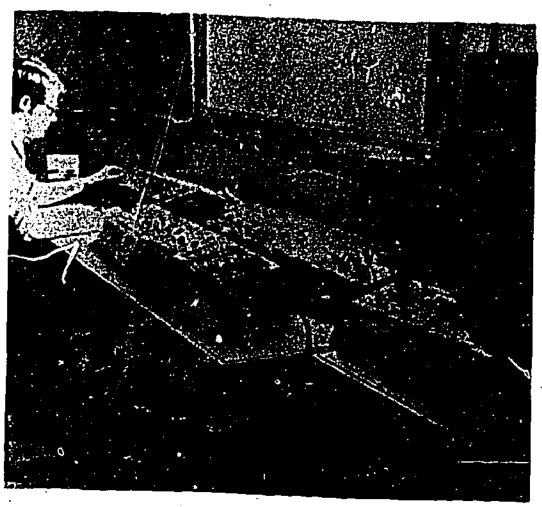
Time spent in orientation in this technology and introduction to systems usage may simplify a very complex technology. Computer language is introduced as a unit of instruction because of differences among manufacturers. Computer components and symbols may be similar but the computer language used may differ. This problem has been greatly reduced in recent years.



The object that looks like a typewriter is in reality a terminal of the IBM 360 computer located elsewhere—indicating the speed, versatility and availability of computer peripheral equipment

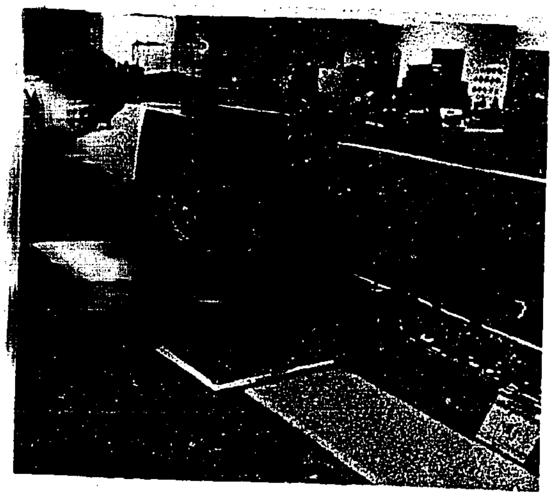
ELECTRONICS

There is an abundance of literature indicating the impact of electronics technology upon our productive society. The profusion of consumer products, manufacturing applications, impact upon communications and transportation industries and its decisive penetration of the medical profession is sufficient evidence to indicate that no one in our current cybernated society will be isolated from electronics technology. Conversely, because of its rapid developments, the time of development and application from the vacuum tube to micro-miniaturization, indicates that electronics, as it is currently taught, will eventually become one of the fastest obsoleting technician career fields.



Authority

Therefore, the impact and understanding of its applicability within our productive society becomes a more viable area of study for industrial arts than of any vocational or technical education. Admittedly, design, installation, maintenance and manufacture will continue to be the province of specially trained technicians and professional experts. However, the responsibilities of analysis, diagnosis and application of remedies are being designed into the product so that indicator lights alert semi-skilled installers when to replace a completely sealed black box unit. This technological change eliminates the laborious task and cost of identifying components, their malfunctions and ultimate repair or replacement.



The manufacture of such black boxes is increasingly being assigned to semi-skilled operatives following rigidly established standards proscribed by the professional designer. Despite the fact that electronics is introduced in industrial arts, the antiquated system of first introducing Kirchoff's law and other mysterious physical and mathematical formulae become meaningless except to the designer and the analyst.

Decisions

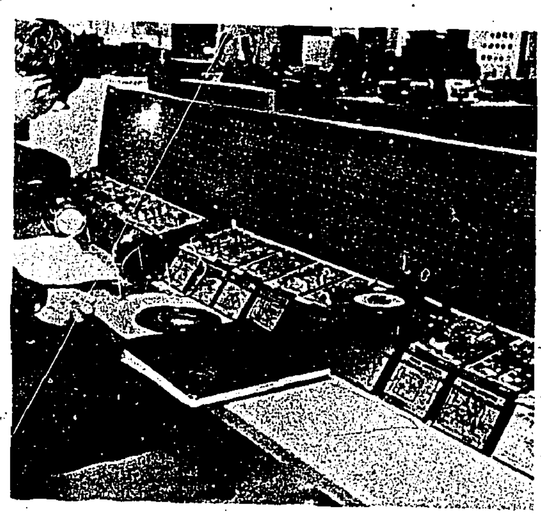
The electronics technology lends itself very readily to the often repeated methodology of teaching from the general to the specific, from systems to principles. Let us review the objectives of industrial arts. If we are to reinforce academic disciplines, interpret and provide exploratory experiences representative of productive society, then it is not educationally significant that industrial arts students become extensively involved in wiring and designing of electronic circuitry. Instead they should become more involved in understanding and recognizing the various electronic systems so prevalent in our productive society.

ELECTRONICS TECHNOLOGY

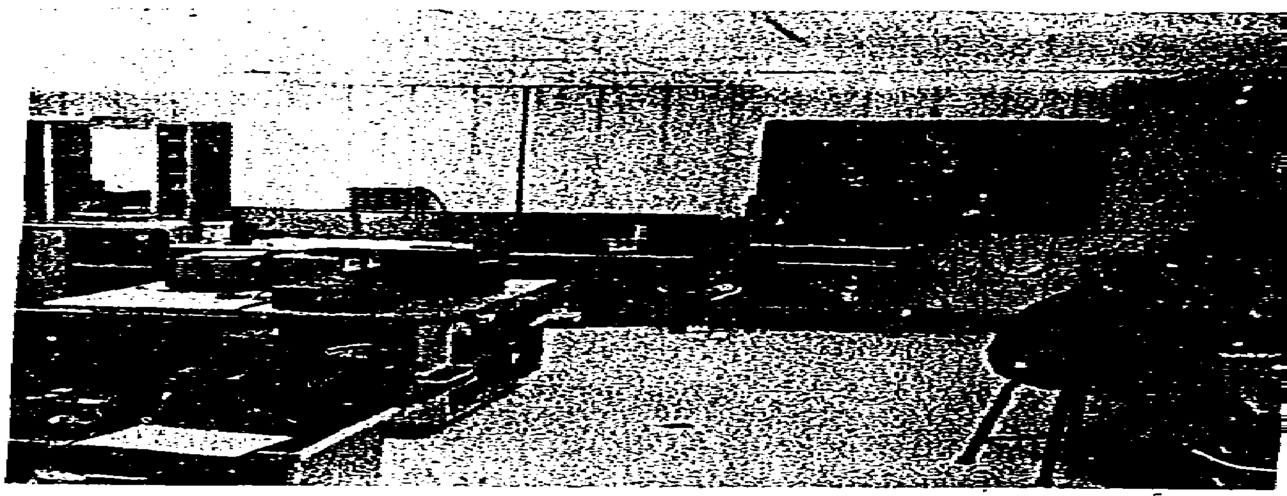
SAMPLE EXPERIMENTAL SITUATIONS	ORIENTATION	INDUCTION			
	USES OF SYSTEMS IN SOCIETY	SYSTEMS		UNITS	
PHONOGRAPH	SOCIETAL - HOME PERSONAL - CULTURAL INDUSTRIAL - SCHOOL	S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
RADIO RECEIVER		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
RADIO TRANSMISSION		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
TRANSISTORIZED SYSTEMS		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
TELEVISION TRANSMITTER		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4

ELECTRONICS TECHNOLOGY MATRIX PARADIGM

It is therefore recommended that if the industrial arts objectives previously stated are to be accomplished and if the previous challenge that educational institutions must reach the remaining 80% of the school population and not just the elite, then electronic technology is used as a medium to meet the objectives and the challenge. A study of the matrix paradigm will reveal that the students are exposed to the most common electronic systems available in most households. As in all previously enumerated technologies an identification of the role of the electronics systems within our society is required. The identification of units that compose the enumerated electronic systems—their function and interrelationship in other systems is of greater educational import than the ability to



anlayze and diagnose a particular malfunctio
This becomes the prime responsibility of th
vocationally trained student and should be onl
a "by-product" of industrial arts. What
becoming more important, and likely to b
more defensible educationally, will be th
source of energy for electronics such as sola
nuclear and chemical.

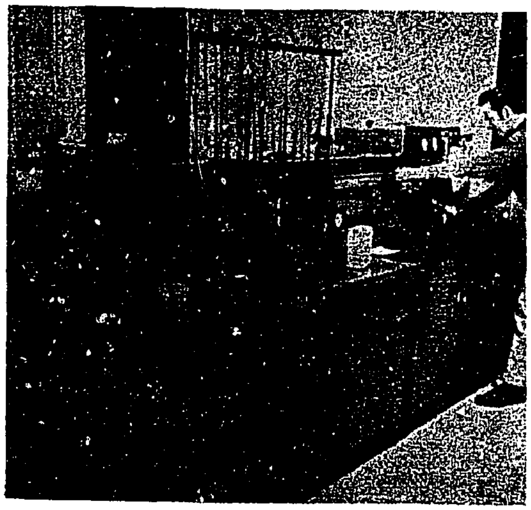


POWER TRANSMISSION

Admittedly, power is transmitted mechanically, electrically or electro-mechanically. However, hydraulics and pneumatics individually and in combinations with some of the previously enumerated technologies is one of the fastest developing technologies. Historically hydraulic technology is one of the oldest but because of the new machining methods chemical developments of fluids and the unique characteristics of pneumatic and hydraulic accuracy of function, this technology deserves to be singled out as worthy of study in industrial arts. It not only satisfies the previously enumerated objectives of industrial arts but is also very representative of prominent technologies within our productive society. Observe the very rapid introduction of hydrofoil vehicles and the potential uses of pneumatic and hydraulic transportation at rapid speeds, horizontally or vertically, and the application of these systems to very high altitudes—supersonic and outer space applications. Whether they be weapons or vehicles, hydraulic and pneumatic power transmission systems are required and capable of absorbing shocks, functioning to a finite degree impossible to be obtained by other transmission systems.

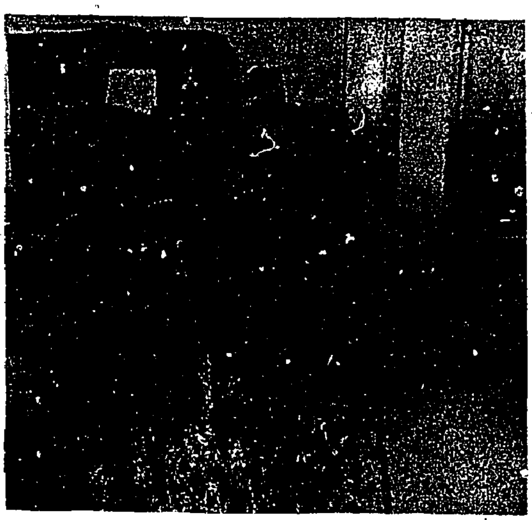
Authority

The forecast that automobiles will be capable of travelling at speeds of one hundred miles an hour, or more, without wheels, make a ninety degree turn safely and without discomfort to the passengers and stop on a dime is not a figment of the imagination nor a drawingboard projection. It is in prototype and is rapidly developing.



Observe the rapid impact of landing characteristics of a supersonic jet on its hydraulic operated landing gear or the equal impact of a hydraulic ramp in the step formation of steel products or pressed steel configurations. All possible with hydraulic technology.

Primitive applications of this technology are in evidence in the home and more sophisticated applications are currently introduced in the newly designed office buildings and other commercial applications. As with other technologies, the approach to understanding the unique characteristics of hydraulic systems and their applications is studied from the general to the specific.



The above picture illustrates such a system where a manually performed drilling operation is now completely controlled and performed with the application of hydraulics. Admittedly this system is a simplified application. However, the same type of application is in evidence in every process and product manufacturing institution within our productive society.

Decisions

To further expedite the study and understanding of the various applications of the power transmission systems and the functions of the units, a pre-assembled test is provided. This expedites the learning process without the need to continually engage in the disassembly of the various systems, pumps, valves, pistons and their ultimate function.

POWER TRANSMISSION TECHNOLOGY

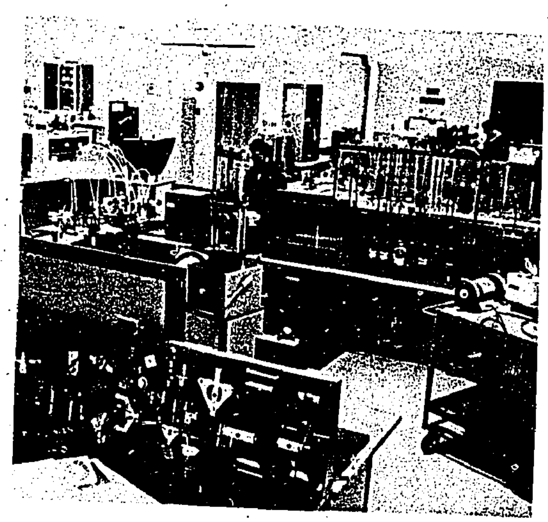
SAMPLE EXPERIMENTAL SITUATIONS	ORIENTATION: USES OF SYSTEMS IN SOCIETY	INDUCTION: SYSTEMS		INDUCTION: UNITS	
SIMPLE CONTROLS	SOCIETAL - HOME; PERSONAL - CULTURAL; INDUSTRIAL - SCHOOL	S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
COMPLEX CONTROLS		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
DRILL PRESS		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
PUNCH PRESS		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4
AUTOMATIC PRESS		S_1	S_2	U_1	U_2
		S_3	S_4	U_3	U_4

POWER TRANSMISSION MATRIX PARADIGM

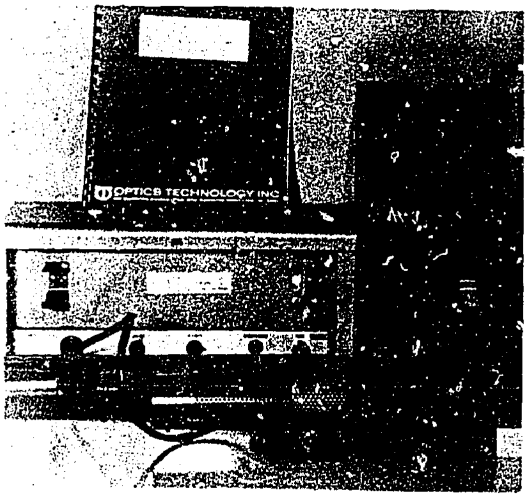
SUMMARY

The recommended practice of housing the seven technologies previously described in one laboratory is designed not only to interpret and give significance to each technology but more specifically to indicate by location, organization and learning sequence the interrelationships of these technologies.

The current practice of teaching each of these technologies in a separate laboratory or shop negates the synthesizing impact of the multiple activity organization. Unit shops or laboratories continue to reinforce the current practice of teaching sciences and other academic pursuits as so many disparate and "pigeon-holed" subjects of learning. This educational practice negates the requisite and



mandatory interpretation of the interdependence of the various sciences, technologies, and the ultimate human science-technology interrelationships as they occur in career categorizations within our productive society.



It must be emphasized that the technologies previously listed were used primarily as a medium to reinforce the other academic disciplines in a secondary school education. Secondarily, the technologies were studied so that the student would be aware of the productive roles of technologies in our cybernated society and to provide the students exploratory applications in these various technologies to aid them in their career decisions. At no time were these technologies introduced as vocational preparation. It is conceivable, because of the multi-faceted application of technologies, that this type of industrial arts learning experience is the best pre-vocational preparation. Competency in other academic areas combined with the industrial arts experiences may constitute the new career patterns of technologists and professionals.

CHAPTER V

PHASE III—MAN AND TECHNOLOGY

INTRODUCTION

THE THREE R'S IN A CYBERNATED SOCIETY

THE SOCIAL ORGANIZATION OF THE WORK AND PLANT

The Formal Organization

The Line Organization

The Staff Organization

The Communication Organization

The Functional Positions

The Informal Organization

The Formal Organization of Labor

Re-Educative Fundamentals

The Individual in Industrial Organizations

INTENTION—SCOPE AND IMPLEMENTATION OF PHASE III

Philosophy

Semi-Automated

Craft

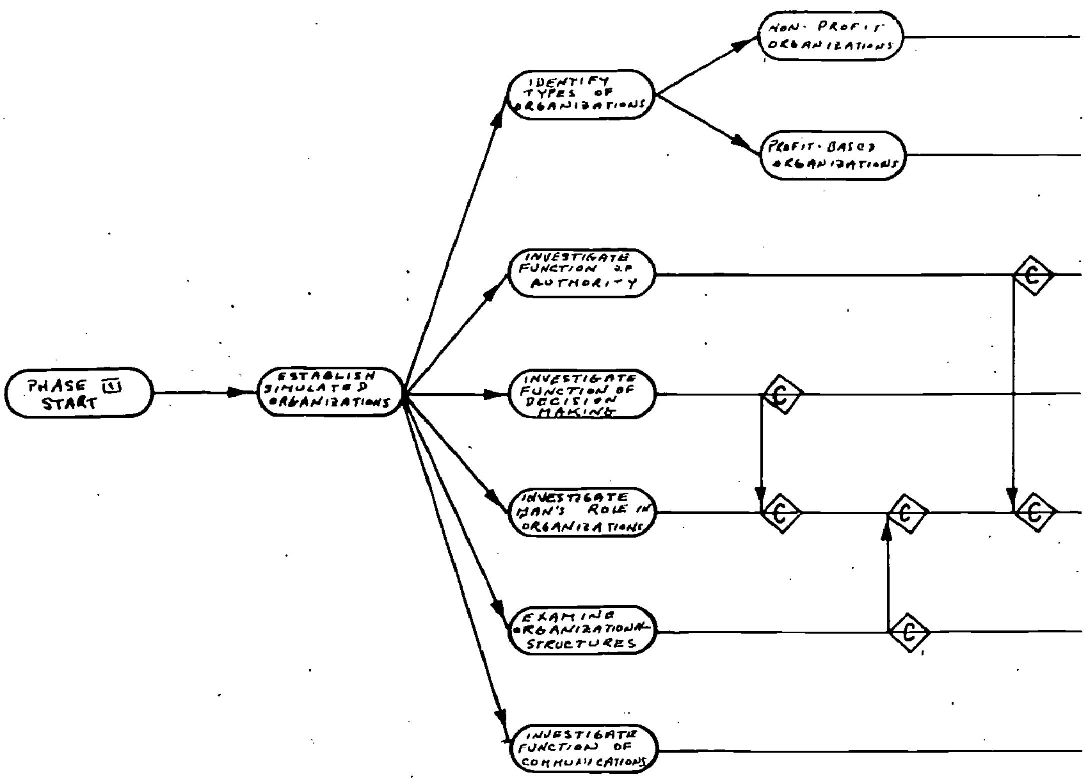
Paper Making

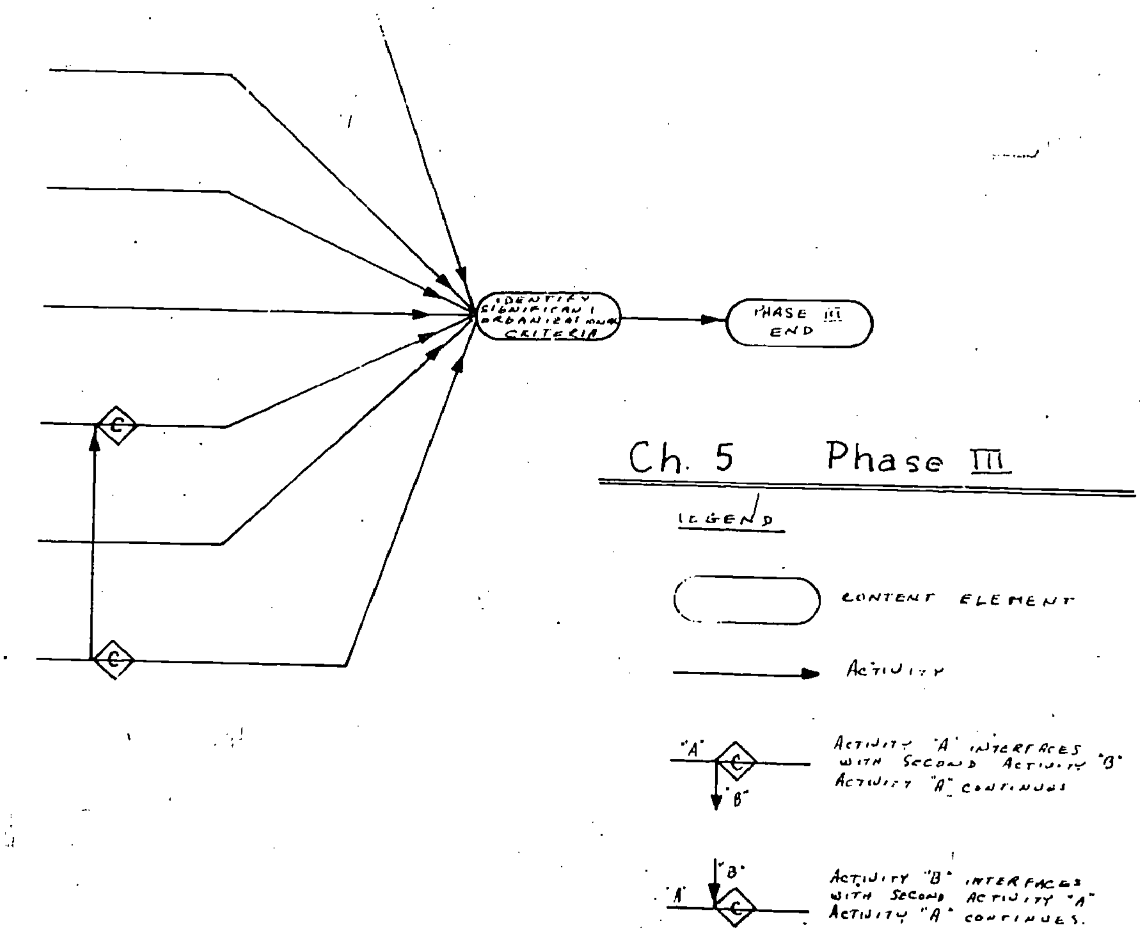
Assembly

Plastics Injection

Machining

Organizing


PHASE III START
ESTABLISH SIMULATED ORGANIZATIONS
IDENTIFY TYPES OF ORGANIZATIONS
NON-PROFIT ORGANIZATIONS
PROFIT-BASED ORGANIZATIONS
INVESTIGATE FUNCTION OF AUTHORITY
INVESTIGATE FUNCTION OF DECISION MAKING
INVESTIGATE MAN'S ROLE IN ORGANIZATIONS
EXAMINE ORGANIZATIONAL STRUCTURES
INVESTIGATE FUNCTION OF COMMUNICATIONS
C


IDENTIFY SIGNIFICANT ORGANIZATIONAL CRITERIA
PHASE III END
C
C
Ch. 5 Phase III
LEGEND
CONTENT ELEMENT
ACTIVITY
"A"
C
"B"
ACTIVITY "A" INTERFACES WITH SECOND ACTIVITY "B" ACTIVITY "A" CONTINUES
"B"
"A"
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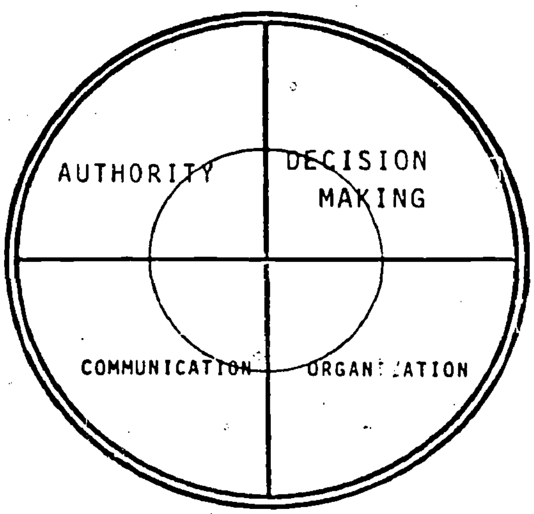
ACTIVITY "B" INTERFACES WITH SECOND ACTIVITY "A" ACTIVITY "A" CONTINUES.

CHAPTER V

PHASE III–MAN AND TECHNOLOGY

INTRODUCTION



How can anyone argue that the impact of technology upon the various institutions of our society and upon man as he functions within these institutions–regardless of career pattern–is not a legitimate area of study for the secondary school? Frequently the secondary school has neglected to confront the unique phenomenon, the impact of technological advancement upon society, almost as if the student were expected to function within a hothouse environment. Regardless of career pattern, can anyone deny that a housewife, a professional person, a semi-skilled operative or a technician, like all citizens, is functioning in a society continually affecting all modes of life? Important individual decisions and the standard of living are drastically influenced by dynamically changing technologies and the institutions employing the technologies.

Nowhere in the secondary school, in any area of study, is the high school student exposed to an intensive study of the confrontations imposed upon man as he functions within the productive institutions of our cybernated society. Some small reference is made in the social sciences. This brief reference to man's confrontations with institutions employing technology becomes an inadequate reference to a highly dynamic influence within our society. Supporting the other industrial arts phases, I and II, this phase III of industrial arts is designed, through practical exploratory experiences, to introduce the student to the various man-science-technology processes and results inherent within a productive institution.

Evidence in the literature indicates that the unique distinguishing feature of the productive institutions on the North American continent, is not the technology or its applications, is the ability of the various productive institutions to coordinate the technological and human efforts, in a successful managerial environment, where the whole effort of the enterprise is greater than the sum of its individual contributing parts. This is accomplished considering individual differences, recognizing the dignity of the individual and confronted by vested interest groups such as political, company, union, customer, and the public. This is also accomplished in a climate of accelerating competition from other companies and other countries.

While the technology in this country, in Russia, or in Australia may be constant, the ability to manage the various resources, human and technological, to produce a product or service of a high quality and at a competitive cost is the unique phenomenon worthy of study for secondary school students. This phenomenon is not only inherent in manufacturing institutions, but is also evident in banking, transportation, communcations, insurance, military, political, the professions, and every organization employing man and technology to produce goods or services. An indictment is levied against industrial arts' pre-occupation with mass production projects as a viable learning activity. Industrial arts educators have attempted to interpret industry. The failure to recognize the full impact of line and staff functions upon the productive enterprise, the technology and its people, the various levels of management, and the impact upon the quality and cost of the product and ultimate consumer acceptance or rejection is as indefensible as some industrial arts educators professing to transmit these unique phenomenon through vicarious learning experiences. Either these educators do not understand industry and the broader aspect of productive society, or they fail to confront the real challenge of secondary education which is the necessity to develop the student's full potential.

An attempt to interpret North American industry without heavy emphasis upon the man-science-technology phenomenon and instead emphasize processes, materials and infrequently technologies, fails to recognize that the value structure of the North American manager and worker is radically different from that of any other culture.

Evidence indicates that the increasing advantage obtained by many of the successfully competing countries in this world, cannot be attributed to their outstanding technological differentiation. However, success can be assigned to the unique sensitivity that the managers within these rapidly advancing industrial countries possess of their culture. Recognizing the value structure inherent within that culture and organizing the human participants in an acceptable combination with technology to produce a quality product or service at a lower cost, has been the successful manager's ultimate model.

Academicians and purists have condemned universities for engaging in the preparation of professional management personnel. I believe this indictment is more applicable to the professional educators. It must be recognized that managers of productive institutions are confronted by extensive competition, vested interest groups and employ all levels of personnel five days a week, fifty-two weeks out of the year. The longevity of a company is assured by their competitive position. Conversely, the educator, may fail or pass a student without real accountability for a standard of performance. The educator, too often, attributes this inability to maintain a high student performance standard or achieve student success to the individual student's inefficiency or deficiency. Educators must recognize that dynamic social-technological events are occurring within our productive institutions. Employees must be trained in much less time and with a higher degree of skill and mobility than has ever been attained by the secondary school. Employers accomplished this in the face of increasing demands from vested interest groups. As an example, current employee pressure indicates that the high seniority and most experienced personnel, who are eligible for guaranteed annual incomes up to 95% of their weekly salary, will take a layoff and insist that management employ the least experienced and the lowest seniority personnel to produce the requisite product or service at a competitive cost and quality. What educator has been asked to confront a similar challenge? What educational institution has attempted to cope with a similar problem? The current recorded performance of secondary educational institutions at an ever increasing cost without the concomitant accountability, may result in the real revolution in education.

The ability to produce professional managers and reap profitable technological results, in the face of tremendous odds, is the unique phenomenon of the productive institutions on this continent. This success is not the result of the introduction of any one staff or line function or the function of any one level of management. It is the concerted effort of all levels of personnel and all department functions, confronted by the demands of vested interest groups in a highly competitive industrial environment, that assures success.

Successful management personnel are recognized by their ability to utilize many of the scientific, technical, as well as social science evidence obtained through valid research efforts. It is this continued interest and investment in the social sciences, and sensitivity to a changing culture, that enables the productive institutions on this continent to maintain international advantage. American or Canadian "know-how" or industriousness has not characterized this movement. It has been the intensive and objective study of fundamental processes as authority communications, decision making and organization that have distinguished this effort.

THE THREE R'S IN A CYBERNATED SOCIETY

I believe that the three R's in our cybernated society that infect our educational institutions are: rigidity, regimentation and result in student resistance or resignation. In fact, the suggested three R's can be illustrated by an opening address at the 1910 Annual Meeting of the National Association of Carriage Builders:

Eighty-five percent of the horse-drawn vehicle industry of the country is untouched by the automobile. In proof of the foregoing, permit me to say that in 1906-07 and coincident with an enormous demand for automobiles, the demand for buggies reached the highest tide of its history. The demand during the present season was a capacity one.

The man who predicts the downfall of the automobile is a fool; the man who denies its great necessity and general adoption for many uses is a bigger fools; and the man who predicts the general annihilation of the horse and his vehicle is the greatest fool of all.

The implications for educators and persons responsible for the maintenance of our educational systems are obvious: in addition to simply imparting knowledge, we must be capable of seeing the future, at least to the extent that we can shape our various types of educational programs in anticipation of changes that are already underway.

The formerly enunciated three R's should be replaced by Research in—method, content, curriculum and learning theory. Reorganization of the administration will permit Resiliency and encourage student Response, Reaction and Representation of ideas. Let us observe industry's reaction to this type of challenge and assess the applicability for educators.

Sophisticated managers recognize that improved technology-automation, cybernation and other innovations give only temporary relief on the competitive market. It is recognized that employees are the most important element of a company and employees of a company are members of society first and them employees. The conflict occurs when employees are confronted with a choice of being members of a union or employees of a company. Why did this confrontation occur? Why was it permitted to occur? Successful managers the world over recognize that today's employees require recognition, not company picnics, Christmas parties nor similar offerings or managerial platitudes. Communication does not mean propaganda; decision making does not mean arbitrary directives and human relations does not mean inquiring about an employee's family, car or other personal affairs.

Effective management which recognizes labor, accepts the premise that profit is not a shameful word, that employees are better educated than ever before and are working in a technological environment that mandates extensive retraining. Effective managers assume the responsibility for providing direction for their institutions not only for today or for 1980, but for a continuing future. Everyone wants to be part of a winning team. Employers set up standards for performance for all employees and identify this standard of performance with the institutional direction. Direction permits employees to seek a sense of identity with the institution and not with any one individual on a personal basis. More important, employees wish to be held accountable for their standards of performance objectively and fairly, and not subjectively or in any discriminatory manner. Finally, when directions change and new technologies are introduced, employees wish to be informed and given the opportunity to prepare for these changes.

Current literature describing the rapid changes in our technological society, with the introduction of new technologies, new skills and new organizational patterns, presents some worthwhile observations for educators. For example, consider the organizational structure of a typical industry at the turn of the century. It was set up according to the "scientific management" rules prescribed by Frederick Taylor. This type of management, in terms of authority configuration, was the "owner-management" type. Authority was dominant and communication was downward. The kind of technologies most prevalent were craft-oriented. The most predominant ethic during this era of management was what has been called the "protestant ethic"—superiors and subordinates alike subscribed to the philosophy that it was good to work and it was sinful not to work. Furthermore, both management and labor subscribed to the "economic man" theory that the worker was contributing his labors for a return of monies and for no other personal satisfaction.

Now let us move in the continuum of time to about the 1930's. While this separation in time was not clear-cut, there were some prominent factors prevalent which make it convenient to identify typical management in the thirties as the "human relations" type of management. This was stimulated principally by the Hawthorne studies and previous studies in France, Germany, and Britain. It was the time of the great depression, sociology was beginning to move into the foreground, and the new type of management was emerging. The worker no longer looked upon the manager or the owner as the infallible leader who had all the answers. The emerging type of management was often referred to as the "professional type." The owner-manager or the son inheriting a business was rapidly disappearing. Technological changes left the craft-oriented types of operation behind as outmoded. Employees could no longer look on their own operations in terms of completed products as the crafts became subdivided into smaller occupations featuring production lines and semi-production lines. Management had to change too, with the realization that they could not just communicate orders downward but as their organizations grew in complexity they had to rely upon larger numbers of specialists within their organizations to keep the operations functional and profitable. So communications began to go upward and horizontally as well as downward. Increased authority was given to technical and scientific personnel. Along with all this, a new social ethic evolved—employees began to consider the right to disagree with management as a personal and institutional right, in contrast to the old ethic that the workers were to believe their managers and to carry out their orders implicitly.

Now let us move into the most recent type of management which has come into being with the introduction of what we call "cybernation." This term denotes the utilization of automated, mechanically-operated equipment combined with the decision making capabilities of computers. Now machines are making decisions for us, and we are beginning to wonder whether technology has advanced to where it is the tail that wags the dog. Computers are challenging and changing organizational structures and authority configurations. The work which inspectors did under the scientific and human relations type of management is now done by machines which maintain reliability control. What seems to be happening now is that the individual is being lost in the shuffle. Everthing is institutionalized. Responsibilities and problems are no longer personal, they are institutional. Authority now does not rest exclusively with management, but it rests with institutions such as the law, the union, the community and the government.

The outstanding changes in our productive institutions which have come about since the turn of the century, and which I have reviewed briefly in terms of both management and labor developments, along with the dynamic and increasing role which research and development is assuming in bringing about technological changes, makes it mandatory that educators concern themselves very seriously with decisions and educational practices compatible with the demands of a Cybernated Society.

I believe that education can change societies and does change people. Education is a central part of the whole amalgam of forces which go to make up a society. Education cannot be separated from that society nor remain aloof from it, even if it should be foolish enough to wish to do so.

There is every evidence to indicate that the majority of students are not myopic creatures by nature. They are not content to keep chipping away at monotonous little bits of knowledge, but they will reach eagerly for intellectual goals of greater promise if we give them the opportunity. The creative limitations of our era are not inherent in our youth; the fault lies in educational systems which close the shutters and batten the hatches against learning environments that might present challenges.

As we search for the answers to our questions in education, we will do well to look at some of the mistakes of the past. Perhaps the development of education has not been the success which we sometimes think it has been. One of the outstanding impediments of education has been the historical dichotomy which has separated preparation for academic careers from preparation for what we call "vocations."

There is nothing new about this type of prejudice which extolls the sciences and humanities and downgrades vocational education. We need not go far back into history to find that the sciences themselves were at first despised by the intellectually naive and hated by the superstitious who looked on science as witchcraft.

What we need to recognize in our educational systems today is that any person of average intelligence can grasp the fundamentals of the sciences and the humanities as well as he can acquire the technical skills of vocational pursuits.

Separating the two forms of education should not be tolerated, particularly in a democracy. A dichotomized educational system amounts to educational apartheid.

Let us understand that a student of engineering or of poetry is first of all a person and only after that a student. Whether he be an engineer, a poet, or a businessman, he needs not only a useful form of knowledge and skill but also a breadth of mind and a depth of character.

This spirit of human learning must permeate our schools and universities, regardless of whether they are formally called technical or liberal arts institutions; otherwise we will produce experts, businessmen, even poets, with a narrow outlook, unaware of their cultural heritage, incapable of making rational choices, and intellectually sterile. If the technical and liberal academic subjects are separated sharply in our educational institutions, if each subject remains unrelated to its wider meaning, they will remain separate in the lives of our graduates and therefore in North American culture itself. And, if the nation is to survive and remain strong, students must have an educational system that is thoroughly up-to-date. Experimenting with substitutes for intellectual learning and calling them vocational programs is not the way to bring our schools up-to-date. We must prepare for comprehensive manpower development, and this means finding ways of teaching fundamentals more thoroughly than ever before, along with finding ways to give the youngsters in our schools proper opportunities to explore the multiplicity of vocational pursuits available to them in our exploding dynamic society. For a student, democracy must include the right to choose his own career, and here the role of education and Phase III industrial arts is to help him choose wisely.

THE SOCIAL ORGANIZATION OF THE WORK PLANT

The study of the social organization of industry is frequently divided into two main categories: (1) the formal organization, and (2) the informal organization. These two categories can be isolated for purposes of analysis, but in the actual work situation, they are closely related and intertwined. They both have distinguishing characteristics relating to the efficiency of the worker, his productivity, and his social adjustment. An understanding of the informal and formal organizations or an introduction to them are of importance to the prospective employee.

The Formal Organization

The formal organization is usually illustrated by the organization chart. It is a means of depicting the series of superior-subordinate or boss-worker relationships, and resembles a rough pyramid with the mass of workers forming the base. In this chart, we do not see the individuals, but only the positions which they occupy and the way their positions fit into the various lines of authority, communication, decision making organization, and the supervisory hierarchy. A person's position in the structure determines to a large extent, his behavior and his relationships with others and even the way he thinks about his job and the organization. Many sociologists refer to the positions on the organization chart as "status positions." The president, superintendent, foremen and the operator have clearly defined duties and relationships with other workers. All of these prescribed positions and relations, in addition to those found in the labor union, constitute the formal organization of industry.

Formal organization is generally considered with respect to management, although there is of course a formal organization of labor, the job classifications and the union. This topic will be dealt with later and its relationship to the productivity of the employee. The function of formal management is to coordinate the activities of all the people as effectively as possible. As organizations grow in size, so do the complexities of their formal structure. C. I. Barnard in *Functions of the Executive* observes that complex organizations grow by the process of social fission. That is, small basic or unit organizations are combined to create the large organization. Other social anthropologists have presented an interesting analogy explaining the management function in the formal organization by stating that the plant, and especially its formal organization, is like an organism composed of many cells and coordinated by a nervous system which reaches every cell. This nervous system is the executive organization reflected by the organization chart.

A study of the basic units of organizations and their relationship to each other should enable the prospective employee to better understand formal organization.

The Line Organization

The line is that part of the structure that formally denotes authority and is directly involved in producing a product or service. The line of authority is a channel through which information moves, and the larger the organization (usually a longer line), the slower the flow of information either up or down the line. The shape of the organizational pyramid should not be tall with a narrow base. In an organizational structure in which the base is broad and the height of the apex is not high, communication should flow more easily. Dubin and many others refer to the line organization as an authority structure. The authority structures of an organization have three separate dimensions. Downward flow of authority gives direction to actual operations, including the choice of purposes and goals for the operations, and their particular characteristics. Horizontal flow of authority coordinates steps in a technological division of labor. Upward flow of authority is limited to situations where protection against hazards or unwarranted disclosure is necessary. The most successful management encourages upward communication before hazards occur.

The Staff Organization

The staff organization is that part of the structure that provides specialist or advisory functions. These are usually functions such as researching, engineering, sales and advising which are not involved directly in the main purpose of the organization, but which assist and attempt to facilitate the achievement of that purpose. Many authors explain the functions of staff personnel as personnel who increase and apply their specialized knowledge in problem areas, and to advise those personnel who make up the 'line' organization and have authority over producing goods and services.

The Communication Organization

This is that part of the structure that permits and facilitates the exchange of ideas and commands. With the increased differentiation of tasks and complexity of organizational structure system and media of communications becomes a factor of major importance. The two most common methods of communication are face-to-face conversation and written comminications. These, however, are not necessarily the most efficient and accurate. What a person does, or action, is considered the most efficient and accurate method of communicating. An important function of executives is to ensure the free flow of communications both up and down the hierarchical structure. Pigors and others state that all kinds of commands and reports flow up and down the line. These may be classified into four categories; technical, financial, inspectional and attitudinal. The first three are formally recognized by management. The last although not so recognized, is nonetheless present.

The Functional Positions

The line, staff, and communication organizations will present a brief, but adequate description of the characteristics of the formal organization's structure. Still within the scope of the formal organization and yet specifically pointed to definite functional positions within the structure, a brief explanation of general position orientations is necessary.

a. The foreman--is generally considered the first level of management. Some foremen can accurately be termed management, whereas others, because they identify with workers rather than management, experience a conflict in their roles. This first-line supervisor, because of his frequent contact with the workers, plans and directs the work of the group for which he has been made responsible and realistically represents the company to the worker. This planning and directing is specific of certain tasks that higher management personnel have instructed him to perform. It is through the foreman that the demands and orders moving down the line are transmitted directly to the work group.

b. The general foreman—is management minded. He is still "visible" to the workers, but depends upon the foreman for information rather than the workers themselves. He is able to voice his opinions and by so doing, influence the decision making of management.

c. The superintendent—is removed from the shop. He is an "invisible" authority. His function is that of planning and coordinating, and his focus is downward on the job; he is busy interpreting the actual production process to his superiors.

d. The manager—is oriented to the future. The main function of this position is top-level management in policy decisions.

e. The president—is constantly concerned with the position of the company in the entire industrial and economic system and with coordinating its activities so that it will successfully meet competition.

The Informal Organization

Man is a gregarious animal, and as such finds it necessary to associate with others, to communicate with them, and to be accepted by them. The consequences of informal personal association, because they relate directly to worker productivity, are of major importance to industrial organizations. Current industry has been unable to locate the 'economic man.' Experiments in the 'human relations management' era determined that more was involved in increasing output than salary increases and improved physical conditions of the workers. Many authorities state the conclusions of the researchers in studies by Mayo and his associates that the researchers came to the conclusion that output shot up in both groups because in both groups the worker's participation had been solicited, and this involvement, clearly, was more important than physical prerequisites. The workers were a social system. the system was informal but it was what really determined the worker's attitudes toward his job.

One of the most important single factors in detemrining output is the emotional attitude of the worker towards his work and his associates. This attitude is a direct result of the employee's personality and work environment. There is need for a person to be more than the mere incumbent of a position in a hierarchical structure—he must be able to identify himself with the direction of the organization. The origin of informal relations at work lies in the demands of the human personality for free interaction with other people. Others define informal organization as a network of personal and social relations which are not defined or prescribed by the formal organization. Why are these informal groups formed and how do they relate to productivity? In other words, what is the function of the informal organization; why is it?

One of the main functions of the informal work organization is to maintain whatever its members have found satisfying In new and expanding industrial organizations, this function is difficult to achieve. Many large and expanding organizations are, in fact, composed of many sub-culture groups, and conflicts frequently arise.

MAINTENANCE OF A COMMUNICATION SYSTEM

This functions to convey any information of interest to the informal members. It is the channel which functions to make and maintain the atmosphere or climate in the work plant and frequently referred to as the "grapevine."

Wherever informal organization exists, everyone feels some constraint on his freedom of action. Since informal organization extends from the bottom to the top of the structure, it follows that everyone's behavior is somewhat informally controlled. This does not mean that there is one continuous informal organization from the top to the bottom of the structure, but rather that informal organization is made up of many small though inter-connected groups. operating within a formal structure. Therefore, from the point of view of the small individual groups, social control is exerted inwardly toward its own members, and outwardly toward other informal groups and toward the formal organization.

The informal social work organization can provide interest and fun in life. In certain instances, particularly in small, static communities, the social life of informal grouping gives people their only social satisfactions. This function of informal organization is rapidly decreasing. There appears to be evidence that a relationship exists between effective group membership and productivity. The Hawthorne plant studies are generally considered as evidence of this statement.

The Formal Organization of Labor

Thus far, the basic principles of organization as they relate directly to and from the perspectives of management have been mentioned. The worker is subjected to and restricted by the formal organization. He experiences some difficulty in having his opinions heard. To achieve this purpose he has an organization which is primarily concerned with interpreting the worker's needs to management. Many authors have described the union as the worker's own organization; it is concerned with what they think is important; the focus of attention is on the workers, not on the work. The existence of a union gives the workers a feeling of:

a. unity as a group, which makes them feel protected and courageous.

b. it has highly formalized procedures by means of which it can bring its demands (the workers' demands) directly to top management, if necessary, and thrust its point of view upon them without being delayed and blocked by intermediate supervisory levels. Communications through the union is not controlled by management.

The following is an oversimplification of the problem where the union and the formal management group vie for employee support.

Re-Educative Fundamentals

I Change way employee sees organization, his facts, concepts, beliefs and expectations.

II Modify employee value orientation

family

religion

community COMPANY?

citizenship

craft or profession

III Employee control over environment

promotion

salary

ideas SUPERVISOR OR STEWARD?

security

decisions

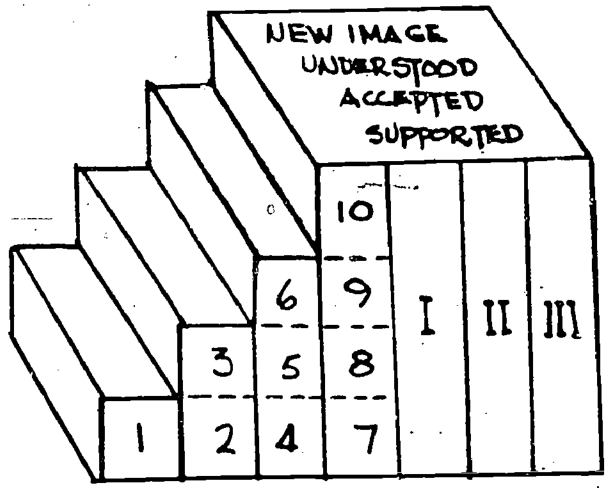
complaints

1. Acquisition of normal and abnormal attitudes alike

2. Attitude change—cultural change peculiar to your company

3. Experience alone does not change attitudes

4. Change related to individuals perception of your company



5 Information alone insufficient to alter attitudes. Information seldom received the way it was transmitted. Recipients not passive—do they understand and accept? Willing to inform more important than facts? Is information multi-standard? Top management information flow effective? How much information is the company willing or should transmit?

6. Stereotypes—wrong concepts

7. Employee sentiments more potent than knowledge

8. Change permanent if new values consistent with action

9. Acceptance only in terms of whole

10. Acceptance related to group belongingness

The Individual in Industrial Organizations

The primary function of any productive institution is to attempt to achieve the direction of the organization as efficiently as possible. The purposes of some organizations are to provide services, without profit (civil service, etc.). For other productive institutions the primary purpose is to achieve the largest profit possible; in many organizations these purposes are interdependent. There is nothing startling about these purposes for they have always been the same, and were it not for the "as efficiently as possible at a profit" portion of the definition perhaps we would not be too concerned about the study of the individual in the organization and his relationship to the achievement of purposes of the institution. Does the individual, in fact, have a relationship to the efficiency and productivity of the institution?

The basic question, simple though it may seem, is not a comparatively recent one. The time and motion studies of the Bethlehem Steel Company by F. W. Taylor was one of the first attempts to increase industrial efficiency by studying the worker. The work of Taylor and his associates did increase the industrial efficiency of workers, but it also revealed to subsequent researchers that human beings are not machines. Attempts to refine Taylor's "efficiency expert approach" finally led to the realization that the worker is a human being who is also a member of a team.

J. A. C. Brown in *Social Psychology of Industry* observes that the emphasis in industrial psychology has shifted from studies of the isolated individual and the physical environment to the consideration of motivation and morale. It is now clear that the most important single factor in determining output is the emotional attitude of the worker towards his work and his workmates.

The importance of considering the individual as a member of a group is illustrated by the experiments in the Hawthorne Works of the Western Electric Company in Chicago between 1924 and 1927. Elton Mayo expressed this concept by stating that in industry and in other human situations the administrator is dealing with well-knit human groups and not with a horde of individuals . . . . Man's desire to be continuously associated in work with his fellows is a strong, if not the strongest, human characteristic.

In their book on Human Relations in Industry, Gardner and Moore have studied the recurring characteristics of industry and then summarized their findings by stating what they consider to be important to the complete understanding of industrial activity.

1. The place of work is a place of action with a purpose. Newcomers must learn what all these activities (people and machines) mean and how they will affect him.

2. Different people do different things, there is a division of labor, and all the variety of things accomplished are the separate parts of getting the job done.

3. The interaction between people is an essential factor in almost all work situations—some form of contact or communication.

All these activities tell us is that the place of work contains two things: one is a set of activities, materials, machines, and processes needed for getting the job done; and the other is the sets of activities and relationships by means of which people work together and which make up the human aspect of getting the work done.

The components of industrial organization which appear in the remainder of this chapter, and which would be the content of Phase III, deal with the activities and relationships which make up the human aspect of getting the work done. It seems appropriate to state that an awareness and understanding of these components by students, prior to their entry into the cybernated society, will better enable them to adjust to their work situations, to respect the rights and responsibilities of others in the work organization, and assist them in becoming more productive employees. These components will provide the students with an opportunity to study group behavior, status positions, and the roles that individuals play in groups. It will also confront them with the inevitable authority and limitations of materials, machines and technology. It will expose students to this total human-technology conflict in a number of surrogate experiences in craft, assembly process, and service type productive institutions.

Some of the general principles of the social organization in industry have been identified. Briefly in review, these principles would provide students with an introduction to: the complexity of organizational structure; the purpose of organizations and the relationship of the employee to the direction; the importance of the worker as a member of a group, both in the formal functional group and informal group; the division of labor; the formal and informal lines of communication and the importance of freely flowing communication; the positions of authority and the relationship of personnel in advisory positions; the function of unions and their significance or insignificance to the worker and management.

Perhaps the most significant omissions involve an understanding of motivation and morale, and leadership. The relationship of morale to productivity can be illustrated in conjunction with the relationship of the worker to the direction of the organization. Ineffective and effective leadership will be illustrated as the students move from one type of simulated laboratory experience to another, each time appointing different leaders and evaluating the techniques used by them.

It is realized that the simulated productive activity will be a surrogate learning experience for the students. It is highly unlikely that the social organization that actually exists in a cybernated society can ever be completely portrayed in a school situation. It is hoped that through experience with this activity and constant evaluation of it, an accurate reflection of the actual situation can be achieved, resulting in increased understanding by the students of the world of work as a craftsman, technician, para professional or professional.

INTENTION—SCOPE AND IMPLEMENTATION OF PHASE III

Among general education subjects, industrial arts has the unique responsibility and purpose of interpreting the productive society to boys, girls, and adults. Any widely accepted list of objectives in the field of industrial arts contains statements pertaining to the development of an appreciation and/or an understanding of industry.

However, when the content of industrial arts is critically examined, it is frequently shown to include little more than artifacts of past generations and civilizations. The content of industrial arts comes, for the most part, from the apprenticeable trades and does not often represent modern productive society practices in these areas. By being primarily concerned with the development of manipulative skills, which are in limited use in contemporary industry, industrial arts fails to reflect the productive society aspects of our world as accurately as it might.

Increased specialization, demands of cybernation of automation and changes in technological processes and materials mandate that industrial arts educators be cognizant of the advancements of productive society if they are to fulfill their responsibilities to the students which they are preparing for the dynamic productive society. Keeping abreast with, forecasting, and interpreting the technical knowledge and skills of a changing productive society constitutes one area of major concern to industrial arts, vocational and technical educators. There is, however, an additional area of vital importance with which the industrial arts educator must be concerned if he is to fulfill the obligations of interpreting the world of work to his students.

An educational experience must be provided that exposes students to the many technological demands imposed upon organizations and their members as they function to fulfill the purpose of the organization. An educational program which professes to interpret the world of work through the acquisition of specific skills and technical knowledge and which neglects the man—man and man—technology conflict in our productive society, does not portray a complete picture of work in cybernated society. Such a program tends to relegate the student to a sort of machine, doing this or that specific set of operations. In competition with machines, the student will lose the race.

An employee does more than manipulate instruments, tools and machines; he has feelings and aspirations. He is not alone in the world of work; he is constantly interacting with others, being affected by their relationships to him. The human or social aspects of productive society directly affects the efficiency of the employee, and for this reason must constitute an integral part of an educational program which prepares students to cope with a cybernated society.

The purpose of this chapter has been implied in the introduction. It needs now to be stated definitely. The purpose is related to the objectives in the following:

1) The main objective (of Phase III) is to familiarize the student with the various impinging forces encountered in producing a product or service, and the impact of these forces upon the quality and price as it reaches the consumer.

2) The students may appreciate the influences of an organization that was evoked by technological demands in providing a product or service. The activity is an integrative factor in again focusing on the interrelated technologies evidenced in our productive society.

Prior to enrolment in Phase III in grade ten (see Chapter II), the students will have been introduced to tools, machines and materials in a multiple activity environment at the grade seven level. This environment (Phase I) includes plastics, materials testing, graphic arts, woods, metals, and ceramics. Phase II at the grade eight and nine levels, introduces students to the various technologies prevalent in our productive society and the interdependence of these technologies.

Specifically, this industrial arts Phase III includes a number of surrogate productive society activities which incorporate the basic social and human principles of productive institutions in a meaningful laboratory experience.

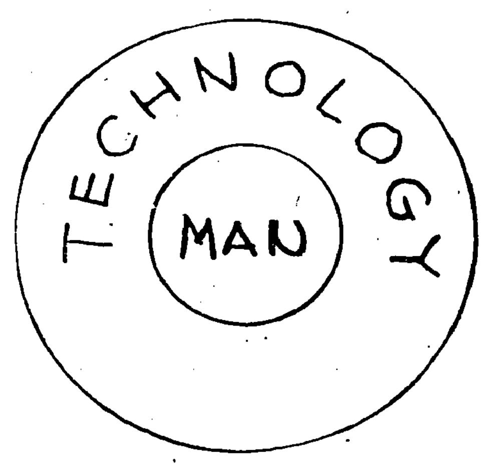
The task of isolating the basic social principles of productive institutions is a monumental one, and no one person has either the knowledge or experience to perform this task perfectly. There is a trend, however, in curriculum development, to determine the basic structure of subject areas. This attempt to identify the basic structure of man—man and man—technology confrontations in our productive society must not be considered as final but rather as initial and exploratory, to be modified and revised through research and experimental practice.

An employee's productivity and efficiency are influenced by factors external to his specific work environment, such as family pressures, condition of health ethnic background, race, and religion, but Phase III in this industrial arts curriculum proposal will be concerned only with those factors which may be classified as internal to the employee's specific environment; that is, those factors which directly influence the productivity of the employee while he is at work. In practice, Phase III will involve at least three or four such simulated activities evidenced in our productive society.

Philosophy

Phase III serves as the synthesizing portion of the total industrial arts program, introducing man as an aspect of study to those aspects of the productive society already covered in Phase I and II (materials and technologies). It demonstrates the interrelationships that exist between man and technology with a view to questioning the wisdom of that role.

This interrelationship may best be expressed by the following diagram:



The implication of this diagram (that technology serves man) is open to question and the names may be reversed in a perhaps equally justifiable interpretation (man is the servant of technology). This reverse view can easily be appreciated by any car owner if he should ever add up the amount of time he spends thinking about his car, or if he should ever consider the degree of emotion evoked when he gets a dented fender, or spends a Sunday washing and waxing his car.

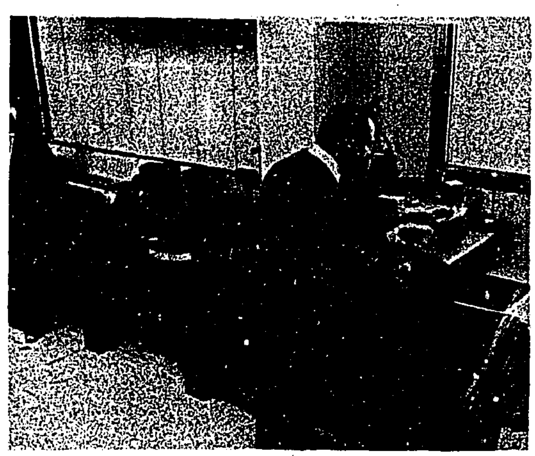
In spite of all the scientific and technical advances made in this world, it is still man who must make them work and, conversely, who is often responsible for their failure to work. A study of the productive society, that fails to include the roles of man as worker, manager, producer, and consumer omits the essence of the productive society and leaves a gap that makes it difficult to understand how the productive society has achieved its present state of development.

Phase III achieves its aim of understanding the role of man vs. technology by simulating a number of companies in a laboratory environment. The students establish a company, produce a product, or service, and study the interactions that occur during the process. It is in the study of these interactions that Phase III is most unique, for where production simulations in other programs have stressed the economic or technical factors in production, Phase III emphasizes the human element in the performance process. For this reason troubled production, a liability in the usual industrial arts production simulation course, is an asset (in fact a necessity) in the Phase III laboratory.

Productive society must be observed as men manipulate men, money, and materials by various methods to produce a product or service for a profit. It is the aim of the Phase III course to study these interrelationships, especially those concerning man, with the view of questioning them.

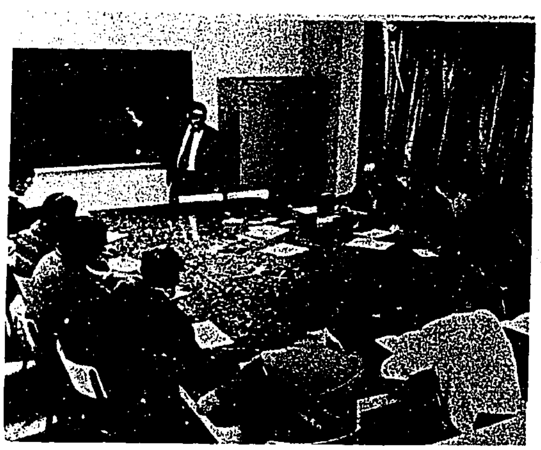
One modern condition of great moment is the harnessing of our already huge technology that expands at an accelerating pace. (Note the Holographic camera in the photo) Modern man is clearly in a second scientific revolution. The

first revolution centered on the steam engine and the spinning machine, and put machines in place of muscle. The second scientific revolution (occuring in the last forty years and especially since 1945), centeres on atomic energy, automation, computers, cybernation, lazer beams, chemical materials and bio-chemistry. It greatly magnifies technically produced energy, changes processing methods, alters the materials on which men and machines work and often substitutes machines for human thought and control as evidenced by the two automated machines pictured here. Although we have been sliding into a technological age on

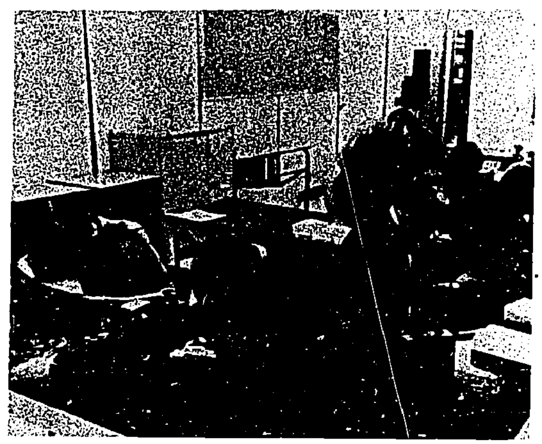


the basis of accumulated techniques produced by the first revolution, we are now in for technology with a vengeance.

By observing the pert chart preceding this chapter, it will be observed that the industrial arts Phase III activities are centered about the productive potential of man, materials and technology by establishing a number of surrogate companies that are representative of our productive society. This phase can be conducted by using a laboratory specifically designed for this type of activity with an accompanying conference room. The outstanding recommended teaching methods are the conference leadership method, role playing, and case studies. This does not imply that other methods described in chapter VII are ignored. However, the Phase III activity organization has needs to be resolved and an organization to form, decisions must be made, authority delegated and the communications channels must be defined. Shown in the photo is a group in a conference session discussing an assembly activity oriented company and its problems. This has been referred to before—what is significant is that students are involved in a crafts oriented company, processes oriented company, and service oriented company which may be a unit of a vertical, horizontal or conglomerate corporate structure.



The assembling of a simple unit by all of the students (shown in the photographs) would enable them to observe the necessary operations required in the assembly process. The assessment of the prototype would illustrate the necessity for having specialists in the organization who are not directly concerned with the actual production, but who advise the production workers in improving their operational techniques, and thus increasing their efficiency.



Once the organizational structure has been established for a specific unit of production, the personnel will assume and maintain their relative positions in the structure until the product has been completed. As new units of production are decided upon, the students should be assigned to positions different from those which they previously occupied so that they will have an opportunity to participate in various positions within the structure, and thus develop a better understanding of the social components of industrial organizations.

Variables can be introduced at different stages of the production process which will block communication or have an adverse effect on group cohesiveness. Students performing the role of management would be required to keep detailed records of the production process, and when the total class meets following or during the completion of the product, the effect of these variables will be studied by the methods described.

If the school facilities are limited, then the current industrial arts Phase I or II laboratories are utilized and a classroom is used as a conference room for discussion purposes. By a study of the pert chart and the following teacher's outline, it becomes evident that students are concerned with man—man, man—materials and man—technology relationships, whether this be an assembly operation, a craft industry, a semi-automated industry or a completely cybernated process industry—the problems are similar but differ in degree.

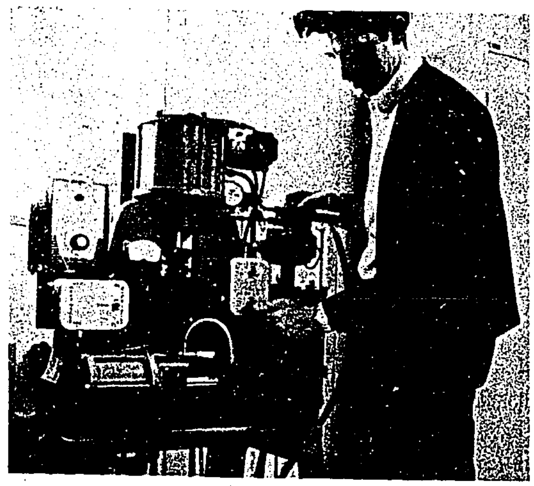
PHASE III INDUSTRIAL ARTS—A SURROGATE PRODUCTIVE INSTITUTION

GOALS

1 The student must become aware of the number of man—man forces that he encounters (regardless of status) in producing a product or service.
2. The student must become aware of the number of man—technology forces that he encounters, regardless of his position, in producing a product or service.
3. The student must understand the impact of these forces upon the quality and price of the product or service before it reaches the consumer and some solutions to improve quality or reduce price or both.
4. The student becomes aware of the different roles, decisions, authority and responsibilities inherent in an organizational hierarchy.

5. The student becomes aware of the significant role of a union in a productive institution and its effect upon him.

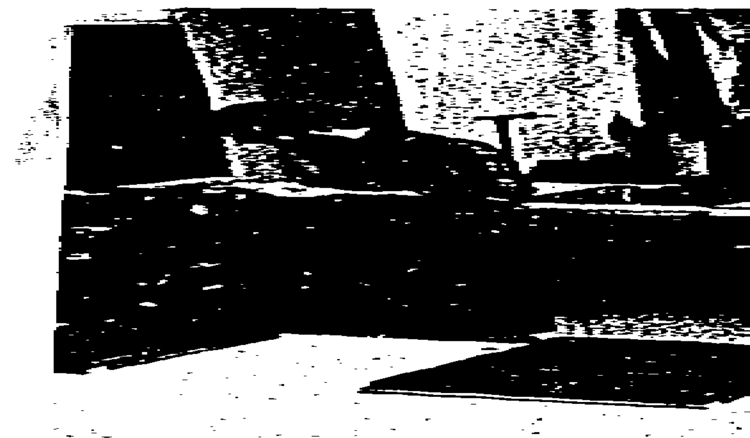
6. As the student is moved from one role to another and from one technology to another, he becomes aware of the differences in the authority of the various technologies he employes. The effect of the technology upon the organizations and communications channels and the ultimate decisions he makes that influences his colleagues, his superiors, and his subordinates. It could be the amount of noise, placement of machines, or any number of factors that influence him as is illustrated in the following photographs.



Semi-Automated

Craft

Paper Makin

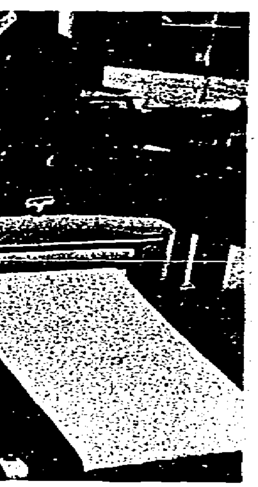


It can readi
have differing ro
surrogate product

A sample ou
operation:

Issue One

Activity
shows a model of
2. stud
organize themselv



ed that students
unction in their
1.

rrogate assembly

describes and
to be assembled.
e prototype and
pa

Information 1. Quality and quantity standards of the product.

2. Basic organizational information.

3. Definition of role playing

4. Division of labor.

5. Requisite authority, decisions, organization and communications.

Issue Two

Assessment of physical layout of laboratory for this activity and its limitations.

Activity 1. Organize flow of work

2. Identify equipment needed

3. Identify employees needed

4. Identify quality control positions

5. Identify cost control positions

(It must be remembered that no corporation has unlimited facilities or funds, therefore, a number of individual conferences or group conferences may be required to cope with problems that arise).

Information 1. Conference Method

2. Equipment, facility and funds required and available

3. Quality control practices

4. Cost control practices

5. Company policies, procedures, directives

Issue Three

Actual Production—(Assembly)

Activity 1. Line and staff interaction

2. Union makes its move

3. Safety

4. Quantity

5. Inventory at end of period

Information

and Resources

1. Whose responsible to describe job?
2. Job Instruction Training (J.I.T.)
3. Union and its role
4. Reason for safety
5. Cost of inventory and storage

Issue Four

Activity 1. Teacher conducts conference on

a. Cost of product
b. Quality of product
c. Quantity and schedule

These can be extropolated into large numbers for an eight-hour day, five-day week.

2. Discuss personnel problems
3. Discuss union problems
4. Discuss organizational problems

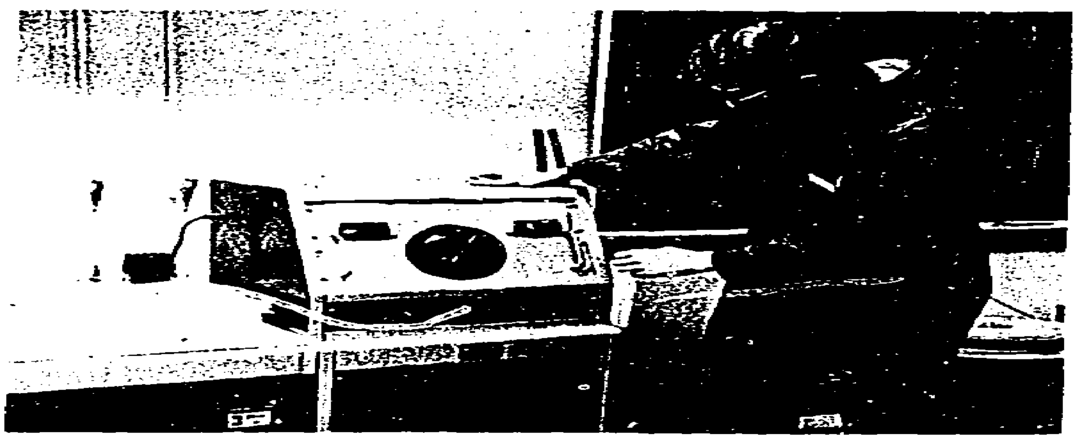
Information
and Resources

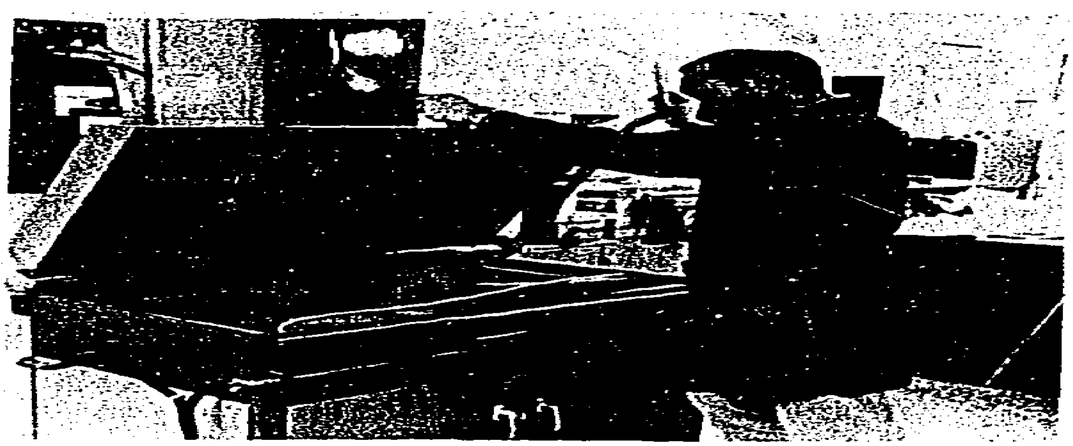
1. Cost and quality of product—how competitive?
2. Errors to avoid—human, processes, technological
3. Group conflicts
4. Communication systems
5. Decision making paradigms
6. Authority—usurped or abdicated
7. Organizational patterns available

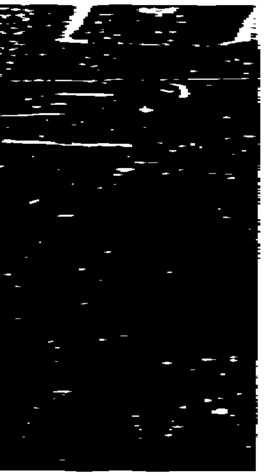
All students in a Phase III industrial arts class may not be required in the assembly operation. Therefore, two or even three surrogate productive institutions may be functioning simultaneously. A specific laboratory is recommended for this phase of industrial arts rather than the use of Phase or II laboratories. Efficiency and learning effectiveness can be achieved if the industrial arts teacher works with a PERT network and schedules optimum equipment and laboratory utilization. All the problems inherent in organization and producing are subjected to a conference session for all students. It may not be a neat administrative package but results in an outstanding learning environment. Remember, we are not attempting to exemplify a problem proof productive process or service—there is no such example.

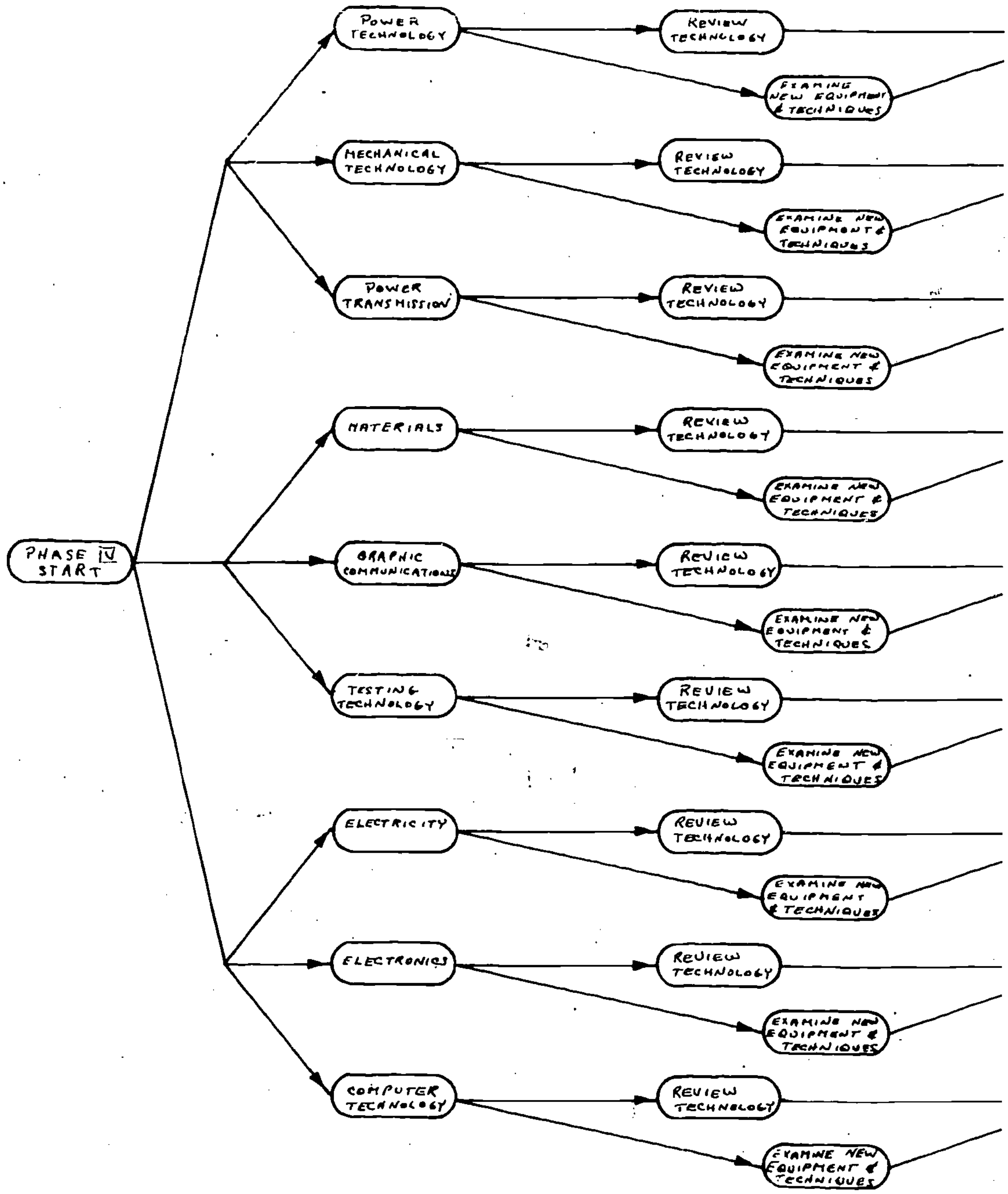
No teacher, no student, no administrator should assume that Phase III industrial arts must have the pre-requisite of Phases I and II. It is recommended for students who are still questioning their career decisions. However, all boys, girls and adults in senior high schools or universities whose career decisions will expose them to our productive society can benefit from Phase III industrial arts without the need for a pre-requisite, other than it should not be introduced before the senior high school level.

Instead of calling this phase Man and Technology, it may be more appropriate to call it Man—Science—Technology—or the pseudonym Manscietech because all are used in the Phase III surrogate experiences. This phase III laboratory experience has been equally beneficial to orientation programs of technicians and professionals, rehabilitation programs and training of hard core unemployed adults.

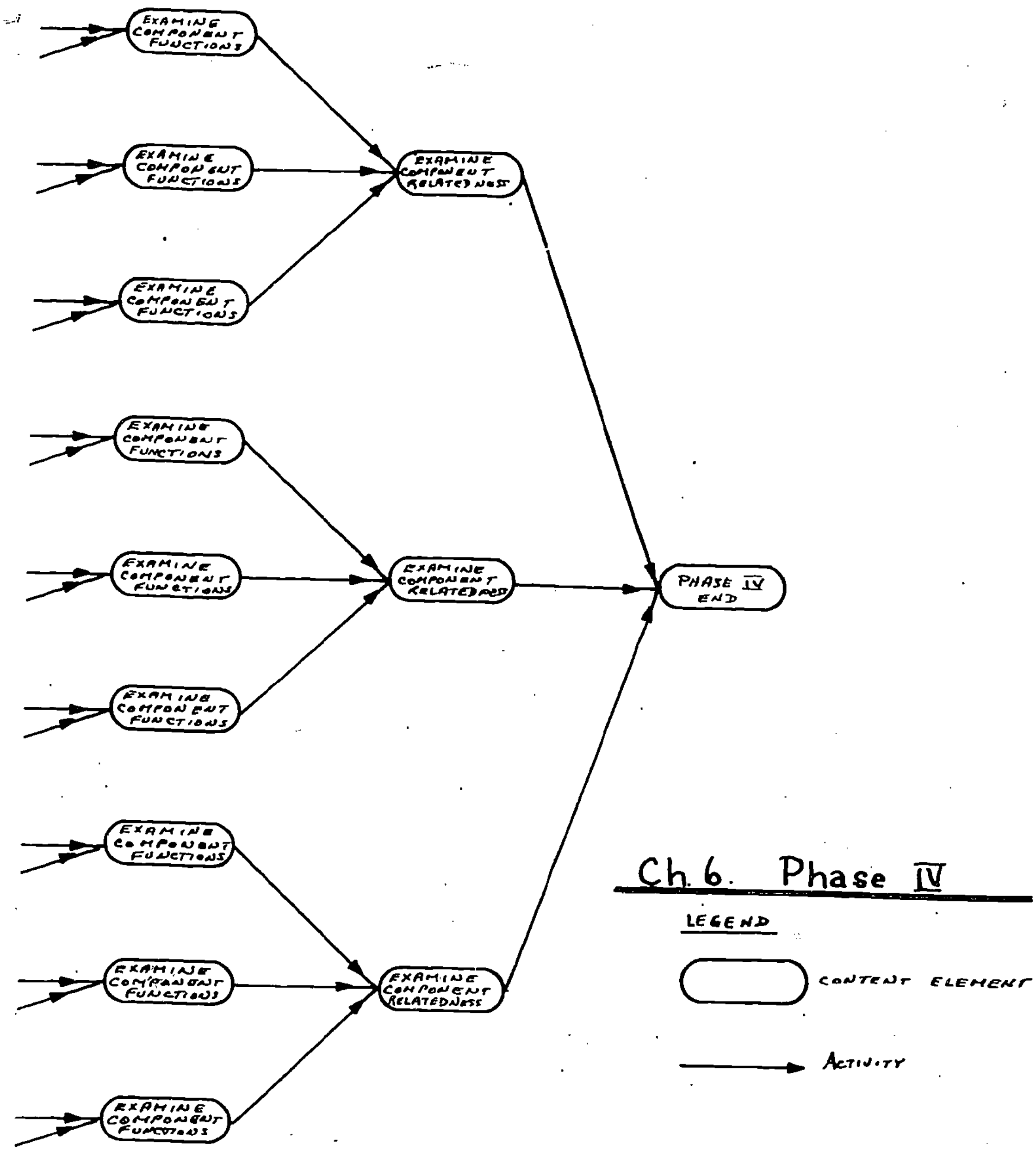








PHASE IV START
POWER TECHNOLOGY
MECHANICAL TECHNOLOGY
POWER TRANSMISSION
MATERIALS
GRAPHIC COMMUNICATIONS
TESTING TECHNOLOGY
ELECTRICITY
ELECTRONICS
COMPUTER TECHNOLOGY
REVIEW TECHNOLOGY
EXAMINE NEW EQUIPMENT & TECHNIQUES


EXAMINE COMPONENT FUNCTIONS
EXAMINE COMPONENT FUNCTIONS
EXAMINE COMPONENT FUNCTIONS
EXAMINE COMPONENT RELATEDNESS
EXAMINE COMPONENT FUNCTIONS
EXAMINE COMPONENT FUNCTIONS
EXAMINE COMPONENT FUNCTIONS
EXAMINE COMPONENT RELATEDNESS
EXAMINE COMPONENT FUNCTIONS
EXAMINE COMPONENT FUNCTIONS
EXAMINE COMPONENT FUNCTIONS
EXAMINE COMPONENT RELATEDNESS
PHASE IV END
LEGEND
CONTENT ELEMENT
ACTIVITY

Ch. 6. Phase IV

CHAPTER VI

CLUSTERS–MATERIALS, PROCESSES AND TECHNOLOGIES CONTROL

INTRODUCTION

INDUSTRIAL ARTS PHASE IV A

Electricity

Electronics

Computers

INDUSTRIAL ARTS PHASE IV B

Power Technology

Power Transmission

Mechanical Technology

INDUSTRIAL ARTS PHASE IV C

Materials

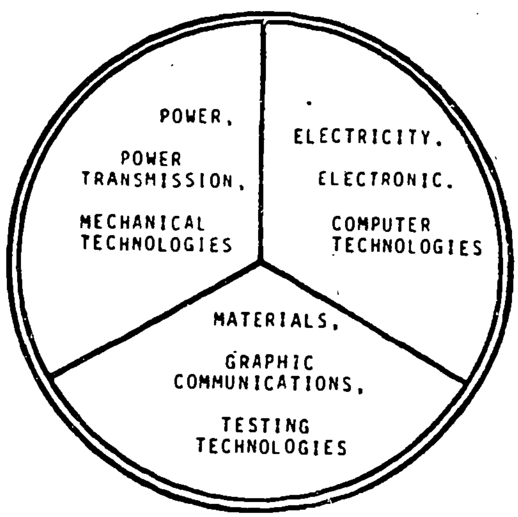
Graphics Communications

Testing Technology

CHAPTER VI

CLUSTERS–MATERIALS, PROCESSES AND TECHNOLOGIES–CONTROL

INTRODUCTION

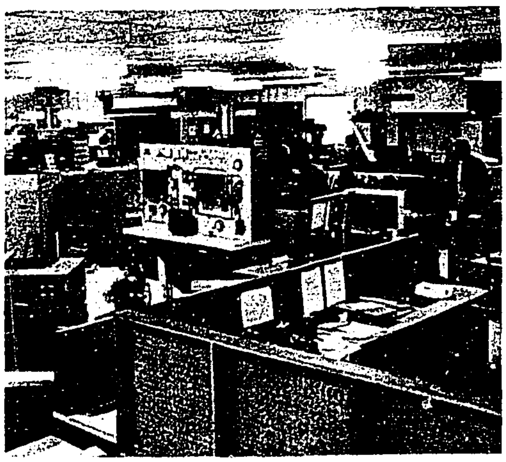


From observation of the PERT chart and the circle, it becomes obvious that Phase IV is a cluster activity. This phase is composed, at a more sophisticated level, of six material areas and seven technologies previously enumerated in chapters III and IV. The objective of Phase IV industrial arts is to review the materials and technology systems and units previously covered and complete these systems with the introduction of components and the examination of component relatedness. In addition, more sophisticated materials and technologies are introduced in the same manner as in Phases I and II.

There are a number of unique features about this phase of industrial arts not as evident in Phases I, II and III. One is that all materials and technologies are housed in one large laboratory, manned by three instructors, and for the sake of efficiency, have been categorized as follows:

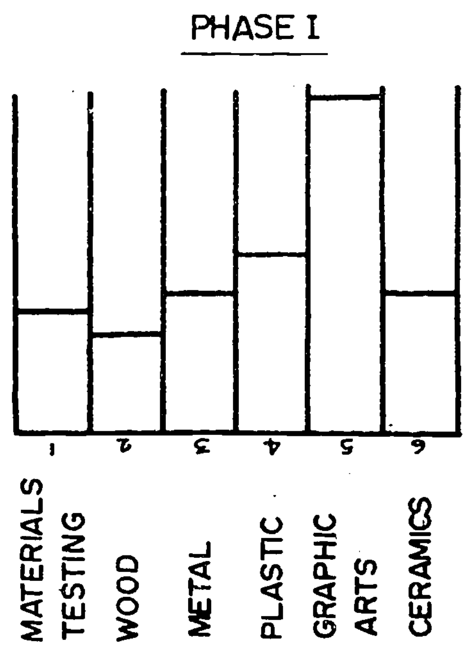
Industrial arts Phase IV-A–Electricity, Electronics and Computers as illustrated in the photo where students are exposed to the previously enumerated systems but now the computers become more complex and analogue computers and logic circuitry is introduced. In electricity they move on to complex AC and DC motors and generators and the requisite controls to utilize them. In electronics the former systems components are covered and other systems such as micro-wave, radar, transmitters and medical instrumentation are introduced. Further emphasis in this area will be described later.

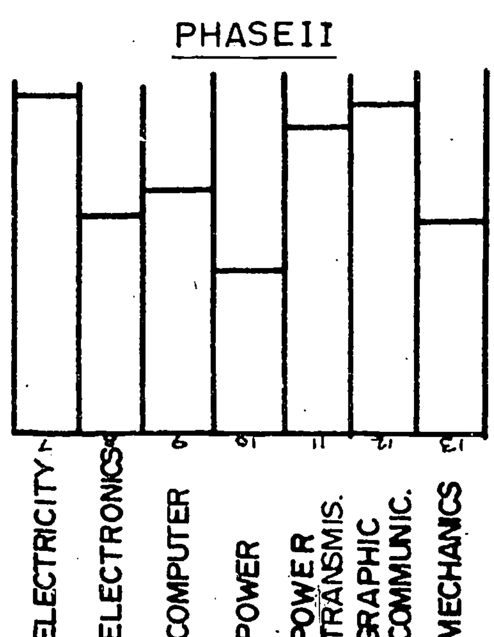
The second grouping can be categorized as Industrial arts Phase IV-B–Power Transmission, Power Automatic controls and Mechanics as illustrated in the photo where students are exposed to internal combustion systems, refrigeration and air conditioning, hydraulics, pneumatics, fuel cells, fluidics and mechanical technologies.



The third grouping in industrial arts Phase IV-C is the Materials, Graphic Communications and Standards technologies depicted in the picture where simply photography is now advanced to holography—the plastic now requires complex water cooled moulds and the graphic communication process combines all previous systems in an automated system from the IBM compositor to the plate maker, offset—collator and finally binding. The attendant equipment—varitypers, light tables, and headliners are all in evidence. The standards section which was materials testing in Phase I and associated testing in Phases II, III and other facets of Phase IV now becomes more complex and sophisticated testing of properties of materials and characteristics of equipment.

What is unique about this laboratory is that a student's critical incident profile may have indicated the following:





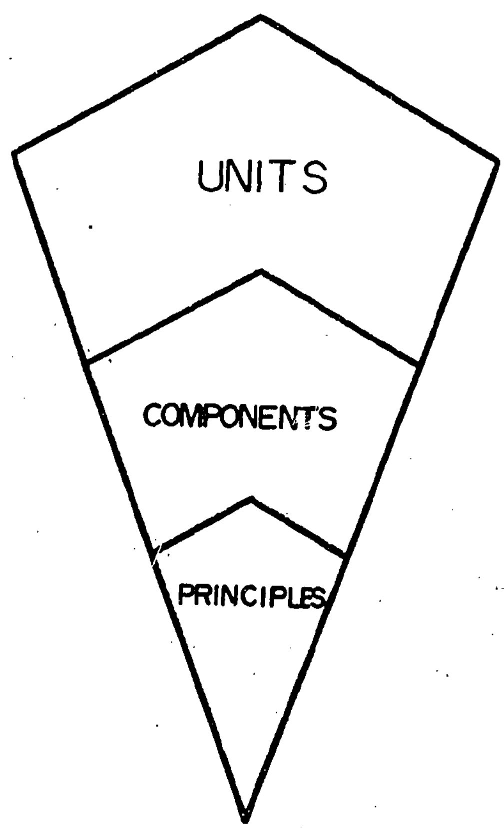
Phase IV industrial arts is recommended for grades eleven and twelve. It is further recommended that the students select a cluster of no less than two nor more than three activities in any one academic year, therefore an optimal program based on the illustrated student's profile would be:

Graphic communication—supported by columns 5 and 12, electricity—supported by evidence of column 7 and power transmission —supported by Column 11. This would be recommended for grade eleven. For grade twelve it would be recommended that he continue his interest in electricity, electronics and computers which the critical incident chart reveals as his next high interest and ability areas. It is never intended that a student pursue only those areas of his highest interest. He may wish to make other cluster selections. This choice should be administratively possible and the manner in which these laboratories are organized entirely probable, so that in grade eleven this student would have three teachers in parts of Phase IV, A, B, and C. industrial arts and in grade twelve he would only have one teacher in Phase IV A. If we as educators really believe in individual differences, then we should design programs that in fact permit the student to exercise this individual difference and with no penalty or departure from the originally stated objectives. This preference could very readily be reinforced by the rest of his current academic schedule which in fact reinforces and is equally reinforced and synthesized by his industrial arts Phase IV selection.

INDUSTRIAL ARTS PHASE IV-A—(Electricity, Electronics and Computers)

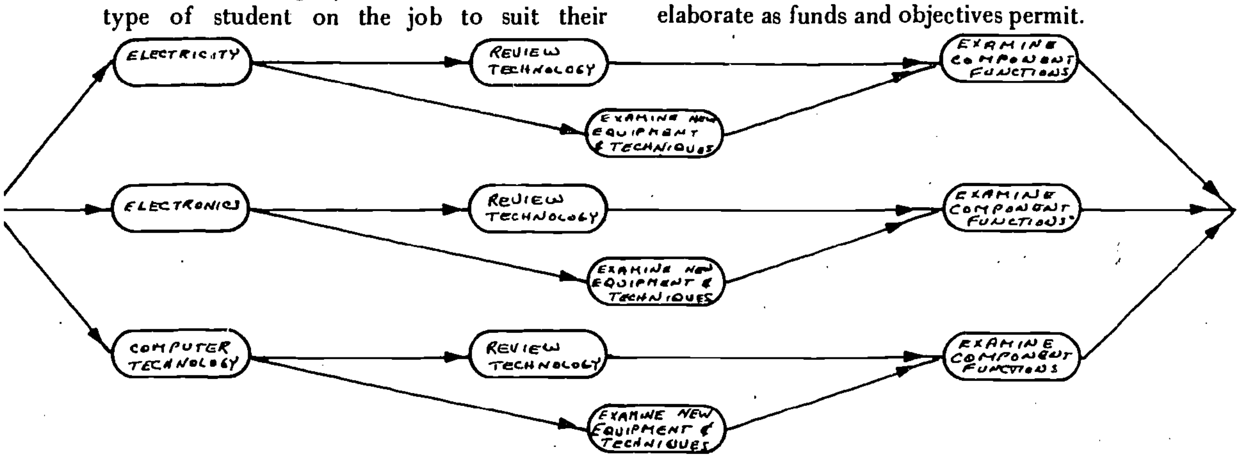
Moving into Phase IV Industrial Arts is similar to taking general science in grades 7, 8, and 9 and then concentrating in Chemistry, Physics, Biology, Zoology and others in grades 10, 11 and 12. It is intended that the student have the prerogative to select any combination of clusters even if he cuts across administratively assigned cluster laboratories. In fact, some high schools that did not have students enter Phase IV industrial arts with any Phase I and II. prerequisite, reverted to the Phase I, and II organization and in some instances had students with the necessary prerequisites of Phases I and II and some without any industrial arts background. Granted, all students could not finish the recommended matrix but they all did leave with a sampling of the technologies. More will be said about this transitional problem in Chapter VIII—Advice to Administrators and Teachers.

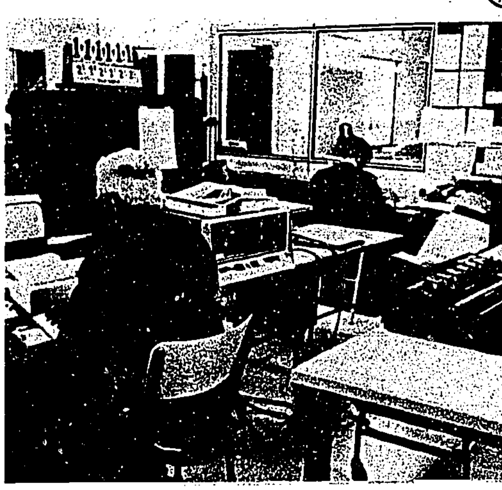
SYSTEMS



Please observe that the pert chart as illustred is the ultimate direction for industrial arts Phase IV-A, and the general to specific systems approach to teaching is still in evidence. What can not and must not be implemented or interpreted is that these clusters represent Vocational education substitutes. Admittedly, these clusters may in the ultimate represent a better introduction into a large number of occupational fields currently not requiring vocational, technical or professional preparation. The literature supports the argument that employers require students with technological breadth and reinforced by a sound academic preparation. The manufacturing industry will then train this type of student on the job to suit their individual needs. This, industrial arts Phase IV can accomplish. It can also satisfy the ever increasing needs represented by the fast growing service industries, transportation, utilities and communication facets of our productive society, as well as the exploratory prerequisite experiences before selecting technical, para-professional or professional education.

The following sample matrix will illustrate that previous matrix experiences have been reviewed. Components and new systems or equipment added to enrich the learning experience. Only a minimal sample matrix for industrial arts Phase IV-A will be illustrated permitting the teacher or school system to elaborate as funds and objectives permit.





This photo illustrates equipment previously illustrated in Phase II computer technology for review and reinforcing principles.

This laboratory is equipped with meter caddies as illustrated to expedite use and minimize cost.

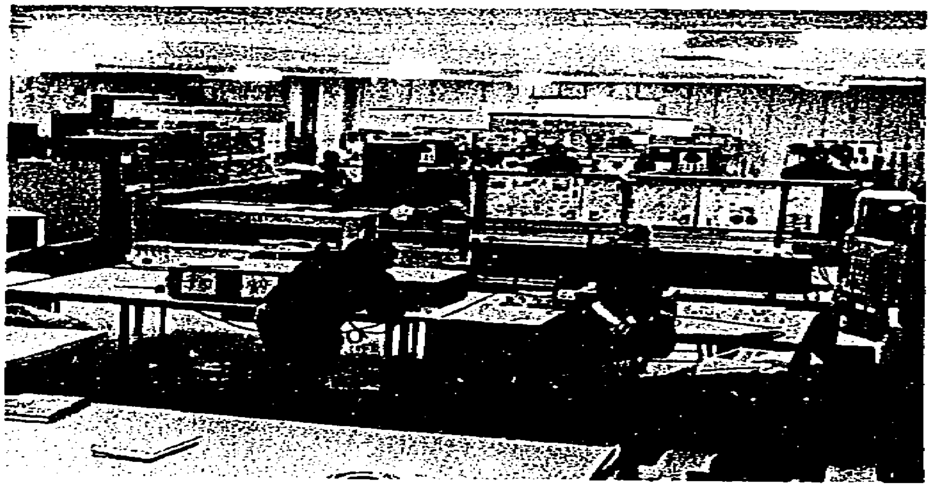
PHASE IV-A INDUSTRIAL ARTS

SAMPLE EXPERIMENTAL SITUATIONS	ORIENTATION	INDUCTION		
	USERS IN SOCIETY	SYSTEMS	UNITS	COMPONENTS
ELECTRICAL				
SIMPLE INDUSTRIAL CONTROLS	REVIEW	REVIEW	REVIEW	C_1 C_2 C_1 C_2 / C_3 C_4 C_3 C_4
MOTOR CONTROL	REVIEW	REVIEW	REVIEW	C_1 C_2 C_1 C_2 / C_3 C_4 C_3 C_4
A.C.-D.C. MOTORS & GENERATORS	SOCIETAL, HOME, INDUSTRIAL, SCHOOL, CULTURAL, PERSONAL	S_1 S_2 S_1 S_2 / S_3 S_4 S_3 S_4	U_1 U_2 U_1 U_2 / U_3 U_4 U_3 U_4	C_1 C_2 C_5 C_6 / C_3 C_4 C_7 C_8
COMPLEX INDUSTRIAL CONTROLS		S_1 S_2 S_1 S_2 / S_3 S_4 S_3 S_4	U_1 U_2 U_1 U_2 / U_3 U_4 U_3 U_4	C_1 C_2 C_5 C_6 / C_3 C_4 C_7 C_8
R & D PROBLEM	RESOLVE OR DESIGN PROBLEM WITHIN THESE CATEGORIES			
ELECTRONICS				
RADIO RECEIVER	REVIEW	REVIEW	REVIEW	C_1 C_2 C_1 C_2 / C_3 C_4 C_3 C_4
RADIO TRANSMITTER	REVIEW	REVIEW	REVIEW	C_1 C_2 C_1 C_2 / C_3 C_4 C_3 C_4
TELEVISION	REVIEW	REVIEW	REVIEW	C_1 C_2 C_1 C_2 / C_3 C_4 C_3 C_4
MEDICAL MICRO-WAVE	SOCIETAL, HOME, INDUSTRIAL, SCHOOL, CULTURAL, PERSONAL	S_1 S_2 S_1 S_2 / S_3 S_4 S_3 S_4	U_1 U_2 U_5 U_6 / U_3 U_4 U_7 U_8	C_1 C_2 C_5 C_6 / C_3 C_4 C_7 C_8
SOLID STATE CIRCUITS		S_1 S_2 S_1 S_2 / S_3 S_4 S_3 S_4	U_1 U_2 U_5 U_6 / U_3 U_4 U_7 U_8	C_1 C_2 C_5 C_6 / C_3 C_4 C_7 C_8
LASER		S_1 S_2 S_1 S_2 / S_3 S_4 S_3 S_4	U_1 U_2 U_5 U_6 / U_3 U_4 U_7 U_8	C_1 C_2 C_5 C_6 / C_3 C_4 C_7 C_8
R & D PROBLEM	RESOLVE OR DESIGN PROBLEM WITHIN THESE CATEGORIES			
COMPUTER				
BITRAN	REVIEW	REVIEW	REVIEW	C_1 C_2 C_1 C_2 / C_3 C_4 C_3 C_4
P D P.-8s	REVIEW	REVIEW	REVIEW	C_1 C_2 C_1 C_2 / C_3 C_4 C_3 C_4
DIGITAL COMPUTER ANALYSIS	SOCIETAL, HOME, INDUSTRIAL, SCHOOL, CULTURAL, PERSONAL	S_1 S_2 S_1 S_2 / S_3 S_4 S_3 S_4	U_1 U_2 U_5 U_6 / U_3 U_4 U_7 U_8	C_1 C_2 C_5 C_6 / C_3 C_4 C_7 C_8
ANALOG COMPUTER ANALYSIS		S_1 S_2 S_1 S_2 / S_3 S_4 S_3 S_4	U_1 U_2 U_5 U_6 / U_3 U_4 U_7 U_8	C_1 C_2 C_5 C_6 / C_3 C_4 C_7 C_8
COMPUTER PROGRAMMING		S_1 S_2 S_1 S_2 / S_3 S_4 S_3 S_4	U_1 U_2 U_5 U_6 / U_3 U_4 U_7 U_8	C_1 C_2 C_5 C_6 / C_3 C_4 C_7 C_8

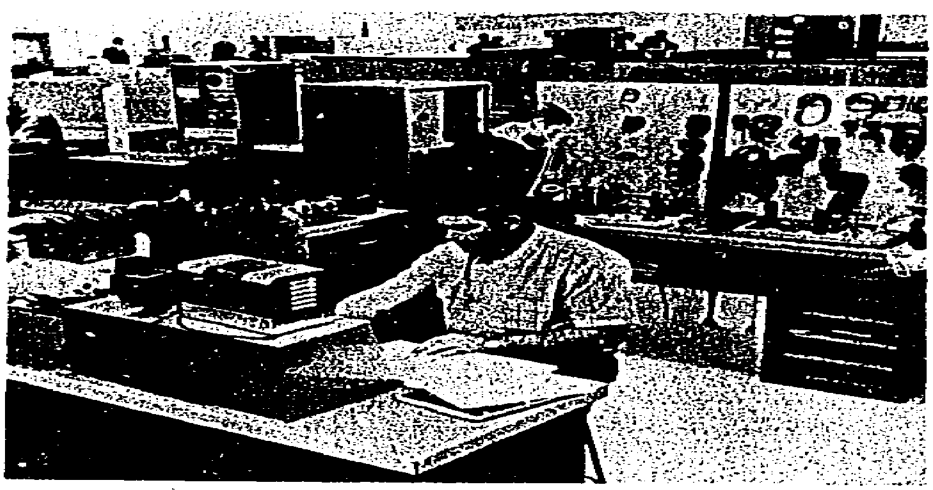
COMPUTER - ELECTRICAL ELECTRONIC

PHASE IV-A INDUSTRIAL ARTS MATRIX PARADIGM

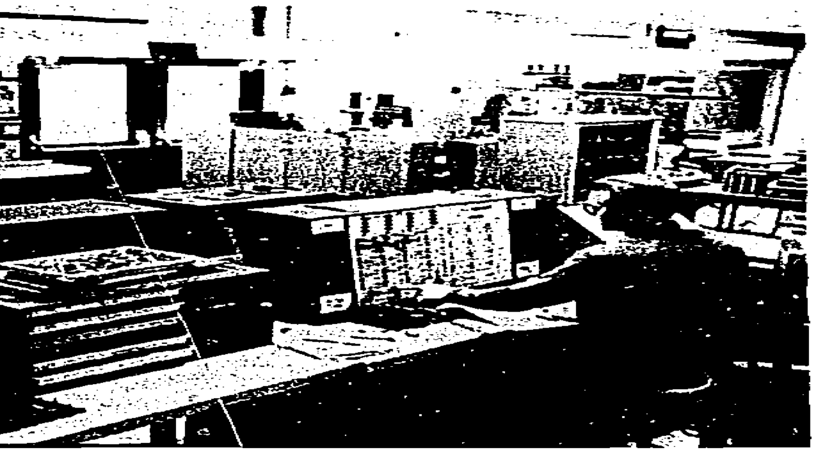
This photo illustrates a larger and more complex PDP 85 computer and logic circuitry panel, plus some medical equipment.

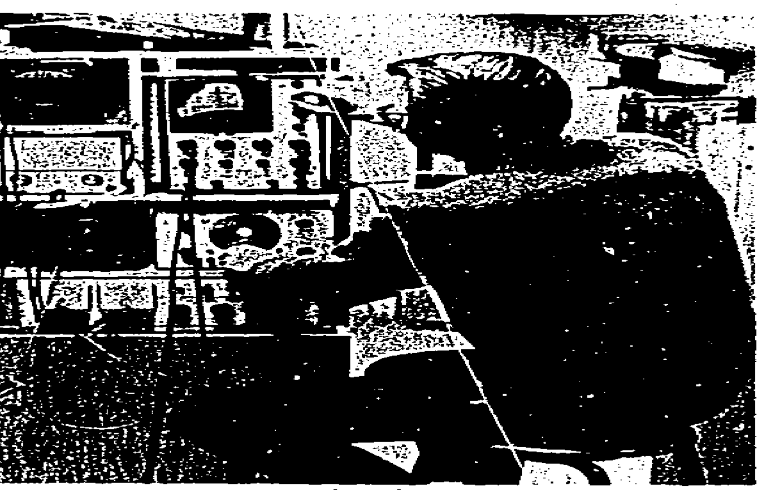


This photo illustrates the AC—DC motor generator section which is supplemented by the industrial control panel opposite this section.



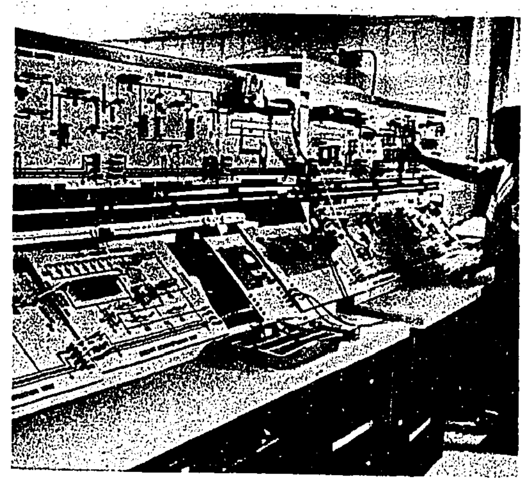
This area represents the R & D section of the laboratory for design or resolution of electronic problem designated by the instructor.

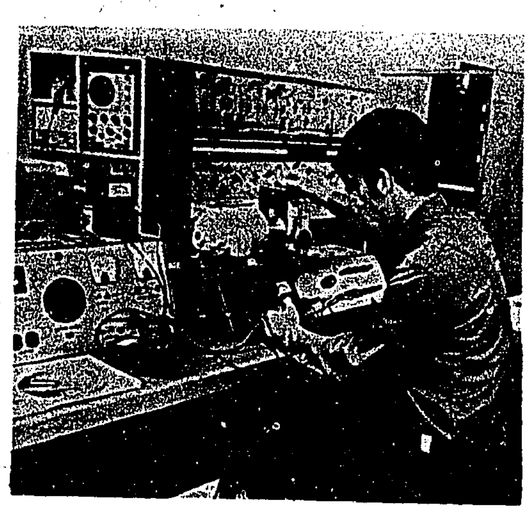




As in all these areas of industrial arts Phase IV-A all equipment is in order/on site, easily accessible to students and in modular shape for ease of use to expediting learning. (Please note – no soldering irons).

This laboratory–electrical–electronics and computer is organized into 18 bench units to embrace systems units and components study as illustrated in the matrix paradigm, permitting an opportunity for R & D type activity in each area and including the maintenance of this equipment. The recommended time allotment for this section of Phase IV is one period a day, five days a week. Therefore, organization, equipment placement for inventory and planning and all teaching aids must be available to optimize learning time. Aids and evaluation techniques will be referred to in the next chapter.



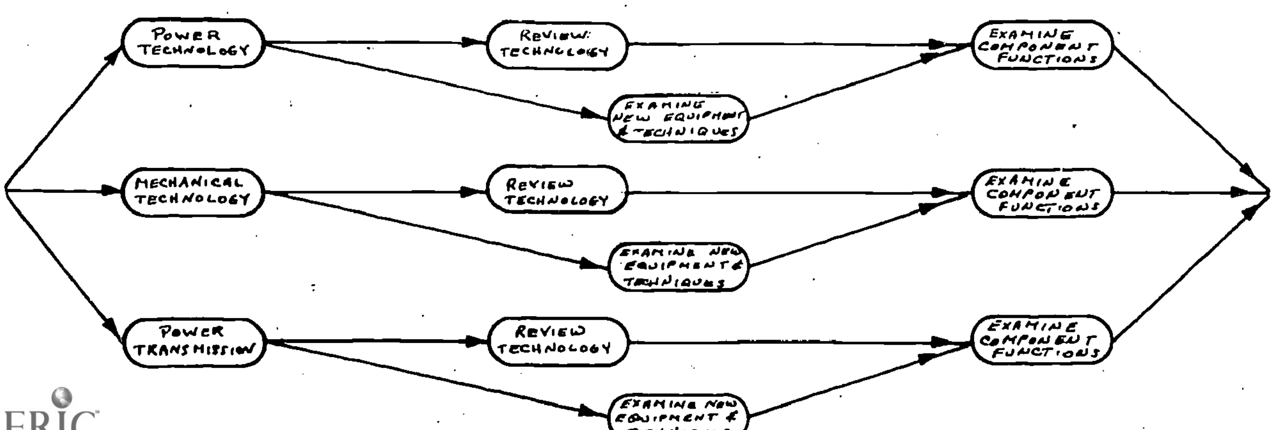


INDUSTRIAL ARTS PHASE IV-B POWER, POWER TRANSMISSIONS, MECHANICS AND INSTRUMENTATION.

In Phase II it has been indicated that power, power transmission, mechanical and instrumentation is a viable representative sample of our productive society. The following photographs and the pert chart will indicate the organization of industrial arts Phase IV-B.

It becomes readily discernible to students that hydraulics may have been a power transmitter in Phase II, it now may appear as a power source—and fluidics is not just a word but is, in fact, a technology that may in combination with other technologies replace the electronics computer and in some environments, it is absolutely necessary that this be accomplished. Again as in the previous section of Phase IV, the student elects to become involved in power, or power transmission or mechanical or instrumentation in combination with some activity of another section such as electricity in Phase IV-A. Then his program could be electrical and hydraulic combinations of study and evidence indicates that this dual technology is rapidly emerging in our cybernated society as automated or cybernated systems.

As in the previous section of Phase IV, it will be observed on the matrix paradigm for this section of industrial arts Phase IV=B, that certain sections of Phase II have been reviewed, components explained and examined and more sophisticated systems or areas introduced.



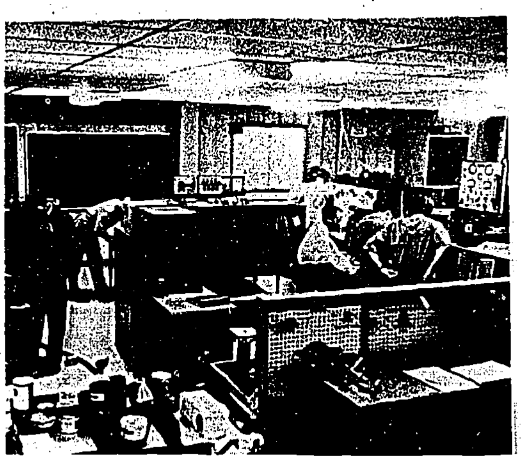
PHASE IV-B INDUSTRIAL ARTS

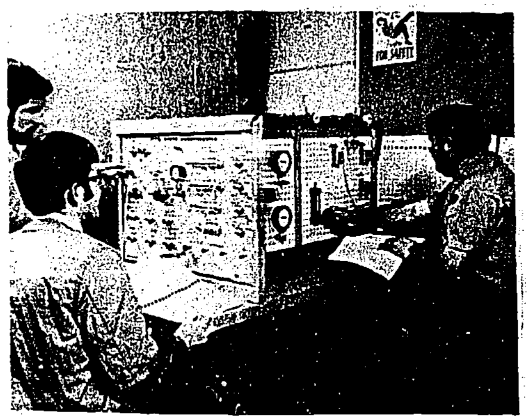
SAMPLE EXPERIMENTAL SITUATIONS	ORIENTATION: USES IN SOCIETY	INDUCTION: SYSTEMS		UNITS				COMPONENTS			
POWER	REVIEW										
INTERNAL COMBUSTION RECIPROCATING ENGINE								C_1	C_2	C_1	C_2
								C_3	C_4	C_3	C_4
PULSE JET								C_1	C_2	C_1	C_2
								C_3	C_4	C_3	C_4
FUEL CELL								C_1	C_2	C_1	C_2
								C_3	C_4	C_3	C_4
COMPLEX FUEL CELL	SOCIETAL, HOME, INDUSTRIAL, SCHOOL, CULTURAL, PERSONAL	S_1	S_2	U_1	U_2	U_5	U_6	C_1	C_2	C_5	C_6
		S_3	S_4	U_3	U_4	U_7	U_8	C_3	C_4	C_7	C_8
STEAM ENGINE		S_1	S_2	U_1	U_2	U_5	U_6	C_1	C_2	C_5	C_6
		S_3	S_4	U_3	U_4	U_7	U_8	C_3	C_4	C_7	C_8
GAS TURBINE		S_1	S_2	U_1	U_2	U_5	U_6	C_1	C_2	C_5	C_6
		S_3	S_4	U_3	U_4	U_7	U_8	C_3	C_4	C_7	C_8
THERMO-ELECTRIC CELL		S_1	S_2	U_1	U_2	U_5	U_6	C_1	C_2	C_5	C_6
		S_3	S_4	U_3	U_4	U_7	U_8	C_3	C_4	C_7	C_8
R & D PROBLEM	RESOLVE OR DESIGN PROBLEM WITHIN THESE CATEGORIES										
POWER TRANSMISSION	REVIEW										
COMPLEX HYDRAULIC & PNEUMATIC CONTROLS								C_1	C_2	C_1	C_2
								C_3	C_4	C_3	C_4
FLUIDICS	SOCIETAL, HOME, INDUSTRIAL, SCHOOL, CULTURAL, PERSONAL	S_1	S_2	U_1	U_2	U_5	U_6	C_1	C_2	C_5	C_6
		S_3	S_4	U_3	U_4	U_7	U_8	C_3	C_4	C_7	C_8
REFRIGERATION		S_1	S_2	U_1	U_2	U_5	U_6	C_1	C_2	C_5	C_6
		S_3	S_4	U_3	U_4	U_7	U_8	C_3	C_4	C_7	C_8
AIR CONDITIONING		S_1	S_2	U_1	U_2	U_5	U_6	C_1	C_2	C_5	C_6
		S_3	S_4	U_3	U_4	U_7	U_8	C_3	C_4	C_7	C_8
AUTOMATIC CONTROL SYSTEMS		S_1	S_2	U_1	U_2	U_5	U_6	C_1	C_2	C_5	C_6
		S_3	S_4	U_3	U_4	U_7	U_8	C_3	C_4	C_7	C_8
R & D PROBLEM	RESOLVE OR DESIGN PROBLEM WITHIN THESE CATEGORIES										
MECHANICAL	REVIEW										
SIMPLE CONSIDERATION OF GEARS & LEVERS								C_1	C_2	C_1	C_2
								C_3	C_4	C_3	C_4
SIMPLE MACHINES								C_1	C_2	C_1	C_2
								C_3	C_4	C_3	C_4
COMPLEX MACHINES A	SOCIETAL, HOME, INDUSTRIAL, SCHOOL, CULTURAL, PERSONAL	S_1	S_2	U_1	U_2	U_5	U_6	C_1	C_2	C_5	C_6
		S_3	S_4	U_3	U_4	U_7	U_8	C_3	C_4	C_7	C_8
B		S_1	S_2	U_1	U_2	U_5	U_6	C_1	C_2	C_5	C_6
		S_3	S_4	U_3	U_4	U_7	U_8	C_3	C_4	C_7	C_8
AUTOMATIC THREADING MACHINE		S_1	S_2	U_1	U_2	U_5	U_6	C_1	C_2	C_5	C_6
		S_3	S_4	U_3	U_4	U_7	U_8	C_3	C_4	C_7	C_8
R & D PROBLEM	RESOLVE OR DESIGN PROBLEM WITHIN THESE CATEGORIES										

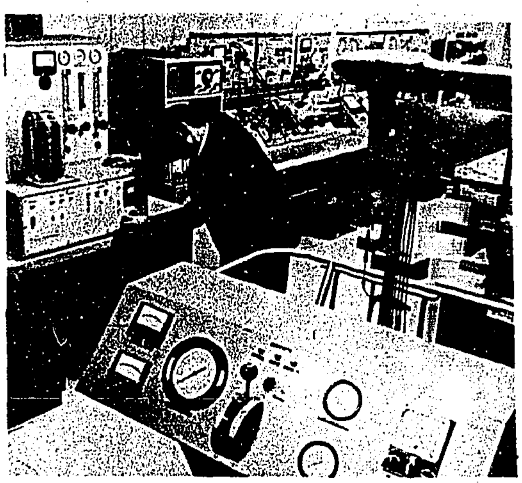
POWER, POWER TRANSMISSION, MECHANICAL & INSTRUMENTATION

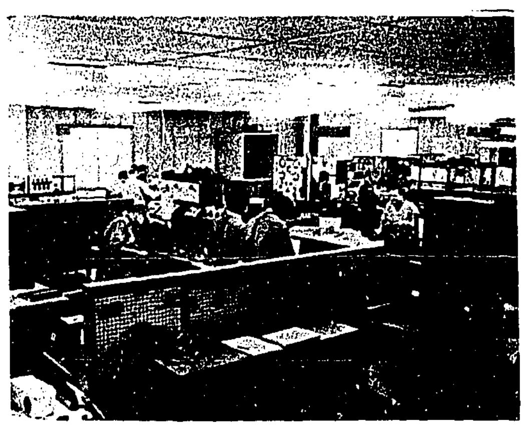
PHASE IV-B INDUSTRIAL ARTS MATRIX PARADIGM

The following photos will help to illustrate the activities of the pert and paradigm. The one picture shows an overall shot of this area looking from industrial arts Phase IV-C section towards the turbine test panel and fuel cell. The other picture shows the fuel cell in the background and the pulse jet in the foreground.



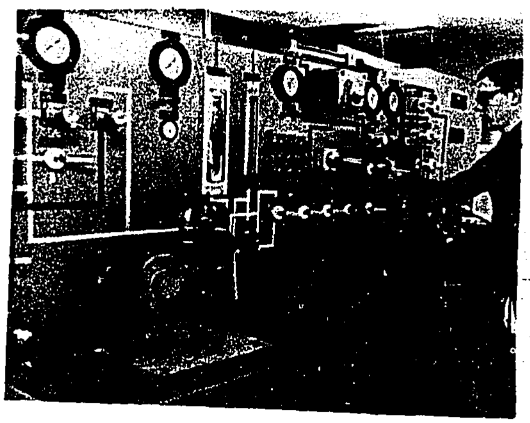


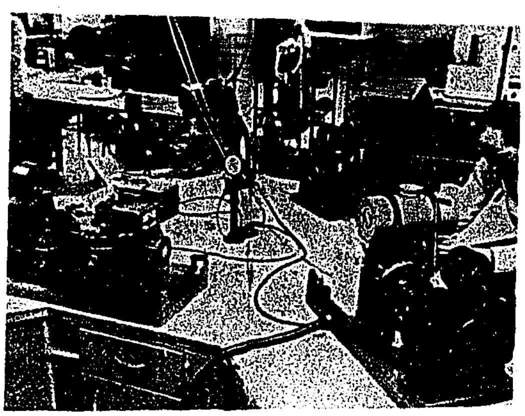




The turbine test panel is in operation and the steam system is visible at the immediate left. Problems of fluidics can easily be learned and resolved on the illustrated unit which can accommodate four students.

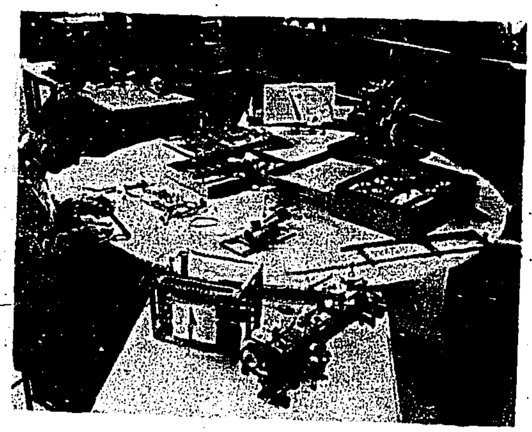
These three pictures in their particular grouping help to recognize that the systems in Phase II are in evidence, but are only reviewed and the components are studied to determine similarities and differences.





If more complex and higher volume hydraulics problems need to be resolved, this unit can accommodate this type of situation.

As in the previous photo, the mechanical section encompasses more complex systems of physics—in combination of complex machines combined with other sources of power—this is an R & D involvement.

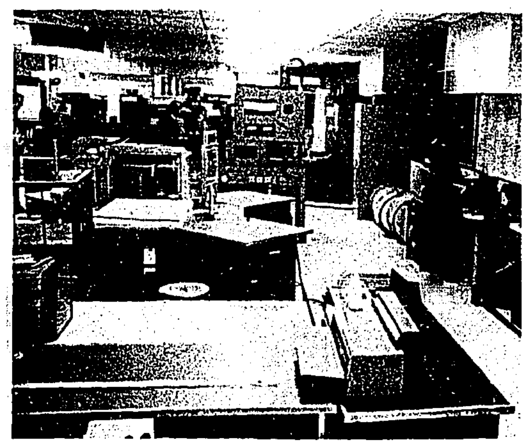


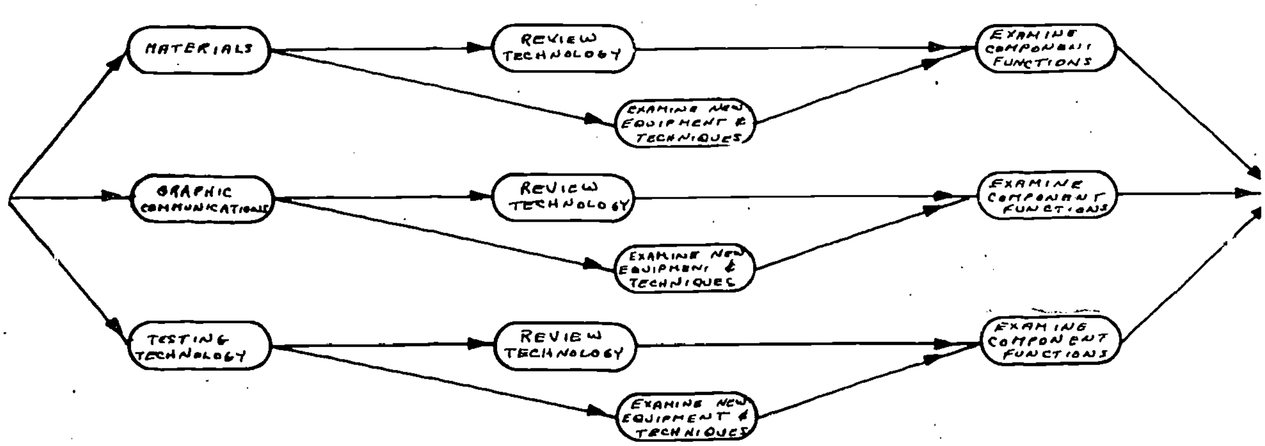
Instrumentation abounds in all areas of our productive society but because of its predominence (other than electrical) we have included a section on instrumentation and refrigeration and air conditioning as systems to incorporate previous systems and networks studied.

INDUSTRIAL ARTS PHASE IV-C—MATERIALS, GRAPHIC COMMUNICATIONS AND STANDARDS

Sufficient argumentation has been cited to validate the offering of materials and graphic communications technology. Now a new term is being introduced that is standards technology. This is a follow-up on the testing technology in Phase I plus the experiences obtained in Phase III where multiple pieces of the same product must be produced to a required standard quality. This is also true in graphic communications as a finished product.

It is readily obvious that the equipment is so designed as to permit more sophisticated exploration of materials, and the process of communications to a measurable standard. Observation of the matrix paradigm for Phase IV-C will indicate that materials testing was completed in the components area and then advanced into the standards technology. It must be remembered that all students do not start on all equipment simultaneously, therefore any order expressed in this matrix or any other matrix paradigm is not intended to indicate a hierarchical order of introducing the activities other than that the R & D problems are left toward the end of the year so that students can cope with the serious problems from some base of experience. Here again it is systems units and components oriented to the society that constitutes the problem's viability.





PHASE IV-C INDUSTRIAL ARTS

SAMPLE MATERIAL OR EXPERIMENTAL SITUATION	ORIENTATION: USES IN SOCIETY	INDUCTION: PRODUCT, SYSTEM				MATERIAL, UNIT				PROCESS, COMPONENTS			
MATERIALS	REVIEW									C1	C2		
										C3	C4		
TESTING										C1	C2		
										C3	C4		
STANDARDS TECH.	SOCIETAL, HOME, INDUSTRIAL, SCHOOL, CULTURAL, PERSONAL	S1	S2	S5	S6	U1	U2	U5	U6	C1	C2	C5	C6
		S3	S4	S7	S8	U3	U4	U7	U8	C3	C4	C7	C8
EQUIPMENT		S1	S2	S5	S6	U1	U2	U5	U6	C1	C2	C5	C6
		S3	S4	S7	S8	U3	U4	U7	U8	C3	C4	C7	C8
MATERIALS		S1	S2	S5	S6	U1	U2	U5	U6	C1	C2	C5	C6
		S3	S4	S7	S8	U3	U4	U7	U8	C3	C4	C7	C8
GRAPHIC COMMUNICATIONS	REVIEW												
COMPOSITION										C1	C2		
										C3	C4		
ELECTRONIC LOGIC COMPOSITION	SOCIETAL, HOME, INDUSTRIAL, SCHOOL, CULTURAL, PERSONAL	S1	S2	S5	S6	U1	U2	U5	U6	C1	C2	C5	C6
		S3	S4	S7	S8	U3	U4	U7	U8	C3	C4	C7	C8
OFFSET		S1	S2	S5	S6	U1	U2	U5	U6	C1	C2	C5	C6
		S3	S4	S7	S8	U3	U4	U7	U8	C3	C4	C7	C8
PLATE-MAKING		S1	S2	S5	S6	U1	U2	U5	U6	C1	C2	C5	C6
		S3	S4	S7	S8	U3	U4	U7	U8	C3	C4	C7	C8
HOLOGRAPHY		S1	S2	S5	S6	U1	U2	U5	U6	C1	C2	C5	C6
		S3	S4	S7	S8	U3	U4	U7	U8	C3	C4	C7	C8
MATERIALS	REVIEW												
METALS										C1	C2		
										C3	C4		
PLASTICS										C1	C2		
										C3	C4		
GRAPHICS										C1	C2		
										C3	C4		
AUTOMATED INJECTOR	SOCIETAL, HOME, INDUSTRIAL, SCHOOL, CULTURAL, PERSONAL	S1	S2	S5	S6	U1	U2	U5	U6	C1	C2	C5	C6
		S3	S4	S7	S8	U3	U4	U7	U8	C3	C4	C7	C8
PROFILE LATHE		S1	S2	S5	S6	U1	U2	U5	U6	C1	C2	C5	C6
		S3	S4	S7	S8	U3	U4	U7	U8	C3	C4	C7	C8
NUMERIC CONTROL MILLER		S1	S2	S5	S6	U1	U2	U5	U6	C1	C2	C5	C6
		S3	S4	S7	S8	U3	U4	U7	U8	C3	C4	C7	C8
AUTOMATED MACHINES	STUDY - ELECTRO-MECHANICAL & ELECTRONIC AUTOMATED SYSTEMS												
R & D PROJECT A	RESOLVE OR DESIGN PROBLEMS WITHIN THESE CATEGORIES - OR INCORPORATE ANY ACTIVITY OF PHASES IV - A OR B												
R & D PROJECT B													
R & D PROJECT C													

MATERIALS GRAPHIC COMMUNICATIONS & STANDARDS

PHASE IV-C INDUSTRIAL ARTS MATRIX PARADIGM

This picture illustrates a numerically controlled vertical mill. The teleprinter can be observed in the background and its relationship to the computers is resolved not only in theory and practice, but also in location. It adjoins the computer section of Phase IV-A.

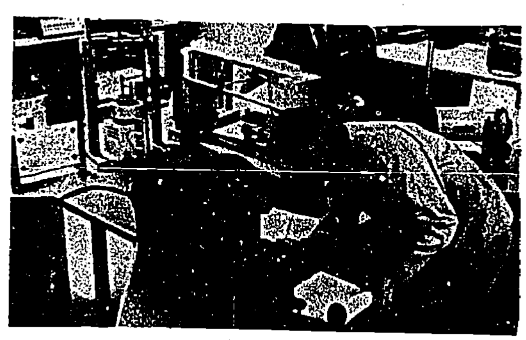
This lathe is equipped with an attachment for automatic profiling as well as a machine-ability panel that can give students readouts on the use of the equipment pictured to the right. This machine as well as the above can become numerically controlled.

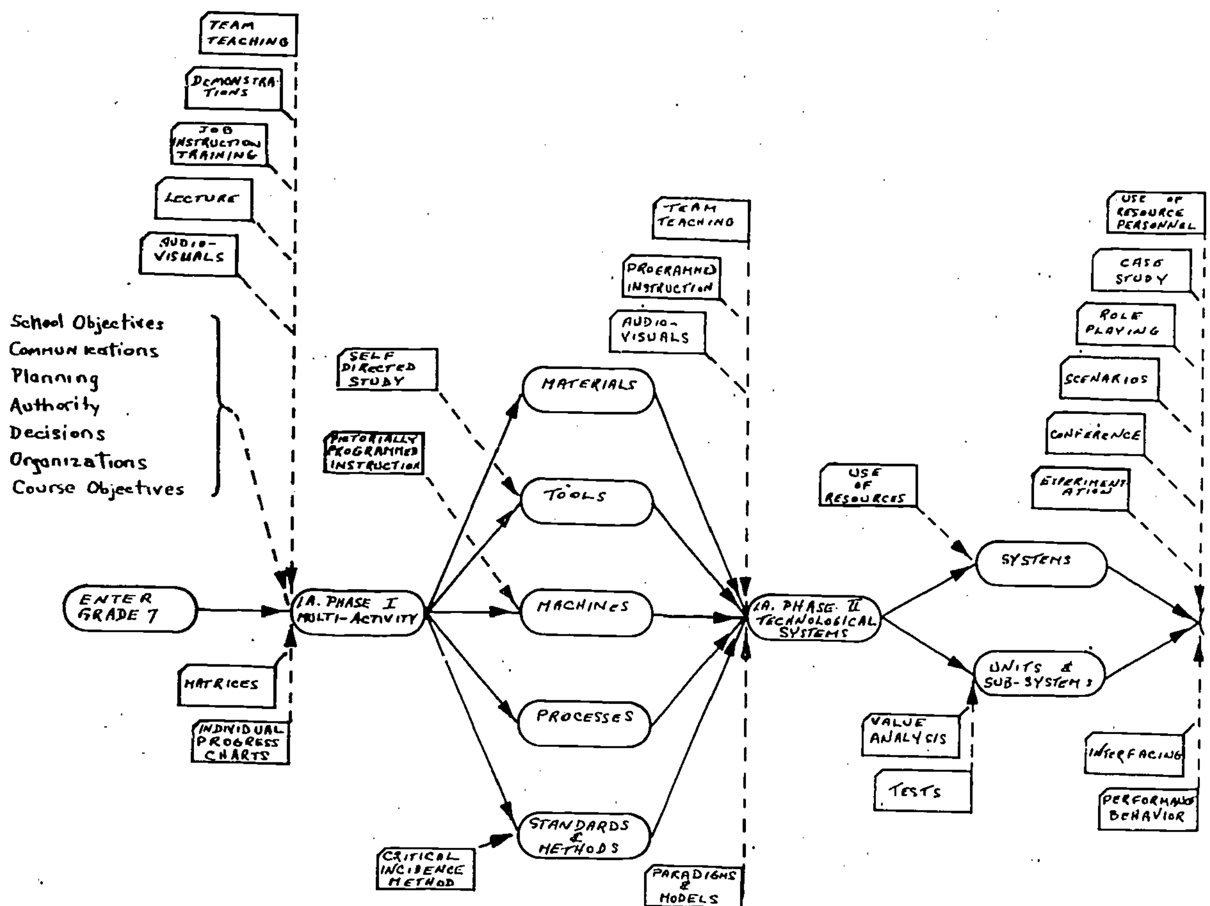
This section of the industrial arts Phase IV-C is equipped with all the latest offset equipment, platemaking, holographic camera and electronic-logic compositions. This is further supported by all the necessary dark room process camera equipment and attendant offset equipment. Illustrated in the photograph is the making of the plate which is put on the offset and the printed page is then run and collated if numbers require. Prior to this, the problem of layout previously learned in Phase III is reinforced and new problems, processes and equipment are introduced. Rolled paper stacks are evident in other photographs of this laboratory. This is to expedite and give more latitude to the student. Rather than the storing of paper stock sizes the offset machine is preceded by an adjustable cutter that will cut and feed as the need requires.

This machine is a vertical plastic injection machine that can be operated manually, semi-automatically or automatically. Another illustration of the inter-dependence of technologies. This particular machine is capable of greater capacities therefore larger plastic products can be produced faster in water cooled moulds and dies.

It is important to remember that students continually move from an observable and understandable whole system as is depicted by the automated machine shown and then try to identify the significant units that make up these machines, complex as they may seem. Initially the movement from general to specific accompanied by audio and written material has proven beneficial to the student to understand the concept. A concept that may be very euphemistic at the beginning makes a greater impression when moving from the known to the unknown. Poor readers can be assisted by an audio tape and research evidence indicates that this poor reader can conceptualize and thereby overcome one of his handicaps by using technology. Research further indicates that poor readers in the experimental group improved in their reading speed and comprehension compared to the control group that did not have this opportunity.

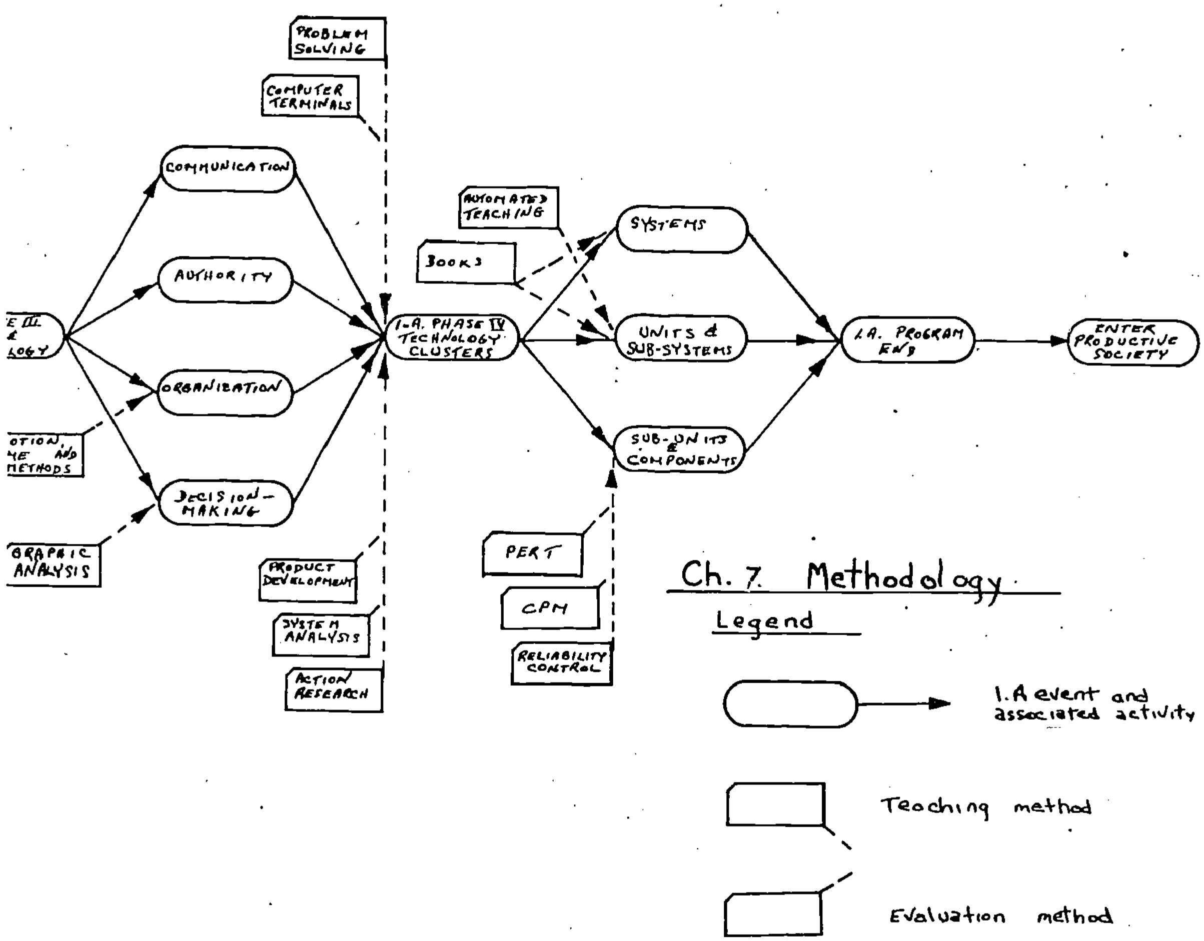
Clustering the technologies and materials in one large laboratory permits a manageable student selection based upon preference and interest rather than some test score. It is interesting to observe students (adults or youngsters) at work in this environment where failure has been nullified and success amplified by the use of technology and methods predominant in our productive society. It is important to caution administrators not to divide this laboratory into three separate labs thus denying the student the daily observation of interactions of man—man, man—technology and technology—technology and the base of all these interactions in the sciences.





Evaluation Methods

Instructional Methods



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SUMMARY

CHAPTER VII

METHODS AND EVALUATION

INTRODUCTION

Regardless, whether the reader subscribes to the program described within this book or continues to interpret industry through six or less craft oriented experiences the least that can be expected from any industrial arts teacher, in terms of method and evaluation of student learning activities within the shop or laboratory, is that the teacher employ well validated and established industrial training methods and evaluation techniques. Even in a very limited interpretation of industry, there is no excuse for any industrial arts man to concentrate his teaching methods on the lecture, demonstration and the infrequent use of visual aids. Nor should he confine his evaluation of student performance to the paper and pencil test or the completed project.

How can any teacher profess to be interpreting industry and neglect to utilize the PERT method to evaluate his and the students' performance? Can any teacher fail to use reliability control to check the validity of prescribed units of study as they relate to the total educational objectives? Rather than subscribe to the discriminatory practice of assigning grades to a number of arbitrary variables as the student performs in the shop or laboratory and ignore the more individual and accurate assessment of each student's performance by using the critical incident method of evaluation—tested and proven within industry?

How can industrial arts teachers say they are interpreting industry or any segment of productive society when they ignore industries' validated personnel appraisal and development programs applicable to all levels of the pyramidal structure based upon each person's performance currently referred to as management by objectives? Can we confine ourselves to lectures and demonstrations and ignore the highly successful conference method, JIT and computer aided instruction? It is not recommended that any one method or evaluation of learning be employed at the expense of other methods. However, it is recommended that a lecture method can be easily replaced, with advantage to the instructor and the students, by taping this material and supplementing it with charts, single concept films, slides, or film strips. This, at least, would be more representative of the methods employed in our productive society—free the teacher for other responsible activities within the laboratory and permit the student to employ this taped material at the time he needs it most with the advantage of repeating any segments that are difficult to comprehend. This could be supplemented by pictorial programmed instructions or computer aided instruction.

The briefly described methods and evaluation techniques are treated more comprehensively in many texts. However, they are briefly described in this chapter to assist in comprehending the role of methods and evaluation in this proposed industrial arts program.

MANAGER—TEACHER

It is my contention that the old student-teacher relationship is not only archaic but that the teacher's responsibility has become so enlarged that he is just as responsible for the learning environment before students enter it as he is when the students are within the laboratory. This is what I mean by the manager-teacher function that should exist, both before students enter and after they enter the learning environment. Let us observe some of the management-teaching functions that would satisfy both situations:

1. Admittedly, the management-teaching function is concerned and accountable for the planning, organizing, motivating, directing and controlling of the learning environment. This does not mean just enthusiasm because only limited mileage can be gained from a zealous instructor.

2. The above must relate to the total objectives of the school and the course and its relationship to the student's objectives. This is accomplished through colleagues, supporting staff, students, funds, methods (described later), materials, machinery, interest of students and time allotted.

3. The above two steps precede this step of specifically identifying course objectives and its value to the students, which in fact is a return on his (the student's) investment of time and money in the course, which can be measured both by himself and his manager-teacher on a short term and long term basis in terms of growth and development within the course.

4. These processes are accomplished by adopting a large variety of methods designed to aid the student in learning and assisting him to evaluate himself. Programs can be designed to accommodate slow learners and fast learners (a most unfortunate term) at the same time giving each a selective sampling of options as previously described in the matrices. This should also be reflective of local community school policies, standards achieved, plans and programs offered and reported with integrity to the public before asking for increases in budget.

5. All four recommendations are predicated upon the recommend leadership that should be evident in the classroom, the local school and community school district. These terms were used consecutively but it does not mean that leadership consistency exists at all three levels of the community learning system, in fact, statistics and literature is abundant to reveal a comprehensive leadership system in the schools is neither apparent nor practiced in too many communities.

It is therefore my recommendation that the manager teacher be accountable for his or her students and their learning environment. Most of this can be accomplished if the enumerated five steps are observed with responsibility to immediate superiors of a viable and proven standard of performance, which means well taught students in a safe laboratory, representative of our cybernated society and closely related to the other learning situations represented within the school.

CONFERENCE METHOD

In the complex industrial plant, business or any productive institution of today there are many meetings, particularly of managerial or technical groups. The average member of management spends considerable time either leading meetings or acting as a participant. Because of the increasing sophisticated technologies and management practices, there is a definite trend toward more meetings. There are more laws today in such fields as wages and labor relations which management and union groups must consider. The technologies are more sophisticated, the industrial machine is more complicated and it follows that there is a need for more highly trained and informed managerial and technical personnel.

The safety movement, development of industrial relations, technological innovations have given rise to problems which every productive institution has found important to discuss in groups. If present day trends continue, the supervisor and technical specialist of tomorrow will be required to spend increasingly more of his time in meetings than he does today.

This conference method is concerned with the techniques and skills involved in leading discussion meetings, frequently referred to as conferences, and is recommended as a teaching method. Meetings may be classified as informational and discussion meetings. The informational meetings often take the form of a lecture and are characterized by the leader doing all or most of the talking. In such a meeting the leader has an objective which is to pass on certain information to the group. The leader has the information which the group lacks. He makes statements and perhaps uses visual or other aids to transmit this information to the group. There is usually a place in this type of meeting to ask questions for clarification. However, the transfer of information is all one way—from the leader to participants. If the leader was successful, all the participants have the information Communications research indicates that this method is most inadequate.

The discussion meetings, however, which are referred to as conferences are characterized by the participants sharing in the presentation of the information. In such a meeting, the leaders purpose is to get the group to reach an agreement about a problem through an exchange of ideas and opinions. The leader through a questioning procedure gets the group to draw on their knowledge and experience and contribute ideas and opinions about the problem. He further gets the group to evaluate these ideas and opinions and thereby reach agreement concerning the problem.

Further examination of the conference method reveals that there are several different situations with respect to the agreement which the leader attempts to get the group to reach during their discussion.

1. The situation in which the conclusion concerning the problem has already been arrived at and the leader's objective in the discussion is to get the group to accept this same conclusion.

2. The situation in which the leader has a problem for which the solution or decision is to be made by the group.

3. The situation in which the leader wants to get information from the group on which he or some others will later base a decision about some problem.

These three types of situations require three different discussion meetings.

1. Directed discussion.

2. Problem solving discussion.

3. Explorational meeting.

THE FOUR STEP PATTERN OF THE CONFERENCE METHOD

There is a process or pattern which has been found useful in leading discussion meetings. It consists of four steps which makes it possible for the meeting to move logically toward the reaching of the meeting objective. A brief description of the four steps follows:

1. The Introduction Step

In this step the meeting topic is introduced. The problem is defined, pertinent information is supplied and the objectives of the meeting are clarified. In accomplishing this, interest is aroused and attention is focused on the problem.

2. The Drawing Out Step

During this step ideas and opinions which have bearing on the problem are brought out. This includes information necessary to reach the objective. The ideas and opinions so drawn out are placed before the group for further discussion.

3. The Getting Agreement Step

Alternative solutions to the problem contained in the ideas drawn out in Step 2 are considered in this step. Evaluations are made, some proposals are rejected, others are accepted, and a final overall conclusion is agreed upon.

4. The Summary Step

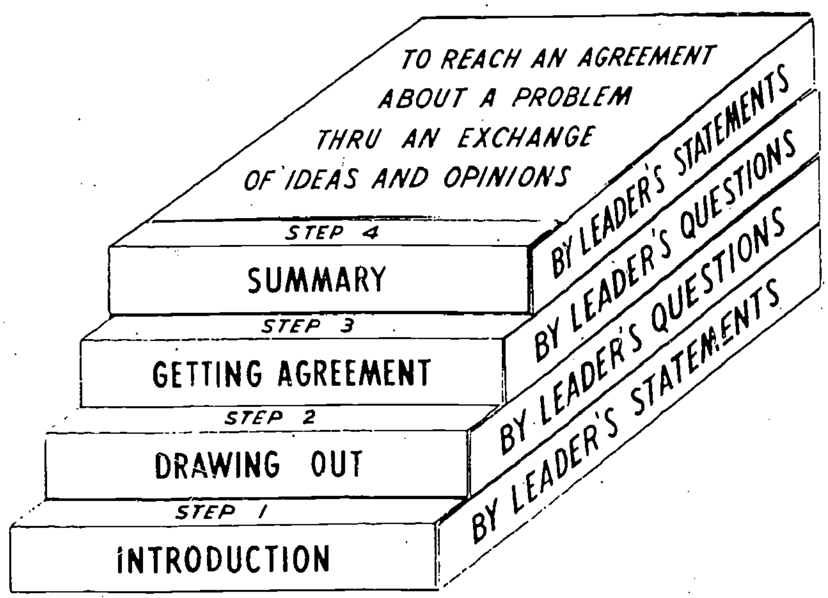
In this step the whole meeting is summed up. The major considerations leading to agreement and the conclusion itself are reviewed.

In carrying out the "four steps" the discussion leader uses two basic tools: statements and questions. He makes

TYPE OF MEETING	LEADER'S OBJECTIVE

DISCUSSION

DIRECTED	TO GET GROUP ACCEPTANCE OF A CONCLUSION
PROBLEM SOLVING	TO GET GROUP TO MAKE A DECISION
EXPLORATIONAL	TO GET INFORMATION FROM GROUP



FOUR STEP PATTERN FOR DISCUSSION MEETINGS

OBJECTIVE OF MEETING

TO GET THE SUPERVISORS AND FOREMAN TO DECIDE ON A COURSE OF ACTION THEY WOULD TAKE IN GETTING FULL COMPLIANCE WITH THE NEW SAFETY REGULATION.

GOOD	INDIFFERENT	POOR
YOU FELLOWS HAVE DONE A GOOD JOB ON OTHER TOUGH PROBLEMS-WHAT IDEAS DO YOU HAVE ON HOW WE CAN LICK THIS ONE ?	WHAT CAN WE DO ?	YOU FELLOWS HAVEN'T PAID ENOUGH ATTENTION TO THIS PROBLEM-WHAT ARE YOU GOING TO DO ABOUT IT ?
YOU ALL DID A SWELL JOB OF GETTING YOUR EMPLOYEES TO WEAR SAFETY SHOES-IS THERE ANYTHING WE DID THEN THAT MIGHT HELP US OVERCOME THIS PROBLEM ?	HOW DO YOU GUESS OTHER SUPERVISORS AND FOREMEN GET THEIR EMPLOYEES TO WEAR GOGGLES ?	PLANT MANAGEMENT IS CRITICIZING US FOR DOING A POOR JOB-WHAT ARE YOU GOING TO DO ABOUT IT ?
BASED ON YOUR EXPERIENCE WITH OTHER SIMILAR PROBLEMS HOW SHOULD WE TACKLE THIS ONE ?	THE SAFETY SECTION SAYS WE SHOULD PUT UP SOME SIGNS-WILL THAT HELP ?	I THINK WE SHOULD .... WHAT DO YOU THINK WE SHOULD DO ?
WE'VE GOT A REAL PROBLEM HERE -HAVE YOU FELLOWS ANY IDEAS ON HOW TO LICK IT ?	BILL, YOU'VE HAD A LOT OF EXPERIENCE IN OTHER PARTS OF THE PLANT WITH EMPLOYEES WEARING GOGGLES-HOW DID YOU GET THEM TO WEAR THEM ?	YOUR EFFORTS HAVE BEEN A FAILURE -WHAT SHOULD WE DO NOW ?
HOW DO YOU THINK WE SHOULD GO ABOUT GETTING OUR EMPLOYEES TO WEAR GOGGLES ?		BILL, HOW DO YOU GO ABOUT GETTING ALL OF YOUR PEOPLE TO COMPLY WITH THIS SAFETY RULE ?
		BILL, YOUR EMPLOYEES SEEM TO BE THE WORST-WHAT DO YOU PROPOSE DOING ?

WORDING OF OPENING QUESTIONS

introductory and lead-in statements and he makes summary statements. He asks discussion questions. He has a stock of auxiliary questions available as needed to guide and stimulate the discussion. The "Introduction" and "Summary" steps are accomplished mainly by the use of statements; the "Drawing Out" and "Getting Agreement" steps are handled mainly by use of questions.

Before he can get up and lead a discussion meeting successfully, however, the leader needs to prepare himself so that he can make the necessary statements and ask the questions which will constitute his leadership of the meeting. He must plan the meeting and prepare a guide which will help him to follow the plan.

Preparing a Leader's Guide

In describing this method, two reasons are given for the leader's failure to run a successful meeting: (1) the leader is not prepared and (2) the leader does not possess the necessary skill. This section describes a way in which a leader can prepare to lead a discussion meeting. This involves the use of a Meeting Leader's Preparation Form.

In beginning to outline his meeting, the leader should analyze the subject carefully. The questions on format under the sub-heading "Analysis of the Porblem" help the leader do this in an orderly fashion. The following comments on each questions will help clarify what the leader does with them.

Analysis of the Problem

1. What is the nature of the problem?

This concerns the reason for the meeting. The subjects discussed at most meetings pertain to some problem of the leader, the group, or both. The first step in preparing a meeting guide is to establish the exact nature of the present situation, or to identify clearly "what is wrong" which causes the leader to hold a meeting.

2. Should it be approached through a meeting?

The leader has an idea he can accomplish something through a meeting. However, at the outset he should double check and make sure a meeting is the appropriate way to approach the problem. Five sub-questions are provided to help the leader determine if a meeting is in order.

Are many involved? If many people are involved in the problem, a meeting may be the economical way to get a solution. If only one person is involved, another method such as J.I.T. or Pictorial Program Instruction may be better.

Will the group be open minded? If the individuals involved have very fixed ideas about the problem and chances of their listening to each other are few, a meeting may be a poor choice. However, if the participants can be expected to listen tolerantly to the other's views, a meeting is indicated.

Will a meeting save time? Some problems can be solved by some other method. Some small matters can be disposed of by direct teacher contact. If so, the total time spent by a group of participants in a meeting may not be justified. However, many problems are more quickly and satisfactorily settled by a group meeting face to face.

Should everyone get the same story? Some problems for instance policy problems, are not settled until everyone has a full and common understanding of what is involved. In such cases the meeting makes it possible for everyone to hear the same story, the same interpretation, or the same set of facts in the same light.

A "yes" answer to most of these sub-questions indicates that a meeting is in order.

3. What do you want to accomplish as a result of the meeting?

Having determined that a meeting is needed, the leader next wants to establish clearly what he hopes to accomplish in the meeting. He should decided what he wants the situation to be after the meeting is over. For instance, a teacher finds that housekeeping is poor because the appointed foremen are not spending enough time in their follow-up. That's the current situation. Now, after the meeting he wants to have the foremen spending more time on housekeeping follow-up. This change in action is what he wants to accomplish. Most experienced leaders say that establishing a clearly defined objective is one of the most important keys to a successful meeting.

4. What type of meeting should it be?

The leader must examine the purpose of his meeting and then decide what type of meeting will serve this purpose. The definitions previously described will serve to guide the leader's thinking.

5. Who should attend the meeting?

The leader must determine who should be present and notify them in time to avoid conflicts with other commitments.

6. Would it be helpful to give the participants time to think about the problem prior to the meeting?

The answer to this question depends on the purpose of the meeting and the individuals who will participate. Sometimes it is very helpful to have the members prethink the problem.

7. What should be the title of the meeting?

The wording of the title of the meeting is particularly important if it is announced in advance, since it can be effective in arousing interest and can shorten the process of defining the scope of the meetings. Usually the title should be brief and yet give an accurate idea of what the meeting is about.

8. What objectives should you give to the group?

The objectives which the leader will reveal to the group should be carefully worded. Sometimes the leader must hold back part of what he wishes to accomplish and not include it in the stated objectives. In certain situations, if the group knows what the leader's plans are, they may not be inclined to participate. Also in wording the objective, the leader should avoid anything which might offend the participants. Any criticism or inference that the participants are at fault should be avoided. For instance a leader's purpose may be to get the participants to change "poor" performance in a certain respect. However, he would announce that the objective was "to find ways to improve performance . . ."

9. What aspects of the problem need to be discussed by the group in order to accomplish the objectives of the meeting?

Here the leader must do some thinking about what must transpire in the meeting in order to get the desired results. He must decide what needs to be talked about in the meeting to accomplish his objectives.

Example: A laboratory teacher-manager is holding a meeting of his area foremen on the topic "Improving Daily Inventory." His objective is to get the foremen to recognize the need for action to improve accurate assessment of equipment before class starts and immediately after it ends. To reach this objective he might plan to consider the following aspects of the problem:

1. The importance of good inventory in the laboratory.

2. Reasons for poor inventory at the present time.

10. How will you draw out or present facts, ideas, or opinions related to these aspects?

Here the leader must decide if the group possesses the facts, ideas, and opinions needed for the discussion. If so, the leader can plan to draw them out by a questioning process. If they have inadequate experience and background, the leader may have to plan to present the material either through lecture or some other method so that the group can consider it. In answering this question, the leader makes some preliminary plans on how he will accomplish this.

Example: In answering this question, the laboratory teacher-manager in the above example would have to plan how he would get the chosen aspects of the inventory problem talked about. He might decide to:

1. Get the group to cite specific things that happen as a result of poor inventory control.

2. Get the group to develop a list of factors which can affect better laboratory inventory.

11. How will you get the group to evaluate these facts, ideas, or opinions in order to get acceptance of established conclusion or agreement on decision?

In answering this question the leader must plan how he will get the group to weigh the "pros" and "cons" of facts, ideas, and opinions drawn from the group. He needs to form an idea of how he will get the group to arrive at the most logical decision.

Example: In the above case the leader might plan to take each inventory problem listed by the group and get group agreement on whether or not it applies to their laboratory area.

Having thought through the above eleven questions the leader is in a much better position to make the notes he will need before him during the meeting. He will have a clearer idea of where he is going and how he is going to get there. The balance of the Meeting format is devoted to space in which the leader can record his guide notes. There should be a section for each of the four steps that go to make up a complete meeting. In the preceding section of this write-up, each of the four steps is discussed in detail. These sections should clarify how the leader goes about preparing his guide.

ROLE PLAYING

In order to evaluate role playing as a method of teaching industrial arts, it is important to understand the role theory itself. Role is defined as a pattern of behavior with any distinctive social position in the culture to which the individual belongs. Most roles identify both rights and duties of that particular social position. Roles cannot exist outside relationships with others and they are usually complementary and reciprocal. The behaviors inherent in each role serve to make social interaction an orderly and reliable process. Roles serve to fix responsibility and outline accepted codes of action in human contact situations.

With this background of the role theory, what application can be made to industrial arts education? In essence, the whole of the educational process is concerned with the way the individual plays his roles in life, how he fits his various roles and how these roles satisfy his needs. What more useful technique could be found to help the child or adult adapt to cultural and technological role expectations than to provide him with opportunities to try out various roles while minimizing the risks involved in this exploration.

To define role-playing as a teaching aid—it is an instructional technique whose aim is to increase understanding of human nature in the man-man, man-science and man-technology confrontations explored in industrial arts. It tends to cultivate an appreciation of why people act as they do; it seeks to provide insight into human relations problems and serves to bring about changes in attitudes and behavior. It is reality practice—practice in decision making and problem solving with consequences.

The problem of introducing role-playing into the industrial arts laboratory demands very careful preparation or the method falls flat. The steps necessary to insure success include a 4-step system of organization as follows:

1. PLAN—the teacher selects, or guides, in the choice of the problem to be explored, but then takes a nondirective role in the enactment.

2. ACCLIMATE—the proper atmosphere for exploration is created in the presentation of the problem—often through a story or case study. The students need to learn that it is safe to explore the situation suggested in the story or case study. The teacher's attitude must get through to the youth or adult as understanding and very objective.

3. ENACTMENT—the students actually work, or "play," through the situation presented in the introduction by exploring all the alternatives and possible behaviors, expressing whatever strong feelings are aroused. The techniques used in the enactment are many and varied.

4. FEEDBACK—here a discussion using the conference method may take place on the alternatives presented, with a study of the relative merits of each.

Steps 3 and 4 may be repeated several times, to lead to further generalizing.

One of the unique facets of role-playing is the "active participation in the situation"—the ENACTMENT' In the traditional classroom the student learns the right answers but often gains little or no understanding, or capacity, to apply them. Active participation, which involves a person testing his own understanding of a problem and trying new ways of solving it, serves to make learning meaningful and useful. However, participation could mean no more than a lifetime of repeating the same mistakes but for FEEDBACK, which interprets, for the individual, how his own behavior appears to others and how others are affected by this behavior. It helps an individual to identify his own "blind spots."

Referring back to the step in the organizational plan called the ENACTMENT—there are many techniques which can be used to insure participation and spontaneity. Sometimes, with older groups, script outlines are necessary in the beginning to help the participants to get across ideas. To ensure involvement of the whole class, those who are watching the enactment must be carefully briefed as to what to look for.

Sequential role-playing is a technique wherein serveral people take the "authority" role in turn—enhancing understanding of the problems involved.

Role reversal is when two players assume roles and later switch these roles.

Interrupted role-playing is used in conjunction with FEEDBACK—a scene is played, then discussed, then replayed in a different light.

Open-ended role-playing lets each individual work out a final decision.

Small unit role-playing is when a large group is divided into small groups each carrying out role enactment individually.

CASE STUDY

William James, a great teacher of philosophy at Harvard made a distinction between people who are "tough minded" and people who are "tender minded." By tough minded he meant people who have the zest to tackle hard problems. They dare to wrest useful truth from stubborn new facts.

Edwin F. Gay, the first Dean of the Harvard Business School was such a tough minded person. In 1908 the "Problem Method" as it was called then, was introduced at that school. Thus the "case method" of human relations was born. Like anything else this teaching method had its growing pains. Only business law was taught for twelve years by this method. Then other courses were added and slowly the method spread. The main problem during this time was the lack of material suitable for the use in this method.

What is the Case Method?

Donald R. Schoen and Philip A. Sprague try to answer this question. Their definition reads as follows: "In a broad sense we can define it by contrast with the so-called lecture method. Instead of textbooks, the case method uses descriptions of specific business situations. Instead of giving lectures, the teacher under the case method leads a discussion of these business situations. In other words real life problems are presented to the students for discussion and analysis." Forthis reason one can see that the method cannot be taught in a rigid way.

Depending on the material, the instructor might present a case, ask a few leading questions and let the class carry on the discussion. This might happen if there are more than one solution to a case.

If on the other hand there is a predetermined end, the instructor has then the problem of reaching this end. He must draw from the participants in finding that solution.

These two approaches are called the directive and non-directive approach.

There is also a combination of both. Here graduatlly agreement to major issues and significant problems emerge. The teacher will permit only discussions that will help to reach these agreements.

The students should have the opportunity to study the case independently before it is presented and discussed in class. According to Pigors and Pigors the teacher can help the students get off to a good start by showing himself in his true character, that is, as an ignorant man thinking, showing interest in and respect for what other people can contribute and ask productive questions.

We can see that the case method is a student participation method and student dominated. The teacher should play a minor role during discussion of a case. However he should be well prepared to answer questions that might follow when various ideas are brought up by the students. The teacher should also see that he keeps a certain order when presenting a case. He should take the following steps:

1. Outline of the situation.
2. Statement of the problem.
3. Exploration for solution
4. Selection of the best solution.
5. Summary.

The student will soon find out that the facts of real situations are very complex and no two individual persons perceive a case in the same way. The student thus must be willing to examine and re-examine the facts. He must be able to think clearly and willing to learn. He should be able to turn ideas into questions that will be productive. for investigation. The student should recognize what he does not know and ask questions that draw the missing knowledge from other minds. He must have the skill to appraise, test and use the ideas which he picks up.

What are the advantages of the case method?

1. The method is a very favorable learning situation because it is very motivating.

2. The student takes part in the discussion and does not play a passive role.

3. The student must think and go beyond his own environment to get solutions.

4. The student learns to sort ideas and data.

5. The student learns to speak freely and is able to express his ideas.

6. Under the case method, a student learns quicly the meaning of language in the subject.

7. The student is better prepared for practical life because he has studied real life situations by the case method.

What are the disadvantages of the case method?

1. No matter how realistic a case is presented it cannot be duplicated. The 100 percent correct picture gives only life experience of the case.

2. The case method is not the best way in teaching methodology such as accounting,

statistics, and other such subjects. The case method implies the existence of a problem. Concepts, and information for above subjects as a case is very hard to transmit to the learner.

3. If a case is handled poorly by the instructor it might be boring or frustrating to the student who seeks truth in traditional manner.

4. Like in any other teaching method, interest must be built up from time to time.

5. Evaluation of students is difficult. The instructor has to keep a record of each class period and participants in the discussion. Any non-participants over a time have to be drawn into more active participation. The instructor might even have to introduce a call list.

In conclusion some points should be brought out. The size of the class should not be too big but should have a fair size (10 to 20). A certain understanding is usually needed to solve the cases.

To reach the objective of the course the material has to be planned carefully and well in advance. Good case material is sometimes not available and experience is needed to compose a case. Too many variables are involved that can make a case a failure.

The world has become more and more complex under the impact of science and technology. It has become a necessity for the teacher to seek new ways and use new methods that have already been successful in providing a learning environment to a society that wants to be educated. The case method is one that has been tried for years and should be used as a method because it has been very satisfactory for the purpose of education.

J.I.T.–JOB INSTRUCTOR TRAINING

1. Definition

J.I.T. is a training program designed for operating equipment that requires short training time. This method is recomended for student leaders, student foremen and manager-teachers on how to instruct properly on the job. The term "leader or foreman" here meaning anyone in charge of students or who directs the learning situation of other students.

2. Advantages of J.I.T.

Consistent use of a scientific instruction technique will help the teacher-manager achieve an efficient operation with minimum effort by:

(a) Reducing waste of time and material.

(b) Increasing the quantity and improving the quality of the work.

(c) Avoiding unnecessary errors and improving morale.

(d) Reducing safety hazards.

Competence as a good training man is one of the leading qualities of a good teacher-manager.

3. When May J.I.T. Be Used?

This skill is necessary:

(a) For instructing new students.

(b) When directing students, issuing an order, putting over an idea when correcting a student.

(c) When initiating new techniques or opening new activities in the laboratory, or in any situation where immediate on-the-job training would be helpful.

4. The J.I.T. Method–Compared to Previous Approaches

Training of students is normally carried out in one of two ways–training on the job in the laboratory, or by formal off the job training out of the laboratory. Training on the job is most often used where a particular person is required to do a specific job. Much training in the past has been by-accident and good luck. Students have been placed in areas and left to learn. Gradually they learned, but it was usually expensive. Learning by mistakes resulted in much work to rectify, waste, higher accident rates, frequent delays and poor learning.

By contrast, the J.I.T. method is founded on these fundamentals:

(a) The teacher-manager organizes the job or activity before starting to instruct or asking a student leader to instruct.

(b) Students are instructed in what is expected of them.

(c) Each learner is shown the importance of his part in the process.

(d) All students are instructed one stage at a time and required to prove their understanding.

(e) There is a thorough follow-up of what is learned.

(f) There is a "check and recheck," to be sure the job is done as instructed.

(g) The method has "right the first time," as a basic aim.

5. Basic J.I.T. Method

I. Getting Ready to Instruct:

(a) Preparing a time table.

(b) Preparing an instruction outline.

(c) Preparing equipment.

(d) Preparing the work place.

II. How to Instruct:

Step 1. Prepare the student.

Step 2. Do the job yourself.

Step 3. Have the student do the job.

Step 4. Follow-up.

6. Job Instruction Training

The on-the-job instruction is usually given to first line workers by supervisors employing the methods taught in the Job Instructor Training course and can be used with equal success in industrial arts laboratories.

7. Specific Advantages of J.I.T.

- The Student becomes more accurate and learns more efficiently.

- Different levels of students are accommodated.

- The student is prepared to move to other activities and starts to learn by the discovery of methods.

- A trained student requires less constant and detailed supervision.

- Good habits are inculcated.

- Good training will often provide students who can act as substitutes when the teacher is busy elsewhere in the laboratory.

- J.I.T. will teach students to recognize more easily and to give special attention to unusual cases.

- Training fulfills a moral obligation to develop all students.

- Training promotes co-operation and teamwork.

-Training minimizes the difficulties caused by drop-outs.

- Training of others frees the instructor so that he may use other methods in other areas.

- Training preserves the advantages of past experience.

- An attempt at J.I.T. training enables you to find out sooner whether the student is suited to do more demanding jobs.

- Definite training develops students much more rapidly than the trial-and-error methods of letting them find out for themselves.

- Training gives a better basis on which the student may exercise his judgment.

- In the process of training, the instructor can learn a great deal about the capacity of the students.

- Trained students take more interest in their work.

8. General Aim and Plan of J.I.T.

The general aim of J.I.T. is the following:

Complete understanding,
To get a job done correctly,
Safely, quickly, and conscientiously.

The general plan is:

The immediate task is to make a trining time table for your unit. That will tell you who needs training on which job and by what date. The next requirement is to make instruction outlines of the jobs or topics where training is necessary. Finally, the "How to Instruct" plan is used in its entirety when giving instruction and watching the learner's reaction.

9. Some Considerations of the Learning Process

1. Value of sense impressions.

In presenting information, the value of each sense in the learning process should be considered

Sense	% Absorbed by the Sense
Sight	87.0%
Hearing	7.0%
Smell	3.5%
Touch	1.5%
Taste	1.0%

2. Limitations of telling.

Telling alone is not a very useful instructional method when the objective is to learn new skills. Many processes are difficult to describe in words, and seem more complicated when described.

3. Limitations of showing.

Showing with the actual tools and equipment which the student will use on the job is most desirable. However, even when seeing a job from the proper angle, most people don't get it. Many motions are hard to copy, tricky points are usually missed.

10. General Job Instruction Training Outline

I. Getting Ready to Instruct:

1. Prepare the training time table.

- Decide how much skill you expect the student to have within a specified time.

2. Prepare an instruction outline.

- Breakdown the job.

- List the important steps.

- Pick out the key points.

- Note all possible hazards.

3. Prepare the equipment.

- Have everything ready.

- Provide the right equipment, tools, and materials.

- Provide supplies, sufficient to do the job.

4. Prepare the work place.

- Have everything properly arranged.

- Just as the student will be expected to keep it.

II. How to Instruct:

Step 1. Prepare the Student

- Put him at ease.

- State the job. Give it a name.

- Find out what he already knows about the job.

- Get him interested in learning the job.

- Place him in correct position to observe the job.

Step 2. Do the job yourself.

- Tell + show + illustrate.

- One important step at a time.

- Stress each key point, emphasize hazards.

- Give reasons "why."

- No more than he can master.

- Do job again having him tell you what to do.

- Make sure he understands.

Step 3. Have him do the job.

- If a hazard is involve, have him tell you what he is going to do before he does it.

- Correct any errors instantly.

- Have him do the job again explaining what he is doing and why he is doing it.

- Question what, where, when, why, how and who.

- Continue until you know he knows.

Step 4. Follow-up.

- Put him on his own.

- Designate to whom he goes for help.

Check frequently and encourage questions.

- Taper off to normal instruction.

11. General J.I.T. Rule:

Until the learner has learned,

The instructor has not taught.

COMPUTER AIDED INSTRUCTION

I' INTRODUCTION

The computer is assuming an increasingly important role in our society. One can hardly look around without seeing some of its applications.

From the computer's early conception, industry and government recognized its value and made wise use of it. They have used the computer for everything from automation to information retrieval systems.

Unfortunately, education has not kept up with this trend. Only in recent years has it seen its way clear to use computers to do school administrative and accounting tasks. This was the beginning for many useful and exciting applications of the computer in education.

One of these applications is the use of the computer for instruction. Although teaching machines have been in use since the early 1920's, they have had little acceptance because of certain limitations. The unique capabilities of the computer may greatly reduce these limitations, making a teaching machine which is very similar to the teacher himself.

However, before we can discuss computerized teaching systems, we must bring about a better understanding of computers themselves.

BASIC COMPUTER THEORY

Simply said, a computer is a machine which handles information and solves problems with amazing speed. It handles all information in the form of numbers. It solves problems dealing with words by first changing them to numbers.

Computers can be classifed into two types according to the way they work.

DIGITAL COMPUTERS

Digital computers solve problems by counting. When a child counts on his fingers he is functioning in much the same way as a digital computer. The early Chinese abacus and the cash register are also fine examples of simple digital computers. The advantage of the electronic digital computer is that it can perform the arithmetic functions in a continuous operation and at extremely high rates of speed.

ANALOG COMPUTERS

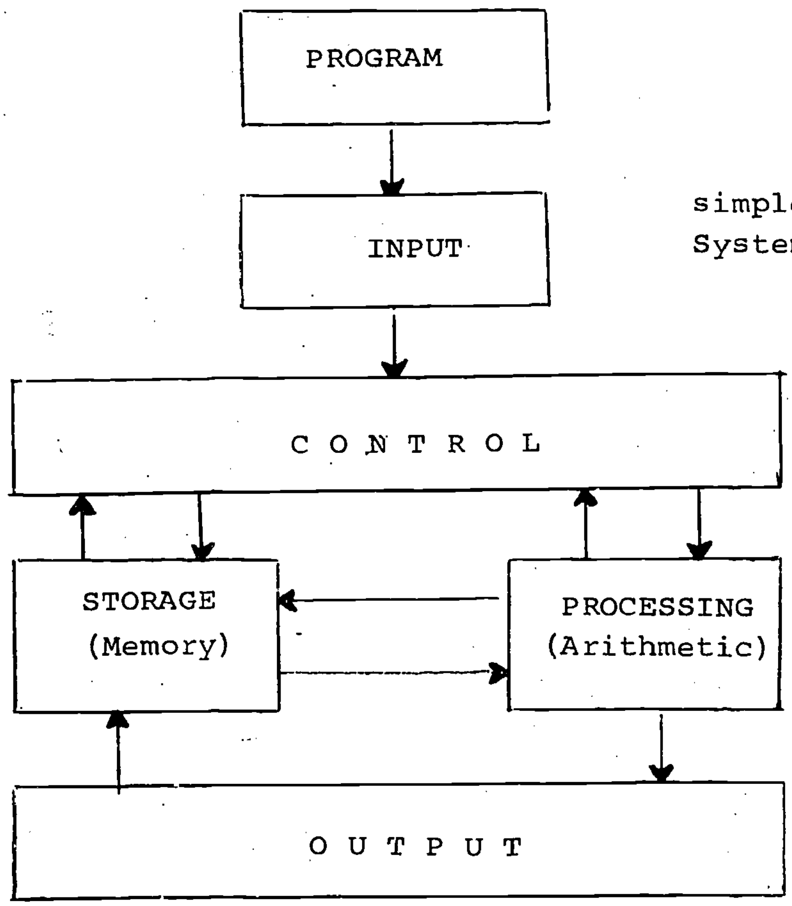
Analog computers solve problems by analogy. They are designed so that they develop a physical likeness of the problem to be solved. A thermometer is an analog computer because it indicates the temperature in terms of the height of the mercury in a glass tube. Another good example is a speedometer. Thus the faster the wheels of the car turn, the faster the gears of the speedometer revolve, resulting in a faster indicated speed.

PARTS OF A COMPUTER SYSTEM

Most general purpose computers consist of five major sections as shown in figure 1. The sections are: (1) The input which sends data and information to the memory. (2) The memory unit stores the data making it available at a later time. (3) The control section acts as a coordinator or switch between the memory and the arithmetic units. (4) The arithmetic unit performs calculations with the data received from the memory, as directed by the control unit. (5) The output records the finished information and delivers it to the computer operator in a useable form. Usually each of these sections is made up of a piece of machinery.

Input Equipment

The input section receives the program, which is a special language used to communicate with the computer, and transmits it to the control section. There are several types of input devices. These include: punch cards, magnetic ink, magnetic tape or disk, paper tape typewriter, cathode ray tube (light pen), optical scanners and voice.



Parts of a simple Computer System.

Control

The control section is a rather sophisticated electronic device which is capable of doing extremely fast switching an and monitoring of the entire computer system.

The control section is a rather sophisticated electronic device which is capable of doing extremely fast switching and monitoring of the entire computer system.

Arithmetic Section

This section is another complex piece of machinery. It receives the information from memory and stores it temporarily in its own internal storage device. Then it performs the mathematical computations and returns the information to memory or to the output.

Memory Section

Computer memory devices usually consist of magnetic equipment such as tape, disks, or cores which are capable of holding thousands of pieces of information for long periods of time.

Output Equipment

As with the input, output equipment for computers can be in many forms. They are: punch cards, magnetic tape, paper tape, typewriters, cathode ray tubes and plotters.

II. GENERAL DESCRIPTION OF THE IBM 1500 INSTRUCTIONAL SYSTEM AT THE UNIVERSITY OF ALBERTA

During the past year a number of television programs have presented a series of documentaries on the application of computers for teaching purposes. The IBM 1500 System is a computing system specifically designed for the purpose of instructing students. The degree to which the system can handle various kinds of subject matter, and various kinds of students is primarily a function of how the course author designs his teaching program. The system is capable of:

(a) presenting textual material on a display screen (cathode ray) at a rate determined by the learner and/or by the author,

(b) associating with each key of a typewriter keyboard special characters such as might be required for a foreign language course,

(c) presenting line drawings on the display screen,

(d) accepting responses from the student via the keyboard or by use of a light pen pointed at a lighted area of the screen,

(e) presenting within the context of a course, black and white or colored photographs,

(f) answer analysis, and corrective action depending upon the response given by the student, i.e., the course can be designed to individualize the teaching approach for given groups of students, and

(g) storage and retrieval of performance records for purposes of evaluating the course material and student progress.

The Entelek Corporation has documented over 250 instructional programs which are designed specifically for instructing students using a computer. A wide range of courses have been constructed by some institutions in the United States. In particular, we would note that such topics as foreign language instruction, mathematics, reading, electronics, physics, chemistry, medical patient management problems, cardiology courses, and many others have already been prepared.

III. THE COMPUTER, THE TERMINALS, AND THE PROGRAMMING LANGUAGES

The IBM 1500 Instructional System which is located on the ninth floor of the Education Building at the University of Alberta in Edmonton is a computer system specifically designed for computer-assisted-instructional use. It has as its base computer the IBM 1130 Computing System with 65,000 characters of core memory and about five million characters of on-line disc storage. The system has been expanded, by additional equipment and programming design, to allow up to thirty-two student learning stations to 'time share' the computing capability of the IBM 1130.

The system presently has eighteen student terminals. Each terminal can consist of any combination of a cathode-ray display screen and keyboard, a typewriter, a light pen, an image projector, and eventually an audio/play/record unit. Currently, sixteen terminals are composed of a cathode ray screen

and keyboard, a light pen, and an image projector. Two terminals are of the typewriter type. Delivery of the complementary audio units is also expected in the very near future. All components of the student station need not necessarily be used by a given course, but it is possible to integrate their use as the instructor desires.

Each student may progress at his own rate through a course without his rate affecting the position of the other students taking the same or different courses at the same time.

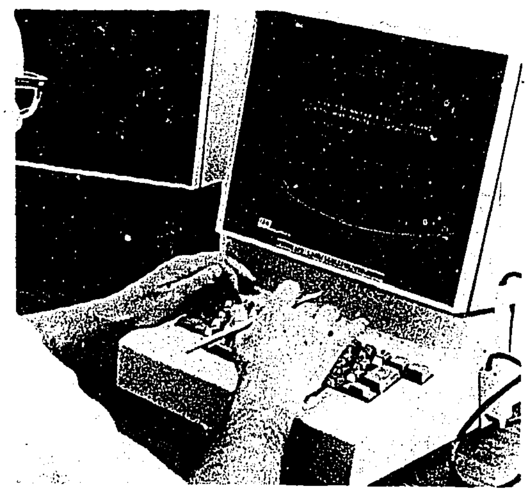
Two programming languages are normally used with the IBM 1500 Instructional System. Coursewriter II facilitates presentation of instructional material and questions as in a 'tutor-student' relationship. The Mathematical Algorithm Translator (MAT) facilitates primarily computational interaction between student and the computer thus providing a powerful tool for problem solving and mathematical experimentation. It is based on the Iverson system of mathematical notation.

IV SUGGESTED UTILIZATION OF THE SYSTEM

EXISTING COURSE INSTRUCTION

During the summer of 1968, Educational Psychology 502 was placed on the system. Approximately three hours of student learning time was made available in addition to extensive use of the system in its calculating mode.

It is suggested that initially, courses which contain relatively fixed material which an instructor has already carefully outlined in his notes, be placed on the computer. Since a considerable time is required to document the course material for purposes of programming, it is suggested that the instructor select a small unit of material to begin with until he gains confidence in the use of the system.



Course material which requires special drawings, (e.g., electronic symbols, flow diagrams, or any other type of line drawings) are easily accommodated. Similarly, for foreign language instruction the instructor may define his own set of characters to be used for the course. For example, if a Russian character set is required, it can be designed and implemented relatively simply.

Photographs which do not lend themselves to line drawings on the display screen can be photographed on 35mm slides and then rephotographed to 16mm film for viewing under program control. For example, a chest X-ray (which cannot be presented as a line drawing) would lend itself to film projector display.

The age groups for which the system can be used depends primarily upon the versatility of the author and his understanding of the learning processes and motor skills of the learner. The minimum motor skill required of the young student is the ability to point the light pen. The 'target' area is defined by the author. Thus, for handicapped children large targets may be defined, whereas for adults a small 'target' is best suited.

The system can easily be programmed to present the learner with a 'responsive' type learning situation in which the material being covered flows in a logical fashion as it would in the classroom. In contrast a number of programmers have already programmed learning situations around the 'simulation' paradigm. For example, an ammeter, a voltage source, and a resistance can be illustrated on the display screen. The student explores Ohm's Law by varying one or two of the parameters. Similarly, a number of 'decision' problems have been programmed. These problems simulate a medical patient management problem in which the student carries out a medical history, physical examination, laboratory tests, and therapy for a hypothetical patient.

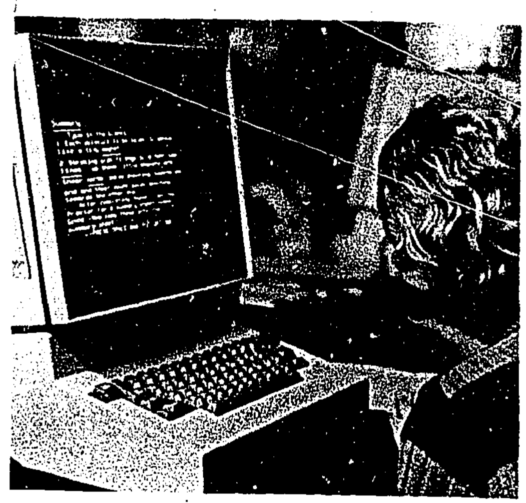
A little creativity on the part of the instructor and programmer can produce fascinating approaches to the presentation of any subject matter.

V. RESEARCH POTENTIAL OF THE SYSTEM

Since computer-assisted-instruction is still new in the educational field, the full research potential of the System has yet to be realized. Previous research has been devoted to the use of simple mechanical teaching machines. As a result the pedagogical approach has been primarily 'Skinnerian.' Since the Instructional System is vastly more flexible than a teaching machine, the researcher is free to use many other strategies.

1. INDIVIDUALIZATION: At the moment little is known concerning the relationship between learner characteristics and the optimum instructional strategy which should be used. This may now be studied.

2. INSTRUCTIONAL THEORY: Because the system can be programmed to handle a wide variety of instructional approaches, and



because of its ability to store all responses made by the student, the testing of various instructional theories becomes open to more precise investigation.

3. SPECIAL APPLICATION: There appears to be numerous areas of application which can now be investigated. For example, little is known of the usefulness of this system with groups having special learning problems, such as the mentally handicapped, the very bright, the under-privileged, and the illiterate adult.

4. THE PROGRAMMING LANGUAGES: Research could be undertaken in the area of relating the language of the system to the educational procedures used by instructors.

VI PREPARING COURSE MATERIAL FOR THE SYSTEM

A primary consideration is that the user decides precisely what he wishes to have the system do for him. From an instructor's point of view, he must know exactly what his objectives are, what subject matter is to be used, what concepts the student should possess before he encounters the new material, what methods or strategies of presenting the material are to be used, how the subject matter is to be sequenced, what behavior on the part of the student indicates the need for remedial work,

and what behavior indicates mastery of the material. These points are consistent with most ideas governing good teaching whether it be in the classroom or with the assistance of a computer.

1. OBJECTIVES: In the context of a given unit of subject matter the instructor should ask himself exactly what behavior he wishes his students to exhibit when they have mastered his material. It is very desirable that these objectives be stated in behavioral terms in order that they may be observed and, thus, lend themselves to some type of evaluation. The objectives are also, of course, directly related to the design of the testing instrument used to evaluate the competence of the student when he is finished.

In order that the instructor not lose sight of his objectives, it is suggested that these be noted in point form to the design of the course material. These objectives should be explicit and amenable to quantitative analysis permitting the instructor to answer the very important question, "Did the student learn what was intended?"

2. THE SUBJECT MATTER: Our suggestion here is that an instructor first prepare a topical outline of the most important concepts and sub-concepts he wishes to teach. This should also include concepts which are prerequisite to the new material to be taught. Finally, for each topic or concept (including the prerequisite concepts) a method of evaluation should be noted.

The course should be divided into a number of 'modules' or units. These 'modules' expand upon the concepts of the topical outline. Consideration should be given to the following in each module:

(a) An introduction to the concept,

(b) an indication of the prerequisite knowledges and skills required of the student,

(c) a pretest of the knowledge and skills the student requires in order to proceed with the new material,

(d) an organization or strategy for presenting the new material noting:

i what text is to appear on the display screen

ii what photographs are required

iii what type of response is to be requested from the student, i.e., keyboard or light pen

iv what specific responses are to be considered correct, and which are definitely incorrect.

(This latter section is similar to the preparation of a lesson for a television production. However, it is more detailed in that the instructor must anticipate and plan for individual student participation.)

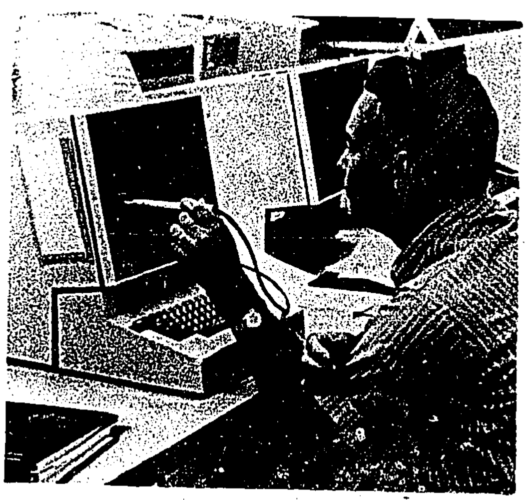
(e) a post-test should be prepared to evaluate the degree to which the objectives have been met. Care should be taken that this does not degenerate into the testing of simple facts, unless this is one of the objectives of the course. Consideration should be given to determining whether certain sections of the material should be presented again, or whether additional remedial material is required.

Instructors should avoid simply transferring their lecture notes to the display screen. In preparing subject matter, the instructor should consider himself directly faced by the student in a tutorial mode. His subject matter should then be, in effect, a simulation of an actual teacher-student interaction.

VII FACTS ABOUT THE EQUIPMENT USEFUL TO THE AUTHOR

Sometimes authors have misconceptions about the system and plan course modules assuming terminal characteristics which do not exist. The following are considerations the author should keep in mind while planning his course modules:

THE DISPLAY SCREEN. The display screen can hold a maximum of sixteen lines of text. When subscripts or superscripts are used an additional half line is used. A maximum of forty characters may be displayed in any line.



LINE DRAWINGS. Line drawings are constructed on the screen by the successive display of small rectangular picture-units called 'graphics.' Such a graphic occupies an area equivalent to three characters high and two characters wide.

CHARACTERS. For display of English text a 'standard system dictionary' exists. In addition when special character sets are required, as for example, a Russian character set or a shorthand character set, these may be designed and associated with specific keys of the keyboard.

LIGHT PEN. The light pen is sensitive to light and not a light source. Therefore, portions of the display screen to which the student is to point must contain a character or some other illuminated text or drawing. The pen cannot be used to point to a photograph on the image projector.

IMAGE PROJECTOR. The image projector can hold over a thousand 16mm photographs in color or black and white. Photographs may be accessed randomly. The procedure which is currently in use for having pictures made available for use with the computer is as follows:

(a) select the material you wish to present to the student

(b) have the material photographed on 35mm slides

(c) number and arrange for reproduction to 16mm.

Consultations with a professional photographer is suggested before an author begins his photography.

COMPUTER STORAGE. All course materials is stored on magnetic discs when it is to be used by the System. Each disc is worth about $100.00 and will hold approximately one million characters of text and computer instructions. A maximum of four discs containing course material and computer instruction can be accessed by the system at one time. Valuable course material should also be punched on cards for 'safety-backup.'

VIII. LEARNING STRATEGIES vs PROGRAMMING CAPABILITIES

Course material is programmed using the language called Coursewriter II. The nature of this language, to some extent, defines the limits within which learning strategies may be programmed. The following are some of the Coursewriter II characteristics which are relevant to the job of the author.

USING THE DISPLAY SCREEN

1. Each time material is displayed on the screen a 'display text' instruction is used. The text to be displayed is part of the computer instruction. Therefore, it is not possible to tell the computer to display the text stored in some memory location of the computer.

2. When the screen becomes full further display of text can be made to start at the top of the screen.

3. The author should provide sufficient time for a student to read and study a particular screen display. Appropriate pauses can be made before new text is presented. The pauses are timed to one tenth of a second

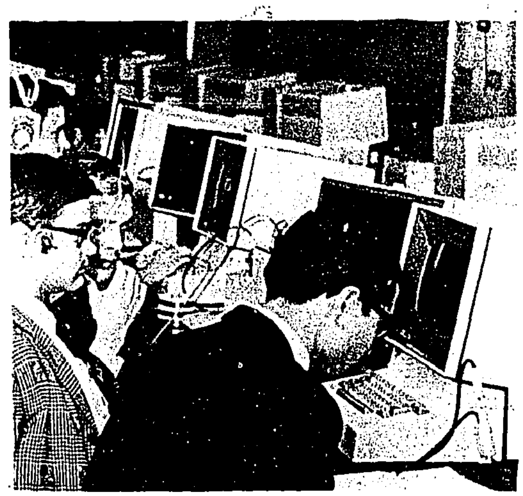
4. The whole screen or a portion of the screen may be erased. A clutered screen can be as distracting as a cluttered blackboard. In the classroom special attention-getting techniques are used unconsciously by the instructor, i.e., pointing to a portion of the blackboard, underlining, circling important material, etc. Similar techniques must be anticipated and planned for presentation on the screen.

5. It is possible to produce animated screen displays. However, it is suggested that such displays not be planned for until the author is fully conversant with the various system considerations that must be taken into account.

REQUESTING RESPONSES

1. A student may be requested to give a response using keyboard or the light pen. Both types of response modes permit the use of time parameters, i.e., a time indicating how long the computer should wait for the response from the student. If this time is exceeded the author may provide for special action to be taken. If the student responds within the specified time, usually the author will wish to determine the acceptability of the response.

2. The author will wish to specify the size of the lighted area to be used according to the motor coordination of the student.



3. When a keyboard response is requested, the computer instruction may contain a parameter indicating how many characters are to be accepted. If the student types in the number of characters indicated, the computer continues immediately with the course sequence. This is true even if the student attempts to type more than the number of characters specified. If fewer characters are typed, then the student will have to let the computer know he has finished typing.

ANSWER ANALYSIS

1. Coursewriter II language permits the use of procedures for identifying the acceptable answers. The author, however, must be prepared to define all the answers which he wishes to be accepted as correct, in addition to those he wishes to be considered incorrect. If all characters of an anticipated correct answer or wrong answer are not to be used for analyzing the incoming response, those characters which are to be used must be specified.

2. The analysis of answers is not easy when several words, a phrase, or a sentence is given by the student. Special computer programs called 'functions' are available to assist with the more complicated response analyses. The author should consult a 'Function Guide' before embarking on the use of complex answer analysis sequences.

PERT—THE NETWORK-BASED APPROACH TO CURRICULUM DEVELOPMENT

INTRODUCTION

Curricula by nature is prescriptive. Objectives are set forth which are intended to be implemented in the classroom. Too frequently there is a tendency, however, to lose sight of the whole due to fragmentation.

The teacher in the multigraded country classroom had an edge on her present day counterparts. The teacher in the small school was able to organize the curriculum content so that each discipline reinforced the others. The possibility existed, under those rather trying conditions, for learning to take place on an integrated front and toward a common goal.

Current trends depart from the ideal situation with curricula independently developed for a multiplicity of disciplines. While the content may be aimed at desirable, though vague, objectives, the meaningfulness to the student is lost because he is unable to grasp the total plan.

What is needed is some method of coordinating and integrating an educational program so that all of the members of the instructional staff can function as a teaching team, each making purposeful steps toward achievement of the total plan.

To develop a curriculum for a program requires a number of well formulated decisions. Implementation of the curriculum requires still more decisions. Each decision alters the total structure of the educational program. The problem is one of predicting the impact of the decision and optimizing the outcome.

Before launching into a possible solution to the problem it will be advantageous to look at the criteria for good decision making.

Ideally the decision making process should result in the optimum solution. Simon has noted decision makers are frequently unable to gather all of the relevant information and are often unable to handle all of the information that is available. Rather than optimizing, the tendency of decision makers is towards adoption of a solution that is "satisfactory." He suggests a good decision is derived in three stages; finding the occasion for decision making, finding possible courses of action, and choosing among the possible courses of action.

The manner in which decisions are made presents factors for consideration. Decisions made at the lowest level of the organizational structure tend to be the most easily implemented since in a sense the decision makers are committed to a point of view—a point supported by Leon Festinger. Observers of the decision making process contend that group decisions are of a higher quality than individual's decisions. The exception occurs when the individual decision maker is an expert in the area of concern. It is easy to conclude from the foregoing that an ideal decision might be one representing the concensus of a group of experts. The remainder of the description of this method is based on the premise that teachers make up such a group of experts.

Two points can now be made about the decision makers.

1. The decision makers must be competent in the area under consideration.

2. The decision maker must have responsibility for action in the area of concern.

Managers of industrial enterprises were for a long time plagued by a lack of adequate decision making data. Two information gathering systems were developed in 1957. E. I. Dupont de Nemours developed a plan known as the Critical Path Method or CPM and the U.S. Navy developed a plan known as Program Evaluation Review Technique (PERT). Both systems provided the long sought means of reflecting the interrelatedness of the multiplicity of small tasks making up projects of the magnitude of some handled by NASA and the Department of Defence. It is a combination of these two systems that I will attempt, in the following discussion, to relate to curriculum development.

Elements of the system are simple; a balloon which is referred to as an event and an arrow representing an activity. Together these elements are able to reflect a complex task with a multiplicity of interdependencies as shown in Figure 1.

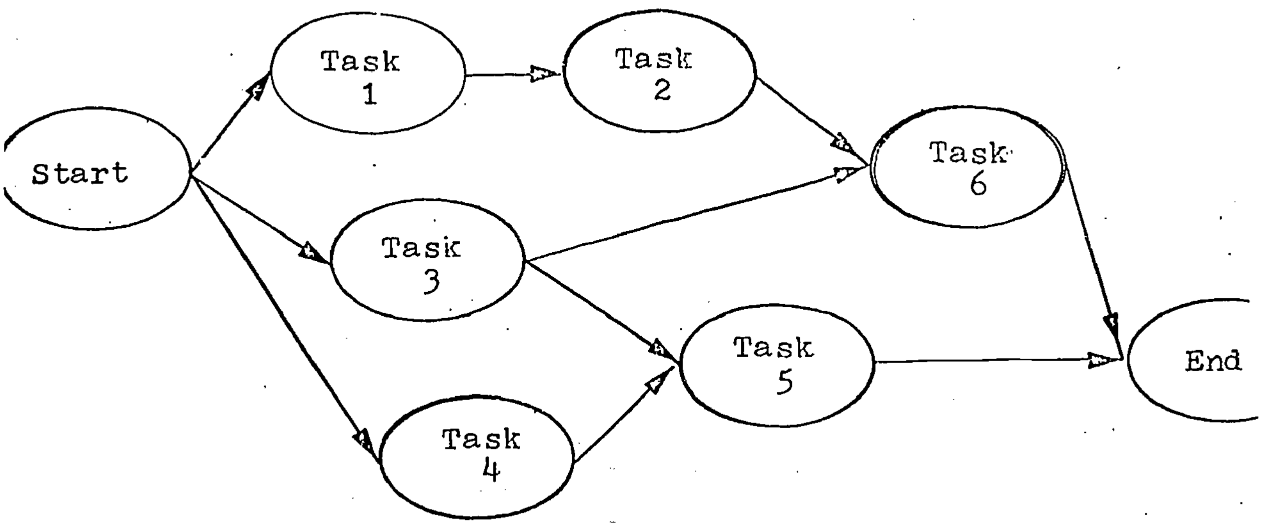


Figure 1. Network structure

Figure 2 identifies the relationships which exist between elements of the network.

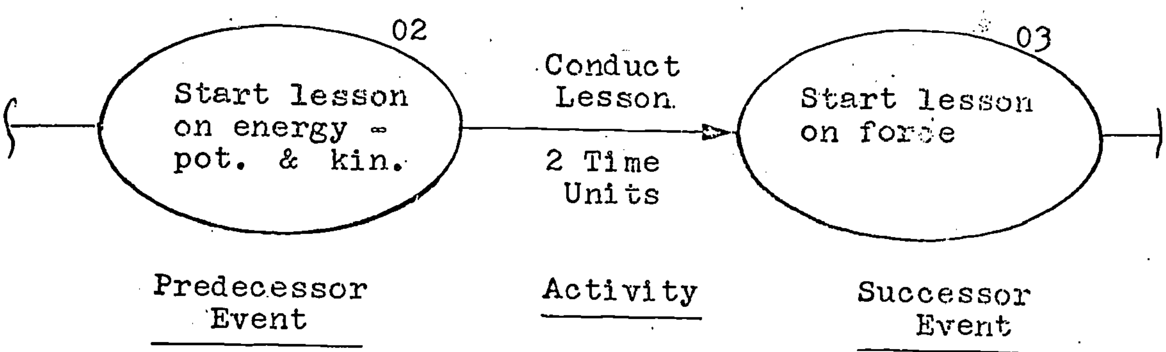


Figure 2. Network elements

In preparing networks certain criteria must be observed. Arrowheads on activity lines represent constraints imposed by predecessor events. Arrowheads leaving an event represent constraints imposed on successor events. With the exception of the start and end events of a network, all events have both predecessor and successor events.

Development of curriculum networks is best handled as a sequence of carefully integrated steps.

The first step involves development of a Course Breakdown Structure as shown in Figure 3. Working as a team, a group of teachers and administrators agrees on the assignment of teaching responsibilities for each of the requisite course objectives. The Course Breakdown Structure serves two purposes. First, it results in a list of specific objectives to be met by each member of the teaching team, and secondly, it eliminates redundancy since only one person is responsible for developing a specific concept.

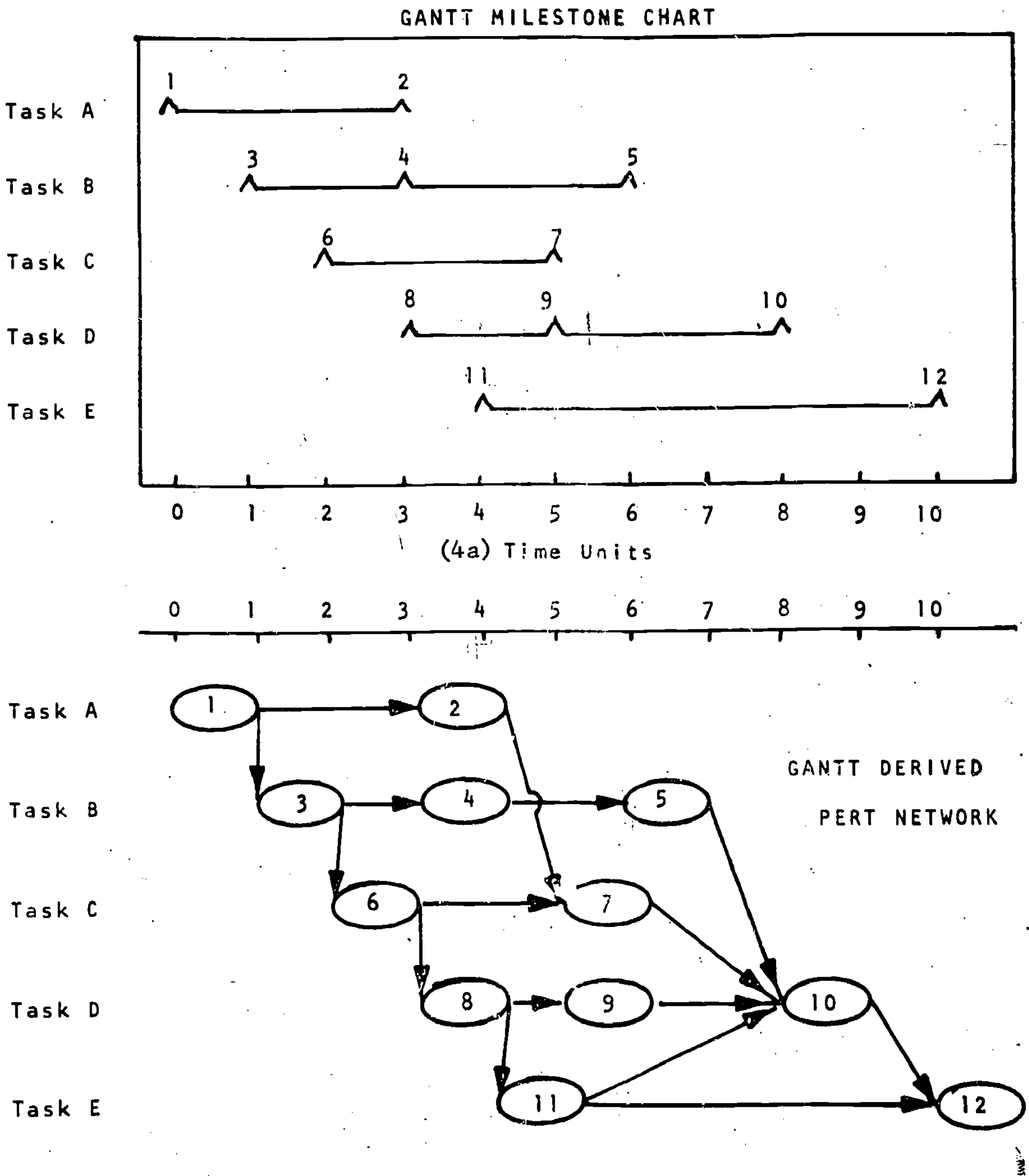
	Dept. A	Dept. B	Dept. C	Dept. D	Dept. E
Objective 1	✓				
Objective 2			✓		
Objective 3		✓			
Objective 4					✓
Objective 5				✓	
Objective 6	✓				
Objective 7				✓	

Figure 3. Course Breakdown Structure

In the second step the individual teacher's each translate their set of overall objectives into a list of specific course objectives as shown in Figure 4a. Miller recommends direct translation from the chart in Figure 4a to a network structure as shown in Figure 4b. By carefully connecting the events together the interrelatedness of the tasks reveals itself in an integrated structure. For a network representing a year of activity there should be 40-60 events. Based on an average of three lessons per event, this would constitute a full year of work.

The third step requires each teacher to actually estimate the length of time each activity will require, and further to insure that the total estimated time does not exceed the time available during the teaching year.

The time estimating procedure is simple. For those activities which are unlikely to have variability due to student differences, simply indicate the expected time for activity completion. Where uncertainty enters in as a consideration, a three time estimate is required. The three times are: the most optimistic time, the most pessimistic time, and the most likely time. The estimating criteria are as follows:



(4b) PERT network derived from a Gantt Milestone Chart (Miller, 1963, p. 29).

Lesson Topic:	Event No.
	Network No. -

OBJECTIVE

LESSON OUTLINE

Content	Resource Material
Process	

Remarks:	MATERIALS

1. The most optimistic time (a) is the best time and has a probability of occurrence of 0.01.

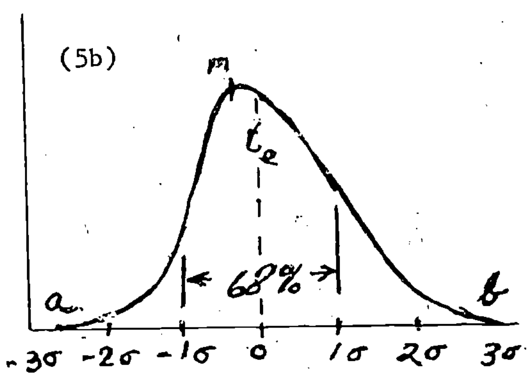
2. The most likely time (m) is the time estimated for the activity under normal classroom conditions.

3. The most pessimistic time (b) is the worst time lapse anticipated, barring acts of God. The probability of time (b) occurring is 0.01.

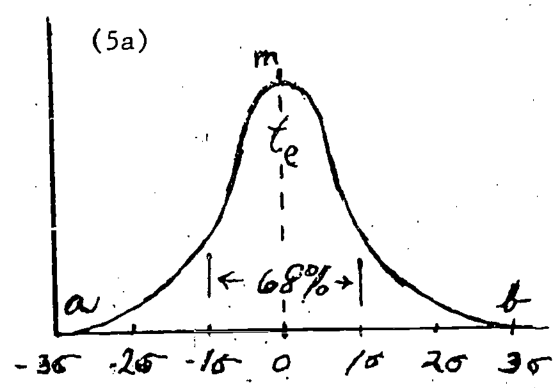
The expected activity to each even (t_c)is calculated by means of the following formula:

$$t_c = \frac{a + 4m + b}{6}$$

Since (b-a) represents the variance of the time estimates, 1/6 of the range represents an approximation of one standard deviation. The expected time tc represents the median of the time estimates. A normal distribution may be expected to follow the curve in Figure 5a. Practice indicates that there is a greater likelihood of events occurring late than early, therefore, the selection of the most likely time (m) determines the shape of the distribution. The result is seen in Figure 5b. In this light an estimate of 2, 5, and 8 time units represents a poor estimate. It is much more likely that the pessimistic time will deviate more widely from the most likely time than will the most optimistic time. A more realistic time estimate would be 4, 5, and 8 time units.



Probable distribution



Normal distribution

The fourth step in the network development sequence requires that all of the teachers involved in step one to meet again to view the structure which results when their individual networks are combined into a single unified structure. Areas of mutual concern are referred to as interface areas and special attention must be given to insuring that both tasks can be accomplished in a time mutually agreeable.

The total time for a specific path to be accomplished can be calculated by adding all of the expected times (tcs) along all constraining paths.

The interfacing of two networks is shown in Figure 6. This process is known as network validation. Once the network validation has been accomplished the networks are essentially complete and a pitorial representation has been developed which represents how the goals of a course curriculum are to be realized.

Further benefits, however, remain to be derived from the networks. The first step in streamlining the networks is to number sequentially each event in the network. For ease of dialogue between several areas it is desirable to assign a specific name or code to the network as a whole.

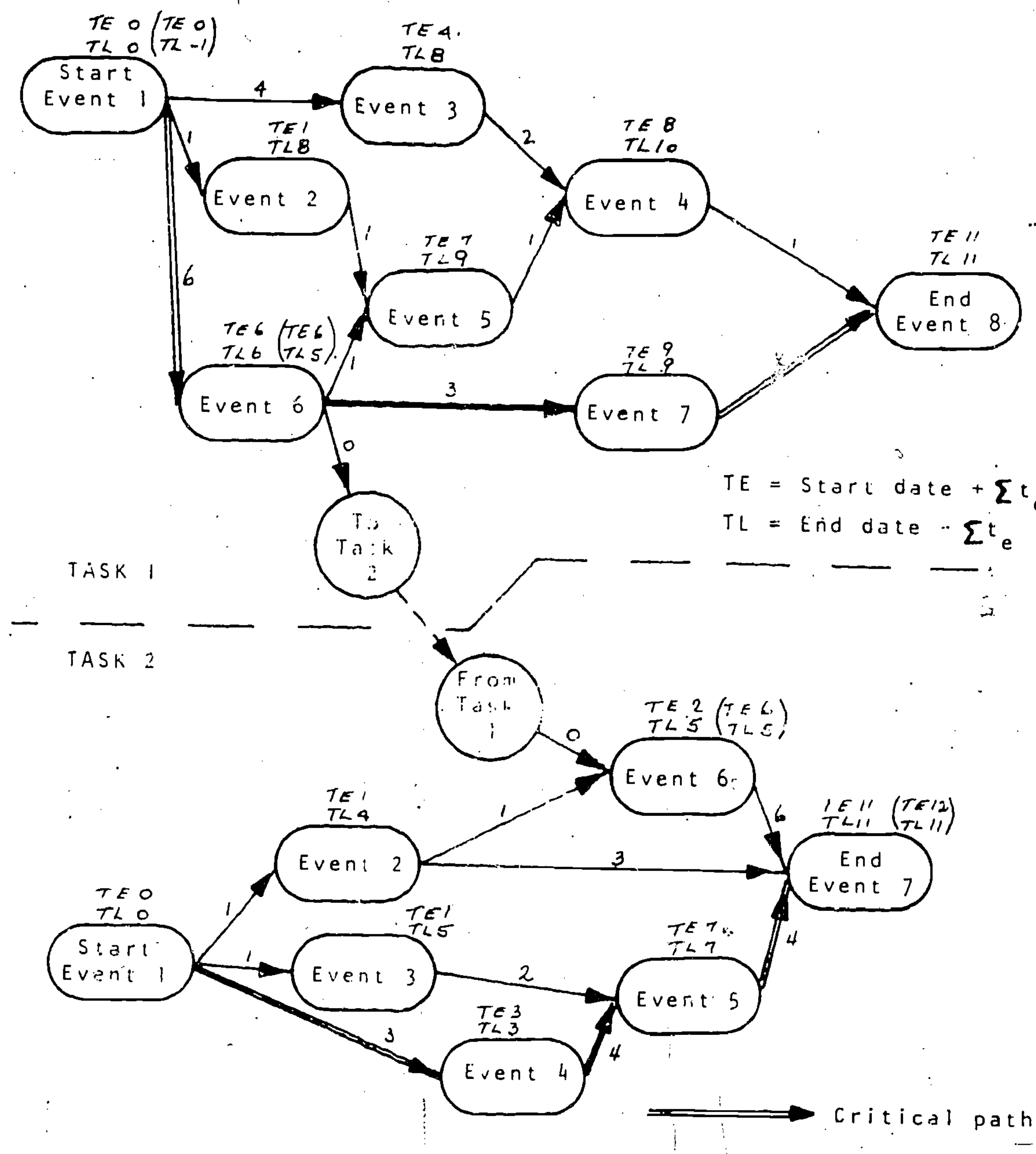


Figure 6. Network validation. The problem occurs when Event 6 of Task 1 places a constraint on **Event** 6 of Task 2 to such an extent that the Critical Path of Task 2 is shifted through Event 6. Figures in parentheses represent the timing after the interface of the two tasks.

Since each event represents a body of knowledge to be prepared, it is possible to prepare worksheets as a prelude to lesson development. A worksheet convenient for this purpose is shown in Figure 7. A worksheet must be prepared for each event in the network. For interface events, the worksheets should perhaps be prepared in committee.

Laboratory Phase ______________ Year ______________

Network code ________ Event No. ______________

Subject ______________ Number of lessons ______

Objectives to be achieved ______________

____

____

____

Specific content area	Remarks
______________	______________
______________	______________
______________	______________
______________	______________
______________	______________
______________	______________
______________	Methods
______________	______________
______________	______________
References	Audio-visual aids
______________	______________

Figure 7. Development Worksheet

The final step comes with implementation of the total plan. Completed lessons can be marked off on the network as progress is made. New areas of study are revealed to the teacher at a glance. Event numbers on the networks provide a ready index to a lesson plan file. Target dates for the completion of certain aspects of the course are available immediately. Planning for resource material can be made well in advance. Perhaps the greatest benefit derived from the fact that teachers know what is happening to their students in every other area of the school. If the initial premise is true—teachers are the best judge of what is relevant to their students—then the completed plan should admirably serve both the teachers and their students.

CRITICAL INCIDENT

General Objectives

Critical incident performance appraisal is the critical evaluation of each individual student's performance on an assigned task. It is one of the key aspects of an effective student evaluation program. The success of the appraisal, however, depends more on the teacher-manager than on a specific program or form. The primary purpose of this material, therefore, is to help the appraiser (the teacher-manager).

Appraisals may be used as a basis for:

1. Providing a record of individual student achievement.

2. Determining areas where student development may be most profitably applied.

3. Determining individual students' strong points and how they may be better utilized.

4. Keeping individual students informed of their performance on an assigned task and motivating them toward greater self-improvement.

5. Determining interests and abilities in an activity area.

6. Evaluating selection and placement on the matrices (previously described).

Since critical incident appraisal may be one method used to serve these needs, these needs should be considered in the development of a student appraisal program, and should be kept in mind when each appraisal is made. The critical appraisal programs are based on a form to be completed by the teacher-manager. While an effective appraisal can be made without the use of a form, a good form:

1. Helps the teacher-manager organize his thoughts more quickly.

2. Serves as a check list of important items to be covered.

3. Provides a uniform approach for easy comparison of individual students on similar factors with similar standards.

Listed below are five of the more important objectives considered in the development of the form.

1. The form should be COMPLETE, covering all important aspects of performance so it will serve all of the uses mentioned above.

2. It should be ORGANIZED in a simple and logical manner so it may be easily understood and administered.

3. All aspects of performance to be appraised should be CLEARLY DEFINED.

4. The form should provide for UNIFORMITY, yet be VERSATILE to meet differences found among various assigned tasks and students.

5. It should be designed to MEET THE NEEDS and uses for appraisals as mentioned above.

Selection of Factors to be Appraised

The selection of the factors to be used in the appraisal is most important. A survey would show some forms using as few as three broad factors and others using as many as 40 or 50 factors. Forms with only a few factors provide little help to the teacher-manager, while those with a large number of factors can be time consuming and may be confusing due to lack of organization and definition.

An analysis of factors used by a large number of institutions in our productive society for a variety of positions showed that nearly all factors can be classified into four basic areas:

1. RESULTS factors—consider the actual change in behavior while tasks were accomplished.

2. METHODS factors—the activities involved in getting the assigned task completed.

3. PERSONAL QUALITIES—the personal characteristics displayed by the individual student.

4. KNOW-HOW—the knowledge, skill, attitudes, and ability possessed by the individual student.

These four areas, however, are rather broad and are of little help toward making a thorough appraisal. Each area, therefore, has been broken down into a minimum number of separate, easily identifiable factors to provide a more thorough guide for the teacher-manager.

The outline which follows shows a rather complete set of factors and describes them very briefly. Obviously, the complete set is not necessary for every position or assigned task. Those factors which do not apply may be ommitted when applied to a specific group of tasks. Those selected are defined in detail appropriate for the tasks so that they may be clearly understood and uniformly applied. The factors with their definitions serve as a check list of points to be considered in the appraisal.

Some Advantages of the Outline

1. The outline approach provides for a complete, simple and organized coverage of the things to be appraised. It helps to show relationships between the factors which make them more meaningful.

2. The outline suggests the order in which the factors are to be appraised. RESULTS are reviewed first to establish what has been accomplished, a primary consideration for any task. The review of METHODS, second, is an analysis of how and why results were or were not achieved. The review of PERSONAL QUALITIES is a third analysis of both results and methods in terms of the personal element.

3. The KNOW-HOW factors provide for a fourth and final analysis. These factors are basic to performance in all the other areas and, as such, are particularly important. Note that these KNOW-HOW factors emphasize what an individual has or possesses more than how he does or performs as the other factors do.

RESULTS, METHODS and PERSONAL QUALITIES are used, therefore, to evaluate what the individual has done—his performance. KNOW-HOW, however, can better be used to evaluate what the individual needs or should have to improve his performance.

Note that any action for improvement will be in terms of these KNOW-HOW factors. Improvement will be in terms of further KNOWLEDGE or SKILL through instruction or exploratory experiences, or in terms of a change in ATTITUDE through coaching, always considering the ABILITY of the individual. The KNOW-HOW factors are used, therefore, for the summary and recommendations of action to be taken and improvements to be made.

4. The outline helps to separate METHODS problems from PERSONAL problems. Weaknesses in METHODS may suggest one type of action while weaknesses in PERSONAL QUALITIES probably will suggest a different approach and perhaps an entirely different solution. This type of analysis is necessary if the appraisal is to be used most effectively as a tool for guidance and development.

5. The outline provides a comprehensive, well-defined, and understandable list of factors or terms which can be helpful communication tools in day-to-day teaching and in the discussion of various student problems and activities.

GENERAL CRITICAL INCIDENT APPRAISAL OUTLINE

Key Words	Brief Description
RESULTS	**Performance Areas**
Volume	- the amount of tasks accomplished
Quality	- the excellence of the work completed
Economy	- the efficiency with which it was accomplished.
METHODS	
(Problem Solving Activities)	
Investigating	- the search for, collection and preparation of information to solve problem
Developing	- the recognition of needs and development of improvements to solve problem
Organizing	- the arrangement of tasks for most effective handling
Communicating	- the proper use and interpretation of information
Controlling	- the evaluation and follow-through to assure conformance to plan or procedure.
(Contact Activities)	
Coordinating	- the development of harmonious working relationships
Negotiating	- the making of arrangements with students in same activity and others
Representing	- representing the Industrial Arts area in communicating with other students
PERSONAL QUALITIES	
Stability-Maturity	- personal adjustment as in self-control, self-confidence, self-reliance
Cooperation	- tact, courtesy, diplomacy in getting along <u>with</u> others.
Persuasiveness	- capacity to influence and secure willing cooperation <u>from</u> others.
Management Attitude	- loyalty and fair play toward laboratory policy and students
Motivation - Drive	- ambition, physical energy, enthusiasm and interest in getting the task performed.
KNOW-HOW	**Development Area**
Knowledge	- the amount of information possessed, through other subject education, exploratory experience, or research
Skill	- the application and use of knowledge and abilities in a practical situation
Attitude - Interests	- personal feelings in respect to the laboratory, the task and other students
Ability	- basic mental and physical capacity.

HOW TO MAKE THE APPRAISAL

Timing

A schedule should be established to assure periodic critical incident appraisal of each individual student's performance. Appraisal should not be limited, however, to the schedule. Additional appraisals may be made when the teacher- manager considers them appropriate, whether for development task changes, movement on the matrix or movement to another activity area.

Securing Performance Information

Once the factors have been defined, the teacher-manager knows what information he needs for the critical incident appraisal. Whenever possible, this information should be secured directly from reports and personal observations. The teacher-manager may need to supplement his observations with information gained from other teachers who have worked with the student. All appropriate sources of information should be used.

Incidents of good and poor performance are easily forgotten if not immediately and systematically recorded. Brief notes kept systematically on both good and poor performance will prove very useful. Records on students are more significant than records on machines, materials or dollars. Ratings based on limited information or on hazy recollections are likely to be inaccurate.

Specific facts are always the most helpful. While opinion may be helpful, the specific performance incidents which determine the opinion are the more meaningful. Obviously, not all facts can or should be recorded. Incidents which are significant, which have a noticeable effect, are worthy of recording. These so-called "critical incidents" are helpful not only in clarifying ratings but also when planning action to be taken. Specific, factual information will help to make the appraisal more objective and easier. Care must be taken, however, not to permit isolated instances or unusual circumstances to unduly influence the rating.

The period covered by each appraisal should be clearly designated. The appraisal then must be based on performance during that specific period. Performance previous to the period and predictions of future performance are not to influence the appraisal.

Using the Graphic Scale

The level of performance on each factor is indicated on the form by making a check on a graphic scale. This scale is shown in an expanded form so that the brief description of each level can be included within the appropriate box.

MEETS REQUIREMENTS

Adequately Meets Req.	Meets Req. Very Well

BELOW

Unsatisfactory	Somewhat Below Req.

EXCEEDS

Consistently Exceeds Req.	Exceptional

Note that this scale is defined in terms of three basic levels. Performance either MEETS REQUIREMENTS, is BELOW, or EXCEEDS requirments. This distinction is usually simple to make.

In order to gain some further distinction, each of the three broad levels is divided into two parts, giving a total of six levels of performance. These six levels are also defined in terms of performance required in the position. The current performance level is indicated by placing a check within the space on the graphic scale which best represents actual performance in comparison with performance required.

Whenever there is lack of information concerning performance on a factor or when a factor does not apply to the task, there is a tendency for the rater simply to give an "average" rating. In either situation, the rater may omit the rating on the factor rather than make a rating which does not represent performance.

When the form is completed, these graphic ratings very quickly point out individual strengths and needs. Effort should be made to emphasize these differences on the graphic scales through the proper use of both high and low ratings This critical evaluation of individual differences is one of the primary purposes of the appraisal.

Note that no numerical values are placed on the scale. The appraisal is not a precision measurement, as numbers may suggest. Both research and experience indicate that a choice between six levels is about as precise as judgements permit. Six levels also seem to give as much distinction as necessary to meet the needs of the appraisal.

Establishing Performance Requirements

Performance requirements should be established at a level which is reasonable to expect and which is needed to satisfactorily accomplish the objectives of the activity area. Requirements should be established in keeping with the overall requirements and objectives of the laboratory and school including the objectives of growth and improvement.

For example, performance which "Adequately Meets Requirements" is at the lowest level acceptable and necessary to satisfactorily fulfill the task requirements. This level serves as the base or zero point for appraisal purposes. Performance at this level should be considered as satisfactory and should have no unsatisfactory implications even though the teacher-manager might hope and strive for performance above this level.

Average performance of a group should not determine requirements, since the average may be either above or below that necessary for requisite task performance. Also, requirements must be established assuming that individuals performing the task have been carefully oriented and indoctrinated. Obviously, pressure due to problems in related areas such as discipline, absenteeism or grading structure should not influence requirements and distort ratings.

Requirements must be established by the teacher-manager. Continuous review and adjustment is necessary, of course, to maintain maximum uniformity between teacher-managers and to keep requirements up to date with current objectives, improvements, and developments.

Using Explanatory Comments

Space for explanatory comments should be provided after each factor. Comments are particularly important in making the rating really meaningful and they should be included whenever possible. There are at least four types of comments which are helpful:

1. Specific incidents or data which show what the individual has actually done.

2. General statements of opinion stated as such to clarify more intangible areas.

3. Comments as to pertinence or importance of the factor.

4. Comments as to the adequacy of evidence or observations upon which the rating was made.

A brief comment should be made whenever a rating is omitted. Ratings which indicate the performance is BELOW or EXCEEDS requirements particularly call for comments either in the form of supporting evidence or explanation. This serves as a guide for the teacher-manager. Inability to cite examples or evidence of high or low performance is one indication that the rating should fall at the MEETS REQUIREMENTS level.

When appraising several students in similar tasks, there are advantages in reviewing them all at the same time. First, review all students on the first factor, then review all on the second factor, etc. This enables the appraiser to concentrate on the definition of each factor for all individuals at the same time and to use a standard which is uniform for everyone. It helps to emphasize relative difference between individuals which can then be reflected on the graphic scale.

Ratings and comments are made for RESULTS, METHODS and PERSONAL QUALITIES factors. The ratings and comments should then be reviewed with the following questions in mind:

1. Are strong and weak points properly emphasized or has there been a tendency to rate "down the middle"?

2. Was there a tendency to rate either too high or too low on the factors?

3. Are there sufficient comments to make the ratings meaningful?

4. Does the appraisal represent the best unbiased judgment of the student's performance?

Appraisal Summary and Recommendations

As indicated previously, the KNOW-HOW factors serve as a final analysis in the appraisal. The effect of KNOW-HOW on actual performance is, of course, reflected in the ratings on the previous areas. The emphasis placed on KNOW-HOW in this final analysis is for the purpose of summary and recommended action.

In order to help the appraiser to organize the summary and his recommendations, the back of the appraisal form should provide for a narrative summary on three separate items, all involving KNOW-HOW.

1. Significant changes since the last review

In the review of significant changes, the teacher-manager should indicate where improvements have been made; whether the individual is moving in the right direction. Has he gained further knowledge, developed further skills or improved in attitude? New interests expressed by the individual are to be mentioned here for consideration in development or placement.

2. Significant strong points

In the review of strong points, the teacher-manager should recommend how any special knowledge, skills, interests or abilities may be better utilized. They may be utilized in terms of the present tasks, additional assignments or responsibilities, matrix changes, transfers or promotions that will make the maximum use of the individual's capabilities.

3. Significant areas for improvement

A review of relatively weak areas suggests where further improvement might be desirable and most profitable. Development may not necessarily be centered on the student's weakest point, since some weak points may have little effect on total performance on the job. Development should be concentrated on those points where improvements will be most profitable to the total industrial arts objectives. Recommendations for development will be in terms of further knowledge, further skill or experience or change in attitude, all in keeping with the ability of the individual student.

When considering development, emphasis should be placed on self-development. What can the student do to improve himself? Recommendation should also be made in terms of what can be done by the teacher-manager in providing the facilities, atmosphere and assistance for maximum self-development.

VALUE ANALYSIS IN INDUSTRIAL ARTS

Introduction

When men give their imaginations free rein, ideas come from anywhere. This is one of the attitudes characterizing value analysis or value engineering, a relatively new concept intended to be applied by highly trained specialists to industrial endeavors to the end that both production and consumption operations w[illegible] be relieved of all unnecessary costs.

Value analysis is not a substitute for standard cost-reduction programs. It is, rather, a different kind of approach to the problem of obscure, hidden costs that shape the prices the consumer must pay. It is so different that it e[illegible] its own distinctive philosophies, e[illegible] basic steps, and approach. It is dedicated to no reduction in quality, safety, features, nor attractiveness of the end product. It operates out of a true understanding of the word "value," seeking always to pin-point maximum value and nor[illegible]l degree of value. It assesses value and is motivated accordingly in terms of the cyclic history of products, potential to expand market and jobs, elimination of human toil, national defense, and it brings the power of its most searching enquiry onto the study of new processes, production, and product materials.

Value analysis will, for example, spearhead studies of a product or a product component in sound, pre-planned steps. Function will be identified, evaluated by comparisons, and caused to yield value alternatives that represent no sacrifice. Value analysis proceeds according to a well phased job plan having seven distinct areas, from orientation to status summary and conclusion. The techniques of value analysis go to the heart of all considerations that may reveal problems, contain solutions or expedite emergence of climate and attitudes, favoring exhaustive investigation and enquiry. Value analysis takes the argument for "common sense" throughout, specifying precise uses for its techniques, emphasizing the employment of specialized knowledge, demanding well-ordered decision environments, insisting on freedom from the threat of personal loss for its advocates, calculating its effect on other work in the business, stipulating effective organization preparatory to its work, recognizing the absolute necessity for high qualifications, traits, characteristics, experience, and training in the analyst, and detailing work content, motivational n[illegible]ds, measurements, and tests to apply to the activities of the value analyst, engineer or consultant.

In actual practice, value analysis demonstrates its worth again and again in combatting unnecessary costs. We see this in the simple example of the replacement of the 79-cent "bull plug" for protecting detonators sent down oil-well pipes by a 7-cent tube of impregnated paper, whereas the conventional plug is a cigar-shaped tube fabricated from aluminum.

The value analysis technique can be of great value to any educator, but most especially to the industrial arts educator. To him falls the responsibility of relating the productive society to the student, and value analysis as a proven tool of business and industry should have a part in the curriculum. The questions is, of course, how do we as industrial arts teachers apply this technique? A few suggestions are given below:

I. AS A METHOD OF DEVELOPING CREATIVE THINKING

The industrial arts teacher has one of the greatest opportunities of any teacher in the system to help students develop this necessary skill. In order for a student to learn to think creatively, he must be guided through some experiences in his education that will give the opportunity to practice creative thinking. One way to do this would be to sit down [illegible]ith the students either individually or as a total group, or in two or three committees, and have them go through the steps of Blast, Create, and Refine in regards to some product, process, material or technology system. This should be preceded by some instruction about the process, and laying down some ground rules for discussion procedures. Most any of the above could be used, and by allowing free suggestions, with meaningful critiques, this could develop into a very meaningful learning experience for everyone in the group. The discussion would lead the students to consider the broad areas of thought employed by productive society by realizing that technology, materials, processes, market, manpower, equipment, costs and sales all have a role in production of a product or service. The process could be further refined by having the students pursue all the implications that arise in production and report to the group on the phase that interests them or that they are assigned. A thorough study of the many facets of industry could be generated just from one value analysis session of one product or service. The only limitation to this process for generating interest and activity about productive society is the imagination of the instructor.

II. AS A METHOD OF ANALYZING LABORATORY, PRODUCTS OR ACTIVITIES

Industrial arts teachers are sometimes at a loss when it comes to finding or suggesting meaningful tasks or activities for students to create in their laboratories. Why not let the students create their own product ideas? Begin by explaining the value analysis procedure then practice it a few times to be certain they understand its use. Then give them some product with the challenge to improve it and make it cheaper and easier. One student may choose to cast it, another may choose to bend it or form it from metal stock, while another may try to make it by weld construction. The advantages and disadvantages of each process can then be studied with a specific R & D goal in mind, and the instruction becomes more meaningful. Again, only the teacher's imagination can limit the use of value analysis in industrial arts product and activity evaluation.

III. AS A METHOD OF ANALYZING AND EVALUATING COURSE CONTENT

While value analysis, as used by business and industry, is utilized mainly for analyzing products to reduce unnecessary cost, the group approach coupled with the penetrating questions can be used to analyze most anything. Industrial arts education is under close scrutiny today and industrial arts educators must begin to refine their programs and aims, just as productive society must refine their products and services. For example, the questions: What is it? What does it cost? What does it do? What else will do? What will that cost? and which three of the alternatives shows the greatest differences between "cost" and "value"? could be applied to any area we teach in industrial arts. If we have the nerve to ask these types of questions, we will probably be rudely awakened to the irrelevancy of most of our programs. However, by using value analyais or some form of it, we can arrive at the answers we need to start becoming relevant. If we are going to teach about industry, or productive society, then we should apply its techniques to evaluate the job we are doing as well as teaching the techniques themselves.

Perhaps the greatest contribution value analysis can have in the laboratory, is the attitude and state of mind it radiates to the user. Teachers have long planned their classroom activities in line with "accepted" procedures, not realizing that there may be another way of doing something. The questioning, challenging, and organized mind of the value analyst allows him to become creative, and innovation is the rule, rather than the exception. In order for teachers, especially industrial arts teachers, to interpret productive society to students, a knowledge of value analysis, and other tools of business and industry, are essential.

APPLICATION OF RELIABILITY TO INDUSTRIAL ARTS

Introduction

In industry, or other institutions of productive society, when a process, equipment or a device works well, and works whenever it is called upon to do the job for which it was designed, such equipment or devices are called reliable.

I do not want to infer or take the position that manufacturing a product made of materials in industry is the same as our schools educating students with all their infinite human variables. However, this section will try to make a case to compare industry and its reliability and the segment of general education, industrial arts education, and its reliability.

In orfer to achieve reliability in a product, industry will design the product with standards or tolerances that they can check with quality control methods and be able to predict the probability of a reliable product. In education we have set up objectives as the goals of our program, (productive phase) and the program is in turn supposed to turn out a finished product—a well educated student.

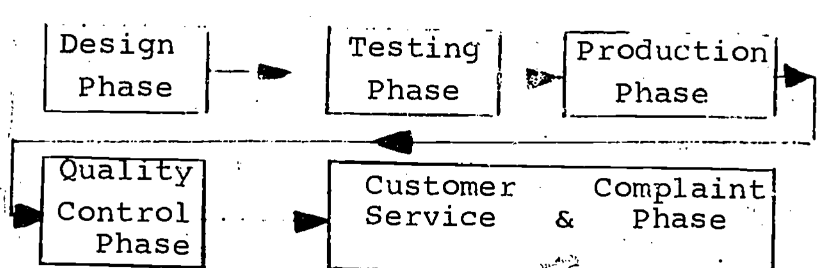
At this point one would wonder if it is the goal of our industrial arts program or the program itself that lacks reliability. Of course we all know that every industrial arts program throughout the country varies considerably from city to city and all have various degrees of sophistication from very good programs to very weak ones with poor programs. It is not the concern of this section to judge the reliability of our objectives and program, but to set up a hypothetical case— that an industrial arts program be designed as industry would design a product for reliability.

When industry sets up a reliability program they have definite phases that the product will pass through before the product could acquire reliability. They are as follows:

Phase I

In industry the design engineers will design a product or service from consumer research studies on what the public wants and will pay for, with reliability in mind. But when we consider any model of modern cybernated society we know that technology, materials, processes, management, testing, manufacturing, quality control, purchasing, finance, sales, and contracts, as well as engineering all overlap and affect the reliability of the final product or service. Therefore, the end result of reliability in a product or service is the effort of team work of all major departments of business or industry. So in designing a new program for industrial arts with reliability in mind, we must consider the school board, school superintendent, principal, school finance and purchasing department, other teachers, industrial arts directors, and the industrial arts instructor, since they all will affect the reliability of the program. Probably every industrial arts instructor realizes that if he doesn't have the backing of the administration and his colleagues and money to finance a program, he will not go far in setting up a new program or even updating the old program so that it would have more reliability.

The overall design of industrial arts programs therefore would require the team work of the entire school organization. The new program with objectives and goals would have to be designed and worded in such away so that they could be measured for reliability.



Phase II

The next phase of product reliability in industry would be testing the product for reliability. Here the model industrial arts program could be field-tested to see if it did what it was designed to do. We have some of this going on presently thoughout the North American continent. Just to mention a few, the American Industry approach at Stout State University, the Industrial Technology approach at Plattville State University, the Orchestrated Systems approach to Industrial Education at Indiana State University, the Maryland Plan at the University of Maryland, the Alberta Plan with four phases, University of Alberta, Edmonton, Alberta and the Galaxy Plan in the Detroit Public Schools.

Phase III

After the testing phase, industry would go ahead and start producing the product or service, providing there was a market. Throughout the production phase quality controls are set up and inspections are made by the different techniques of inspections through the use of gauge checking, comparative testing, frequency distribution, and correct sampling procedures. With these quality control methods, the understanding and cooperation of management, and use of total communication, rigid tolerances can be held and it will be possible to predict the reliability of the product.

Phase IV

In education the actual production of a product would be augmenting the recommended industrial arts program in this text in an entire school system as part of the general education. In order that education, particularly industrial arts education, can be measured on a more reliable basis, we will have to set up some type of "quality control." This means we will have to have some type of standardized measurement that can be used to evaluate the performance of the program. As it is now we rely on someone's opinion that is generally subjective and not too objective. How can this be accomplished? By having objectives that lend themselves to evaluation and measurement.

Apparently if we have a situation where we are not doing the job we are supposed to accomplish, many changes will have to be made. If our goals (objectives) are correct, then we will have to find means of meeting the goals. If our goals--objectives truly represent what we should be doing, then the goals must be evaluated in some standard manner of performance and the performance facts systematically collected. When we can do this then the day may come whe we can consider the possibility of reliability.

Since some industrial arts general objectives are difficult to measure in a standard and systematic way, then perhaps we should add one more objective that would embrace all the other industrial arts objectives:

Task and Course Behavioral Objective:

Industrial arts should obtain and realize all other objectives through measured student behavioral changes made on each task satisfactorily performed in the laboratory.

Robert Mager's book, *Preparing Instructional Objectives,* states that a set of behavioral objectives must indicate the following three items:

1. The terminal behavior expected of the student.

2. The conditions under which the behavior will be performed.

3. The minimal acceptable performance.

This means that if industrial arts education is going to improve their evaluation of present level of student competence. Then the student will proceed to perform the individualized task. He is told exactly what terminal behavior is expected of him in the behavioral objective, how to learn this behavior, and the minimal acceptable performance. After

completion of the task the student could take a self test to check himself on what he has learned. If he feels he did not achieve the stated behavioral objective of the task, then he may want to review or go back and do the task again. When the student feels he is ready he will take the post-test.

The first question that would come to every industrial arts laboratory teacher's mind "But where and how does one get the time to prepare an individualized instructional packet for every task to be learned in this course?" The author does not have any clear or pat answer—however, earlier in this text I mentioned that in industry the overall reliability picture was the result of team work. For the one lab teacher to construct an entire new course and implement the course with the necessary new methods without some help would be nearly an impossible task. If the administration is willing to back up the industrial arts program, then possibly a paid summer workshop would be a solution. (State or federal agencies or professional organizations).

Now it becomes quite apparent that if industrial arts courses are to be taught on some type of individualized basis, then our program will have to incorporate a variety of teaching methods. Many industrial arts labs are lacking in the necessary instructional hardware that will be needed. The following methods can be used to implement the individualized instruction and will be described in the next section of this chapter.

1. 8mm single concept film in easy to use cassetts, viewed in a projection box.

... in student operated projection box.

4. Overhead projector with transparencies for student use as well as the teacher.

5. Pre-recorded magnetic tape instruction if the visual is not nece[illegible]ry.

6. Study pictures to accompany an individual unit.

7. Multi media carousels for students that may combine any of the above.

With industrial arts programs basically oriented on an individualized instruction basis and with all concepts and tasks pre-tested and post-tested, with a minimal acceptable performance of each task, it can be readily foreseen that with this type of standardized evaluation of performance one could have some resemblance of quality control.

With more and better facts of performance collected over a period of time, the higher the probability of good reliability for an industrial arts program.

Phase V

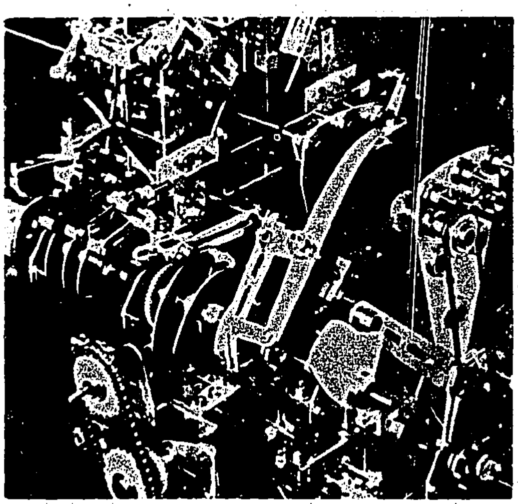
The final phase of any reliability program in industry would be the customer service and complaint phase. Here industry gets the feedback from the buyer, customer, and user of the product or service. This area would usually include the maintenance of the product.

In industrial arts education you are sure to get this, usually free of charge. Many parents will tell you that they think the industrial arts program is good and they are really glad that their Johnnie or Jane is so fortunate to have the opportunity to learn in a laboratory like your program now has. Probably very few realize that if the recommended program could be inaugurated tomorrow that many present programs might make a pretty poor showing in comparison to what it really should be. Also, if this type of industrial arts program with individualized instruction backed with every conceivable combination of instructional hardware and software were in effect, we might gain more industrial as well as professional respectability, as well as some degree of reliability.

AUDIO VISUAL

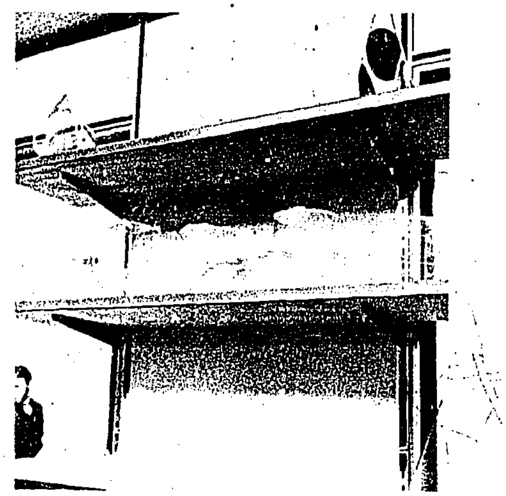
Introduction

Possibly this section of the chapter could be referred to as automated learning or instructional technology. However, the term audio visual is used because of its predominent usage and is intended to mean more than the use of machines to aid instruction. The industrial arts program described in this text adheres to the philosophy that any device or method—yes, specially designed software, books, pictorial programmed instructions and models are all encompassed in this section only as a quick perusal of the number of aids available to make the teaching of industrial arts more meaningful. In fact, the word available is more important than number of pieces of



equipment or software. The industrial arts student must have available whenever the need arises, the requisite supplementary audio visual software or computer assisted instructional devices to reinforce, introduce or further supplement his or her learning and thereby free the teacher-manager for more emergent tasks.

This centralized "X" bench illustrates some of the equipment available and the necessary software stored and coordinated with the student's level and area of learning.



It could very well be a model—as is illustrated in this and other pictures throughout this text, that is the very principle that this program emphasizes. Science and technology are not the exclusive province of science and math classes but are in evidence in all of productive society and therefore mandate that if technology is to be studied then materials, technologies and processes must be used to aid the learner, thus the following objectives and samples.

1. To be able to present audio-visual media to teachers in an organized procedure, giving the teacher-manager a background, application and techniques for using each piece of equipment.

2. To be able to construct your thinking on how audio-visual aids and software will improve

your efficiency as a teacher by giving an example of how you can incorporate these into your area.

3. To be able to compare the state of the art of audio-visual aids used in education as compared to productive society.

4. Be able to organize into a workable module the necessary equipment and programs to complement each area of laboratory instruction.

5. Be able to develop a statement involving instructional technology media for the future.

The 8mm, Super 8, Silent and Sound

In 1961 manufacturers introduced 8mm sound projectors to the commercial market. These projectors were capable of recording and reproducing sound via magnetic tracks on the film itself. Although magnetic sound tracks on 8mm film had existed previously they were not marketably feasible.

Industry seemed to be the first organization to respond to the advantages of 8mm sound film. Such firms as Ford, Caterpiller and Do-all make use of 8mm sound in their internal sales programs.

In 1965 a Japanese company introduced a new 8mm film with an area 50% larger than conventional 8mm film. This brings us to the present with audio super 8 and a multitude of production and viewing equipment.

The efficiency of today's simplified 8mm equipment allows a wide variety of uses limited only by the imagination of the user.

Industrial arts teacher-managers should be aware of the tremendous potential of this media.

The development of the audio "Super 8 Cartridge" film system has provided the teacher with a valuable teaching device ready and waiting for application.

Advantages

1. Ease of operation which allows the cartridge to be placed in the hands of the student.

2. Films provide "front seats" for many learning experiences.

3. The equipment needed for this media is relatively inexpensive.

4. The loops can easily be produced by the teacher if a simple planning sequence is followed.

5. May be used in study carrels or for large group instruction.

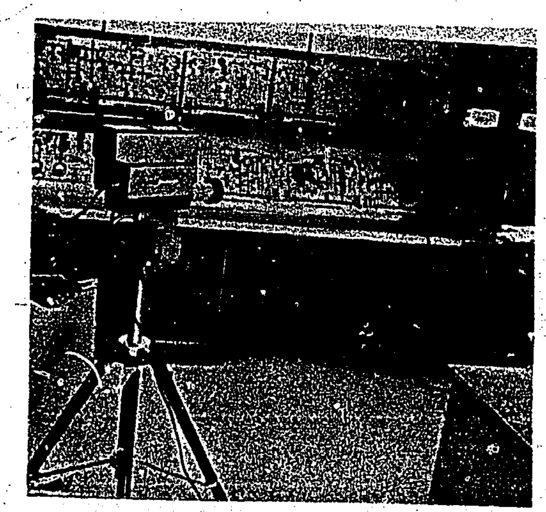
Techniques

1. Telescopic photography utilizing the telescopic lens, to give close-up views.

2. Stop motion permits the study of movement, or the results of movement at any given instant.

VIDEO TAPE RECORDER

Teaching with the video tape recorder is commonly called micro-teaching. Micro-teaching may be defined as a vehicle for research on the teaching-learning process and teacher behavior which provides controlled laboratory-teaching experience.



The control focus of micro-teaching is to improve the effectiveness of learning experiences for students through the best possible controlled teaching procedures. While micro-teaching has been employed chiefly for teacher training, it has other advantages for bringing audio visual information into the classroom.

Advantages.

1. Improvement of teaching techniques.

2. Teacher and student self-evaluation

3. Immediate feedback and reinforcement of audio and visual information.

4. Large group or small group instruction.

5. Before class preparation of an experiment or concept.

6. It is portable and versatile.

7. Students can operate it.

8. Close-up views of hard-to-see demonstrations.

9. Students can progress at their own rate by viewing and revising information.

10. Access to instructional programs from the several national libraries of tapes for in-class use or independent study by students.

Applications

1. Preparation of an experiment.

2. Field trips recorded.

3. Supplementary information.

4. Equipment setups.

5. Improving teaching techniques.

6. Student performance

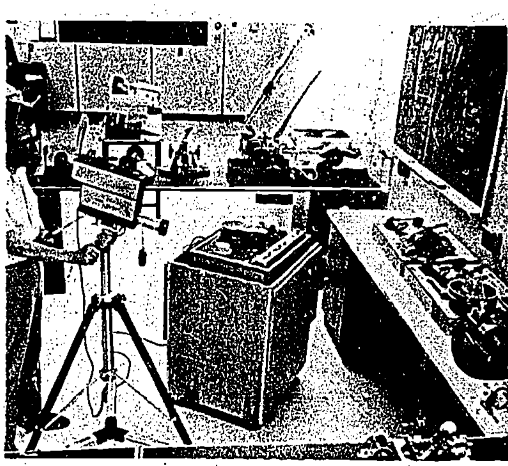
7. Testing

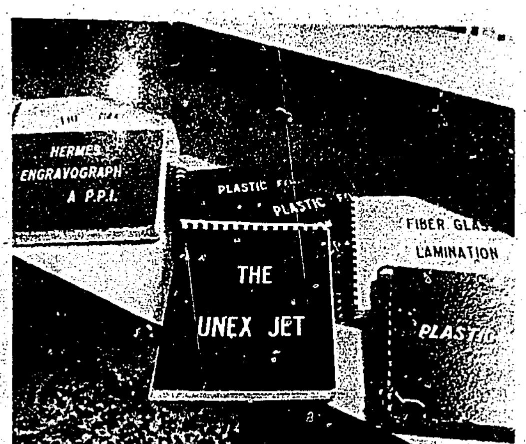
8. Single concept tapes of those hart-to-explain concepts.

9. Information that is not physically practical for the student to see in his particular situation.

a. field trips

10. To have a monitor within a carrel so the student can dial the appropriate video tape.





SLIDES AND AUDIO TAPES (Models)

A versatile camera used by many teachers is the 35mm. Film exposed in such a camera may be used as:

individual black and white paper contact prints

enlarged black and white or color prints

individual 2 x 2 color or black and white slides

uncut originals double-framed 35mm film strips, black and white or color.

Advantages

1. Little skill is needed to obtain good results.

2. Very little investment is required to get full benefit of this media.

3. When narration is provided, no reading ability is rquired. (Use of magnetic tape narration).

4. Slide sets can be tailored to fit practically any situation; extreme flexibility.

5. Slide sets are easily revised by adding or taking away slides.

Techniques

1. Coordinating 2 x 2 slides with a magnetic tape.

2. Producing build-ups like overhead transparencies, but on 2 x 2 slides.

3. Synchronize sound automatically, by using a projector which is triggered by a magnetic impulse. This is done with a special device (a programmer) to record on the tape a signal of pre-determined frequency. The signal automatically advances the slide.

PROGRAMMED INSTRUCTION

Programming is the process of determining the sequential steps a learner must take to arrive at a predetermined behavior. The program is tailor-made. No procrustean adjustments on the learner are permitted; either it fits the learner, or back it goes to the programmers for retailoring. Thus programming is the decision making as to what should be learned and the determination for a specified group of learners as to what should be the sequential steps by which the division of activities or parts of subject matter will be presented for the most effective and efficient learning. Obviously rigorous testing, research and refinement—the learners being the experts as to whether the program actually teaches what it proposes to teach.

The machining that is associated with programmed isntruction serves two interests: (a) OBJECTIVITY—as is essential in records for research data, or as a means for factoring out the influence of teacher personality in instructional research, and (b) EFFICIENCY. In instances where instruction is automated, the investigator can experiment with different media and patterns of presentation—relatively free from that great instructional variable, the teacher personality.

TEACHING MACHINES

Teaching machines consist of two basic types. The LINEAR which has the student read a question or a statement, make a response, then move program up to check the answer. This type of machine is economical, has foolproof operation, and is versatile.

They come in a variety of models such as, programmed instruction on rolls of paper, on film strips, and using both an audio tape and slides.

BRANCHING type is where a student responds to a question and the machine is programmed to give either reinforcement for a correct response, or shows that he made an incorrect response and tells him why.

INDIVIDUAL LEARNING PACKAGE

Learning can and should be accomplished by other media besides one set method of teaching. No longer is the teacher the only or the best source of learning all of the time. It is time that educators do what industry is doing. That is, the teacher-manager simply coordinates those activities which will accomplish the objectives of the laboratory. Individual learning packages is one method that accomplishes this. Some of the advantages are as follows:

ADVANTAGES

1. The flexibility for a student to choose the method of learning that is best for him.

2. Allows the student to work at his own rate.

3. Increases student-teacher communications by telling the student what is expected of him and how he will be tested.

4. Uses the problem solving technique.

5. Allows for student response and allows the student to really become involved in the learning process.

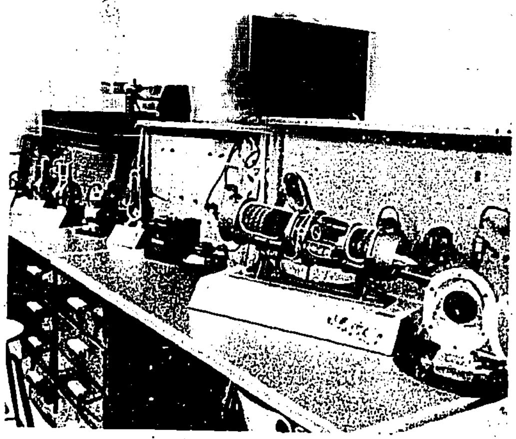
6. Organized and productive instruction.

7. Instruction written for the student instead of the teacher.

8. Ability to record a student's progress in an almost errorless path to successful learning.

9. Ability to measure a student's change in behavior.

Even though individualization is such an outstanding characteristic of programmed learning, the teacher will want to capitalize on the stimulation that derives from good social settings and interpersonal relations. When a class has developed a climate in which there is enthusiasm for learning, the classroom would be a setting in which the programmed materials would gain from the social stimuli for learning. There is another side to this coin: If the study hall is a place where "playing around" is popular and efficient study is the exception, proerammed materials will perform no miracles.



MULTI-MEDIA SYSTEMS

A Multi-media system begins with a specific set of objectives and is then designed to meet those objectives in the most efficient manner. Each component of the system is developed in order to accomplish a specific purpose through the best media available. All components are put together to reinforce each other in a fashion that will produce the best environment for learning. The system also provides for individual differences by allowing the learner to make judgments and decisions on content, sequence, scope and treatment of the lesson.

Role of the Teacher-Manager

help those students which require remedial explanations

teach small groups

direct the work of the students

evaluate the progress of the students

evaluate the results of the media on instruction

Advantages

1. individualized instruction 2. more than one method of presentation

3. capitalizes on visual and auditory senses

4. highly organized and structured

DIAL-RETRIEVAL SYSTEM

Programs or units of instruction are recorded on audio and video tapes. The student simply dials the code of the unit he desires and it is presented to him in a carrel through a monitor or headset.

MULTI-MEDIA KITS

These kits contain a variety of teaching materials. The reason for the development of such kits is due to the emphasis upon the planning of learning experiences on a more systematic basis. These kits include:

films

filmstrips, both silent and sound

study pictures

2 x 2 slides and sound tapes

V.T.V.R. ETC.

Some systems combine automated and manually controlled operations in presenting sound or silent film strips, motion pictures, slides or other materials with taped narrations, quizzes and instructions.

The interesting feature of this system is that presentations may be controlled either manually by the instructor or automatically by electronically pulsed tapes. The system moves easily from one medium to another, stops for work assignments, starts up again, and registers and tallies student responses to work assignments.

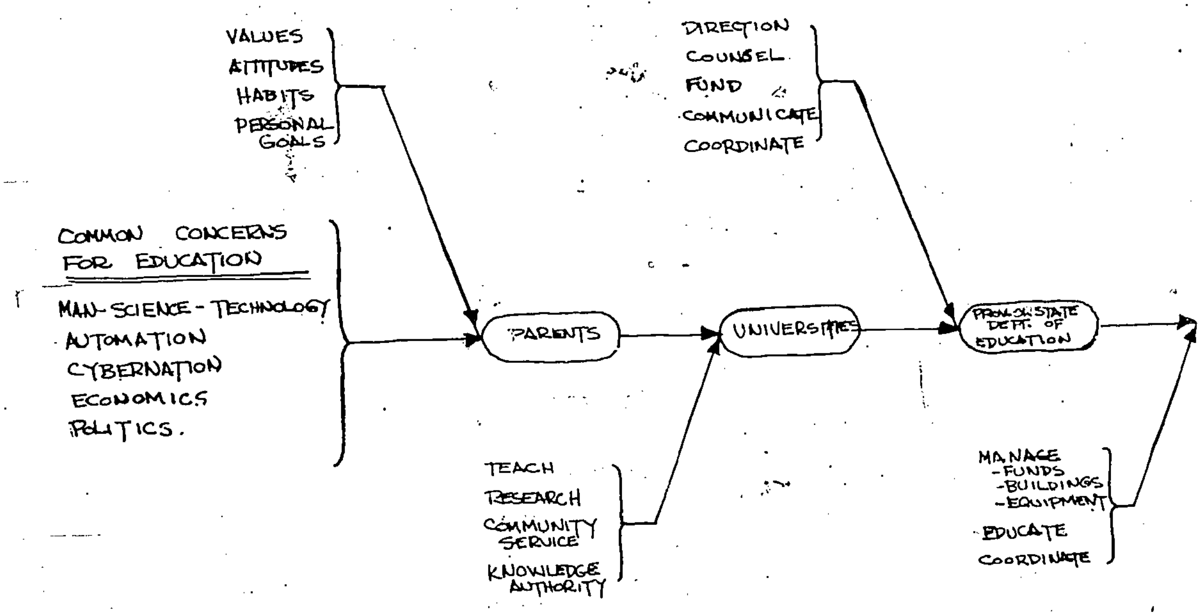
SUMMARY

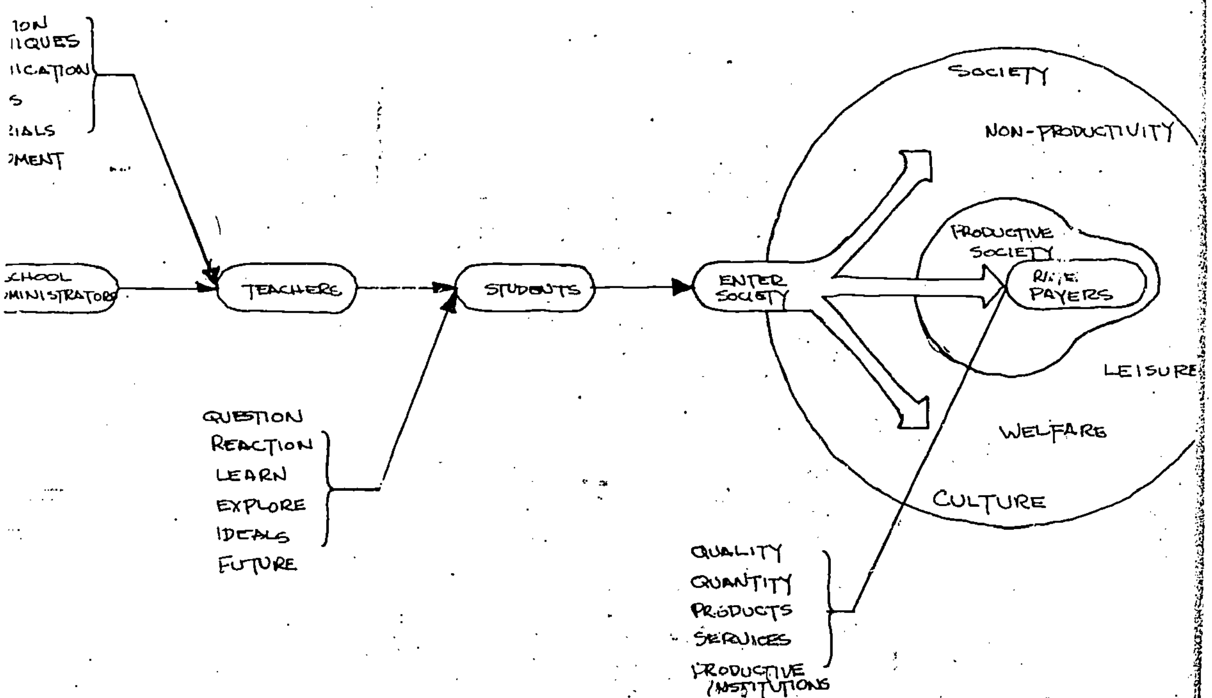
Observation of the Pert Chart preceding this chapter would tend to lead the reader to accept certain methods of teaching or evaluation as exclusive to a particular industrial arts phase or activity. This definitely is not so. To avoid repetition, this pert method was used to suggest that our experience indicated success with all these methods at any stated industrial arts phase of instruction but we had equal success with all methods in all four phases of the prescribed industrial arts program.

Many descriptions of methods listed have been eliminated and will be included in the follow-up text on teaching and evaluation methods and techniques. However, this sample of methods illustrated in this chapter definitely indicates that we must certainly make our teaching and thereby student learning more subjective, more individualized and less "group think" oriented.

CHAPTER VIII

CONCLUSIONS, RECOMMENDATIONS, EPILOGUE


VALUES
ATTITUDES
HABITS
PERSONAL GOALS
DIRECTION
COUNSEL
FUND
COMMUNICATE
COORDINATE
COMMON CONCERNS FOR EDUCATION
MAN-SCIENCE-TECHNOLOGY
AUTOMATION
CYBERNATION
ECONOMICS
POLITICS.
PARENTS
UNIVERSITIES
PROV. OR STATE DEPT. OF EDUCATION
TEACH
RESEARCH
COMMUNITY SERVICE
KNOWLEDGE AUTHORITY
MANAGE
-FUNDS
-BUILDINGS
-EQUIPMENT
EDUCATE
COORDINATE



Ch 8 EDUCATIONAL RESPONSIBILITY

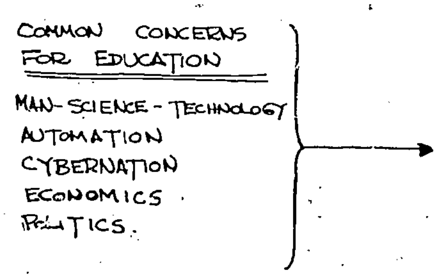
CHAPTER VIII

CONCLUSIONS. RECOMMENDATIONS, EPILOGUE

The program described in this text and particularly this chapter is designed for all aspects of society and all facets of education to consider seriously the man-science-technology constellation of confrontations and the resultant affect upon our North American society, culture and all of mankind. It was never intended that this recommended industrial arts program would resolve all the ills of education or society. It is intended, however, to indicate that we should concern ourselves with the ecological imbalance, air and noise polution, the nuclear bomb, fifty percent of the world population goes hungry, large numbers of our youth are educationally neglected, minority groups must fight and in some cases die because we lack the concerted effort to harness our collective capabilities and overcome the problems. This text was designed to indicate that this industrial arts approach does make break-throughs and that we must depart from the traditional value system and traditional solutions to societal problems with outmoded techniques or the introduction of gimmicks as solutions, be they fads, products or educational goals.

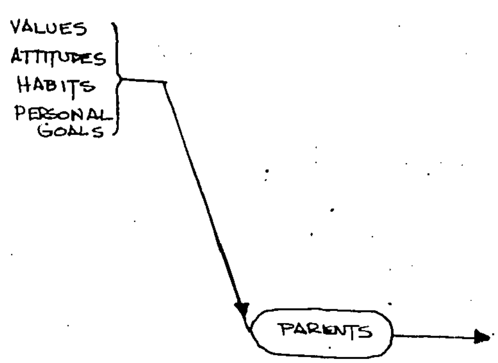
As an example a study of the chart accompanying this chapter would seem to indicate that our problems are minimal and can easily be identified and resolved. This is not the case. Each of the subsytems on this chart is worthy of lifelong study. What is intended is that we look at education as a total system and how we in each subsystem contribute to society and the total system so that if a child fails, it is all subsystems preceding the student that have failed. Undoubtedly, there may be arguments for a re-alignment of the subsystems and certainly assignment of greater responsibilities to each subsystem. What is important is that the student must not be condemned the failure without first looking at all of the subsystems affecting his educational environment. Above all, I do believe that the taxpayer has made worthy contributions at all levels and the preceding subsystems must be equally responsive to their individual responsibilities. Each area of the chart [illegible] be treated individually as further evidence for the introduction of the prescribed industrial arts program in an age of technology, automation and cybernation.

Common Concerns for Education



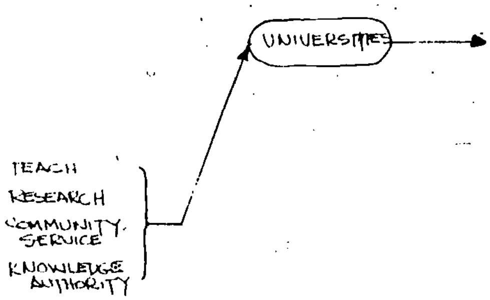
These concerns for education are not intended to indicate absolutes nor negate educational concerns articulated by others. However, there has been a serious neglect in all educational circles to consider or design programs that will cope with problems caused by the man-science-technology constellation of confrontations. We all have accepted the benefit of science and technology without too much concern for man in these innovations. Galbraith denounces technocracy without due credit to the many contributions of the many institutions of our productive society. It is our ability to provide extensive goods and services and to export the management of some to other countries that enables us to devote more attention to man and his role in this complex cybernated era. Granted we may have started earlier. That is my greatest plea for introducing the recommended industrial arts program to boys and girls at as early an age as is possible, and not fragmented aspects of the various goods and services producing segments of society but the study of common elements represented in all institutions in our productive society. It is also recommended that the proposed program not be confined to secondary schools. The student majoring in engineering, social studies, economics and political science could benefit enormously from the Phase III aspect of the program. Adults who have been displaced because of automation or cybernation could become reoriented to a new job classification by enrolling in Phase I and/or Phase II of the recommended program. It must always be remembered that education must be continuous in our dynamic North American continent if we are to cope with the number of problems created by technology and science and often tolerated and encouraged by the economic and political segments of society at the expense of man.

Parents



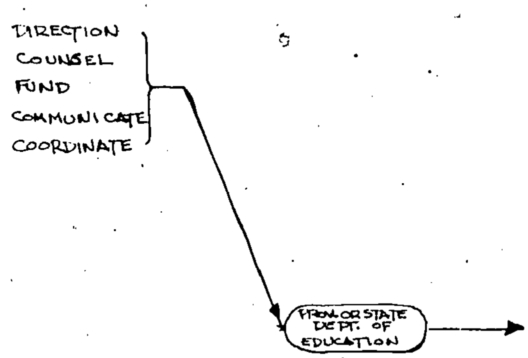
After we recognize that the cited concerns of education are viable then the first subsystem of the total educational system is the parents. It must be remembered that parents are taxpayers too and may also be victims of automation and cybernation, therefore requiring additional education or re-education to continue their role as taxpayers, contributing members of a productive society, citizens as well as parents of subscribing members to the educational system. It is not surprising to read about all members of a family subscribing to the educational system at all levels. However, subscription is not sufficient. Parents must be vocal at election time and at meetings pertaining to any aspect of the educational system and not only on visitation day. At this point, the educational system has been at fault in assuming too many of the roles of the parent. The parents must by continually involved in the education of the child. To state that "the only ones that are interested are the parents of the better students" is to beg the issue. In this day of technology if you can't bring the parent to the school, then take the school to the parent. 8mm single concept films have been used by the sales segment of our productive society, why not education? Not just final grades but the total education that involves their child. Will we reach them all? Certainly not, but we will have reached a greater number than at present. There are many technological innovations that can bring the school to the parent to communicate the purpose of the school and its aims for their youngsters, which in fact, can also be geared to a feedback system requiring a response other than a signature on a report card or an appearance when the situation is critical. Much can be learned from the cybernated age to apply to and involve the parent in the total educational system. Conversely, parents can take more initiative at home to provide the necessary leadership that their youngsters require, but not in terms of lecture or by comparison with problems at the parent's age. We have "milked" all the mileage we can from the depression syndrome, now it's time to focus on a viable future for our youngsters in an age we find difficult to fathom. Why the parental "hangup" with the youngster's long hair, short skirts or concerns for the underprivileged. Are not these good Christian values and attitudes? As long as the student is clean, why this concern for molding our youngsters into our image of the future? When in fact we ourselves have difficulty understanding our roles in the future—will we have a future? Not if we persist in the traditional outmoded attitudes and fail to encourage our youth to question, to react, to explore, develop ideals and shape a future for themselves with a proper education. Not as craftsmen, technical barbarians or technocrats but youth that will exploit science and technology for the benefit of mankind.

Universities



I believe that the role of the University is more vital at this period than at any other period in our history. It is easy to state that the University should be the authoritative source of knowledge and that its chief responsibility is to teach, conduct research and service the community. Close observation and casual perusal of the current publications will indicate that the University is not in fact performing its learning leadership role. It is easier to vocalize the responsibilites than to implement them. I don't blame students for harassing the administration. They have learned as other movements have learned, that it is the "squeaking wheel" that gets the grease. I have believed, and experience at many levels of education has vindicated my position, that all students want to learn. They are anxious to explore and question—but the climate in all educational institutions should permit this, however, the acts do not substantiate the articulated goals. Universities too frequently are monoliths of tradition and sinecures of tenure for professors that perpetuate the traditions. Too much research is confined to miniscule study that does not warrant the use of paper and ink to record it. Too many universities are repositories of authoritarian professors with antiquated ideas. The system is such that younger professors with ideas and the courage to explore them are all too often discouraged or replaced. The university of tomorrow must become a leader and authority of knowledge; a breeding ground of new ideas and an environment that will encourage more questions and have the courage to confront student reactions and a vital ideals change agent, not an institution where professors worship at the alters of tenure, academic freedom (actually academic irresponsibility) and publish or perish. By overt acts, the university must become an institution where students are encouraged to learn and this learning becomes the prime motive and criteria. Not in a static, proscriptive manner, but in a more permissive, question and answer seminar and small informal groups of constant discussion. Students should be able to see professors without the tedious "visiting hours" type of format. This does not recommend chaos but relief from publish or perish routine that would free many qualified professors and courses and curricula could be more prescriptive rather than proscriptive. Students want and need direction but they don't need "fur-lined ruts" to be followed year in and year out.

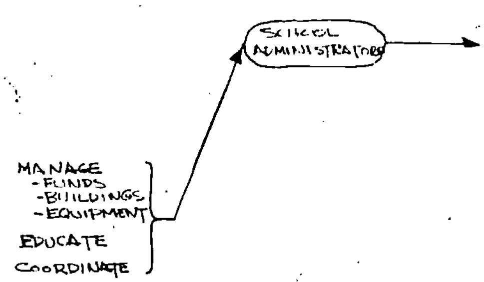
Provincial or State Departments of Education



In the total system of education, the subsystem, the provincial or state departments of education must play a very prominent role. With the ever-exploding universe of knowledge and the concommitant cost of maintaining institutions of learning within the state or province, it is imperative that a department of education have a vital role in the educational p... 's appointed or elected members of the ...partment representing all of the people ... n the state or province, the department of education should provide direction for the schools through funding and counsel so that learning for each child and resident of that state or province is possible and profitable. Too often because of their funding role, the education department incumbents become too authoritarian and fail in these areas of counselling and communicating with administrators of various school districts. Too frequently these departments of education also become an extension of the university tradition and compromise, therefore failing to permit exploration and innovation at the local level. Further, if innovation proves successful, they forget or become too engrossed in other areas to communicate this vital information to the rest of the state or province. The fact that so many private enterprises of our productive society have been successful in penetrating a state or province with software or hardware is indicative of the indictment, rightfully placed, that the coordinate aspect of the educational process within the state or province has not been seriously considered or implemented by thn department of education. Second to the university and in close collaboration with its many studies, surveys, innovated programs could be instituted, initiated and funded. The federal government in conjunction with the state or province could also induce many such programs as has been evident in the past but not too successful in the present. I have no aversion to using the private sector of the North American continent to inplement or innovate new educational program, but I do believe that departments of education and universities are remiss in their duties if in a state or province which is highly industrialized, that several universities in cooperation with the state departments are not confronting the current issues of education, instead are leaving it to the private sector. The evidence is too frequent to enumerate.

In my opinion a state or provincial department of education should attract the most capable and competent educators to fulfill the responsibilities of the educational department office, that is to provide direction obtained from the representative of and needs of the people in the state or province. The department should have or obtain sufficient "seed" funds for required surveys and research pertinent to the needs, yes even produce software at the initial stage of exploration of any new program. Holding committee meetings of teachers or administrators is further removing education from a vitally changing environment. People from our productive institutions should also be represented and requested to contribute both funds and personnel. More than any other subsystems of education, the state or provincial department of education should be the voice of all the people and their needs, and not just the university, the publis school system or the needs of productive institutions: not just youth, but also adults, not only formal but also informal and non-institutionalized education. As a service department—the departments of education, all of them, could learn much from similar institutions in our productive society such as utilities, communications and transportation sectors of our productive society who serve the public effectively and efficiently.

School Administrators



In this category, it is intended to include all personnel involved in the administration of the school system, starting at the top with the policy making decisions of the school board through the various levels of administration to the department head at a local school level. As with the university, so it is with the school system administrator's main responsibility to educate the citizens of the state or province ..n its jurisdictional limits. It must be added t is the teacher in the final analysis as the agent of the school board that represents the school policies to the subscribers-- the students, adolescent or adult. Their administrative efforts and policies must be exerted to facilitate this primary task to educate, through effective coordination and use of funds, facilities and personnel.

Direction

The first and most fundamental step and gravest responsibility of administrators is to provide education direction that is in the best interest of subscribing students, regardless of age, within its jurisdiction. It will further delimit comment to the industrial arts program previously described because volumes have been written on administration with mixed results. If administrators at all levels of the school concede that one of its main responsibilities is to educate and anticipate the needs of its subscribers so that the students may become more enlightened and responsible citizens in our society, then inclusion of the described industrial arts program provides a rationale for direction of education and inclusion in the secondary school program. The objectives are reiterated to indicate its viability and unique contribution not attributable to other subject areas.

1. Reinforce the other academic disciplines.

2. Synthesize the educational experiences of the student .

3. Interpret productive society (technology, automation, and cybernation)

4. Provide exploratory experiences with materials and technologies as a guidance for future career selection.

Programs

If administration accepts the recommended industrial arts program, then the logical next step is to organize a set of programs for implementation. This in no way is confined to the recommended new industrial arts program. There must be stages of phasing out the old and phasing in the new. There must be a program designed for funding this change and this could entail a program of building modification or new building or additions. Further, there is the need to establish a program of in-service or university-based up-grading program of industrial arts teachers already employed and finally a program of orientation for the whole staff is mandated so that the proper goals and programs of implementation are understood and implemented. The program of equipment was left until the last to permit administrators the necessary time and funding to make the requisite transition. Hardware can be phased out and new hardware purchased as funds permit with the objectives originally outlined. This program is equally adaptable to adults or adolescents, slow learners or fast learners, but the software differs, therefore a program of software and hardware purchase must be implemented and scheduled.

Establish a Standard of Performance

No program is worthy of introduction unless a standard of performance is established, not only for the student but for the teachers and those responsible for coordinating or administering these programs throughout the system. As in all good administrative practice, feedback from the teachers who will ultimately implement the program and a follow-up of students subscribing to the program should be utilized to establish a reasonable standard of performance of introduction and up-grading of the recommended program. This need for feedback from students and instructors should not be taken for granted or dismissed too lightly. Evidence indicates that many good educational innovations have failed because a standard of performance and the complete program was imposed upon the teacher without the opportunity for feedback. This feedback could result in changes, improvements and modifications because of local situations. This feedback is predicated upon the often quoted communcations paradigm of:

a) Ideation

b) Encoding

c) Trnasmission

d) Decoding

e) Action

Meaningful actions concommitant with or contrary to original program objectives indicates whether administration is in fact getting the desired results and whether the instructor may be developing a program contradictory to the objectives and in fact, obviating the original direction.

a) Ideation

Accountability

Holding people accountable for a course of action cannot be relegated to a fact that they possess a degree or two or previous experience. Organizations in our productive society have discovered that institutions in the same business providing the same goods or services find it necessary to orient and indoctrinate all new personnel or incumbents to the new program and its relative position to the rest of the programs. It is erroneous and costly to assume that any teacher, new or experienced, can or will successfully implement or innovate without the requisite, encouragement, counsel and support of administrators. Therefore, the first line of accountability in this industrial arts or any new program introduction requires requisite administrative encouragement and follow-up to make accountability a meaningful process.

Review

This proposed program and every subejct matter field should be carefully and periodocially reviewed for direction. This step seems to be fairly common. What seems to be lacking is that administrators at any or all levels who find it necessary to change direction for valid reasons do not make the necessary changes in programs, standards of performance and areas of accountability. This failure causes more grievances, apathy, and mediocre performance in school systems than all other dysfunctional administrative acts combined.

Many researchers and much of the literature supports the above statement and prescribes for all administrators the following set of guidelines for raising the levels of aspiration for all personnel:

a) Personal example

b) Persuasion

c) Consistency in behavior

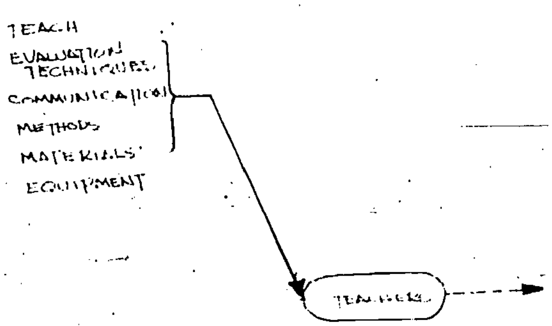
d) Regular rewards (not necessarily monetary)

e) Emphasis upon positive discipline

f) Emphasis on self-discipline

As a final note to all administrators, consider the one room schoolhouse with one teacher and eight grades. She was an interface agent long before we coined the phase. She knew what was the content at each grade level in each subject and also was cognizant of each student's limitations and adjusted her teaching accordingly. I do not mean that we should revert to the old red schoolhouse, but I do strongly recommend that the least all school administrators can do is see that all subject matter is properly interfaced to accomplish curricular and school program direction.

Teachers

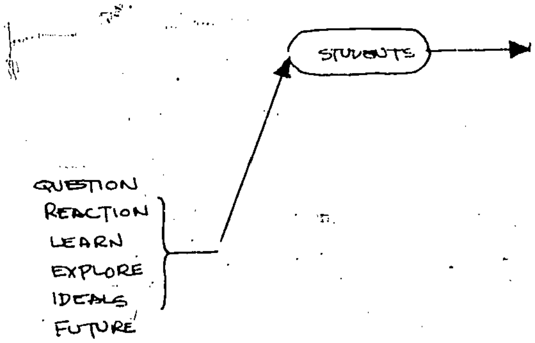


As a very vital subsystem of the total education system, the teacher can either be a stimulator for new knowledge, ideas, successes and ideals, or a harbinger of traditional authoritarian manner with very little learning taking place. I am most concerned in this book with industrial arts teachers. Many of them have worked hard and very diligently without the requisite encouragement of the administrator, the assistance of the department of education or the innovative contributions mandated of universities. They and others in different subject areas have made notable contributions to education and their students. However, an equal number have been purveyors of mediocrity, paragons of tradition and worshippers of the status quo.

I have stated the case before, and I repeat again that every industrial arts teacher must be a teacher-manager of his laboratory representing a dynamic technological society, not a teacher of a very small segment of our productive society and call this exploration. He or she must possess the requisite skills that are current in our cybernated society. Not the mimicry of words used in these technological and material areas, but be cognizant of the rapid changes that are taking place in technology and their impact upon society and the students as members of that society. It is imperative that all industrial arts teachers recognize that all occupations have become intellectualized. The main responsibility of the current industrial arts teacher-manager is to acquaint the students with a sampling of materials and technologies so that the other academic subjects become more meaningful in the school as well as in life itself. Teaching-managing is not training; it is educating, as an agent of the school board. Leave the training to the private sector who has the narrow outlook on the world—we must concentrate on the total human being, not objectively but subjectively because each of our students are individuals with differences immeasurable with the current state of the art. I recently attended several conferences, one on technological forecasting and one on the future. I was the only industrial arts educator present. How can we say that we represent the current productive society when we are either too busy or ignorant of such conferences: explaining the latest in technological advances? Yes, we can read about them, but how many of us do or have the opportunity? Can we look to the professional organizations, the departments of education or the universitis for this assistance? I have stated my case and feel that as teachers of industrial arts we should make our professional organizations the viable spokesmen for the profession with the courage to assemble significant programs of development and interest compatible with other professional organizations. We, all industrial arts teachers, possess a need for achievement and our professional organizations should acknowledge our contributions and their value from other groups. We are in an environment that cries out for solutions to a multiplicity of problems. I believe this can occur among ourselves. Present our subject matter field as indispensable to education. We then can go about setting up a higher standard of performance and with ample feedback if we will have a viable program and a receptive audience in the administrators, departments of education and universities. I present just such a program in the preceding chapters and some new methods of implementing it. This program is not a final answer—there is no such answer to our rapidly advancing dynamic technologies, but it has been accepted by students, parents, administrators, and departments of education and is currently used in at least one university.

This is a start. It is prescriptive not proscriptive. There is plenty of opportunity to capitalize on our current strengths, improve upon our weak areas and walk proudly with our other academic colleagues. Remember the first Russian sputnik and America's response to more emphasis on math and science. That was not all we lacked—no one mentioned the polytechnical aspects of the Russian system. A polytecnic that gave meaning to science and math and other disciplines. I suggest that we cannot do less.

Students



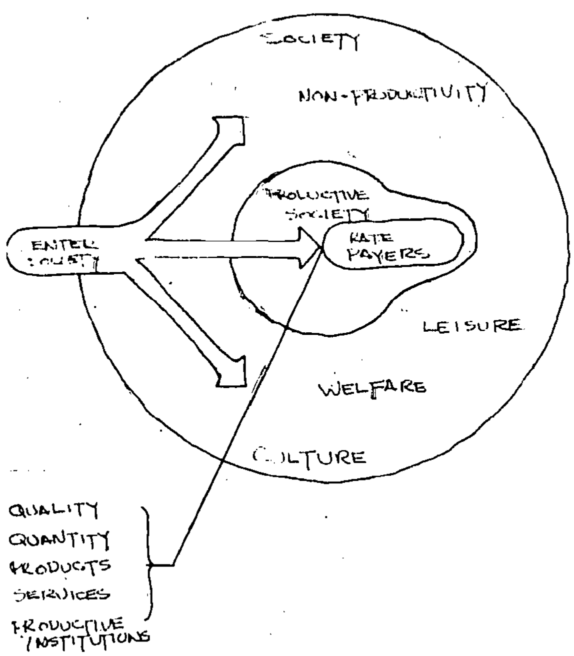
The last subsystem in the total system of education, before entering productive society are the students. They must be the last to be faulted in any educational failure in society. In fact, they are already in society and so much a part of the real society about them that many teachers fail to understand them, their language, habits or values. I have assigned six tasks to students, not as a model for finding the ultimate truth, but as an an attempt to provide their generation with an opportunity to hopefully improve upon our present generation. This is not stated as an apology for my generation. Evidence indicates the dynamic effects of the sciences and technologies of my era. That was my plea for introducing the recommended industrial arts program. However, my generation has also developed devices of all encompassing doom, and products that may negatively alter our ecological balance. It has also neglected to perfect a social science with results compatible with the physical sciences. We [illegible] failed to heed and understand many segments of our society. In fact, the PERT chart at the beginning of this chapter illustrates my point best. We have been eager to fault the student for failure and neglected to examine closely the subsystems that have contributed to his failure. I therefore strongly recommend that students question teachers, professors, parents, politicians, their peers and themselves in their search for truth and for some solution to the problems confronting them now and in the future. I further recommend that students react to information, knowledge, action or policies of the other subsystems. I did say react, yes and dissent, but not destroy. React with a purpose and direction. If direction is not clear then the next responsibility is assigned to students to learn. Learn, not parrot back facts, but learn by asking questions. It takes courage to ask questions and to stimulate your peers to do the same. We cannot look to history for answers to many of our current and future problems. Seek options, alternatives for future action.

Our cybernated society poses a man-science-technology constellation of problems never before faced by man.

Therefore, all students must learn, to their best abilities. Don't leave all the need to be stimulated to the teacher—this is being led. Stimulate yourself. You are in an age of geometrically expanding knowledge and you should learn accordingly. I would be so bold as to suggest that you never stop learning and that your formal learning subsystems may operate twenty hours a day, six days-a-week and fifty weeks each year for optimal usage by you as a learner, whether an adolescent or adult. To assist in learning, I strongly suggest exploration with ideas and knowledge. That is why the recommended industrial arts program is proposed, to permit you to learn by exploration and the multiplicity of interaction of science-technology and man, the types of careers available to every student who is willing to learn and has the courage to explore and thus learn some more.

It is my sincere belief that students on the North American continent today have greater problems facing them in the future and simultaneously the advantage of a growing science and technology, as well as an affluent environment, to permit them, more than ever, to pursue their ideals and thereby framing a future more compatible with their desires. However, I must caution, that youth of today can become as apathetic and traditional as many adults if they don't diligently attempt to pursue their ideals, be masters of their future and commit themselves to a learning that involves both the emotions and the intellect.

Society and Rate Payers



I have referred to society through this text and particularly the impact of technology, materials and science upon man in our culture. All productive institutions, services or products in our current and more so in our future society, will be confronted by the man-science-technology trilogy. The current dialogue about man and his environment and actions of science and technology give me great doubts that any real "breakthrough" will be forthcoming. The actions of the youth and concern of some adults tend to ameliorate this fear. I do not envision the extensive leisure that many forecast. So much so that half of our probable working population was never going to be given an opportunity to work from cradle to grave. I believe the values in society will change; some leisure time may be added but wholesale unemployment is not part of my forecast, not only because of increasing service needs on this continent, but the increasing needs and wants of the other 70% of the peoples on other continents. Isolationism is no longer a viable doctrine for whatever reason. Total global involvement is inevitable and mandated, now and more so in the future because of our improved communications and transportation. Hopefully, wars may become unacceptable as a means of resolving differences. Our concern with the preservation of every human being on the globe and the raising of standards of living are scientifically possible. Our lack of technological understanding, humanly improbable now, but with time, courage and wisdom, probably can be accomplished long before the year 2000.

I make one more plea for the ratepayer as a subsystem in our society and in the education of the populace. Before we ask taxpayers to contribute any more funds, subsystems of parents, universities, departments of education, administrators, teachers, and students must make a greater effort and more efficient use of funds already available. It is only right that the ratepayer request, yes demand, better quantity and quality of our educational system for funds expended. No extensive statistics need be cited—there is ample evidence that education can be improved in quality by a factor of at least 20% without the expenditure of an additional cent of tax monies. It must be remembered that in our culture, the success or failure of the educational system or any system will depend upon the wisdom of the people using the system. Therefore, the effort of each subsystem of education must be greater than the sum of its components if our culture and society can improve and resolve the difficulties of the future.

EPILOGUE

Men and women who have the ability to think ahead, and the energy to pursue their visions of a brighter future for our society are the men and women who provide the momentum which keeps our society progressive. As long as any society has in it the healthy growth elements to give it some direction, it will advance. Otherwise it will become unstable and fall apart.

The implication for educators and persons responsible for the maintenance of our educational systems are obvious: in addition to simply imparting knowledge, we must be capable of seeing the future, at least to the extent that we can shape our various types of educational programs in anticipation of changes that are already underway.

Applying the crucial observation to industrial arts education specifically, we must ask ourselves: "What direction are we providing which anticipates tomorrow's manpower and social needs on the North American continent?"

An illustration of the changing world of work is the following advertisement clipped from a magazine: "WANTED: Man to work on nuclear fissionable isotope molecular reactive counters and three-phase cyclotronic uranium photosynthesizers. No experience necessary." What educational program would you recommend for the student who will answer future ads like this? Would you label it academic, vocational, technical, or commercial preparation? What type of person would be best suited to function in the classification which the ad described? And speaking of classifications, what type of classification was it? You will probably recognize that the person who would fill such a position would be described as a technician, a "grey collar" worker.

The rate at which the world of work is changing, and the extent to which technical jobs are replacing traditional skills, are succinctly pointed out by John L. R. Snider in a paper published several years ago. He states that forty thousand jobs a week are being eliminated in the U.S. labor force. This drastic eradication of employment is occurring in the middle of a decade in which Snider estimates that some twenty-six million youngsters will be seeking their first jobs. He further points out that there is a danger, with all the job elimination and the attendant confusion, of society losing sight of its own manpower future. Spengler extrapolates this to its limits and argues tha the propensity of our society to become blinded to its own future can lead to moral decay and embroil it in carnage and desecration, thereby spelling the doom of western civilization. In short, the society that cannot see its future has no future. Applying the moral to ourselves as educators, we must face the fact that the future of education, particularly for industrial arts education, depends on what kind of direction we give it. Whether we are preparing our students to cope adequately with the cybernated problems of the future is a question we must face squarely.

MISTAKES OF THE PAST

As we search for the answers to our questions in education, we will do well to look at some of the mistakes of the past. Perhaps the development of education has not been the success which we sometimes think it has been. One of the outstanding impediments of education has been the historical dichotomy which has separated preparation for academic careers from preparation for what we call "vocations." It has been argued that studying for a vocation is inherently simple, in contrast to the complicated study of the sciences and of the man. These arguments, of course, are simply prejudices. If the study of man is more complicated than studying for a vocation, we must account for the fact that the literature of antiquity (when men were supposed to be relatively ignorant) reveals a profound knowledge and understanding of man.

There is nothing new about this type of prejudice which extolls the sciences and humanities and downgrades industrial arts education. We need not go far back into history to find that the sciences themselves were at first despised by the intellectually naive and hated by the superstitious who looked on science as witchcraft.

What we need to recognize in our educational systems today is that any person of average intelligence can grasp the fundamentals of the sciences and the humanities as well as he can acquire the technical skills of vocational pursuits.

Separating the two forms of education should not be tolerated, particularly in a democracy. A dichotomized education system amouets to educational apartheid.

I maintain that the future for industrial arts education on the North American Continent can be as bright as the future of science has become. However, educators involved in industrial arts programs must not draw an unjustified line between education for wisdom and education for vocations. A student excelling only in academic disciplines may become as functionally illiterate as a high school drop-out in our industrial and business society of tomorrow unless he acquires the skill of applying those disciplines in our productive society. His position will be equally as untenable as that of a student who will prepare himself with manipulative skills that are rapidly becoming obsolete without acquiring a proficiency in the academic disciplines.

WE NEED BALALNCED EDUCATION

The foremost constant in modern literature on education is the evidence that students who possess a wholesome combination of academic and manipulative and problem solving skills make the most rapid adjustments to job classification changes. We can no longer categorize students as belonging to either the elite or the less elite tract. The democratic framework in which our economy is growing up demands that all citizens shall be contributing members of our productive society.

Any system which denies students requisite academic preparation because of arbitrary administrative decision or academic bias or because of the reluctance to change traditional teaching methods will turn out to be its own worst enemy in the decades ahead. No student who hopes to be successful in our productive society of tomorrow can reasonably expect to achieve this success unless his awareness of technology is accompanied by optimal academic preparation, enabling him intelligently to apply his knowledge toward solving problems and select options in a cybernated productive society.

None of the problems of our productive society exist in an educational vacuum, and this will become more obvious as time goes on. The solutions to our technological problems require liaison between educators and every segment of society, from the government down to the family, and these solutions will not be found in merely setting up isolated vocational education programs or institutions. The basic issue is not the construction of an organization or system just to cope with current and temporary manpower problems, but rather the provision of greater access to a meaningful education itself. Unless wer make a balanced, well rounded education available to more people, we will continue to lag behind in the field of technological change, and we will fail to satisfy the future manpower and social needs of the North Anerican continent.

In teaching North Americans to be free and responsible citizens in a democratic society, let us not make the mistake of separating vocational from liberal education, science from the arts, philosophy from politics or education from life. Let us not go off balance by subscribing to innovations for the sake of innovations, or become technical barbarians by yielding to pressure groups representing specialized areas of our economy. We must not shrivel when we hear a few people with small minds and big voices denouncing progressive educational ideas.

Let us understand that a student of engineering or of poetry is first of all a person and only after that a student. Whether he be an engineer, a poet, or a businessman, he needs not only a useful form of knowledge and skill but also a breadth of mind and depth of character.

This spirit of human learning must permeate our schools and universities, regardless of whether they are formally called technical or liberal arts institutions; otherwise we will produce experts, businessmen, even poets, with a narrow outlook, unaware of their cultural heritage, incapable of making rational choices, and intellectually sterile. If the technical and liberal academic subjects are separated sharply in our educational institutions, if each subject remains unrelated to its wider meaning, they will remain separate in the lives of our graduates and therefore in the North American culture itself. If the nation is to survive and remain strong, students must have an educational system that is thoroughly up-to-date. Experimenting with substitutes for intellectual training and calling them vocational programs is not the way to bring our schools up-to-date. We must prepare for comprehensive manpower development, and this means finding wasy of teaching fundamentals more thoroughly than ever before, along with finding ways to give the youngsters in our schools proper opportunities to explore the multiplicity of vocational pursuits available to them in our exploding dynamic society. For a student, democracy must include the right to choose his own career, and here the role of industrial arts education is to help him choose wisely.

The object of education must be more than just to reward youngsters with diplomas for attending classes or for demonstrating ability to parrot back facts; the object must be more than just to retain a selected few of our citizens in institutions, supported by all of our citizens, to pursue what they may call pure knowledge. The object must be to produce educated men and women, enough of them, educated well enough, to meet the needs of our modern society. Evidence indicates that Canada and the United States among the nations of the world, have an enviable amount of "lead time" if they wish to be more than just a world fountain of materials or an assembler of prefabricated parts. But we must begin now to use this lead time. We should be working towards tripling the number of graduates from our high schools, technical institutes and universities, without sacrificing standards.

Accordingly, my recommendations for strategies start with the proposal that we try to find ways of providing all our students with an educational environment which provides proper emphasis on academic disciplines as well as voational pursuits. Secondly, I recommend that we do some research on the mobility factor which it seems many occupations of the future in our technological society--will feature. We may have to develop in our students the ability to anticipate occupational changes which accompany technological changes, and to make intelligent vocational choices accordingly. In line with this, I recommend we do some research on thy provision, at the secondary or post-secondary level, of a core of skills and technological awareness aimed at helping the worker of the future to make the necessary transitions in his occupation or profession. The transitions which may be required can be made most efficiently and effectively when the student has been provided with the necessary basic academic and problem-solving skills and concepts introduced in the recommended industrial arts program.

AUTOMATION, PRODUCTION AND MANPOWER

There are two ways of looking at automation, or perhaps we should say historically there are two stages in the development of automation. First, we have the automation which stems from assembly line production. This is a process with effects not unlike those experienced during the first industrial revolution, when crafts broke down into simple activities and it became possible for the unskilled worker to be included in the industrial world. Secondly, however, while automation broke down the skilled crafts into simple, repetitive tasks, it then led to computer technology and all the recent ramifications in this area, such as numeric control machines and related glamorous and hybrid technologies. When we look at this, we draw quite a different conclusion about the nature of work. While automation simplified some traditional skills, it introduced a much more vast area of technology which again minimizes the need for unskilled menial activities and creates work that is quite complex in nature.

Efforts to adjust our society to automation are hampered by the problem that far too many people still consider the assembly line the prevailing symbol of automation. Fathers still tell their sons, or suggest by implication, that extensive schooling is unnecessary. Again the examples and experiences of the past are poor predictors of the future, and a good corrective step we could take would be a considered campaign to rid ourselves of the assembly line as the prevailing symbol of automation. Inter-generational advice predicated on intragenerational experience is not always good advice. As educators we must be concerned and continually aware that we do not attempt to design any educational programs for the next generation based solely on the experience or small modification of the previous generation.

We must also be alert to the fact that the changing nature of work demands that vocational preparations must not be confined to the acquisition of skills, but along with this there must be an improvement of skills themselves. The concern we should have in this respect is indicated by recent statements coming from various scientists to the effect that impending changes in skill concepts will be so radical that forty years from now the traditional production worker who operates a machine or scientific academician will be as much a fossil as the hand weaver has been since 1830.

Today we still distinguish between skilled jobs and jobs which are unskilled or repetitive, between office worker and factory worker, between white collar and blue collar (or grey collar and no collar). Fifty years from now all repetitive jobs will be unskilled. As we attempt to design educational programs for our youth it is imperative that we appreciate the changing nature of productive institutions in our productive society. Burch of Fortune Magazine recommends that 70% of our work force by 1990 will be used in service occupations.

Current literature describing the rapid changes in our technological society, with the introductionof new technologies new skills and new organizational patterns, presents some worthwhile observations for educators. For example, consider the organizational structure of a typical industry at the turn of the century. It was set up according to the "scientific management" rules prescribed by Frederick Taylor. This type of management, in terms of authority configuration, was the "owner-manager" type. Authority was dominant and communication was downward. The kind of technologies most prevalent were craft-oriented. The most predominant ethic during this era of management was what has been called the "protestant ethic"—superiors and subordinates alike subscribed to the philosophy that it was good to work and it was sinful not to work. Furthermore, both management and labor subscribed to the "economic man" theory that the worker was contributing his labors for a return of monies and for no other personal satisfaction.

Now let us move in the continuum of time to about the 1930's. While this separation in time was not clear-cut, there were some prominent factors prevalent which make it convenient to identify typical management in the thirties as the "human relations" type of management. This was stimulated principally by the Hawthorne studies and previous studies in France, Germany, and Britain. It was the time of the great depression, sociology was beginning to move into the foreground, and the new type of management was emerging. The worker no longer looked upon the manager or the owner as the infallible leader who had all the answers. The emerging type of management was often referred to as the "professional type." The owner-manager or the son inheriting a business was rapidly disappearing. Technological changes left the craft-oriented types of operation behind as outmoded. Employees could no longer look on their own operations in terms of completed products as the crafts became subdivided into smaller occupations featuring production lines and semi-production lines. Management had to change too, with the realization that they could not just communicate orders downward but as their organizations grew in complexity, they had to rely upon larger numbers of specialists within their organizations to keep the operations functional and profitable. So communications began to go upward and horizontally as well as downward. Increased authority was given to technical and scientific personnel. Along with all this a new social ethic evolved—employees began to consider the right to disagree with management as a personal and institutional right, in contrast to the old ethic that the workers were to believe their managers and to carry out their orders implicitly.

Now let us move into the most recent type of management which has come into being with the introduction of what we call "cybernation." This term denotes the utilization of automated, mechanically-operated equipment combined with the decision-making capabilities of computers. Now machines are making decisions for us, and we are beginning to wonder whether technology has advanced to where it is the tail that wags the dog. Computers are challenging and changing organizational structures and authority configurations. The work which inspectors did under the scientific and human relations type of management is now done by machines which maintain reliability control. What seems to be happening now is that the individual is being lost in the shuffle. Everything is institutionalized. Responsibilities and problems are no longer personal, they are institutional. Authority now does not rest exclusively with management, but it rests with institutions such as the law, the union, the community, educational enterprises and the government.

Another change in management is the new interest in education and the consequent emphasis being placed on its importance. This includes internal company training programs. Training and retraining are becoming a way of life in industry and business. Rapidly changing technologies, machines and processes make training programs mandatory.

RESEARCH AND DEVELOPMENT

We have had a broad look at the changing nature of our work force and suggested that educators must anticipate changes in occupational skills as our technologies advance. We have identified the major movements in business and industrial management since the turn of the century. Now we must consider another important facet of this whole picture, namely, research and development. Often regarded as a single phenomenon and abbreviated as R&D, research and development in our productive institutions is accelerating technological changes to such an extent that there could be serious sociological repercussions unless we anticipate the changes and prepare for them. The creation of knowledge, fostered by our society's institutions, is no longer left to chance, nor is it merely a by-product of other functions such as teaching or management. Vast areas of knowledge, accumulated over many years, form the base from which new fields are being explored. Our productive institutions are investing increasingly more time and talent in the development of knoweldge, and specialists in the various areas of knowledge and are concentrating on the utilization of this knowledge to bring about increased production.

A steady stream of inventions is coming from our large industrial and business laboratories. Many of these inventions are predictable long before they materialize, but time itself, in terms of the lag between discovery and use, is being predictably shortened. It has been pointed out that 112 years elapsed between the discovery of photography and its commericalization, but the corresponding time lapse for the telephone was only 56 years, radio was 35 years, radar 15 years, television [illegible] years, but it took only six years for the atomic bomb to become a reality and five years for transistors to find their way from laboratory to market, and three years for micro-miniaturization.

Research and development is a social institution devoted to putting new knowledge to work in the market as soon as possible. In short, this dynamic institution is devoted to collapsing time and accelerating change. Research begins with feasibility studies, which lead to experimenting, and finally development. The feasibility stage of research represents attempts to discover as rapidly as possible, whether certain efforts have economic potential. Once this potention is ascertained, then the developmental approach is applied to ascertain what functional and marketable prototype can be developed. In the third phase the prototype is further developed to fit into a multiple production type of framework and empirically validated.

The outstanding changes in our productive institutions which have come about since the turn of the century, and which I have reviewed briefly in terms of both management and labor development, along with the dynamic and increasing role which research and development is assuming in bringing about technological changes, makes it mandatory that educators concern themselves very seriously with designing adequate industrial arts programs for students who will soon enter the North American technical and professional manpower pool. This educational planning and programming must start right down at the secondary school level.

ALBERTA UNDERTAKES A RESEARCH PROGRAM

The Department of Industrial and Vocational Education at the University of Alberta in Edmonton, Alberta, Canada, is engaged in a research program which seeks to take cognizance of the rapidly changing characteristics of our productive society, some of which I have outlined. A four-phase education program has been set up which complements regular and traditional academic programs, and which encompasses the junior and senior levels of high school. This four-phase program, which has now been in effect for seven years, embodies a great deal of research.

Phase I, designed for eighth grade junior high school boys and girls, exposes the students to machines, materials and processes in six activities incorporating the fields of ceramics, graphic arts, plastics, metals, woods and materials testing.

Phase II of the program exposes youngsters to seven technologies, including computers, electronics, graphic communications, power, power transmission, mechanics and electricity.

The third phase, designed for tenth graders, takes into account the social aspects of current developments in our productive society. The various types of productive institutions in society are examined in terms of authority configurations, communications processes, decision making processes and how organizational theories are implemented. An interesting challenge here is to impart to the youngsters the demands imposed upon all levels of employees as they function in a technological environment. These students rapidly discover whether they wish to comply with or resist the numerous technological demands which are being made.

Phase IV of the program features a cluster of the previously enumerated areas that reflect the individual student's interests and abilities. This stage leads on to higher levels of learning in much the same way as high school science brances out into chemistry, physics and biology at the university level.

Each phase of this education program is subjected to the three kinds of research, or research in its three phases, which I outlined in connection with research and development in business and industry, viz., feasibility studies, developmental and experiemental.

The program has yielded encouraging discoveries about students confronted with vocational choices, and it points up particularly the value of encouraging them to use their own initiative and to express their personal preferences in a democratic way. This, of course, does not negate the need for guidance, it simply provides the guidance counsellor with valuable indicators to help him carry out his advisory tasks. The program is conducive to identifying those limitations of students which might inhibit the acquisition of performance skills in certain areas. Low achievers and the high achievers can be sorted out on the elementary plateaus of the program, and academic deficiencies can be diagnosed and corrected.

Students exposed to this program as a rule either maintain the plateau they have reached or subsequently improve to varying degrees in their academic fields. In contrast, control students not exposed to the program show an almost invariable dip in their academic group profile in all classifications.

By altering teaching methodology and introducing technological teaching aids for low achievers, we have found it possible to maintain their academic grade averages at par with the rest of the class. Devices we are using include taped instructions for the poor reader, highlighting areas in which he is experiencing deficiencies, so that by persistence the low achiever can grasp concepts and technical terms which the average achiever absorbs more readily. The Mark II Autotutor is another device which has been a distinct advantage as a supplementary teaching aid. It permits the presentation of a considerable amount of course content over a relatively short period of time.

Another aspect of our experimental approach in this laboratory program which should be pointed out is that the instructors have modified their teaching methods to make them more like management techniques than lectures. Classes are carefully organized to permit students to apply their own intelligence to solving problems and carrying out assignments. The student is encouraged to learn by experimenting.

Disciplinary problems usually posed by low achievers in a classroom have been minimized in our laboratory. The principal reports a pronounced absence of disciplinary problems, while the low achievers in the control group present pretty well the usual number of problems. Evidence indicates that better laboratory organization of matrices reflecting various levels of experience overcomes most disciplinary problems. In other words, assignments for low achievers must be geared to their capabilities but yet present a challenge. Learning experiences of both low achievers and more advanced students must result in an adequate sampling of each activity and a sense of accomplishment in order to be satisfactory. This aspect of our program arose in part from criticisms levied by business and industry, and subsequently identified by Franks and the M.I.T. group, that students must be exposed to a more intelligent and challenging environment at junior and senior highschool levels. There is every evidence to indicate that the majority of students are not myopic creatures by nature. They are not content to keep chipping away at monotonous little bits of knowledge, but they will reach eagerly for intellectual goals of greater promise if we give them the opportunity. The creative limitations of our era are not inherent in our youth. The fault lies in educational systems which close the shutters and batten the hatches against learning environments that might present challenges.

In conclusion, may I quote Dr. H. S. Broudy, an internationally-known Professor of Philosophy of Education and who told a group of educators at a conference in Edmonton, "If it takes a ton of paper to make a ton of steel, it will take more and more knowledge about the world to understand the world of work, and it will take even more if educators aspire to anything more than catching up with the dynamics of economic change. We are, all of us, therefore, condemned to develop our powers of knowledge and wisdom to a degree hitherto believed to be impossible for the common man. Strange as it may seem, it is the machine that may in the last act force us to become eminently human."

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