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INTRODUCTION

The Journal of North Carolina Technology Teacher Education is a publication through which technology teacher educators may share the findings of current research in technology education. The research reported in the journal may serve to provide a foundation for change in improving the discipline and its practice. Further, the reported research may provide the basis for further in-depth investigation of selected topics pertinent to educational change.

The journal provides contributors with an avenue for refereed publication. The referee process by colleagues assures purity of the research process. However, the journal is not limited to publications that have met all the rigors of the referee process. Referee or non-referee status of each published article will be visibly indicated on the title page preceding the article.

Authorship in the journal is not limited to technology teacher educators. Articles from graduate students and interested persons outside the discipline will be welcomed.

Dr. James V. Haynie, 1989-90 council president, proposed the journal to colleagues in the council, published the first call for papers and established criteria for the referee process. The vision of Dr. Haynie is evidenced in this first publication of technology teacher educators in North Carolina.

The reality of this first journal is but a beginning. Council leadership hopes that each future call for papers will see an increase in North Carolina research activity and in the growth of the journal through the reporting of such activity for publication.

Professionally yours,

Jane M. Smink, Ed.D.
Editor

NORTH CAROLINA COUNCIL OF TECHNOLOGY TEACHER EDUCATORS MEMBER INSTITUTIONS

North Carolina Council of Technology Teacher Educators (NC-CTTE) is a council within the North Carolina Technology Education Association. Purposes of the council are: 1) to provide research pertinent to the discipline of technology and 2) to serve the needs of individual and institutional members.

Member institutions of the North Carolina Council of Technology Teacher Education are:

Appalachian State University

East Carolina State University

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North Carolina A&T State University

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as

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in

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by

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(Refereed Article)

Anticipation of Tests and Open Space Laboratories as Learning Variables in Technology Education

The value of tests as learning activities (beyond their evaluation function) has been studied in various settings. This study sought increased understanding of this factor and also investigated the motivational value of announcements to students that a test will be upcoming. Further, the effects of using pre- or post- instruction announcements were examined. Finally, this paper reports some unanticipated findings on the effects of noise on learning in open space laboratories.

Background

Studies have been conducted to determine the benefits of tests as aids to learning and to examine the relative benefits of reviews. Nungester and Duchastel (1982) studied testing vs. similar on-task time spent in review. Students were tested for retention two weeks later and the researchers concluded that testing provided greater gains in student retention than either review time or control conditions (filler activity). The results favored increased use of testing as a learning aid. Similar findings had been reported as early as 1923-1924 by Jones and also in 1975 by Laporte and Voss. The effect has been termed the "consolidation effect" in recent years (Duchastel, 1981), and it has been the subject of a small number of studies.

Purpose

The purpose of this study was to investigate the value of tests as aids to learning in technology education. Additionally, the motivational value of announcements to students that a test will be upcoming and the effects of using pre- or post-instruction announcements were examined. An important and significant finding was acheived on an unrelated factor: The effect of noise on learning in open space laboratories. This finding is reported here also.

Research Design and Methodology

Eighth grade students were shown a color videotaped lesson of approximately 35 minutes length. A total of 283 students and five teachers from two schools participated in the study. The lesson concerned "space-age" materials developed for and by NASA in the space exploration program. The lesson featured colorful graphs which illustrated comparative characteristics of the materials under study and actual demonstrations such as destructive and non-destructive tests on some materials.

The students' regular classroom teachers made announcements to each class which told students that they would or would not be tested the next day. Some groups heard their announcements immediately before they viewed the tape, others received the announcement immediately after viewing the tape. Some groups were tested the next day as announced. Some groups were not tested, but they received a structured review conducted by their teacher from a pre-prepared outline provided by the researcher. The review required approximately the same amount of time as the test it replaced. Still other groups participated in a filler activity (from their normal class activity) which was unrelated to the taped lesson. Two weeks later, all groups were asked to take a delayed retention test in exchange for small gifts. The delayed test was an alternate form of the original post test, but no items were shared by the two tests.

Groups were randomly assigned to treatments. The treatments/groups were arranged as shown in Table I.

Table 1

Assignment of Treatments to Groups

	Timing of Announcements	
Treatment	Announcement Prior to Videotape	Announcement After Videotape
Test Announced, Test Given	1	5
Test Announced, Review Given	2	6
Test Announced, Filler Given	3	7
Review Announced, Review Given	4	8

Note. Each cell (groups 1-8) includes one intact class from school A and one from school B.

Two instruments were used in this investigation. Each was a 20 item multiple-choice test on the materials and technical facts presented in the videotaped lesson. The items were paired such that parallel items appeared on each of the two tests.

Since this was the first study conducted with these particular videotapes and instruments, validity and reliability data available is limited to that obtained in the present study. Content (face) validity was initially established by administering the tests to a group of students who also read the script of the videotape. Then, graduate students read the script and reviewed the entire 50 item test battery with the items randomly arranged. Ambiguous items were deleted or clarified prior to production of the final instruments.

Cronback's Alpha procedure was used to establish reliability at = .67. According to Thorndike and Hagen (1977), tests with reliability approaching .70 are within the range of usefulness for studies of this type.

Classes from two buildings were randomly assigned to the eight treatments. To increase the statistical power to an acceptable level, and to maximize the effects of randomization of subjects while using intact groups, two classes (one from each building) were assigned to each group. Thus, the total sample included 16 classes. Five teachers were involved--three from building A and 2 from building B. The only limitations mentioned when requesting groups from the school administrators were that the teachers be known to have good class control (and to be able to give clear directions), and that none of the groups be located in a school which is markedly different than the County norm (such as a special education center or a gifted-and-talented center).

The students were enrolled in eighth grade industrial arts classes. Seventy-six percent of the students were male and 24% were female. Classes were predominantly white, middle class with a small mixture of representatives from other racial/ethnic groups. The sample groups did not differ markedly from the general population of the County.

The teachers were asked to show the 36 minute videotape to the class. The teacher also read a prepared announcement concerning an upcoming test or review as assigned for each group. The next day, teachers administered the test to the post test groups; conducted a "question and answer" structured review with the review groups (following an outline provided by the researcher); or provided normal class activities for the filler groups. Two weeks after the videotape was shown, the teachers administered the delayed retention test to all groups.

Data was collected on mark-sense scoring answer sheets and analyzed with the SPSS-X, 2.0, statistical package. The primary statistical treatment was conducted via analysis of variance. Follow-up analyses of selected factors were conducted by the _t_ test procedure. Alpha was set at the .05 level for all initial tests. The specific follow-up comparisons used were selected to answer the following research questions:

1) Does anticipation of an upcoming test motivate students to learn at increased levels due to increased study during the interval between instruction and the test?

2) Does anticipation of an upcoming test motivate students to learn at increased levels due to increased attention during the actual instruction period?

3) Does time-on-task contribute to student learning levels regardless of testing?

4) Does time-on-task in the form of a structured review contribute as much to student learning levels as does testing?

Findings

The initial analysis was conducted via analysis of variance. The intended plan was to conduct _t_ test follow-up comparisons of the above contrasts, if and only if, the omnibus _F_ test showed significance. The _F_ value found was 1.47 which had a probability of .179 (see Table 2). This value was too low to justify any

Table 2

<u>Summary of the Initial Analysis of Variance of Main Effects</u>

Source	D.F.	Sum of Squares	Mean Square	F	p-value	Findings
Between Groups	7	113.21	16.17	1.47	.179	n.s.
Within Groups	275	3031.44	11.02			
Total	282	3144.65				

n.s. = nonsignificant

further analysis concerning the primary problems of the study. Additionally, informal examination of the means and standard deviations of the scores on the delayed retention test (shown in Table 3) clearly showed that no significant differences (in relation to the original research questions) had been detected by this study.

Table 3

<u>Means of the Eight Treatment Groups</u>

Group	Mean	S.D.	n
1	6.34	4.06	35
2	5.45	2.88	31
3	5.85	3.18	34
4	6.63	2.81	38
5	6.19	3.55	37
6	7.81	3.37	31
7	6.05	2.96	38
8	5.87	3.53	39

Since the study failed to replicate common findings which have been very consistent among similar studies in the literature concerning the usefulness of tests as aids to learning (Duchastel, 1981; Nungester and Duchastel, 1982; and Laporte and Voss, 1975), it was determined that some uncontrolled extraneous variable may have operated during the study. Further, since randomization had been used as effectively as possible within the limits of available samples, and all of the teachers selected had been rated by their administrators as effective teachers with good control, no differences should have been expected among the means for the teachers. Thus, the first step in the investigation to determine what may have confounded the study was to ignore experimental groups and compare the means of scores achieved by students of each teacher. These five means appear in Table 4.

Table 4

<u>Means of Classes Taught by Each Teacher, Ignoring Experimental Treatment Groups</u>

School	Teacher	Means	S.D.	n
A	1	4.90	3.87	31
A	2	4.88	2.29	57
A	3	5.21	2.27	63
B	4	7.48	3.07	63
B	5	8.07	3.94	69

The omnibus _F_ test on this contrast yielded a value of 14.37 which is significant beyond the .001 level (see Table 5).

Table 5

Summary of Analysis of Variance of Means by Group and Teacher

Source	D.F.	Sum of Squares	Mean Square	F	p-value	Findings
Main Effects	11	633.65	57.60	6.35	.001	*
Group	7	125.98	17.99	1.98	.058	n.s.
Teacher	4	520.44	130.11	14.37	.000	*
2-Way Interactions	4	87.85	21.96	2.42	.049	n.s.
Group/Teacher	4	87.85	21.96	2.42	.049	n.s.
Total	282	3144.65	11.151			

n.s. = nonsignificant

Further examination revealed that the means for all of the teachers from school A (open space school) were significantly lower (beyond the .05 level) than those from school B (traditional labs). Additionally, the sub group means from school B (alone) showed apparant trends supporting the common previous findings by others. In contrast, the sub group means from school A were almost identical to each other with only a slight trend which opposed the general findings of most previous studies. The data from school B was analyzed separately by _t_ tests and found to support the finding that tests do serve as aids to learning (.05 level)--the most consistent finding in the literature. The means from school A did not even support this very common finding. It was felt that no further _t_ tests were justified and that some difference must have existed between the two schools which accounted for the failure of the original study to replicate the findings of other similar studies. Follow-up investigation to isolate the interfering extraneous variables found that:

1) The 1986 SRA scores of eighth graders in the two schools were very similar with students in school A scoring at the 73rd percentile and those in school B scoring at the 68th percentile. The scores of both of these schools were above

average for their State (51st percentile). So, the general ability of students from each of these schools was similar, with school A scoring only slightly higher. This factor could not account for the higher post test scores acheived by students in school B.

2) Informal questioning of administrators in the two schools and the County central office found a consistently held general perception that school A was a slightly better learning environment than school B and that it had slightly better students. Every administrator questioned predicted that students in school A would score higher than those in school B. Two administrators used the phrase "flagship school" in describing school A. All administrators were surprised when they were told the results as found. Again, students in school B should not have outscored those in school A due to this factor.

3) The teachers, likewise, had been rated by administrators as being about equal in experience, control, and effectiveness.

4) The last factor considered in the followup investigation was the physical environment of the laboratories. School A was an open space school and school B had traditional separate laboratories. This had been forseen as a potential source of extraneous variables by the investigator, and teachers in the open space lab complex had been instructed to move their classes to a small auditorium (about 90 feet from the lab) for each session of the experiment. The scheduling of the videotape equipment and the auditorium had

been arranged by the researcher.

Follow-up investigation discovered that, despite the instructions to the contrary, all of the teachers in school A chose to show the tapes and conduct the reviews and tests within the open space lab complex. Normal "production" activities took place within other areas of the lab complex while the videotape was shown. The production area was partly screened from the seating area by a seven foot tall partial height partition, but noise from the production area was not effectively blocked. Informal survey of students revealed that they had difficulty hearing the tape and the review. Further, students reported that this was the typical manner in which films and videotapes were handled in these classes. Some students shared (without prompting) that even teacher directed lessons given in the facility were often difficult to hear due to distractions from the production area. It was determined that distractions (particularly noise) from the production area had interfered with the learning by students in the open space lab complex. This was the only factor which could be found which appears to explain why the students in school B outscored those in school A. Further evidence that students in the open space laboratory (school A) were confused and distracted may also be inferred from the fact that 2.1% of their responses were either double strokes or ommissions, compared to only 0.9% useless responses from students in the traditional lab.

Conclusions

It was concluded that:

1) Noise from adjacent activities must be blocked to

maximize learning via videotaped materials.

2) Use of an open space laboratory complex for instruction via videotape while production activities are in progress limits the effectiveness of the instruction due to interfering noise and distractions.

3) The basic design protocal of this study is potentially useful, but an extraneous variable confounded findings on the primary problems of the present investigation (effect of testing).

4) The videotape and test instruments developed for this study are adequate for use in future studies of similar nature.

5) Further investigations on the primary problems of this study (testing in technology education courses) should be conducted with the protocal and instruments developed here.

6) Further studies should be conducted to determine how to most effectively utilize existing open space laboratory facilities.

7) Further studies should be conducted to determine the specific relative advantages and disadvantages of open space laboratory facilities.

Implications

Leaders in industrial arts/technology education are in general agreement that modern and future technology education curricula can best be presented and studied in open space laboratory facilities (DeVore and Lauda, 1976; and Cummings, Jensen, and Todd, 1987). Likewise, there are considerable advantages inherent in open space labs. The flexibility such labs provide makes it possible to teach a wider range of innovative courses than feasible in traditional labs (Hill and Brown, 1975; Fowler, 1975; Daiber and LaClaire, 1986; and Todd, 1978). The spaciousness and open atmosphere encourage freedom of expression and group centered behavior among students (Peterson, 1979; Fry and Addington, 1984). The variety of equipment available in such labs makes possible the study of topics related by concept instead of by materials or processes (Jasnosz, 1975; and Cummings, Jensen, and Todd, 1987).

These are all important advantages of open space laboratories, but, there are limitations which must also be considered. The very freedom which open space schools afford for students sometimes leads to increased confusion and disruptive behavior (Beeken and Janzen, 1978). Keeping order in class can become a more difficult task for the teacher. The most important disadvantage of open space, however, is the one found in this investigation. Unless the space is used in appropriate ways, activities in one area can become serious interferences for students studying in ajacent areas (Evans and Lovell, 1979). This should not be seen as a criticism of open space--it is intended as a warning that open space should be used effectively.

It is important, as Bennett (1937) warned very early in the history of manual training, that quiet areas be used for quiet learning endeavors and noisier activities be effectively separated from quiet study areas. This principle must be considered in the design of new facilities and in the renovation and utilization of existing facilities (Silvius and Curry, 1967; and Prakken, 1972). Moving students to a nearby classroom, seminar room, or other private area for the viewing of a film or videotape may introduce some inconvenience and disruption, but if this is required to ensure adequate effectiveness of the lesson, it must be done. The same need may exist when lessons are presented by the teacher. Use of headphones to deliver the audio portion of audio-visual media may also be effective. If open space labs are to become the norm and a halmark of the new technology education, then teacher education programs must prepare their graduates to properly use open space. Studies should be conducted to determine the specific attributes and limitations of open space (Marshall, 1981; and Horowitz, 1979). Information concerning effective utilization of open space should be included in laboratory management and methods courses for both undergraduates and inservice teachers.

When used appropriately, open space laboratory complexes could be an important and visible feature of the movement toward (high) technology education, but inappropriate uses of such facilities could have very detrimental effects. Users of open space are encouraged to study the effectiveness of all aspects of their labs and their programs with critical attention to maximization of the advantages of open space while avoiding the disadvantages.

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Using The Characteristice

of

Technology

to

Develop General Understanding

by

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(Refereed Article)

Using the Characteristics of Technology to Develop General Understanding

Introduction

The recent national studies of education provide much support for the concept of technology education. To take advantage of this climate of support, technology education professionals must take a fresh look at the technology education curriculum and ensure that it produces the general understanding of technology that is called for in the national studies.

A unique opportunity exists to express the ultimate philosophy of technology education through the development of meaningful programs that are of value to the largest segment of the student population. A central question to be asked is--what knowledge related to technology is of most worth to students today? To answer the question we must examine the language of the call for a study of technology, examine what technology is, and develop a comprehensive curriculum that enables students to understand technology and how it affects our life today. If we can accomplish these objectives, then we are in a strong position to obtain the support of the whole educational community and provide a strong contribution to the whole of education.

The premise:

There is much support for the concept of technology education in the recent national studies of education.

However, the exclusive focus upon technical content may not produce the general level of technological understanding that has been expressed in the national studies. To produce a general understanding of technology, technology must be defined and the essential characteristics of technology must be identified. If the characteristics of technology are identified, then learning activities can be developed for each characteristic and the result will produce a general understanding of technology.

The call for technology education:

Several national studies of education have recommended that students be introduced to a study of technology.

> "In the Carnegie report we also call for a study of technology by all students."
>
> "... we can and must help every student learn about the technology revolution which will dramatically shape the lives of every student."
>
> "The issue ... is the changing of our society, driven by a technology revolution that is as fully important as the industrial revolution over 100 years ago. By that I mean the changes in our manufacturing, the changes in our construction, and most especially the changes in our network of communications and in the transportation that moves us from place to place."
>
> "If we can find a way to relate technology to the larger values, then I believe this nation will not only survive, but, for coming generations, will flourish with dignity as well".
> Boyer, E.L., "A perspective on education." Technology education: a perspective on implementation. Reston, VA: International Technology Education Association, 1985.

"We recommend that all students study technology; the history of man's use of tool, how science and technology have been joined, and the ethical and social issues technology has raised."
High School: A Report on Secondary Education in America, Ernest Boyer

"People must understand the limitations as well as capabilities of emerging technologies. The technologically literate person should have a sense of what technology can and cannot be."
Educating Americans for the 21st Century, National Science Board

The mathematics and science now offered to our young people could be greatly enriched if we were to incorporate a technological content."
A Nation at Risk, National Commission on Excellence in Education

Paul DeVore stated in his book Technology: An Introduction that "life today, depends upon a technology the most people do not understand,". (DeVore, 1980, p. 215) It is the mission of technology education to provide this understanding in the schools of America. Many issues in the world today are a result of a lack of understanding about technology. It is important that the youth of America have the opportunity to have access to programs that provide an introduction to the study of technology. To provide a perspective about the current purpose of technology education, the following brief history is provided.

The History--Manual, Industrial, Technological Education

Industrial arts programs began their history in 1906 as an evolution from the previous manual training and manual arts programs. The name manual training and manual arts implied a program that valued the development of manual tool skills and craft knowledge. The name industrial arts implied a broader content and a different philosophy.

The growth of industrial arts programs paralleled the development of America as an industrial nation during the early 1900's. America was changing as laborers and factory workers were replacing farmers as the dominant occupation. Industry was providing new consumer products, new jobs, and new skills were required of the youth of America. There was a need for industrial arts programs to provide an opportunity in a school environment to develop skills and try out abilities and talents that could be useful in understanding a new and changing industrial world. Knowledge was applied in purposeful activity--woodworking, metalworking, and drafting were the primary courses used to accomplish the objectives of industrial arts programs. The purpose of the programs was to provide general knowledge--knowledge that everyone should know as a basis for living in a society that was heavily influenced by industry.

The movement to technology education began in 1937 with the publication by William Warner et al. of "A Curriculum to Reflect Technology." This effort began as a movement to increase the relevancy of industrial arts, to broaden its scope, and provide a name that more accurately described the curriculum content. The "arts of industry" provided a too narrow focus for program development and did not adequately describe the potential of the program. Technology Education has been adopted as a more appropriate name to help facilitate certain curriculum changes. The changes include emphasizing the application of knowledge and theory, the historical evolution and impact of technology, the creativity and problem solving associated with technology, and current applications of technology. The philosophy and orientation of technology education has not changed. The mechanics of implementation have changed in response to our changing society in an effort to contribute in the most relevant and meaningful way to the process of education.

What is Technology?: Definitions/Models

It is important to derive the characteristics of technology from an accurate understanding of the definition of technology. This supplies the direction for our curriculum efforts. To be technology education we must exhibit the characteristics of technology in our programs. When students complete a technology education course they must understand the technology that sustains daily life and appreciate the technology they come into contact with each day. In English classes students learn the communication skills that are necessary in our culture. In math classes students learn the computational skills that are the basis for successful functioning. In technology classes students need to understand the technology that is the foundation of our society.

technology--from "technologia," a Greek work meaning the systematic treatment of an art. (Monsma, 1986, p. 11) techne--(greek concept) practical knowledge used for the purposeful formation of matter to serve man's needs. The Greek word logos means science. (Dorf, 1974, p. 126)

Became associated with the mechanical or industrial arts as distinct from the fine arts, crafts, or more general skills. Technology referred to the study or systematic organization of the knowledge of machines, tools, and industries, particularly those of the Industrial Revolution. (Monsma, 1986, p. 11)

Technology in its broadest meaning connotes the practical arts. ... Technologies are bodies of skills, knowledge, and procedures for making and doing useful things. They are techniques, means of accomplishing recognized purposes. (Merrill, 1968, pp. 576-77)

... a body of knowledge is justifiably called a technology "if and only if (i) it is compatible with science and controllable by the scientific method, and (ii) it can be employed to control. transform or create things or processes, natural or social, to some practical end deemed to be valuable." (Bunge, 1976, p. 174)

Engineers are inclined to identify technology with the actual process of constructing material artifacts, while engineering ... develops the knowledge required to design those artifacts. (Monsma, 1986, p. 12)

"any systematized practical knowledge, based upon experimentation and/or scientific theory, which enhances the capacity of society to produce goods and services, and which is embodied in productive skills, organization, or machinery. (Gendron, 1977, p. 23)

a distinct human cultural activity in which human beings ... form and transform the natural creation, with the aid of tools and procedures, for practical ends, or purposes. (Monsma, 1986, p. 19)

Technology is that whole collection of ways in which the members of a society provide themselves with the material tools and goods of their society. (Alcorn, 1986, p.218)

The organization of knowledge for the accomplishment of practical tasks. (Mesthene, 1970, p. 25)

> A study of the technical means undertaken in all cultures (a universal) which involves the systematic application of organized knowledge (synthesis) and tangibles (tools and material) for the extension of human faculties that are restricted as a result of the evolutionary process. (Pytlik, Lauda, Johnson, 1985, p. 7)

> The science of the application of knowledge to practical purposes and the totality of means employed by a people to provide itself with the objects of material culture. (Webster's Third New International Dictionary)

Emphasis: What knowledge is of most worth to the majority of people?

There are several traditional emphases of technology education programs: technical skills, theoretical knowledge, career information, and socio-cultural impacts of technology. Skill development is essential for the training of technicians and trades people. Knowledge and theory related to a technology are important for engineers, and industrial technologists. Occupational information is useful for a career as a guidance counselor or in personnel work. Anthropologists and sociologists must understand the cultural impact of technology.

Technical Skills
Valuable to trades, technicians, some engineers, avocational value to some adults.

Technological Knowledge
Specialized knowledge valuable to engineers and industrial technologists. General knowledge of value to everyone.

Occupational--Careers
Of temporary use in making an informed decision regarding suitable employment. Matching interests, abilities, and opportunities.

Socio-cultural
An analysis of culture is the basis of all education.. All education is relative to the culture--a well educated person in a high tech society may be poorly educated for life in a stone age culture. The basis for rationale for the manufacturing, communication, transportation, construction clusters lies within the analysis of culture.

Figure 1.
Emphases of Technology Education

Technology education derives some content from each of these areas however the emphasis needs to be broader than any single area. Content for a general study of technology must be derived from an analysis of our culture--the technology that is used every day and the technology that supports daily life--how it works, and how it affects us. To accomplish this it may be easier not to focus upon skills, knowledge, or careers, but the characteristics associated with technology in a general sense. Skills, knowledge. and careers must be included as a component of the curriculum, but a broader perspective is required to provide the proper perspective.

Lenski and Lenski are two sociologists who provide considerable support for the study of technology in the schools of America. Their area of expertise resides within the analysis of cultures and the identification of the elements that are present within all cultures. These elements are known as functional requisites, and are essential for the continued survival of all cultures. Lenski and Lenski indicate that "the first step in analyzing any society should be to determine its basic technology. This assures that we take into account the most powerful single factor influencing the life of that society." (Lenski and Lenski, 1978, p. 104)

Misconceptions about Technology Education:

There is a misconception among the public and our own students about the purpose of our program.

> "Technology as parallel subject matter to science has never found any major place in our K-12 system. Those concerned with technology education face an enormous challenge. ... they must re-think, de novo, how and what one would teach the average citizen about technology." (Roy, 1990, pp. 5-6)

A focus on the characteristics of technology could help by resulting in the general understanding of technology that has been the purpose of introductory classes.

> "Every citizen would be expected to know about those parts of contemporary human experience which are obvious to all, which affect all in daily living. A simple algorithm to guide the choice of what to know, ... is to follow the activities of an average pupil through an average day. From alarm clock, to the light switch, to the clothes worn, the rubber in the sneakers, to the stove heating water for coffee, to the car being driven to work, there is an infinite opportunity to use these objects and experiences for teaching technology and applied science, and derivatively basic science. This "applied science"

must become the necessary core for all students, prior to being exposed to any abstract science. The beauty of using the same common human experience--eating, getting dressed, driving--is that they can be updated at each successive level; and with increasing depth and sophistication, can form the connecting introduction to any part of physics, chemistry and biology. This is the technological literacy necessary for all citizens; it is also a much better groundwork to make science more likely to be attractive to larger numbers. (Roy, 1990, pp. 11-12)

> Past educational practice has "cut the heart out of general education by dividing it up among watertight disciplines." To alleviate the math/science crisis entering via the interest in the societal problem is best. For the 10% to be scientists--entering via science may be the most effective. STS has emerged as the central core of a general education curriculum that is not handed over to disciplines. (Roy, 1990, p. 13)

How much science needs to be known to be an effective citizen in America? Most people do not need to know science or to do science. They need to know about science--the scientific method, objectivity, observation, explanation, prediction, experimentation, rationality, the contributions of science and the applications of science in daily life. How much technology needs to be known to be an effective citizen in America?

Characteristics of technology

Paul W. DeVore concluded in Technology: An Introduction that a "precise matrix or taxonomy of characteristics of technology does not exist." (DeVore, 1980, p. 233) A listing of the attributes of technology would be valuable for an introductory course in technology to help evaluate the comprehensiveness of the content. The following excerpts have been selected from the many people who have written about technology and identified selected characteristics of technology.

"no description of the techniques used in a primitive society can be adequate to any degree without an account of the values and structure of that society. ... with more sophisticated and large-scale societies this truism holds too - and even more forcefully."

"Scientific technology has invaded almost every part and every aspect of modern life. Yet the average, educated, person knows least about technology and is frightened by both logarithms and the screwdriver. ... Technology should be demystified by making its tools available to the general public at popular prices."
Agassi, J. Technology, philosophical and social aspects. Dordrecht, Holland: D. Reidel Publishing Co., 1985.

... though science and technology are universal, there are also particularistic aspects to them. Science is a body of ideas, some only distantly practical, if at all while others are directly useful in the human enterprise. Technology is fundamentally problem-solving. The particularity of science and technology derives from the fact that each country has its own complement of problems. (identified 30 characteristics)
DeGregori, T.R., A theory of technology. Ames, IA: Iowa State University Press, 1985.

"Technique has become the new and specific milieu in which man is required to exist, one which has supplanted the old milieu, viz., that of nature. The new technical milieu has the following characteristics:

1. It is artificial;

2. It is autonomous with respect to values, ideas, and the state;

3. It is self-determining in a closed circle. Like nature, it is a closed organization which permits it to be self-determinative independently of all human intervention;

4. It grows according to a process that is causal but not directed to ends;

5. It is formed by an accumulation of means which have established primacy over ends;

6. All its parts are mutually implicated to such a degree that it is impossible to separate them or to settle any technical problem in isolation ...

Ellul, J., "The technological order" Technology and Culture 3., Chicago: University of Chicago Press, 1962.

"In the Carnegie report we also call for a study of technology by all students."

"... we can and must help every student learn about the technology revolution which will dramatically shape the lives of every student."

"The issue ... is the changing of our society, driven by a technology revolution that is as fully important as the industrial revolution over 100 years ago. By that I mean the changes in our manufacturing, the changes in our construction, and most especially the changes in our network of communications and in the transportation that moves us from place to place."

"If we can find a way to relate technology to the larger values, then I believe this nation will not only survive, but, for coming generations, will flourish with dignity as well".

Boyer, E.L., "A perspective on education." Technology education: a perspective on implementation. Reston, VA: International Technology Education Association, 1985.

Monsma identified five key elements of technology:

1. human cultural activity

2. involves persons exercising freedom and responsibility in response to God

3. involves forming or transforming the natural creation

4. with the aid of tools and procedures

5. for practical purposes or ends. (Monsma)

"Science is primarily seeking an understanding of nature, and technology is attempting to provide systems, goods, and services of value to people. Science is seeking truth. Technology appreciates truth, but in its absence is expected to get on with the job." (James L. Adams, Stanford University)

Maurice Daumas, ... concluded that prior scientific discovery did not play any large part in technological change until the 1850's.

White, L.T., "Medieval technology." (Rolf Buchdal Lecture on Science, Technology and Values). Raleigh, NC: North Carolina State University. 1981.

A synthesis of characteristics

The following listing was developed from a review of literature in the philosophy of technology since 1980. The listing represents an effort to synthesize a manageable number of the most important characteristics of technology for use in technology education curricula.

1. Technology is developed in response to the needs of society. Technology originates with a need, a perceived need, or a want and is adopted, rejected, or modified over time according to the values of a particular society. Technology is a universal in all cultures. Technology supports the quality of contemporary life. Technology is the critical variable with respect to the human condition.

Necessity is the mother of invention is an illustration of this idea. Inventions that seem curious today seemed very rational, at least to the inventor, at the time of invention.

2. Technology is practical. Technology is pragmatic and the efforts of technology are toward something that is workable. Technology is application oriented and involves

doing. The emphasis is on implementation. The technological imperative suggests that technology is action-oriented and if a particular technology is available, it will be utilized. Know how is an example of practical knowledge.

3. Technology is problem-oriented. Technology begins with a problem derived from the needs of society. A definite process can be used to obtain results. A creative search for the solution to a new problem may produce a sudden act of insight--a breakthrough.

Problem solving usually involves decision making trade-offs. The techniques of technology assessment can be used to anticipate and evaluate the positive and negative consequences of a particular technology. Technology is problem and environment specific.

Problem solving activities provide students with opportunities to be creative. Students will not be able to create technology, but, the majority will have the opportunity to discover their innate, inventive genius that is characteristic of all of humanity.

4. Technology is future-oriented. The focus is on what is to be, what could be, and what should be. Sometimes the length of time required in research and development causes the parameters of the original project to change.

5. Technology is cumulative and evolutionary. Technology adds up and accumulates and can be applied to other areas. If the prerequisites are available to support development there could be a substantial breakthrough--a revolution.

Because technology is accumulative it is also accelerating increasing the magnitude and rate of change. (DeVore, p. 27)

6. Technology is multi-disciplinary. Knowledge from several diverse disciplines is brought together. Technology is eclectic and pragmatic. Contemporary technology is science based. From an educational perspective technology is an integrator of knowledge. Technology has proceeded from the mechanical and directly observable to the abstract, science/math-based technology of today.

7. Technology creates new realities and possibilities. It determines what is to be. There have been technological breakthroughs that have revolutionized the world and the way we think about the world. The future is alterable. Technology produces new insights and new knowledge, and has created an impressive record of human achievement.

8. Technology multiplies and extends human abilities and impacts. The difference today is the rate and magnitude of the changes. Awesome technical accomplishments have been achieved!

9. Technology creates an artificial environment and insulates us from the realities of nature. In the middle of a desert, Sun City, AZ has been created with air conditioned homes, swimming pools, and lush vegetation. Many beneficial technologies have also resulted in unintended and unanticipated effects. DDT, the Aswan Dam, Acid Rain, Love Canal, the destruction of the ozone layer, and the

deforestation of the rain forests have resulted from technology gone awry.

10. Technology has certain governing values: skill, craftsmanship, ingenuity, simplicity, functionality, appropriateness, optimization, objectivity, efficiency, effectiveness, creativity, conservation, control, precision, etc.

11. Technology is an organized, coordinated system. The universal systems model--input, process, and output--is useful in understanding complex technological systems.

Conclusion

The benefit of using the characteristics of technology as a foundation for an introductory course is that the results of the course add up to a general understanding of technology. A disconnected combination of activities may not necessarily produce the comprehensive general understanding of technology that is necessary to gain the broad public support that could be gained from addressing the national call for a study of technology. The use of these characteristics does not suggest that our existing curriculum structure is not good and we must start over. This article suggests the range of characteristics of technology that are known to exist should be present within any introductory class that has the purpose of producing a general understanding of technology.

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Evaluating the Levels of Concern

of

Technology Education Student Teachers

with the

Curriculum Change from Industrial Arts

to

Technology Education

by

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(Refereed Article)

EVALUATING THE LEVEL OF CONCERN OF TECHNOLOGY EDUCATION STUDENT TEACHERS WITH THE CURRICULUM CHANGE FROM: INDUSTRIAL ARTS TO TECHNOLOGY EDUCATION

Introduction

Educational change is a multi-faceted issue. Determining the level of concern of teachers involved in the implementation process of a new innovation is important for recommending appropriate change principles to facilitate the process. This evaluation involved students in a technology education teaching methods course. They will begin student teaching the following spring semester 1990. The majority of the students began in the industrial arts education curriculum when they entered North Carolina State University.

The North Carolina Department of Public Instruction has mandated that technology education be implemented in the entire state the academic of year 1989-90. After speaking with technology teachers in many different locations in the state, the researcher found that they assumed curriculum change will be a slow process. A variety of concerns appeared to affect both experienced and beginning teachers. The students involved in the teacher education program have voiced the concern that they will be lacking certain technological skills required to follow the state mandated curriculum.

Educational Change

The literature concerned with strategies of innovation in education is very diverse. Fuller (1969) believed that there was sufficient evidence to support a developmental conceptualization of teacher concerns. She stated three phases of concerns that affected teachers, a pre-teaching phase: non-concern, early teaching phase: concern with self, and overt concerns: how adequate am I (pp. 219-220)?

Havelock (1973) used three models to illustrate the strategies and the tactics of innovation associated with them. The three strategies are; 1. "Problem-Solving (P-S), 2. Social Interaction (S-I), and 3. Research, Development, and Diffusion (RD & D)" (p. 154).

The problem-solving strategy rests on the primary assumption that the innovation is part of a problem-solving process which goes on inside the user. Problem-solving is usually seen as a patterned sequence of activities beginning with a need, sensed and articulated by the client, which is translated to a problem statement and diagnosis. Havelock (1973) stated that after the client-user has formulated a problem statement he is then able to conduct a meaningful search and retrieval of ideas and information which can be used in formulating or selecting the innovation.

The social interaction strategy places emphasis on the patterns by which innovations diffuse through the social system (Brickell, 1961; Clark & Guba, 1965; and Havelock, 1973). Havelock (1973) suggested that five generalizations support the process of innovation diffusion; "the individual, user, or adopter belongs to a network of social relations which largely influences his adoptive behavior, his place in the network is a good predictor of his rate of acceptance of new ideas, informal personal contact is a vital part of the influence and adoption process, group membership and reference group identifications are major predictors of individual adoption, and the rate of diffusion through a social system follows a predictable S-curve pattern" (p. 159).

The research, development, and diffusion strategy is guided by the assumptions that the "sequence in the evolution and application of the innovation" should support the rational sequence and the planning, and "co-ordination of labor" the passive, but rational, consumer "will accept and adopt the innovation if it is offered to him at the right time and in the right form." (p. 161).

When speaking of impediments to change Fullan (1982) stated that "many of those concerned with educational reform have been preoccupied with developing and advocating the goals of change, as if all that is needed are good intentions". Fullan wrote that "even good programs are not enough, if it is simply expected that others will easily accept them or could be forced to" (p. 103).

Educational change theory is developing an awareness of the concerns of teachers in the change process.

implementation of innovations can be accomplished when teacher concerns are primary. Hall and Hord (1987) contended that principals and other facilitators can be more effective and change can be successful if the concerns of teachers are considered. Hall and Hord went further to state:

> What is new in the "concerns" theory is that it provides change facilitators with ways to assess and catalog the different perceptions teachers can have. With this diagnostic information in hand, it is possible to be more effective in adjusting interventions so that they are related to teachers' perceptions (p. 53).

Koppel and Miller (1987) suggested a set of "needs" that would help facilitate the change from industrial arts to technology education. They believed in providing a program for all students, "those interested in various vocations; college-bound technically and nontechnically oriented students; or simply those who wished to increase their skills, competencies, and problem-solving abilities". They suggested closing the gap between what is taking place in industry and what is being taught in schools and phasing out the project-oriented curriculum and moving toward more creative and problem-solving techniques. Koppel and Miller also suggested improving the attractiveness of the course offerings "to appeal to a broader range of students", and for providing "greater choice among elective courses in light of the increased number of credits required for graduation", and for "integrating the courses more fully into the total school curriculum to show students how various subjects and skills relate to one another" (p. 78).

Statement of the Problem

This study was designed to determine the level of concern among technology education students who were preparing for student teaching. The goal of the survey was to determine the level of student's concern with the recent curriculum change from industrial arts to technology education. Additionally, the study was designed to recommend appropriate educational change principles to facilitate the transition process for future technology teachers.

The Context of the Evaluation

The Program

Industrial arts has had a more static, project-oriented, curriculum. The literature illustrates that a need exists to prepare students for the rapid development of technology and how it relates to their world. By including four technological systems, manufacturing, construction, communications, and transportation, the students will be able to relate technological innovation to their daily lives. Within these four systems, creativity, problem-solving, and research and experimentation will be stressed. Correlation with other subjects, such as mathematics and science, will give the four systems a practical relevance.

The Stakeholders

The curriculum change from industrial arts to technology education is taking place throughout the country. However, this evaluation will concentrate only on the concerns of the technology education teaching methods course students in the technology education department at NCSU. The stakeholders are the professors who will be interested in the outcome of this evaluation and who have taught the individual students and have been implementing the new curriculum.

Issues and Concerns

The two issues that will be addressed in this evaluation are whether the students will be prepared to present the new technology education curriculum to the middle and high school students at their respective student teaching locations and whether they have a positive outlook about the curriculum change from industrial arts to technology education. Observing and documenting the student teachers' concerns will, hopefully, be used to make positive changes in the curriculum adoption process.

Instrument and the Source of Data

The Stages of Concern Questionnaire (SoCQ) was designed by Hall, George, and Rutherford (1979). It was used in this study by permission. The SoCQ is a thirty-five item, Likert-type questionnaire. The data was presented graphically and by percentiles.

Hall, George and Rutherford (1979) have refined distinctions among seven categories of concerns, as follows:

6. <u>Refocusing</u> - The focus is on more universal benefits from the innovation, including the possibility of major changes or replacement with a more powerful alternative. Individual has definite ideas about alternatives to the proposed or existing form of the innovation.

5. <u>Collaboration</u> - The focus is on co-ordination and co-operation with others regarding use of the innovation.

4. <u>Consequence</u> - Attention focuses on the impact of the innovation on student in his/her immediate sphere of influence. The focus is on relevance of the innovation for students, evaluation of student outcomes, including performance and competencies, and changes needed to increase student outcomes.

3. <u>Management</u> - Attention is focused on the processes and tasks of using the innovation and the best use of information and resources. Issues related to efficiency, organizing, managing, scheduling, and time demands are utmost.

2. <u>Personal</u> - Individual is uncertain about the demands of the innovation, his/her inadequacy to meet those demands,

and his/her role with the innovation. This includes analysis of his/her role in relation to the reward structure of the organization, decision making, and consideration of potential conflicts with existing structures or personal commitment. Financial or status implications of the program for self and colleagues may also be reflected.

1. Informational - A general awareness of the innovation and intrest in learning more detail about it is indicated. The person seems to be unworried about himself/herself in relation to the innovation. She/he is interested in substantive aspects of the innovation in a selfless manner such as general characteristics, effects, and requirements for use.

0. Awareness - Little concern about or involvement with the innovation is indicated.

Discussion of Results

The literature concerned with change supports the concept that change is personal. Measuring the level of concern of the technology education student teachers identified concerns that can be addressed and understood, creating a positive student teaching experience.

The seven levels of concern presented by Hall, George and Rutherford (1979) are developmental. As a teacher becomes familiar with the innovation he/she will progress to the refocusing level. However, Hall et. al. (1979) suggested that when a person is first exposed to the innovation it is best to have a moderate refocusing level to allow for learning and experience. The student teachers' level of concern results illustrated expected outcomes.

The levels for the ten different students differed in many ways. However, there were similarities in some of the levels. For example, the Awareness level was low for the majority of the students. This indicated that they knew and understood the innovation, but that they needed more information about the diverse technology education subject areas. In addition, the new student teaching assignments produced a high level of concern on the Informational level. Questions such as, "What will I need to know?" and, "What will be required of me?" are both Informational and Personal level concerns. The Management level of concern was not high for the majority of students. This was due to the lack of teaching experience and exposure to time management which is critical for effective teaching. Since the student teachers were concerned for their own success the Consequence level was not a serious concern for them. How technology education affected the their students and how the would evaluate them was not one of the student teachers' most pressing concerns.

Appendix D illustrate the various levels of concern using percentile scores. The Informational and Personal levels were the highest. The percentile scores show the intensity of the specific concern. Clearly the students were concerned about the information they will need to perform well and how they will be affected personally by the student teaching experience.

<u>Recommendations</u>

The levels of concern have "peaks". These "peaks" indicate a higher level of concern. Student F had a high level of concern in the Management level. Student E had a low Management level, meaning less anxiety or confusion when anticipating the requirements that will be necessary to carry out his/her duties. Students with differing levels of concern in specific areas could help each other by sharing their methods or techniques that help them to feel confident. Communication is very important for the resolution of concerns. Identifying the students with a high specific concern level and teaming them with students with low concern on the same level, will reduce anxiety and create a working relationship among contemporaries.

Using the Stages of Concern Questionnaire to determine the level of concern that teachers have with a new innovation provided an accurate method for diagnosing areas where facilitation assistance can be directed. The technology education student teachers had a positive overall attitude about their upcoming student teaching assignments.

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Appendix A

SOC QUESTIONNAIRE ITEMS

0	1	3 4 5	6 7
Irrelevant	Not true	Somewhat true	Very true

1.	I am concerned about students' attitudes toward this innovation.	0 1 2 3 4 5 6 7
2.	I know of some other approaches that might work better.	0 1 2 3 4 5 6 7
3.	I don't even know what the innovation is.	0 1 2 3 4 5 6 7
4.	I am concerned about not having enough time to organize myself each day.	0 1 2 3 4 5 6 7
5.	I would like to help other faculty in their use of the innovation.	0 1 2 3 4 5 6 7
6.	I have a very limited knowledge about the innovation.	0 1 2 3 4 5 6 7
7.	I would like to know the effects of reorganization on my professional status.	0 1 2 3 4 5 6 7
8.	I am concerned about conflict between my interests and my responsibilities.	0 1 2 3 4 5 6 7
9.	I am concerned about revising my use of the innovation.	0 1 2 3 4 5 6 7
10.	I would like to develop working relationships with our faculty and outside faculty using this innovation.	0 1 2 3 4 5 6 7
11.	I am concerned about how the innovation affects students.	0 1 2 3 4 5 6 7
12.	I am not concerned about this innovation.	0 1 2 3 4 5 6 7
13.	I would like to know who will make the decisions in the new system.	0 1 2 3 4 5 6 7
14.	I would like to discuss the posibility of using the innovation.	0 1 2 3 4 5 6 7
15.	I would like to know what resources are available if we decide to adopt this innovation.	0 1 2 3 4 5 6 7
16.	I am concerned about my inability to manage all the innovation requires.	0 1 2 3 4 5 6 7
17.	I would like to know how my teaching or administration is supposed to change.	0 1 2 3 4 5 6 7
18.	I would like to familiarize other departments or persons with the progress of this new approach.	0 1 2 3 4 5 6 7

19. I am concerned about evaluating my impact on students. 0 1 2 3 4 5 6 7

20. I would like to revise the innovation's instructional approach. 0 1 2 3 4 5 6 7

21. I am completely occupied with other things. 0 1 2 3 4 5 6 7

22. I would like to modify our use of the innovation based on the experiences of our students. 0 1 2 3 4 5 6 7

23. Although I don't know about this innovation, I am concerned about things in the area. 0 1 2 3 4 5 6 7

24. I would like to excite my students about their part in this approach. 0 1 2 3 4 5 6 7

25. I am concerned about time spent working with nonacademic problems related to this innovation. 0 1 2 3 4 5 6 7

26. I would like to know what the use of the innovation will require in the immediate future. 0 1 2 3 4 5 6 7

27. I would like to coordinate my efforts with others to maximize the innovations effects. 0 1 2 3 4 5 6 7

28. I would like to have more information on time and energy commitments required by this innovation. 0 1 2 3 4 5 6 7

29. I would like to know what other faculty are doing in this area. 0 1 2 3 4 5 6 7

30. At this time, I am not interested in learning about the innovation. 0 1 2 3 4 5 6 7

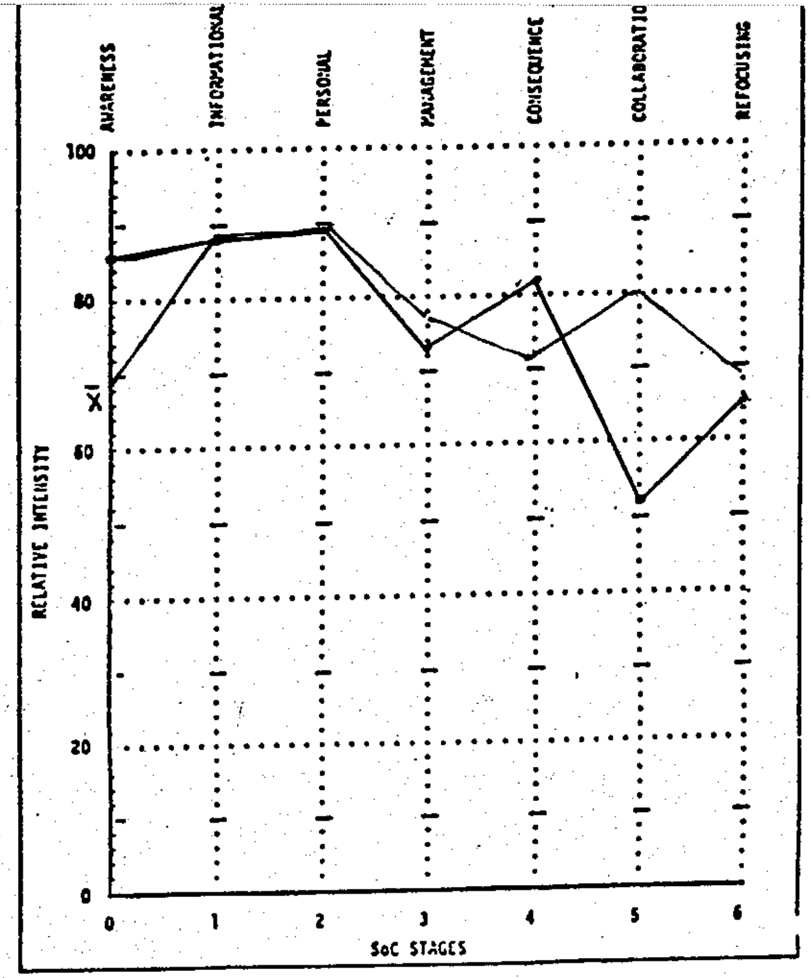
31. I would like to determine how to supplement, enhance, or replace the innovation. 0 1 2 3 4 5 6 7

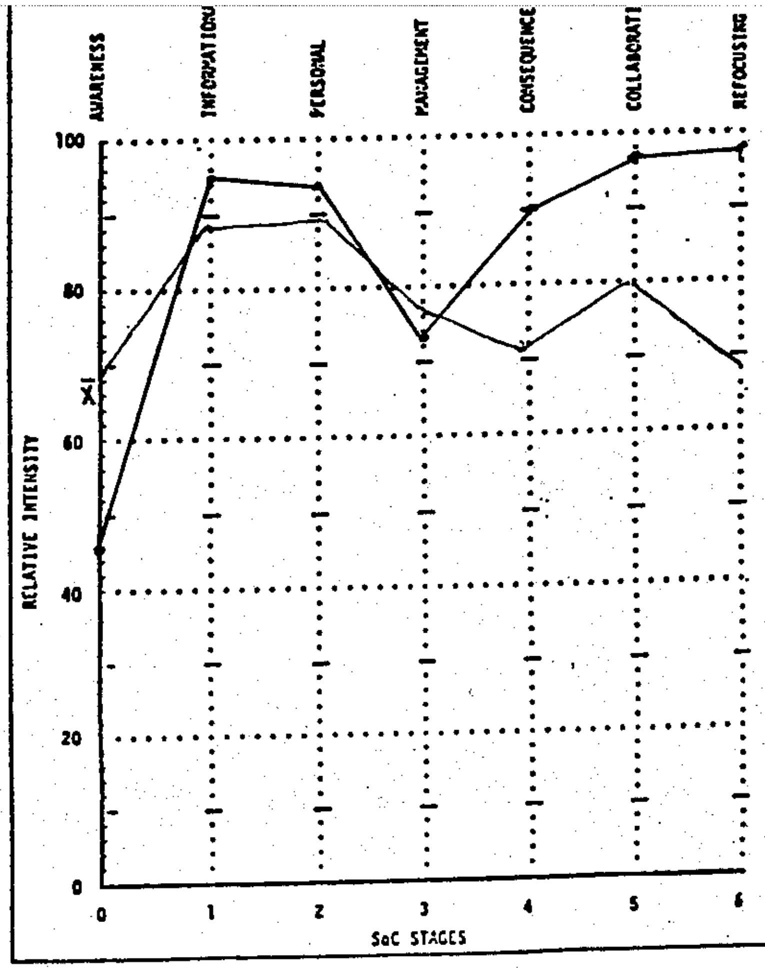
32. I would like to use feedback from students to change the program. 0 1 2 3 4 5 6 7

33. I would like to know how my role will change when I am using the innovation. 0 1 2 3 4 5 6 7

34. Coordination of tasks and people is taking too much of my time. 0 1 2 3 4 5 6 7

35. I would like to know how this innovation is better than what we now have. 0 1 2 3 4 5 6 7

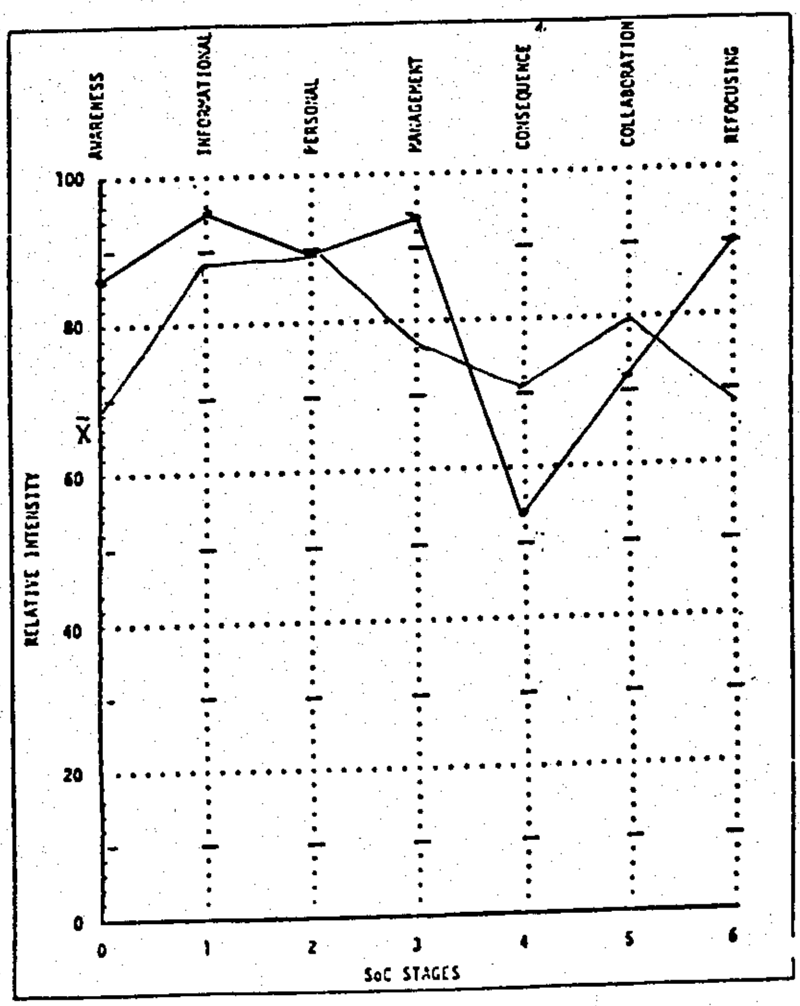


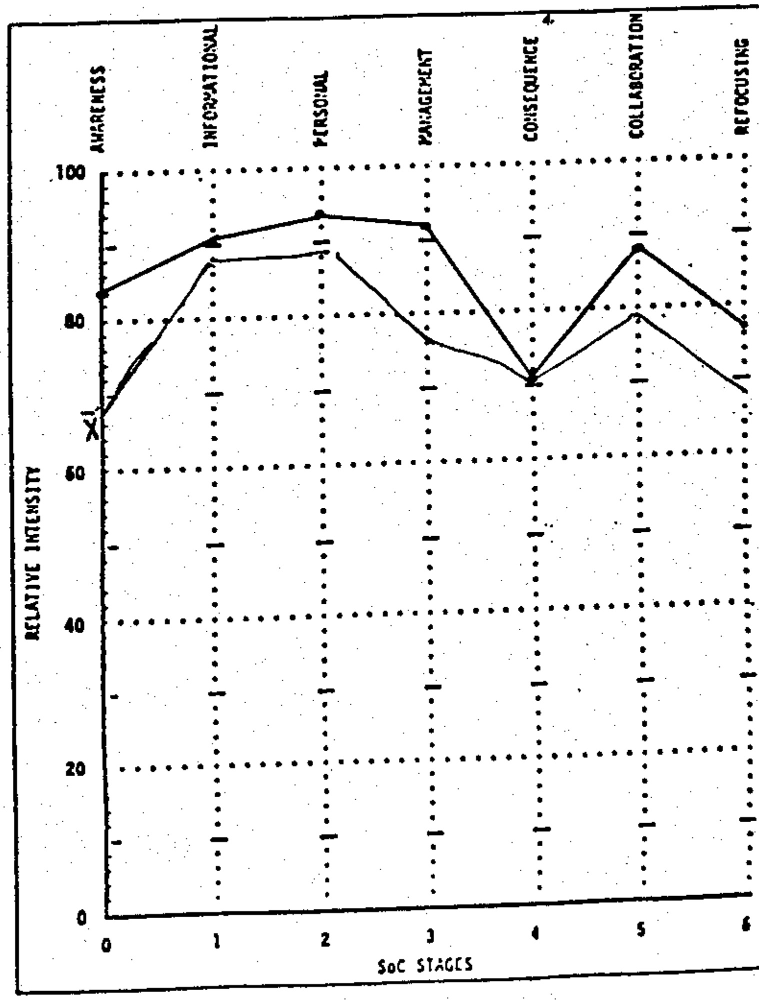


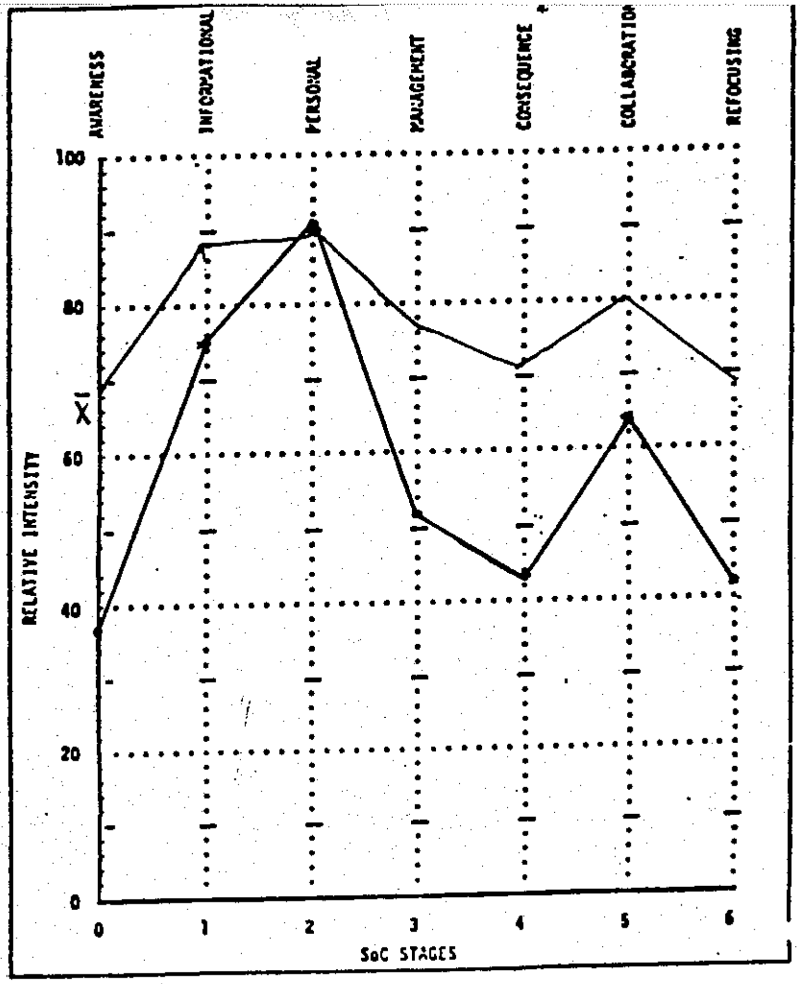
Student A

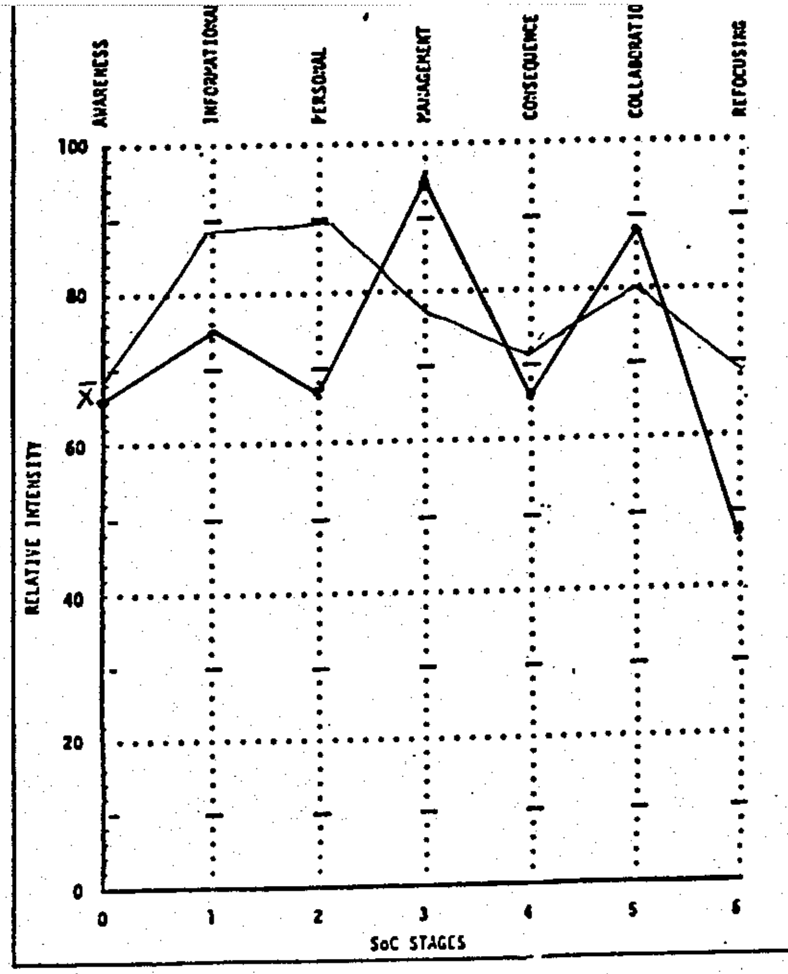
Appendix B

Student B









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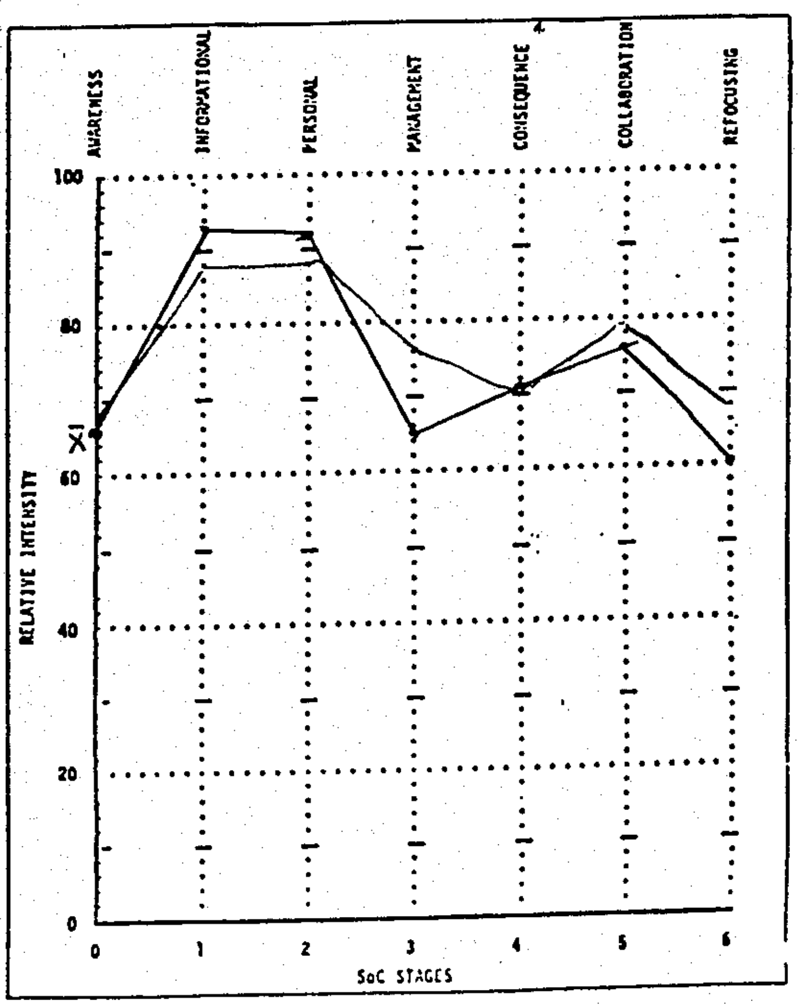

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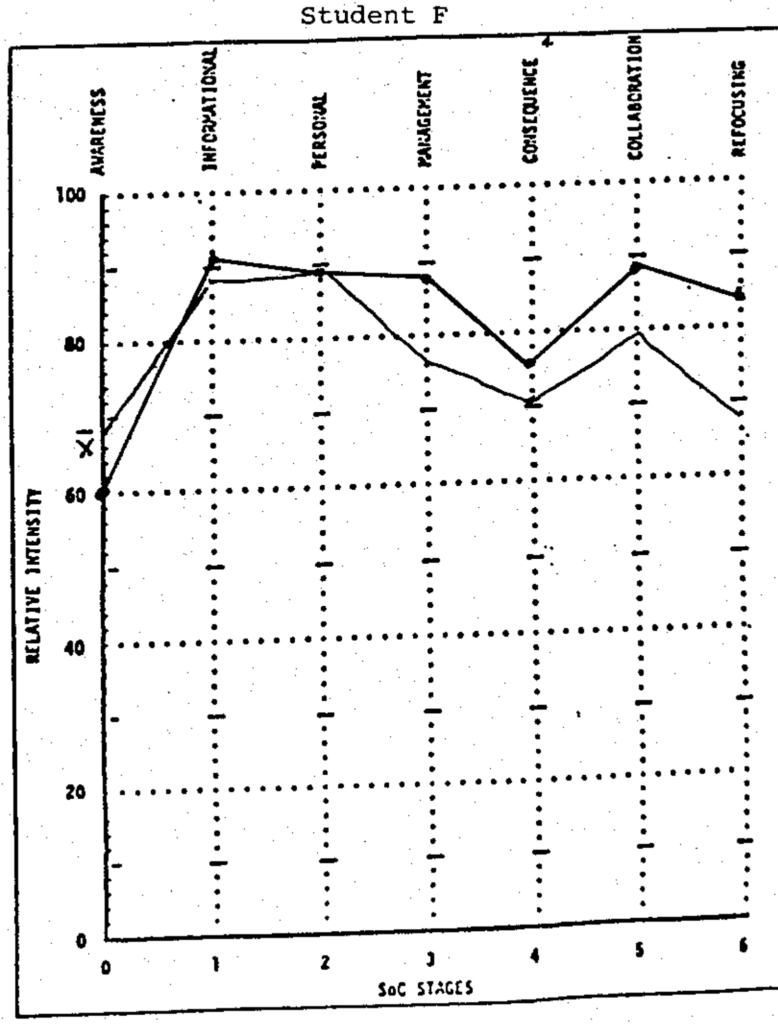
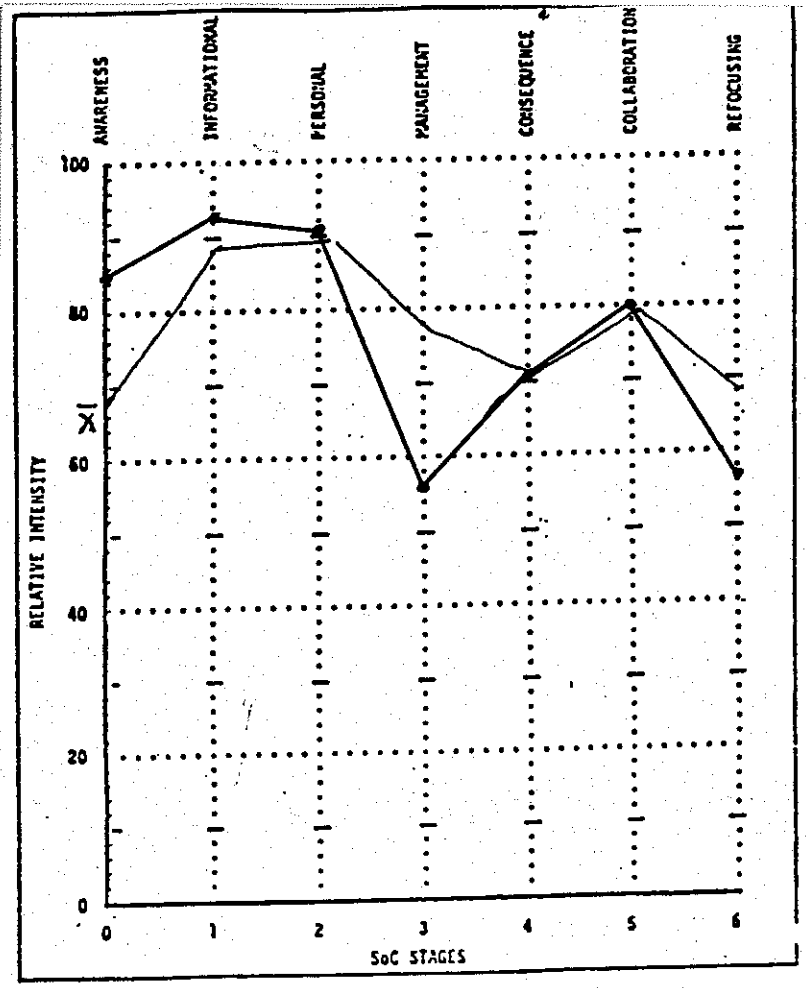
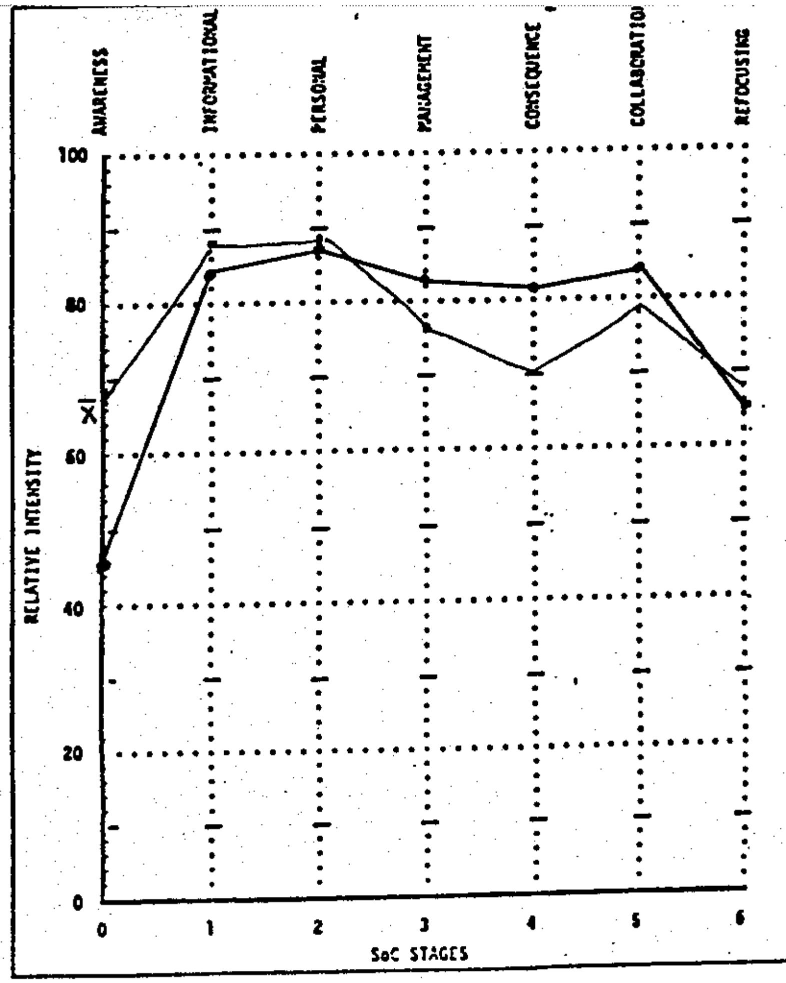




Student I



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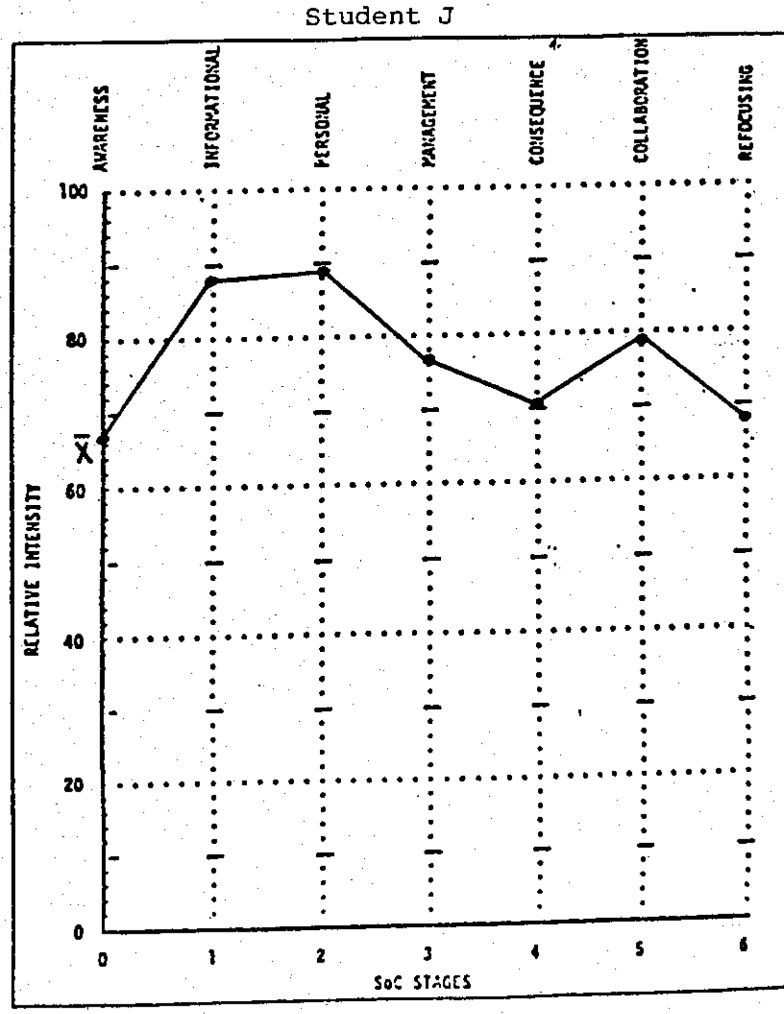
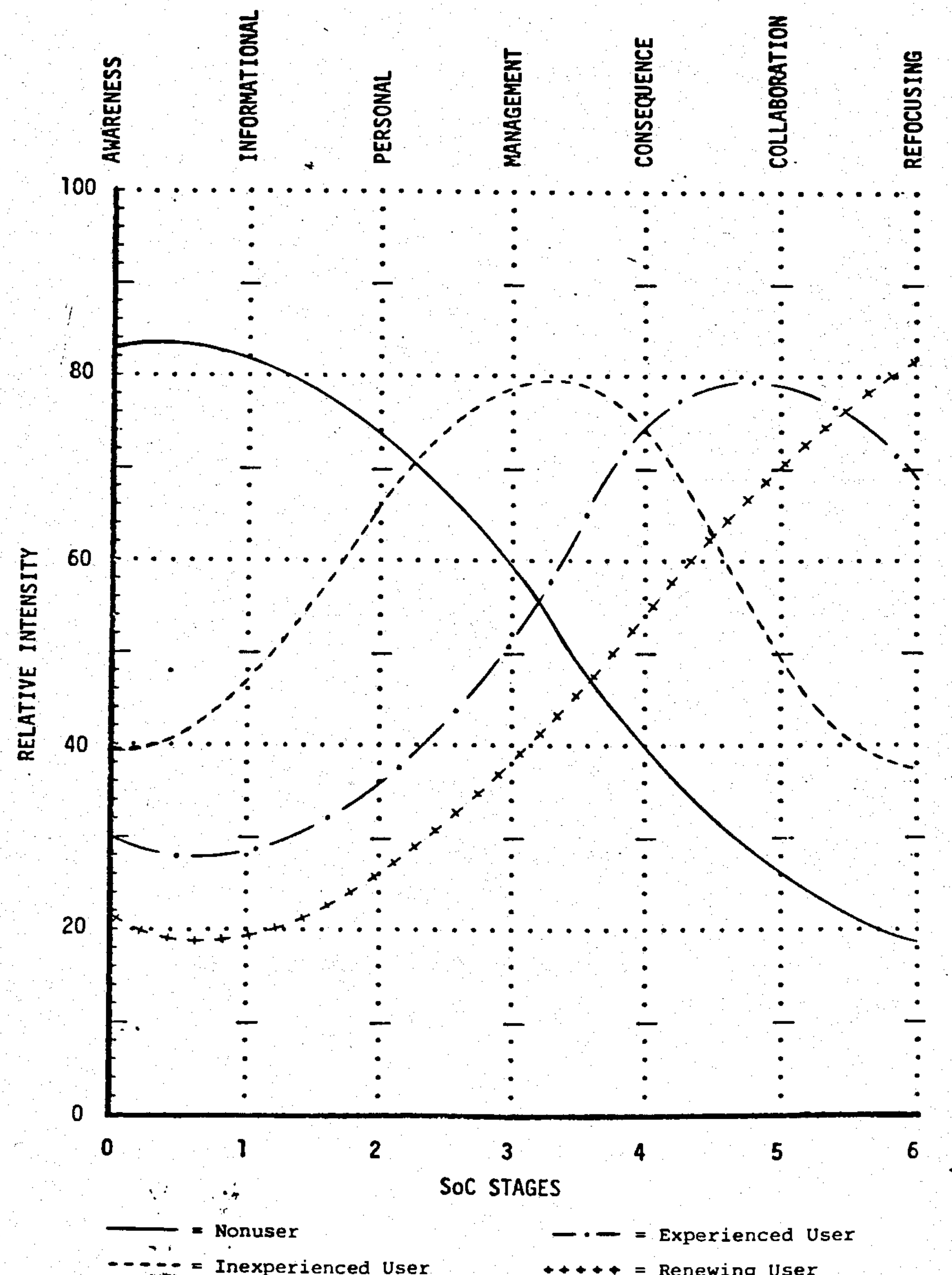


Appendix C

Hypothesized Development of Stages of Concern



Appendix D

Student Percentile Scores

Levels of Concern	0	1	2	3	4	5	6
Student A	86	88	89	73	82	52	65
Student B	46	95	94	73	90	97	98
Student C	86	95	89	94	54	72	90
Student D	84	91	94	92	71	88	77
Student E	37	75	91	52	43	64	42
Student F	66	75	67	95	66	88	47
Student G	66	93	92	65	71	76	60
Student H	60	91	89	88	76	88	84
Student I	86	93	91	56	71	80	52
Student J	46	84	87	83	82	84	65
Student $\bar{X}$	66.3	88	88.3	77.1	70.6	78.9	68

Final Report

of the

1989 International Leadership Development Symposium

for

Association Leaders in Technology Education

by

Robert and Marilyn Wenig

North Carolina State University
Raleigh, North Carolina

(Refereed Article)

FINAL REPORT
of
The 1989 International Leadership Development Symposium

Introduction

Historical Background

The 1989 International Leadership Symposium was the third such time it was conducted (the previous two were in 1985 and 1987). The idea grew out of the 1983-86 AIAA/ITEA Professional Improvement Plan (PIP). In August, 1984 ITEA President-Elect Dr. William Dugger appointed this writer as Task Force Chair of the Leadership Committee. The chair obtained information from the committee which consisted of James Bensen then at Stout); William Dugger; Thomas Hughes, Virginia Department of Education; and Milton Miller, then at University of Missouri. A proposal was written and funds were received from the Technical Foundation of America.

Forty-eight participants attended the 1985 symposium at U W Stout. The second symposium (1987) had 25 participants and was held at Camp Caraway near Asheboro, North Carolina. The reason why the third leadership symposium was promoted and funded lies totally in the wide-spread evidence of the success from the previous two. The former participants have shown outstanding leadership at the local, state, regional, national, and international levels. Other documents note what this success is.

1989 Symposium Development

The 1989 leadership symposium was born from the continued need for ITEA to promote increased leadership development among technology educators. This writer, on the suggestion of Past ITEA President Jane Smink, wrote a proposal to fund a one-week leadership program which was submitted to Jane Smink and Kendall Starkweather in the fall of 1988. Kendall Starkweather submitted the proposal to the Technical Foundation of America, and it was funded.

Participants

Recruitment

The symposium was designed to serve 50 participants. Even though extensive time and energy were extended by all people involved to recruit quality participants, 28 attended (see Appendix A). Some members of the 1985 symposium have said, "48 participants, the number who attended the '85 symposium,were too many." The decision has been made that next time the symposium is held, recruiting will begin a year before to provide greater opportunity to get the message out to state and province associations and local school districts. Also an encouraging note, a number of states that have sent representatives to the three symposiums are automatically including the cost of sending new officers to the next symposium. Regardless, the 28 participants who attended in 1989 were exceptional technology educators who made the symposium a very successful experience. Further, at least 10 people dropped in for 1-6 hours but could not attend the entire event.

Representation

Sixteen states had representatives at the symposium. Region one sent five, region two 13, region three eight, and region four two. Illinois sent the most participants with four, followed by Indiana, Ohio and Wisconsin with three each. The largest group of participants was local classroom teachers (18 of 28 or 64%) followed by two state supervisors, one local school supervisor, two professors, two university department heads, one university associate dean, one doctoral student and one university executive secretary. The attendees were all white with four women. Ages ranged from 4 in the 20-30 age group, eight in the 31-40 age group; nine in the 41-50 age group; and seven in the 51-60 age group. The educational levels of the participants were as follows: 26% had a doctoral degree, 8.6% had a six-year certificate, 43% had a master's degree, 17% had a bachelor's degree and one had an associate degree.

Program

The Program Conceptual Model

Over the years, leadership development has been a vague, most elusive fascination. Repeated research to pin-point specifics of what makes a good leader and how to develop them continues. The theoretical base of leadership has moved from the leader exercising autocratic power to one of empowerment. Society has fostered a humanity that demands to have greater control over life. Those leaders who have failed to comprehend the shift to empowerment found themselves less and less able to lead. No one today wants to work for a person or organization that has an autocratic environment.

The knowledge that led to the shift of leadership by force to empowerment of others was the first part of the three-part conceptual model used to develop the leadership symposium program. The second contributing factor for developing the program was the immense and valuable information from the field of self-development. Noted experts such as: Hill, Maltz, Mandino, Zigler, Waitley, Schwartz, Dyer, and a host of others provided insights about how humans can self improve. It is a proven fact that people cannot lead others until they are able to lead themselves. The basis of this self leadership lies in having a healthy self image. The third source of data used in developing the program conceptual model was music. Music is the universal language that reaches the human emotions faster and with less difficulty than any other training medium.

The blending of the information from the three area (leadership empowerment, field of self -development and music dynamics) provided the conceptual model for program development. Setting the scope and sequence, identifying content and selecting presenters were all done by using the model to gain the best possible leadership development format. In addition, past symposium participants, training experts and others were consulted in putting the final touches on the program.

Program Purpose and Objectives

Purpose: Prepare 50 or more new and emerging technology education association and other leaders at the University of Wisconsin-Stout during July 22-27, 1989 to assume responsibility for providing vision and influence for the technology education profession.

Objectives: Each participant will:

1. Identify with an effective leadership style that generates a positive influence on others
2. Plan, organize, and control to develop leadership knowledge and skills in:
    a. Visualization that aligns, inspires, and motivates people plus sets direction

b. Communication that gains commitment by sharing vision which captures the imagination and builds support for the vision

c. Positioning that sell, projects, and gives integrity and predictability to the organization

d. Positive self regard that can build an understanding of self and others to reduce conflicts, increase team efforts, and association effectiveness

e. Association operation management that enhances the use of time and meetings and how to market the product

f. Empowerment that enables the followers to lead and grow through the use of transformational leadership methodologies by the leader

d. Monitoring and assessing programs

e. Establishing schedules and using time wisely and how to conduct effective meetings

3. Apply these leadership forces to his/her own personality for achieving maximum results

4. Demonstrate how to effectively plan, organize, and control state/province professional associations

5. Indirect Objective: Develop a new and exciting winning spirit by discovering how his/her free-flowing natural talent can shape the destiny of the profession.

Program Organization and Operation

The five day, 40 hour, 13 session program was fast paced, extensive and varied to capture participant interest (see symposium schedule, Appendix B). The symposium started on Saturday evening of July 22, and ran through noon Thursday, July 27. The typical training day started at 8:30 AM and ended by 9:00 PM. The daily program (8:30-4:45) concentrated on personal and association leadership. The evening activities were specifically devoted to technology education leadership and benefits including a Wednesday evening banquet and speaker. A very positive factor to the success of the symposium involved the ITEA Board of Directors who were meeting at Stout during the time the symposium was occurring. Several members of the Board made excellent presentations to the participants plus humbly relating to them at meals, breaks and free time. The participants were impressed with the kindness and concern they showed them. Also, they were impressed with the extensive work the Board was doing to develop the next five-year plan.

Evaluation

The symposium evaluation required the development, implementation and analysis of two instruments. The two formal evaluation forms were as follows: end-of-session evaluation form and end of symposium evaluation form. Informal responses from participants and the Board provided opportunities to monitor the program to make changes in future symposiums.

The Formal Evaluation Process:

The Individual Session Evaluation Forms (see Appendix C). After each of the 13 sessions the participants were asked to complete this evaluation form. The program directors reviewed these forms during the evening to monitor how participants felt about the individual presenters and how the total symposium was going. Changes were made where possible.

__The End of Symposium Evaluation Form__ (see Appendix D). Foremost, the form was designed to determine how well the symposium objectives were met. Further, the evaluation form sought feedback from participants to assess the value of the 13 presentations, symposium organization and operation, the extent personal needs were met, how the overall development process went and a place to put comments.

Part I: of the evaluation instrument assessed how well the symposium objectives were met by the program (see Table I). The highest ranking objective was 3, I can apply these leadership forces to my own personality for achieving maximum results, with a mean average of 4.52 out of a possible 5. The next highest mean ranking was the indirect objective, item 5, participants developing a winning spirit, 4.5 out of 5. The lowest mean ranking was 3.74 which went to objective item 2-b.; communication that gains commitment by sharing vision which captures the imagination and builds support for the vision. When the individual means were averaged together a grand mean of 4.21 out of 5 was obtained.

TABLE I

Achievement of Symposium Objectives Using Rank Ordering by Means

Item	Description	N =23 X	Rank
3.	I can apply these leadership forces to my own personality for achieving maximum results..	4.52	1
5.	__Indirect Objective__: I developed a new and exciting winning spirit by discovering how my free-flowing natural talent can shape the destiny of the profession.........................	4.5	2
1.	I can identify with an effective leadership style and know its impact on others.............	4.43	3
2*-d.	Positive self regard that can build an understanding of self and others to reduce conflicts, increase team efforts, and association effectiveness................................	4.30	4
4.	I can demonstrate how to effectively plan, organize, and empower state/province professional associations..............................	4.26	5
2*-f.	Empowerment that enables the followers to lead and grow through the use of transformational leadership methodologies by the leader..	4.26	6
2*- c.	Positioning that sells, projects, and gives integrity and predictability to the organization..............................	4.2	7
2*- h.	Establishing schedules, using time wisely , and conducting effective meetings	4.17	8
2*- a.	Visualization that aligns, inspires, and motivates people plus sets direction...............	4.1	9
2*- g.	Monitoring and assessing programs..............................	4.04	10
2*- e.	Association operation management that enhances the use of time and meetings and how to market the product..............................	4.0	11
2*- b.	Communication that gains commitment by sharing vision which captures the imagination and builds support for the vision..............................	3.74	12

* Note: 2. I can plan, organize, and control to develop leadership knowledge and skills in:

Part II: of the symposium final evaluation form assessed the value of the 13 session presentations (see Table II). Topic presentations number seven, Where are you going? Positioning, gaining support for the vision received a perfect 5 out of 5 mean ranking. The lowest ranked topic was number 11, Public relations for voluntary organizations, with a mean average of 3.56 out of 5. Collapsing of the individual means into one grand mean gave an average mean of 4.32 out of 5.

TABLE II

Rank Order Evaluation by Means of the 13 Symposium Sessions

Item	Description	N =23 X	Rank
12.	Session #7 Topic: Where Are We Going? Positioning, Gaining Support for the Vision	5.	1
18.	Session #13 Topic: Empowerment	4.74	2
7.	Session #2 Topic: The New Leadership	4.65	3
15.	Session #10 Topic: Time & Its Use	4.56	4
9.	Session #4 Topic: Vision Building, Why?	4.5	5
8.	Session #3 Topic: A Perspective View of Technology Education	4.47	6
6.	Session #1 Topic: The Winning Formula	4.4	7
13.	Session #8 Topic: Self Leadership	4.32	8
11.	Session #6 Topic: Informal Group Discussions	4.26	9
10.	Session #5 Topic: Communication, Key to Inspiring Followers	4.17	10
14.	Session #9 Topic: ITEA & LSP Interaction	4.	11
17.	Session #12 Topic: Dev. & Imp. Assoc.'s Plan of Action	3.9	12
16.	Session #11 Topic: Public Relations for Volunteer Organizations	3.56	13

Part III of the symposium final evaluation related to assessing its organization and operation (see Table III). The top ranked item for the symposium organization and operation was item c, attitude of staff with a mean of 4.86 out of 5. Following very closely was item e, helpfulness of staff, (4.8) and item d, organization of symposium, (4.78). The lowest ranking was received by item a, pre-symposium communication, 3.17 out of 5. Collapsing the nine individual ranked items into one gave a grand mean average of 4.37.

TABLE III

Rank Order Evaluation by Means by How Well The Symposium was Organized and Operated

Item	Description	N =23 X	Rank
c.	Attitude of staff	4.86	1
e.	Helpfulness of staff	4.8	2
d.	Organization	4.78	3
b.	Availability of staff	4.69	4
i.	Location of Symposium	4.6	5
f.	Symposium rooms	4.56	6
h.	Cost of Symposium	4.35	7
g.	Accommodations	3.48	8
a.	Pre-symposium communication	3.17	9

Part IV of the overall final evaluation assessed how well the symposium met participants' personal needs (see Table IV). The highest ranking went to item 24, would you recommend this symposium to someone else in a similar position, 4.87 out of 5. Item 21 , to what extent did the symposium meet your personal needs, received a high mean, yet, it was the lowest for Table IV with a 4.52 out of 5. The collapsed grand total was a very high 4.68 out of 5.

TABLE IV

Rank Order Evaluation by Means of How Participants Felt Personally about the Symposium

Item	Description	N =23 X	Rank
24.	Would you recommend this Symposium to someone else in a similar position?	4.87	1
25.	Overall, how would you rate the total leadership symposium as a useful and productive experience?	4.78	2
23.	How much do you feel you have learned?	4.65	3
22.	To what extent will what you have learned affect your behavior as a state/province association leader?	4.56	4
21.	To what extent did the Symposium meet your personal needs?	4.52	5

Item 20. Were the notebook materials helpful in making your Symposium experience beneficial? Yes 23. No 0 ***Comments***: It was great for organization, limited my note taking, can be used for follow-up training, I don't have to hunt for items to use later for administration and supervision, excellent way to keep-up with materials, good idea being loose leaf for adding information during week and later, easy to keep track of material, should help when needed later, put everything into one grand order, help to review material at home, easy learning process, handouts will be invaluable later, and a thorough and well done for reference and reinforcement of what I learned

Overall Comments :

Pros

* Program well done
* Presenters were all good, both high and low keyed
* Excellent--all technology teachers need this symposium, just not association leaders
* Self awareness, confidence building, sharing, listening, positioning, planning, accepting change, group interaction, and able to lead self as well as others, all in a week---what more could I say
* We all need to become leaders for the benefits of future educational growth and progress
* Symposium is the high-light of my summer-outstanding
* Now I know where to start with our vision--thank you it was great
* Thank you for the opportunity --food excellent and too much
* Good conference, especially the information on the Disc needs styles
* Fantastic experience that I'll never forget
* I have never felt so good about myself and technology education, thank you
* Greatly benefited from symposium
* It was really well done, thanks
* Excellent, well done
* Selection of presenters was outstanding
* Flowed well, very well
* Group worked together great
* Learned a great deal and had fun time doing it, thanks
* Absolutely wonderful learning experience
* The experience will have a positive affect on the way I conduct my professional career

Cons

* Have time for state officers to work on planning
* Some presenters too low keyed
* More enjoyable if schedule was changed from morning to evening
* Some instances have more activity
* Rooms need to be air-conditioned

* Need memory improvement
* Poor chairs
* Have central recording of presentations
* Better publicity for people in new association positions
* More free time between last day session and supper

The participants' positive statements were repeatedly given, while the negative ones were listed just once. The meaning from this data are that the pros were felt by most participants while the cons were solely individual.

Informal Evaluation

If one were observing and listening to the participants to determine the value of the symposium experience, one would hear and witness the following: 99 percent attendance, cooperation of group, singing enthusiastically, interaction with directors, abundance of smiles and laughter, etc, etc. However, the best two indicators of personal growth and development by the participants from the symposium came Wednesday evening and Thursday noon. First, Wednesday evening at the banquet the director received a memento with a small book attached with each participant telling how much he/she enjoyed the symposium. Second, Thursday noon during the closing remarks, all the participants congregated at the front of the room and acted out a song they had practiced, then ran about thanking each ITEA Board member for the symposium.

When I went back to my room after the Wednesday evening banquet, I read the notes written to me. One note was especially gracious which read, "I'm a better person for knowing you." Please, don't misunderstand my intent for sharing this note. The real significance of this note and others plus thanking the ITEA Board would lead the observer to believe that these symposium participants began reaching the essence of being a leader for they gave of themselves to others.

APPENDIX A

Participants of the 1989 International Leadership Development Symposium

Participants of the1989 Leadership Symposium
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APPENDIX B

The 1989 International Leadership

Symposium Schedule

1989 INTERNATIONAL LEADERSHIP SYMPOSIUM SCHEDULE

SATURDAY JULY 22	SUNDAY JULY 23	MONDAY JULY 24	TUESDAY JULY25	WEDNESDAY JULY26	THURSDAY JULY 27
	Breakfast 7:15-8:15 →	→	→	→	→
Travel Day to Stout See Attached Map	**Session 1,** 8:30-11:30, *Bob Wenig* **The Winning Formula** Factors of Winners,They Deserve to Win Desire to Win	**Session 4,** *Bob Wenig* **Vision Building, Why?** Vision vs Strategic Planning How to Create Your Own Vision	**Session 7,** *Jim Bensen* **Where Are Gong** **Positioning -Gaining Support for the Vision**	**Session 10,** *Charles Krueger & Jerry Coomer* **Time and its Use** The Biggest Time Robbers Reduce Time Robbers Find More Time Use Time More Wisely	**Session 13,** *Alma Baron* **Empowerment** Leader Strategies-Indiv .Gp Climate for Motivation Involvement- Dec. Making
	Break10:00-10:15 →	→	Break 10:00-10:15 →	→	→
During The Day	Dream of Winning Discipline to Win Dimension to Win	Develop your own Leadership Purpose Transform your Purpose into a Sensory-Rich Vision Sharing Results	Define Positioning-Actions Phase of LS Strategy Plan and Design Environment/Climate Changing Circumstances Creating a Climate for Change	**Conduct Eff. Meetings** Making Meetings Productive Role of Leader Present info Effectively Get Group Involved Control & Conclude Meeting	How to Bring about Change Effectively How to Work Effectively with Committees How to Work with Outside Constituencies Symp. Evaluatioin
	Lunch 11:45-12:30 →	→	→	→	
Check in time is between 1:00 and 8:00 PM Sunday	**Session 2,** 1:00 -4:15 *Richard Meiss* **The New Leadership** Leadership Context Commitment Complexity	**Session 5,** *Walter Waetjen* **Communication, Key to Inspiring Followers** How to Share a Vision Interpretation of Reality Social Architecture- Culture of an Organization	**Session 8,** *Bob Wenig* **Self Leadership -** Understand Self & Others Personal Profile System Background (DISC) Adm. Instrument Intrepretation	**Session 11,** *Lorin Robinson* **Public Relations for Volunteer Organization** Image Building	Luncheon 12:00-1:30 Recap and Certificates Bob Wenig, Jane Smink, and others
	Break 2:30-2:45 →	→	Break 2:30-2:45	Break 2:00-2:15	**Leaving Stout**
Evening Activity	Character Competence Responsibility and Trust Molecule of Mgt. Selected Definition-- Transformational	Changing the Social Arch. How to Communicate Assessing Comm. Skills Developing Comm. Skills	Sharing Results Application to Leadership Reading People Team Building Case Study	Marketing Associations Wayes and Means	Have A Great Trip Home and thanks for sharing your time with us.
6:30-7:00 Reception, with Refreshments	Open Group Sharing 4:15 -5:15 →	→	Open Group Sharing 4:30- 5:30	**Session 12,** 3:30- 5:15 *Tom Baldwin & Jane Smink* **Dev. & Implement an Assoc's. Plan of Action**	
7:00-9:00 Orientation Introductions and speech by *Jim Johnson*	Dinner and Free Time 5:15-7:00	Picnic-Recreation 5:30-7:30	Dinner and Free Time 5:15-6:30	Wis. & North Carolina Tech. Educ. Assoc	
Future of Technology Education	**Session 3,** 7:00-8:00 *Don Lauda* **A Perspective View of Technology Education**	**Session 6,** 8:15-9:00 Informal group discussions Work on Group Visions	**Session 9,** 6:30-7:30 *Rich Bray* **ITEA & LSS Inter action** 7:30-9:00 Band Concert & Ice Cream	**Reception** 6:00-6:30 **Banquet** 6:30 -7:30 **Speaker** *Ralph Hood* **Partner Exchange** 7:30 - -	

APPENDIX C

The Individual Session Evaluation Form

Leadership Symposium

Session Evaluation Form

Directions: Please complete this evaluation form for each of the 13 sessions. The results will be used to closely monitor the symposium and make changes accordingly.

Session #_______ Presenter____

I. Complete each of the following open-ended statements with your own thoughts.

A. The session____

____

B. Today I learned____

____

C. Personally, I would rather____

____

D. The presenter of this session____

____

E. The main difficulty of this session____

____

II. Please respond to the following:

A. What was the most satisfying or positive aspect of this session?_______________

____

B. What was the least satisfying or negative aspect of this session?_______________

____

C. I would improve this or future sessions by _______________________________

____

D. How can we better help you to enjoy the symposium?_______________________

____

Other Comments:

APPENDIX D

The End of Symposium Evaluation Form

The 1989
International Leadership Symposium
FINAL EVALUATION FORM
University of Wisconsin-Stout
Menomonie, WisconsinJuly 22-27, 1989

We would like you to answer the following questions pertaining to your experience with the 1989 International Leadership Symposium by completing each item using the appropriate responses. Your response will assist the staff in better planning and conducting future symposiums on leadership to make them more beneficial to participants.

Part I: How well were the Symposium Objectives Achieved? Circle the number (one, strongly disagree; two, disagree; three, undecided: four, agree; five, strongly agree) that best describes how you feel about the statement in terms of your symposium experience.

1. I can identify with an effective leadership style and know its impact on others...........1 2 3 4 5
2. I can plan, organize, and control to develop leadership knowledge and skills in:
   a. visualization that aligns, inspires, and motivates people plus sets direction....... 1 2 3 4 5
   b. communication that gains commitment by sharing vision which captures the imagination and builds support for the vision.. 1 2 3 4 5
   c. positioning that sells, projects, and gives integrity and predictability to the organization.. 1 2 3 4 5
   d. positive self regard that can build an understanding of self and others to reduce conflicts, increase team efforts, and association effectiveness....................... 1 2 3 4 5
   e. association operation management that enhances the use of time and meetings and how to market the product... 1 2 3 4 5
   f. empowerment that enables the followers to lead and grow through the use of transformational leadership methodologies by the leader.......................... 1 2 3 4 5
   g. monitoring and assessing programs.. 1 2 3 4 5
   h. establishing schedules, using time wisely , and conducting effective meetings 1 2 3 4 5
3. I can apply these leadership forces to my own personality for achieving maximum results...1 2 3 4 5
4. I can demonstrate how to effectively plan, organize, and empower state/province professional associations...1 2 3 4 5
5. Indirect Objective: I developed a new and exciting winning spirit by discovering how my free-flowing natural talent can shape the destiny of the profession.....................1 2 3 4 5

Part II: Session and Presenter Evaluation. Please circle the number that best represents your feelings; (one, represents very poor; two, poor; three, average; four, good; five, excellent).

6.	Session #1 Topic: The Winning Formula, R. Wenig	1	2	3	4	5
7.	Session #2 Topic: The New Leadership, R. Meiss	1	2	3	4	5
8.	Session #3 Topic: A Perspective View of Technology Education, D. Luada	1	2	3	4	5
9.	Session #4 Topic: Vision Building, Why?, R. Wenig	1	2	3	4	5
10.	Session #5 Topic: Communication, Key to Inspiring Followers, W. Waetjen	1	2	3	4	5
11.	Session #6 Topic: Informal Group Discussions	1	2	3	4	5
12.	Session #7 Topic: Where Are We Going? Positioning, Gaining Support for the Vision, J. Bensen	1	2	3	4	5
13.	Session #8 Topic: Self Leadership, R. Wenig	1	2	3	4	5
14.	Session #9 Topic: ITEA & LSS Interaction, R. Bray	1	2	3	4	5
15.	Session #10 Topic: Time & Its Use, C. Krueger & J Coomer	1	2	3	4	5
16.	Session #11 Topic: Public Relations for Volunteer Organizations,L. Robinson	1	2	3	4	5
17.	Session #12 Topic: Dev. & Imp. Assoc's Plan of Action, T. Baldwin & J. Smink	1	2	3	4	5
18.	Session #13 Topic: Empowerment, A. Baron	1	2	3	4	5

Part III: Evaluation of Organization and Operation of the Leadership Symposium. Rating Scale: one, very poor; two, poor, three, average; four, good; five, excellent.

19. Please rate the following items about the Symposium:

a.	Pre-symposium communication	1	2	3	4	5
b.	Availability of staff	1	2	3	4	5
c.	Attitude of staff	1	2	3	4	5
d.	Organization	1	2	3	4	5
e.	Helpfulness by staff	1	2	3	4	5
f.	Symposium rooms	1	2	3	4	5
g.	Accommodations	1	2	3	4	5
h.	Cost of Symposium	1	2	3	4	5
i.	Location of Symposium	1	2	3	4	5

20. Were the notebook materials helpful in making your Symposium experience beneficial? Yes ____,No____

Explain____

____

____

Part IV: Personal Needs: Please evaluate the statement by circling the number that best describes your feelings.

21. To what extent did the Symposium meet your personal needs?..........................	1	2	3	4	5
22. To what extent will what you have learned affect your behavior as a state/province association leader?	1	2	3	4	5
23. How much do you feel you have learned?..	1	2	3	4	5
24. Would you recommend this Symposium to someone else in a similar position?....	1	2	3	4	5
25. Overall, how would you rate the total leadership symposium as a useful and productive experience?...	1	2	3	4	5

Overall Comments ______________________________

____

____

____

____

____

____

______________________________ ***Need More Room , Place on Back***

Thank You For Sharing Time With Us for

It Has Been A Most Delightful Experience

Perspective: Technology Education

and

Indepth Technology Course Offerings

by

Elmer E. Erber

East Carolina State University
Greenville, North Carolina

(Non-refereed Article)

PERSPECTIVE: TECHNOLOGY EDUCATION AND INDEPTH TECHNOLOGY COURSE OFFERINGS

During the decade of the eighties much has been said and written defining the role of technology education as a new basic in general education. The major thrust has been given to the potential it has for the development of technical literacy through involving students in problem solving activities related to various facets of humankind's technological systems. Strong emphasis has been placed on problem solving as central to the educational process. Proponents of technology education perceive problem solving within the structure of technological systems as process which integrates content from various academic subject areas with content from various technological components of the systems. They also perceive the study of the components of technology systems as being based upon a synergetic approach; and therefore, the teaching and learning of content should not be compartmentalized, taught and learned separate from the system of which it is a part. As such, technology education is a means to learning the new, relearning the old and applying academic principles, concepts, processes and skills within technological and educational experiences of students. Although this approach to technology education is very commendable and has much potential for the creation of educational excellence is it now possible also to have commendatory and excelling educational experiences within highly structured and specialized technology courses? within definitive, technical courses? within the concentration of the specifics of a technical phase of a technology system? In the judgment of the author, there appears to be a need to implement such courses within the technology education curriculums especially at the secondary level within grades eleven and twelve. This is particularly true of the foundational courses within the technical sciences. Let us examine the rationale for this judgment.

Today many educators within technology education would have one believe that it is an "educational sin" to structure and teach highly specialized courses based on definitive and fundamental principles, concepts, processes and skills. They profess that the interrelatedness of the technological systems and the integrative character of the applied knowledge within each of these systems are the bases for studying the systems within a problem solving framework. To approach the study of technology otherwise is "heresy." However, the successful study of technological systems. The implementation of problem solving activities and the development of problem solving abilities are not limited to achievement within broad exploratory and nonstructured content courses in technology, but also are achieved unquestionably within highly specialized courses such as electronics, materials science, metallurgy, mechanics of materials, fluidics, dynamics, thermodynamics and others.

Indepth study within the forementioned technical science courses of a highly specialized nature provides students numerous and challenging opportunities for problem solving of a judicial and creative nature. For indepth study demands indepth thinking, it demands the creation of meanings in terms of "organized connectiveness." Study within technical science type courses requires more than the development of surface or skeletal understanding of content but a substantive understanding of content in the creation of solutions to problems of an applied nature. Herein, students experience content at the highest levels of cognition. They develop foundational concepts that have universality in application to system conceptualization, adaptation and creation; that transcend the boundaries of the various technological systems. Concepts that have universality in application to technological systems provide the basis for "knowing" the technology rather than for "knowing about" the technology. These concepts serve as intellectual resource from which emanate true and relevant understandings of components that define technological systems world wide.

Students engrained in the fundamentals of the technical sciences have the capability to recognize and interpret knowledge embodied within various contemporary technology systems and to conceptualize it into meaningful and exciting scenarios. Herein lies the conceptualization of tools, machines, instruments, materials, devices, computers, lasers, robots and other components of technological systems. For the applied technical science principles and concepts are the "heartbeats" of contemporary technological systems within communication, construction, manufacturing and transportation technologies. For example, a robotic system is but a sophisticated application and integration of principles and concepts from hydraulics, mechanics, electronics and automated cognition as well as other technical knowledge. As the principles and concepts of the technical sciences become the "heartbeats" of technological systems must not these become the "heartbeats" of technology education? As specialists create the "heartbeats" within technological systems by thinking and working together within a team concept, seeking to invent and innovate new technology, is it not possible for students in technology education to work and think individually and/or cooperatively in the application of principles and concepts based on indepth study of the technical sciences, to invent and innovate solutions to technological problems? The author believes the answers to the above questions are yes; and therefore, technology education must provide students opportunities to study the technical sciences indepth to enable them to better conceptualize technological systems, to develop more meaningful levels of technological literacy and to more easily understand and adapt to technological change. Herein, emphasis is based on the understanding and operation of principles and concepts in their applications to components rather than on operating components of technological systems. As the system's components are subject to modifications and obsolesence, the principles and concepts continue to possess permanency and currency. As the components change, the principles and concepts remain contemporary, only their sophisticated combinations in their applications change. Within the technical sciences the tools, machines, instruments, materials, devices, computers, lasers, robots and other technological equipment are perceived as areas of application and as "technological tools" to be applied to system's problem solutions. Problem solving within this technological milieu is likened to a "living dictionary" as the principles and concepts in their applications take on a new nature in the form of enriched meanings.

The offerings of indepth technical science courses at grade levels eleven and twelve also have potential for meeting one of the science credits needed for graduation from secondary school programs. For example, an electronics course offering that has the prerequisite of basic algebra has the potential for meeting a science credit. The technology and time are "ripe" for the implementation of such an offering. For today's technological world is saturated with applications of principles and concepts of electronics. Electronics pervades almost every facet of living. How can technology education avoid offering special indepth study in electronics when society's contemporary adaptive systems in communications, construction, manufacturing and transportation are highly integrated with electronics in structure, operation and control? Let technology education be cognizant of the need to offer such a course and have the foresight and fortitude to move toward implementation. Even though many school systems have dropped non-mathematical electronics from trade and industrial education programs for various reasons, this should not deter technology education in the implementation of a mathematically based electronics course. If any course in technology has a "common learnings" base for the decade of the 1990's, it is electronics. As Dr. Walter B. Waetjen, President Emeritus of Cleveland State University and Chairman of the Technology Education Advisory Council, stated in one of his addresses in relation to technological literacy, that students should be as familiar with micro chips as chocolate chips.

Yet another reason for offering indepth courses in technology education is to provide a career thrust. Dr. Franklin J. Keller, former Principal of Metropolitan Vocational High School, New York City, believed that every boy and girl should be going some place occupationally and educationally. Such thinking is not foreign to democracy in education. Within a democratic society each person who is educable and physically able to work should earn his/her living and also provide for the welfare of those who are unable to do so. Therefore, career education should be infused into every facet of education and be an integral part of the educational system. The very fact that a bridge spans a body of water or an abyss gives added significance to the concept of the bridge; also the very fact that technology education provides career information, indepth exploration and career self-evaluation gives added meanings to the educational experiences of students. Indepth technical science courses as well as indepth technology courses (e.g. CAD, mechanisms, descriptive geometry, automated manufacturing, other) provide for indepth exploration where students have opportunities to experience successes based on self-discipline as well as on "knowing" and "knowing how." Herein, meaningful and enlightened direction is provided for the decision-making process as it relates to career and educational choices. Such courses offered at grade levels eleven and twelve and articulated with technical institutes, community colleges or universities provide a continuum in technology education that accelerates the students toward career and educational goals, that helps students on their ways to becoming not only technologically literate but productive citizen-workers within a technological and democratic world.

In conclusion, I challenge technology education within the first years of the decade of the 1990's to consider, create and implement meaningful, indepth, mathematically based technical science courses and highly specialized technology courses as means to enriched technological literacy, disciplined learnings and advanced standings in post-high school technology programs. As such, technology education becomes a significant and an integral part of the educational continuum for students interested in pursuing advanced technological study and careers in the technologies of the future. For herein, lies the potential for the creation of citizens who can participate effectively in the future's decision-making processes as these relate to the appropriateness of technological systems and their implementation.