Elements common to quality and success in secondary technology education programs
by Lemuel E Miller

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Technology Education
Montana State University


Abstract:
The purpose of this study was to identify and rank those factors that contribute to the quality and success of secondary technology education programs. An expert panel consisting of fifteen secondary technology education teachers, recognized through the International Technology Education Association, 1996 program excellence award, participated in a three-round Delphi survey.

In the first round survey, participants were asked to identify five elements that contribute to quality in secondary technology education programs, and five elements that contribute to success in secondary technology education programs. A second round survey, employing a ten point rating scale, ranked the 36 quality statements and 44 success statements identified in the first round survey. The third round study achieved consensus regarding the importance of identified program quality and success elements, and determined an assigned ranking for these factors as perceived by the panel of experts.

Significant program quality elements identified included; dedicated instructors, knowledgeable and multitalented facilitators, individuals who have a strong belief in the need for technology education, personnel who are committed to excellence, personnel who have a vision of the future, and classroom teachers who are flexible and open to new ideas. Flexible, environmentally friendly facilities were important as well.

Departmental support, administrative support, community support, and strong leadership on the part of the program area teacher were identified as being key program success elements.

# ELEMENTS COMMON TO QUALITY AND SUCCESS IN SECONDARY TECHNOLOGY EDUCATION PROGRAMS

by

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APPROVAL

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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Many hours were spent isolated from my wife Peggy and son Daniel as I committed to research and writing. I am indebted to Peggy for keeping me on schedule, and reminding me of my desire to see this project through to completion.

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## ABSTRACT

The purpose of this study was to identify and rank those factors that contribute to the quality and success of secondary technology education programs. An expert panel consisting of fifteen secondary technology education teachers, recognized through the International Technology Education Association, 1996 program excellence award, participated in a three-round Delphi survey.

In the first round survey, participants were asked to identify five elements that contribute to quality in secondary technology education programs, and five elements that contribute to success in secondary technology education programs. A second round survey, employing a ten point rating scale, ranked the 36 quality statements and 44 success statements identified in the first round survey. The third round study achieved consensus regarding the importance of identified program quality and success elements, and determined an assigned ranking for these factors as perceived by the panel of experts.

Significant program quality elements identified included; dedicated instructors; knowledgeable and multi-talented facilitators, individuals who have a strong belief in the need for technology education, personnel who are committed to excellence, personnel who have a vision of the future, and classroom teachers who are flexible and open to new ideas. Flexible, environmentally friendly facilities were important as well.

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# CHAPTER 1

## INTRODUCTION AND METHODOLOGY

The emerging educational discipline of Technology Education is at a crossroads in its ongoing evolution. Varied program models have developed from the perceived need to establish technological literacy in our population. Many of these programs have evolved through a transition from Industrial Arts Education curricula to programmatic instructional classrooms emphasizing Technology Education.

Zuga (1989), in her review of written curriculum documents from 1898 to 1988 noticed a definitive repositioning of goal statements, hence a theoretical shift in the field over the period. Historically it was noted that the instructional goals of Industrial Arts instruction closely reflected the importance of manual training, fine motor skill development, the use of tools and the importance of consumerism and career exploration. Today however, Zuga noted that greater emphasis was more likely to be placed on the subjects of industry and technology, the teaching of cognitive and affective intellectual processes, and the role of consumerism.

Zuga (1989) described curriculum designs that have emerged from this shift. Academic curriculum designs emerged to focus on the body of knowledge that comprises the varied disciplines of technology. Technical curriculum designs were based on the analysis of performance or process. Intellectual processes curriculum focused on problem solving, critical thinking and traits such as creativity and problem solving. Social curricular design utilized real world situations to enhance education or create educational events that impact the future. Lastly, personal curriculum designs were learner-centered and focus on the individual needs and interests of the student.

## Present Program Approaches

Petrina (1993) commented on one familiar approach to program transition. In writing on the packaged approach to program modeling, Petrina provided a critical review on the Modular Approach to Technology Education (MATE), commenting that; "MATE represents more of a continuation of problematic Industrial Arts practices than a change." (Petrina, 1993, p. 73). Another programmatic discussion was brought forth by Purcel (1993), who suggested that Technology Education should focus on the technological method and the basic notion that technology was a means of meeting human needs with attention paid to the societal consequences, advancing technical skills, and the growing knowledge base. Additional review of program methodology was provided within the Project Based structuring of Technology Education. This methodology emphasized the use of tools, processes and critical thinking to establish group collaboration on projects.

Further complicating the future of the Technology Education profession is the fact that a myriad of definitions for Technology Education and Technological Literacy exist. A close examination revealed that these definitions share certain commonalities (Savage, 1990). Just as there appeared to be some degree of agreement within the profession regarding program taxonomy, a review of current literature revealed that there was little current data that was supportive of those elements that contributed to quality programs of instruction in Technology Education.

Lacroix (1987) recognized the importance of this problem, and stated that we have as yet to clearly define what was acceptable professional performance in our field.

> The significance of this problem to technology education is considerable. Indeed, technology educations continued acceptance by the educational community is directly dependenton the quality of its curriculum, and this curriculum is dependent upon the quality and effectiveness of the instruction. (Lacroix,1987, p.32)

Technology Education is an emerging curriculum that has roots within the more traditional Industrial Arts curriculum. Purcel, (1993) stated that two major changes were driving the shift from the traditional Industrial Arts curriculum to the implementation of Technology Education programs.

> As society has evolved from the industrial age to the information age, the composition of the work force has changed and the amount of training and breadth of education needed by students to be

> adequately prepared for jobs and to become technologically literate has increased. Fewer and fewer people actually participate in production and service occupations requiring industrial age skills and practices. Therefore, industrial arts-based technology education programs have been viewed as less important in the general education of all students. (p.2)

The transition from programs of Industrial Arts instruction to programs reflecting an emphasis on Technology Education has been largely driven at a grass roots level throughout the country. Numerous successful programs of technology education are recognized annually through the criteria established by the International Technology Education Association's Program Excellence Awards (ITEA, Affiliate Representative Resource Book, 1996). The International Technology Education Association attempts to place notable programs in the national and international spotlight every year by recognizing superior technology education programs in member states, provinces, and countries. These award winning programs serve as a standard for comparison and models for the development of other programs.

Pullias in a 1992 article entitled "What is Technology Education", described the three methods that individual teachers may take regarding the implementation of Technology Education. Described in detail are the revolutionary, evolutionary and an approach that is representative of a tact that would disguise what we have been doing for years and make it look like a new curriculum.

A review of the current literature has suggested that there are a number of highly successful and nationally recognized programs of Technology Education in the country. These programs have developed through the methods suggested by Pullias, and are based upon curriculum designs described by Zuga. The question then becomes one of seeking the elements that were common to program quality, and then success, within site based Technology Education programs.

## Purpose of the Study

The purpose of this study was to identify and describe the elements common to secondary Technology Education program quality and success.

## Need for the Study

Numerous successful programs of Technology Education are profiled each year by the International Technology Education Association (ITEA). Each of these programs thrived under the influence of local, regional and national resources that directly or indirectly influenced program success. Recognizing the dynamic forces that drive technology and the modern work-place, the need for future planning for technology education, and the forces driving technology education curriculum, there appears to be a need to describe, through consensus building, those elements that are common to quality and success in programs that have currently been assigned places of excellence within the profession.

When examined, identified Technology Education programs of excellence within the profession, showed a relationship between program quality and program success. The literature leads one to believe that quality programs insure success in programs.

> First impressions and quality delivery of services are important for technology educators. When we describe our programs, when people stop in and look at our laboratories, and when students talk about their experiences in classes, we can rest easier if these experiences are based on quality. (Bensen, 1990, p.3)

Quality programs of instruction become important in development of technological literacy. Establishing technological literacy within our population is a goal of Technology Education. Hayden (1991) mentioned that technology was a learned phenomenon, therefore being literate about technology should also be a learned phenomenon. Hayden further stated the need for additional research that investigated the methodology that contributed to or increased technological literacy most efficiently. He went on to state in his recommendations for further research the following; "It seems logical that before we try to increase a student's technological literacy we first know the best way or ways to do so."(p. 41)

A review of the literature currently available in the field indicated that many practitioners were cautious in describing how they believe technological literacy should be developed. However, teacher educators, practitioners, and professionals from business and industry recently convened to develop a rationale and structure document for the study of technology. The need for technological literacy was presented in the document "Technology for All Americans, A Rationale and Structure for the Study of Technology".

> Technological literacy is much more than just knowledge about computers and their application. It involves a vision where each citizen has a degree of knowledge about the nature, behavior, power and consequences of technology from a broad perspective. Inherently, it involves educational programs where learners become engaged in critical thinking as they design and develop products, systems, and environments to solve practical problems. (ITEA, 1996, p. 1)

Descriptive material developed from the results of this study may help to improve the condition of secondary Technology Education Programs nationally, and will fill a definitive research gap, hence giving us one indication of the status of the profession at this point in time.

## Research Questions to be Answered by the Investigation

1. What are the core elements contributing to quality and success in secondary Technology Education programs?
2. What is the rank assignment regarding importance of the elements contributing to quality and success in secondary Technology Education programs?

## Assumptions

1. The researcher accepted the validity of the criteria used to select the 1996 ITEA Program Excellence Award recipients. Award selection criteria is further detailed in the section labeled appendices.
2. Further definition of the elements contributing to program strength in secondary Technology Education is necessary, as there exists a knowledge gap within the profession. (Bensen, 1990)
3. There exists consensus regarding elements of program quality and success, among nationally dispersed educators administering secondary Technology Education programs of distinction.
4. A consensus based ranking of secondary Technology Education program quality and success elements can be achieved.

## Limitations and Delimitations

For purposes of organization, the following conditions were applied to this study:

### Limitations

Study Period. A three round Delphi type study employing a Panel of Experts from the 36 programs selected in the 1996 ITEA Secondary Program Excellence Awards, will be conducted from December 1996 to March 1997.

Study Population

The initial study employing a panel of experts was selected as described in the section entitled Methodology.

Delimitations

Scope of the Study. A self selected panel of experts from 15 geographically dispersed Technology Education programs representing middle and high school educators was used to complete a three round Delphi study as described by Issac and Michael (1981).

## Definitions

1. *Delphi Technique*: A research process designed to generate group consensus while minimizing associated disadvantages such as the bandwagon effect of majority opinion, powers associated with a persuasive individual, vulnerability of associated group dynamics and the unwillingness of individuals to abandon publicly stated positions. This process initially identifies group members

who will generate the consensus position, however the researcher interacts with them individually to provide collective feedback from the group. An informed consensus is derived from the group after several rounds of sampling from the group. (Issac & Michael, 1981)

2. *Industrial Arts Education*: "Industrial Arts as a curriculum area is defined as those phases of general education which deal with technology - its evolution, utilization, and significance; with industry - its organization,materials, occupations, processes, and products; and with the problems and benefits resulting from the technological and industrial nature of society." (Maley, 1978, p.273)

3. *MATE*: Modular Approach to Technology Education. "Connotes a self contained (i.e., "everything" is there for the student) instructional system defined by programmed learning theory, technological devices and equipment." (Petrina, 1993, p.72)

4. *Project Based Technology Education*: An educational methodology gaining acceptance in Technology Education, whereby students collaboratively apply tools, materials, and processes to the cooperative solution of realistic design challenges. (Graumann, 1993)

5. *Quality as applied to Technology Education Programs*: Those programs that attract better employees (faculty), are selected by more clients (students), whose products are in higher demand (graduates), and provide better service in real world application (teaching). (Ritz & Loepp, 1990)

6. *Strategic Planning*: A process associated with understanding the environment, defining organizational goals, identifying options, formulate and implementing decisions, and evaluating performance. Placed in the context of a plan, it is a process of exploiting the new and different opportunities of tomorrow. (Morrison, Renfro & Buchner, 1984)

7. *Technology Education*: "The knowledge and study of human endeavors in creating and using resources, processes, and systems to manage the artificial and natural environment to extend human potential and enhance the relationship of these to individuals and society." (Savage, 1990, p.8)

## Methodology

### General Description

Due to the exploratory nature of the problem presented, descriptive research was appropriate for this study. It is anticipated that information derived from this study will provide a basis for additional research.

As previously described in the section entitled Purpose of the Study, a panel of experts was assembled and the Delphi technique used to sample consensus on the issue of the elements determining quality and success in Technology Education Programs.

Population. The study population consisted of individuals self selected from the 36 secondary programs recognized by the International Technology Education Association as ITEA Program Excellence Award Recipients in 1996.

Development of Survey Instruments. The initial panel of experts study utilized the Delphi technique in the form of a ten item query to develop a listing of 36 quality elements and 44 success elements. The second round survey instrument emerged from elements identified in the first round study. As described by Issac and Michael (1981), the third and last round of questions developed a ranking of these elements.

Study Administration. The respective study instruments were administered by mail during the time period previously identified in the Study Period. Extensive follow up procedures were used, including second letters soliciting survey response, and telephone contacts as necessary.

Data Collection and Reporting. A detailed description of the ranked factors contributing to program quality and success was compiled and reported as based upon the research conducted.

# CHAPTER 2

## REVIEW OF THE RELATED LITERATURE

The advent of the emerging educational discipline of Technology Education is largely seen as an extended transition of the well known Industrial Arts Curriculum. The need for Technology Education is supported in the following quote from Dugger, Bame, and Pinder, (1985),

> Because American Culture is distinctively characterized as technological, it becomes the function of schools to give every student insights and understandings of the technological nature of the culture. This is what the program of Technology Education strives to do. (p.7)

The reader will note that earlier we provided definitions that clearly provided insight into the cognitive domain associated with Industrial Arts Education and Technology Education. "Industrial Arts as a curriculum area is designed as those phases of general education which deal with technology - its evolution, utilization, and significance; - with industry - its organization, materials, occupations, processes and products" (Smith, 1970, p.20). This definition of Industrial Arts Education can be contrasted to the following definition of Technology Education that was presented by Savage (1990). "The knowledge and study of human endeavors in creating and using resources, processes, and systems to manage the artificial and natural environment to extend human potential and enhance the relationship of these to individuals and society" (p.8). The similarities between the teaching disciplines was mentioned as well as the apparent, natural transition from a program reliant on manual arts practices to one emphasizing information age technologies. The discipline of Technology Education clearly progressed from programmatic models of Industrial Arts Education. Again we can add further proof to this transition by the following quote that mentioned the relationship between progress and technology.

> Progress has always been directly linked to the management of technology. The study of technology should be an integral part of the school curriculum with emphasis on the fact that people control technology. Only people can determine whether technology will be applied to their benefit or to their ultimate disadvantage. (Dugger, Bame, Pinder, 1985, p.3)

Literature clearly supports the internal need for a change in curriculum structure that is present within the Industrial Arts and Technology Education community. An external need for change and transition is supported by a study completed by Daugherty and Wicklein, (1993) in which they surveyed mathematical, science and technology teachers on their perceptions of Technology Education. In concluding remarks on the study, Daugherty and Wicklein commented that "The issue of how technology education is perceived has influenced, and will continue to influence, the development of the technology education discipline." (p.44) The authors of the study further described the apparent disparities between perceived teaching methods, curriculum content and curriculum integration needs amongst those surveyed.

Daugherty and Wicklein (1993) provided evidence in their study that suggested a compelling need to further investigate and describe various phenomenon within the profession. Quoted below are their recommendations for further study.

1. The technology education profession should develop strategic plans to overcome stereotypical perceptions of the discipline.
2. Technology education potential cannot be fully reached until there is a clear understanding across disciplinary boundaries as to what characteristics exemplify technology education.
3. Technology education can more effectively emphasize the connections between mathematics, science, and technology education.
4. Coordinated planning that includes professionals from mathematics, science and technology education is a critical component for the future of integrated curriculum among the three disciplines.
5. Workshops and presentations should be provided for mathematics and science teachers in an effort to improve their perception of the technology education discipline.
6. Further study should be conducted examining the public perception of technology education as a discipline in the secondary school.
7. Research should be conducted investigating the methods of overcoming stereotypical perceptions often held by associated secondary education faculty members. (Daugherty & Wicklein, 1993, p.44)

Clearly apparent in the summary provided by Daugherty and Wicklein was the need to overcome stereotypical perceptions of the discipline. Other elements included identifying the boundaries of the Technology Education discipline, more effectively emphasizing the math, science-technology education connection and the need to pursue planning that would place Technology Education in an appropriate role as a critical component of any integrated curriculum.

Layton (1993) examined Technology Education from the perspective of Science Educators.

> At an international conference on science, technology and mathematics education in 1991, one science educator dubbed technology as "the new kid on the curriculum block", adding that we need to keep a careful watch on developments to see if the relationship with other subjects would evolve as "bully or buddy", "colonizer or collaborator". Certainly, the inclusion of technology as a component of general education poses intriguing problems of curriculum organization and inter-relationships, to say nothing of content, pedagogy and assessment. (Layton, 1993, p.57)

Additional emphasis for the importance of Technology Education is provided in the Secretary's Commission on Achieving Necessary Skills report also known as SCANS. The SCANS report specifically identified technology as a work-place competency. "Technology: Selecting equipment and tools, applying technology to specific tasks, and maintaining and troubleshooting technologies" (SCANS, 1993, p.5). The SCANS report further contrasted the present school learning environments with those of anticipated future learning environments. Presented in Table 1 is an informative comparison of today's schools with those of tomorrow. This comparison is meaningful in the discussion of this study, as apparent here are the future trends that will shape quality education.

**Figure 1:** SCANS Report, Future Schools Comparison.

| TODAY'S SCHOOLS | TOMORROW'S SCHOOLS |
|---|---|
| STRATEGY | |
| -Basic Skills development. | -Thinking Skills development. |
| -Testing separate from teaching. | -Assessment integral to teaching. |
| LEARNING ENVIRONMENT | |
| -Reliance on short-term memory. | -Active knowledge construction. |
| -Students working as individuals. | -Cooperative problem solving. |
| -Basic before higher order. | -Skills in real problems context. |
| MANAGEMENT | |
| -Supervised by administration. | -Learner centered, teacher directed. |
| OUTCOME | |
| -Some students learn to think. | -All students learn to think. |

(SCANS, 1993, p.7)

Also set forth in the SCANS report were benchmarks for high performance education. Benchmarks of performance become critical if an organization is to improve operating efficiencies and operational direction. Without attention to direction organizations become blinded by what George Washington University Professor, Jerry B. Harvey (1993) termed the "Abliene Paradox." This term described a condition where an organization is going about its business with no real destination of thought processes or planning.

Pullias (1997) mentioned that a current curricular trend in Technology Education is the modular classroom.

> They seem to be the trend. However, questions are beginning to surface regarding life after modular.

> Many teachers are beginning to discover that modular labs are limited in the kinds of experiences they provide, and are virtually "dead end" (Pullias, 1997).

Pullias developed thoughts critical of modular or canned learning environments. He mentions that the modular concept is only a stop-gap measure for what Technology Education really needs. In concluding Pullias mentioned the need to think beyond modular and the mediocrity in instruction that he believed to be associated with this form of curriculum delivery.

The educational discipline of technology education does indeed find itself at a crossroads in evolution. Given the lack of perceived direction, the apparent control being exerted on curriculum through the influence of the Modular Approach to Technology Education-MATE (Petrina, 1993), and the perceived need on the part of leading professionals in Technology Education to seek change, a formal strategy defining critical program elements is needed.

The development of educational standards in Technology Education programs is not a new concept. However, emerging National Standards for Technology Education will soon have some influence on the profession. To date numerous national, regional and state planning guides have brought about structured program change. Cuetara, (1988) mentioned that program guides and the standards they often define, present a systematic approach to attaining regionally or nationally accepted program benchmarks. Often ignored in program guides were descriptions of benchmarks that define quality experiences, quality environments, and a measure of the importance of local resources to the success of Technology Education.

Lacking also were strategic plans that define direction in program growth and evolution. Morrison, Renfro, and Buchner (1984) illuminated the need to further understand and define our future learning experiences by stating the following; "Rapid technological developments in computers and telecommunications are revolutionizing instruction and management" (p.1).

## Strategic Planning

A basis for modern strategic planning is established through a collection of data that examines the internal and external forces influencing organizations.

> Modern strategic planning recognizes that organizations are shaped by outside forces at least as much as by internal ones. In particular, it represents an effort to make this year's decisions more intelligent by looking toward the probable future in coupling the decisions to an overall institutional strategy. (Morrison, Renfro & Buchner, 1984, p.1)

Strategic planning has gained a renewed acceptance in the public and private sectors of our society. However, the concepts apparent in modern strategic planning have in fact been well known to us for some time. Skinner (1968) recognized concepts aligned with strategic planning.

> Education must become more efficient. To this end curricula must be revised and simplified, and text books and classroom techniques improved. In any other field a demand

for increased production would have led at once to the invention of laborsaving capital equipment. Education has reached this stage very late, possibly through a misconception of its task." (Skinner, 1968, p. 29)

Skinner mentioned that there was a misconception of the task. If it were our intent to improve classroom techniques and revise curricula to keep pace with changes in society then there must be a renewed interest in quality of our product. "Technology education programs must all make quality a priority" (Ritz, Franzie & Loepp, 1990, p.5). Defining what constitutes a quality program in Technology Education will become an on-going task within the profession.

This statement was further explained by Ritz, Franzie and Loepp, (1990):

> Quality programs are deserving of more funding; they attract better employees (faculty); they are selected by more clients (students); their products are in higher demand (graduates); and they provide better service in real world application (teaching). (p.7)

Understanding the elements that define quality in instruction and facilities is critical to the profession. In commenting on the role of educational facilities in successful Technology Education programs, Brad and Terry Thode (1993) emphasized the importance of the Technology Education facility in the public's eye.

> As programs and curricula change there are a number of points of view about the role that facilities play in the successful technology program. While most would agree that a comprehensive curriculum must first be in place as the foundation for any facility and equipment

> decisions, there are those who believe that this most visible part of the program creates that public relations image and proclaims loudly that something new is going on. (Thode, 1993, p.17)

Cummings, Jensen and Todd (1987) further emphasized the program quality-facilities connection. Todd further commented on the need for facilities to be flexible, responsive to change and economical.

## Summary

We are in the midst of an evolution that is changing many industrial arts education classrooms to programs reflecting the modernistic approach of technology education. The transition is seen as a natural synthesis as curriculum strives to keep pace with the times. The diversity of programs and curricular approach were mentioned as being areas of concern. These concerns are further compounded with the apparent misconceptions of technology education that exist in the math and science education communities.

The apparent lack of strategic planning in the discipline was evidenced by several authors. Research appears to be lacking that would be supportive of the need to define program quality and success elements. Information defining program quality and success elements would provide educators with the benchmarks necessary to enhance programs through strategic planning. Adding further weight to this statement is a comment by Waetjen (1991) reflecting on the need for research in Technology Education.

> Die hards claim that research isn't needed and instead offer up dozens of anecdotal accounts of students who have benefited from taking courses in technology education. But no matter how titillating the anecdotes, they simply do not convince deans,superintendents and boards of education. Only research results will be convincing. Research has moved from the periphery to the very core of the educational process. Indeed research has established itself as a primary vehicle by which change is promoted and effected in education. (p.3).

A base of research in the discipline of Technology Education must be established if practicing educators are to understand the importance of program elements such as facilities, on-going curriculum revision, equipment needs and trends, public relations, and the critical general education connection. Technology Education is a field of study that seeks to establish technological literacy in our population. At least one scholar has suggested that to increase technological literacy, we must first understand the best way or ways to do so (Hayden, 1991).

It is the intent of this study to describe and rank the elements common to secondary Technology Education program quality and success. Only through such base-line data can we gain the insight into the profession that would further lead to long range strategic planning.

# CHAPTER 3

# RESEARCH METHODOLOGY

This study was conducted to identify elements common to quality and success in secondary technology education programs. Research data was used to develop a ranking of elements common to quality and success in secondary Technology Education programs. The research methodology and associated procedures are described in this chapter.

## Method Selection

The expert panel or Delphi survey methodology was chosen as the method of data collection. The Delphi process was originally developed in the 1950's by Olaf Helmer and Norman Dalkey who were scientists at the Rand Corporation. This consensus building research methodology was initially developed for purposes of forecasting futures (The Consummate Design Center, 1996). The Delphi technique was initially used for researching military related policy issues. Delphi studies have since seen wide application in Social Science and Educational research.

Many variations of the Delphi methodology exist, however, essential components appear to be the selection of anonymous experts, and sequential questionnaires generated from continual feedback (Lindstone & Turroff, 1975). The Delphi methodology is ideally suited for needs assessments or analysis of future directions when experts are widely scattered across geographic regions or where experts are likely to have diverse opinions. Strengths of the Delphi study instrument are the combination of written (qualitative) and numerical (quantitative) data and its ability to form consensus based expert opinions. Limitations associated with this methodology are the time involved for postage based feedback and the apparent lack of stimulation from face to face feedback. Another danger is that participants could be too homogeneous or like minded, thus producing a skewed data set (Strauss & Ziegler, 1975).

According to Strauss and Ziegler (1975), Delphi studies fall into one of three identified classifications, numeric, policy and historic.

> The goal of the numeric Delphi is to specify a single or minimum range of numeric estimates or forecasts on a problem. The goal of a policy Delphi is to define a range of answers or alternatives to a current or anticipated policy problem. And, the goal of the historic Delphi is to define a range of issues that fostered a specific decision or the identification of the range of possible alternatives that could have been poised against a certain past decision. (p. 11)

Strauss and Ziegler (1975) mention that there are four possible objectives or secondary goals for any Delphic exercise;

1. To explore or expose underlying assumptions or information leading to different judgments;
2. To seek out information which may generate a consensus of judgment on the part of the respondent group;
3. To correlate informed judgments on a topic spanning a wide range of disciplines;
4. To educate the respondent group as to the diverse and interrelated aspects of the topic. (p.11 )

A modified Delphi study was selected for this study due to the nature of the research questions and the selected study population. These research questions were:

1. What are the core elements contributing to quality and success in secondary Technology Education programs?
2. What is the rank assignment regarding the importance of the elements contributing to quality and success in secondary Technology Education programs?

The study population consisted of 15 participants who were self-selected from the 36 secondary Technology Education programs receiving 1996 ITEA secondary Program Excellence Awards.

Selection of the Expert Panel

Participants in this study were self selected from the

36 secondary Technology Education programs receiving 1996 ITEA Program Excellence Awards. The Program Excellence Award is one of the highest honors given to classroom teachers. This award is presented annually in recognition of selected teachers outstanding contribution to the profession and their students. The award selection process requires that programs be nominated by an ITEA affiliate association. A written assessment procedure is required in the selection process. ITEA also requires that 60% of the technology faculty be ITEA members (ITEA, Affiliate Representative Resource Book, 1996). The written assessment instrument used by ITEA to select Program Excellence Award candidates appears in Appendix A as International Technology Education Association, Program Excellence in Technology Education, Program Self Study.

After initial identification of potential expert panel members, a screening letter was mailed to the 36 Program Excellence Award candidates on December 1, 1996. This letter is detailed in Appendix A as Study Participation Survey Form. This letter asked that potential participants express an interest in participating in the study. Participants returning a positive response provided general demographic information, information regarding the composition of their school and teaching situation such as grade range of the school, number of students at the school, school setting (rural, urban, suburban,) and specific classes or subjects taught. Additionally, participants were asked to describe the number of years they had been teaching, the number of years in their present position, their specific teaching endorsements and their professional association memberships. Approximately 15 individuals responded positively to the Study Participation Survey Form by the December 15, 1996 cut off date. A listing of expert panel members can be found in Appendix A as Expert Panel Members.

## Data Acquisition and Analysis

This study employed a three round Delphi technique. Detailed here are the procedures used to develop the survey instruments and the scope of the data gathering process.

### Development of the Survey Instruments

A three round Delphi study was selected as the instrument of choice for purposes of answering the research questions. Rounds one and two of this study identified elements important to answering research question one.

1. What are the core elements contributing to quality and success in secondary Technology Education programs? A third round Delphi probe would answer research question two.
2. What is the rank assignment regarding the importance of the elements contributing to quality and success in secondary TechnologyEducation programs?

This Delphi study model was aligned with one described by (Turoff, 1970) where the first round or probe asked that expert panel members give their comments regarding a particular set of issues. A second round instrument was developed from comments generated in the first round survey, at this time participants are asked to rank comments. The third and last round instrument sought to attain consensus ranking or stable disagreement.

The three survey instruments were mailed to expert panel members. Each survey instrument consisted of a personalized letter signed by the researcher and Dr. Scott Davis, Department of Education. Participants were given the option of returning their survey in an enclosed postage paid envelope or via FAX. The first round Delphi probe was followed up with a post card mailing reminding participants to return the survey instrument promptly. In addition to this follow-up, phone calls were made to selected study participants reminding them of the pending deadline for round one submission. Second and third round survey questionnaires included a second mailing to participants home addresses. Participants were further induced to return survey instruments on time, as a stick of gum was included in each survey mailing and crisp one dollar bills were included in the last survey mailing. The cover letters and survey instruments associated with this study are further detailed in Appendix B.

The instrument used in the first round was open ended.

Expert panel members were asked to identify five (5) program quality elements and five (5) program success elements. Participants were asked to use short concise statements. This instrument was designed to insure anonymity of responses as was detailed by Strauss and Ziegler (1975). The first round survey questionnaires were mailed to participants on January 17, 1997. Participants were not asked to sign the surveys. There was a 100% response to the first round instrument.

A synthesis of data received from the first round query resulted in 36 quality elements and 44 success elements being identified by expert panel members. Data synthesis consisted of eliminating the duplication of responses.

A further breakout of data resulted in first round data classification in the categories detailed in Table 1, and Table 2. Table 1 depicts the categories and related responses that expert panel members identified as being related to program quality elements. Table 2 depicts the categories and related related responses that expert panel members identified as being related to program success elements.

**Table 1:** Program Quality Elements Identified.

| Category | Number of Items Identified |
|---|---|
| Quality Curriculum Elements | 16 |
| Quality Facilities and Equipment Elements | 10 |
| Quality Support Structure Elements | 10 |

**Table 2:** Program Success Elements Identified.

| Category | Number of Items Identified |
|---|---|
| Success Student Skill Development Elements | 9 |
| Success Personnel Elements | 17 |
| Success Support Structure Elements | 18 |

A second round survey was developed from the responses that expert panel members generated in the first round instrument. A six page, second round survey asked participants to assign value to the categorized first round responses. A ten point range Likert summated scale was used to allow expert panel members to express their attitudes towards the developed statements. Likert scales gauge attitudes, all points on the scale are labeled according to value (Griggs & Anderson, 1997).

The second round survey was mailed to all participants on January 23, 1997. A due date of February 19, 1997 was set for completion of the second round survey instrument. Thirteen of fifteen surveys were returned in the second round.

Data collected in the second round was used to develop the third round survey instrument. The third round instrument was important in developing consensus by answering the second research question; -What is the rank assignment regarding the importance of the elements contributing to quality and success in secondary Technology Education programs?

The third and final survey instrument was developed from data collected in the second round survey. In the third survey, expert panel members were asked to rank the significant quality and success factors identified by the second round survey data. This survey was mailed to participants on February 26, 1997, and was requested back by March 14, 1997. Fifteen of fifteen surveys were returned in the last round questionnaire.

Data Analysis

This study required that data be collected using a modified Likert type scale. Griggs and Anderson (1997) reported that a likert scale gauges attitudes. All points on a likert rating scale are labeled. Study participants were asked to select the numerical value that most closely reflected their attitude toward a particular question or statement. The research questions required that data be collected that identified the core elements contributing to quality and success in secondary Technology Education Programs and that a final rank assignment of important factors be determined. The researcher chose to use descriptive statistics for the analysis of survey data.

Griggs and Anderson (1997) stated that descriptive statistics allow us to judge how varied the responses are to a given question, what is typical, and the pattern that the responses fall into.

The researcher utilized the following statistical analysis. Mean or (mathematical average), median (midpoint response) and standard deviation (a measure of reliability).

Griggs and Anderson (1997) stated that mean and median are standard measures of central tendency, therefore are good measures of what is typical.

Results of the second and third round surveys were statistically analyzed and plotted the Delta Graph Pro software version 3.0. This software package was used to determine the mean, median and standard deviation from the second and third round surveys. Delta Graph Pro was also used to generate detailed tables of research findings. A complete analysis of the second and third round surveys is found in Chapter 4.

# CHAPTER 4

# RESULTS

This study was an attempt to identify and rank the elements contributing to quality and success in secondary Technology Education programs. A series of three surveys employed a 15 member panel of experts to collect survey data. The panel of experts consisted of 15 self-selected secondary Technology Education practitioners from 14 states. An analysis of the data gathered from the three survey instruments is presented in this chapter.

## Data Gathering

A preliminary study screened 36 potential panelists and identified fifteen individuals from secondary Technology Education programs who agreed to participate in the study. In order to gather the data necessary to answer the research questions, the panelists were surveyed three times.

Demographic Data of Expert Panel Members

The fifteen expert panel members came from fourteen states and represented the eastern, east central, west central and western regions of the country as identified by the International Technology Education Association in the Affiliate Representative Resource Book. A map detailing the divisions of the United States according to criteria provided by the International Technology Education Association appears in Appendix A as ITEA Governance Region Map. An initial Study Participation Survey Form collected the following information:

* Grade range of the school.
* Number of students at the school.
* Specific classes the expert panel member was responsible for teaching.
* Number of years that the expert panel member had been teaching.
* Number of years that the expert panel member had been in his/her present position.
* Specific teaching area endorsements maintained by the expert panel member.
* The professional memberships maintained by the expert panel member.
* The expert panel members school location (rural, urban, suburban,), as based on the individuals definition.

Grade Range of the School.

The initial Study Participation Survey Form asked that participants identify the grade level range of their school. The results compiled from the fifteen survey forms returned are detailed in Table 3. The majority of study participants teach in schools spanning grade nine to grade twelve level.

**Table 3:** Grade Range of Schools, Expert Panel Members.

| Grade Range of School | Number of Expert Panel Members |
|---|---|
| K-12 | 2 |
| 5-8 | 5 |
| 9-12 | 8 |

Number of Students at the School.

Expert panel members were asked to provide the total enrollment for their school. This information provided the researcher with a better understanding of local conditions (small school as compared to large school). The sizes of schools as reported by individual expert panel members is identified in Table 4.

**Table 4:** School Size, Expert Panel Faculty Members.

| Size of School | Number of Expert Panel Faculty Members |
|---|---|
| 0-250 | 1 |
| 251-500 | 3 |
| 501-750 | 3 |
| 751-1000 | 2 |
| 1001-1250 | 1 |
| 1251-1500 | 1 |
| 1751-2000 | 1 |
| 2001-2250 | 2 |
| 2251-2500 | 1 |

<u>Specific Classes the Expert Panel Member was Responsible for Teaching</u>.

It was difficult to plot data collected from this question. It became obvious to the researcher that there was little uniformity to as to the specific course titles reported by expert panel members. However, after synthesizing the responses the information could be represented as found in Table 5. Course titles provided, appeared to be linked to Technology Education curriculum themes.

**Table 5:** <u>Specific Classes Taught by Expert Panel Members.</u>

| Course Titles (Synthesized Categories) | Number of Expert Panel Members Teaching (Courses in this Heading) |
|---|---|
| General Technology Education | 13 |
| Manufacturing Technology | 7 |
| Transportation Technology | 2 |
| Communications Technology | 4 |
| Power and Energy Technology | 3 |
| Advanced Studies in Technology | 3 |

<u>Number of Years that the Expert Panel Member had been Teaching</u>.

Information was collected concerning the number of years that the expert panel member had been teaching. The results from the fifteen Study Participation Survey Forms returned are presented in Table 6.

**Table 6:** Years of Teaching Experience, Expert Panel Members.

| Number of Years Teaching | Expert Panel Members Reporting |
|---|---|
| 0-5 | 2 |
| 6-10 | 2 |
| 16-20 | 1 |
| 21-25 | 4 |
| 26-30 | 5 |
| 31-35 | 1 |

Number of years that the expert panel member had been in his/her present position.

Study participants were asked to indicate the number of years that they had been in their current teaching assignment. This information is reported in Table 7.

**Table 7:** Years in Current Teaching Position, Expert Panel Members.

| Years in Current Teaching Position | Expert Panel Members Reporting |
|---|---|
| 0-5 | 6 |
| 6-10 | 2 |
| 16-20 | 2 |
| 21-25 | 2 |
| 26-30 | 3 |

Specific teaching area endorsements maintained by the expert panel member.

Table 8 detailed the specific teaching area endorsements maintained by expert panel members.

**Table 8:** Specific Teaching Area Endorsements Maintained by Expert Panel Members.

| Endorsement | Number of Expert Panel Members |
|---|---|
| Middle School Technology Education | 2 |
| Secondary Technology Education | 5 |
| Industrial Arts - Technology Education | 4 |
| K-12 Technology Education | 3 |
| Vocational Certification | 3 |
| Special Needs | 1 |
| Industrial Science | 1 |
| Earth Science | 1 |
| Drivers Education | 2 |
| Aviation Science | 1 |
| Computer Science | 1 |
| Mathematics | 1 |

Professional Memberships Maintained by the Expert Panel Member.

Panelists were asked to provide a listing of the professional organizations that they maintained membership in. Table 9 provides a description of the professional affiliation of expert panel members as reported in the Study Participation Survey Form.

**Table 9:** Professional Association Memberships Reported by Expert Panel Members.

| Association Name | Panelist Reporting Membership |
|---|---|
| State Technology Education Associations | 15 |
| State Vocational Education Associations | 4 |
| International Technology Education Association | 15 |
| American Vocational Association | 4 |
| National Education Association | 3 |
| State Education Association | 3 |
| Epsilon Pi Tau | 1 |
| Phi Delta Kappa | 1 |

The Expert Panel Members School Location.

Panelists were asked to select from: Rural, Urban, or Suburban in describing the location of their school. Table 10 presents school locations reported by expert panel members.

**Table 10:** School Location as Reported by Expert Panel Members.

| School Location | Number of Expert Panel Members |
|---|---|
| Rural | 4 |
| Urban | 2 |
| Suburban | 9 |

## Synopsis of Demographic Information

Demographic Data was collected to demonstrate and define the diversity of the study population. Panelists represented schools that varied in size and location. The years of classroom teaching experience of panelists varied as did the number of years in present instructional positions. Panelists maintained a number of teaching endorsements. Panelists listed the range of technology related subjects that they taught as well as the diversity of educational teaching endorsements.

## Round One Procedure

This study was conducted for purposes of identifying the core elements contributing to quality and success in secondary Technology Education programs. The study also attempted to determine the importance of the elements contributing to quality and success in secondary Technology Education programs as based on the perceptions of an expert panel. A Delphi research model employing a panel of experts from fifteen secondary Technology Education programs was used in data collection. The first round survey asked that panelists provide five factors that are quality elements in their technology education program, and five factors that led them to achieve success in their technology education program. Participants were asked to use short, concise statements in their responses. The round one survey cover letter and survey instrument appear in Appendix B.

The first round survey was mailed to expert panel members on January 6, 1997. Panelists were asked to return the survey instrument by January 17, 1997. Follow up post cards were sent to all of the participants in the survey approximately five days after the initial survey instrument was mailed. Follow up phone calls were made to approximately 8 late responders the week of January 13, 1997. Fifteen of fifteen participants returned the round one survey.

Synthesis of Round One Results

The data collected in the first round survey was synthesized and formed the basis for the second round instrument. Based on the data, 61 quality elements and 59 success elements were identified. These elements were reviewed for similarities and differences.

The synthesis involved the elimination of duplication of responses and the grouping of quality elements in the three categories. The researcher identified 36 of the original 61 quality elements in three distinct categories as being unique. It was determined that the quality responses from the first round survey could be grouped according to; curriculum elements, facilities and equipment elements, and support structure elements. Expert panel members identified 16 elements relating to curriculum, 10 items relating to facilities and equipment elements, and 10 items relating to support structure elements.

The 59 success elements were synthesized in the same manner as the quality elements. After examining expert panel input and eliminating the duplication of responses, a logical grouping of support structure elements, personnel elements, and student skill development elements emerged. Of the 59 original responses relating to success elements in secondary Technology Education Programs, 44 were identified as being unique. Participants identified 18 support structure elements, 17 personnel elements, and 9 student skill development elements.

The statements collected and synthesized into the 36 quality elements, and 44 success elements were grouped according to the following categories: quality curriculum elements (16) statements, quality facilities and equipment elements (10) statements, quality support structure elements

(10) statements, success support structure elements (18) statements, success personnel elements (17) statements, and success student skill development (9) statements. This information was developed into a six page round two survey that employed a ten point scale rating system.

## Round Two Survey Instrument

Each expert panel member was mailed a second round survey instrument. The second round survey instrument consisted of 80 statements across six categories describing elements relating to the quality and success of secondary technology education programs. The second round survey and cover letter appear in Appendix B. The second round survey consisted of a six page questionnaire printed on bright yellow paper, a postage paid return envelope, a stick of gum for enticement, and the opportunity to FAX the survey back. Two identical sets of survey instruments were mailed to the study participants. One survey instrument was mailed on January 23, 1997. A second identical survey was mailed to the participant home addresses on January 27, 1997.

The survey instruments in these two mailings were coded to prevent duplication in responses. Participants were asked to return these surveys by February 19, 1997. On February 10, 1997 the researcher made selected phone calls in an attempt to have study participants return second round surveys. On February 21, 1997 thirteen of fifteen surveys were returned. The researcher made the decision to proceed with the second round data that had been collected from the thirteen responses. Dalkey (1969) found Delphi reliability to be a function of group size. When the number of participants per group were thirteen or greater, questions of process reliability were satisfactorily answered. According to Dalkey group response of thirteen participants or greater developed reliabilities of 0.80.

Analysis of the data collected in the second round survey included the calculation of the mean, median and standard deviation. Delta Graph Pro Version 3.0 computer software was used to compile a statistical analysis and develop visual graphics from the data.

A ten point likert scale was employed in the survey. Expert panel members were told in the survey instrument that a ten represents the highest level of importance, where a one represents the lowest value of importance.

Statistical calculations of mean, median and standard deviation were performed for all factors that related to the quality and success of secondary Technology Education programs in the second round survey.

Data from the round two survey is displayed in tables 11 through 16. The mean, median, and standard deviation are presented for each statement that expert panel members were required to respond to.

Table 11 describes data on **quality curriculum elements**. Mean data responses ranged from a low of 7.08 to a high of 9.69. Standard deviation scores ranged from a low of .63 to a high of 2.74. Median scores are represented in the third data column, and range from a low of 6 to a high of 10 on a ten point rating scale.

**Table 11:** Quality Curriculum Elements.

| Element | Mean | Median | S.D. |
|---|---|---|---|
| Lab activities provide challenging opportunities for the learner. | 9.62 | 10 | 0.96 |
| Curriculum is revised annually to integrate new technology. | 8.92 | 10 | 1.55 |
| Curriculum is flexible to meet students needs. | 9.23 | 10 | 0.93 |
| Classroom facilitators follow a detailed curriculum structure. | 6.31 | 6 | 2.36 |
| Classroom activities are integrated with core subject areas. | 8.77 | 9 | 1.42 |
| Integration with other curricular areas is a part of program planning. | 8.31 | 8 | 1.70 |
| Students have extensive experience with a number of applied technological activities. | 8.54 | 9 | 1.56 |
| Core technologies are taught as elements of larger technological systems. | 8.15 | 9 | 1.77 |
| Class offerings are based on student interest inventories. | 7.08 | 8 | 2.50 |
| Classroom activities are correlated with life skills. | 8.54 | 9 | 1.61 |
| Classroom activities emphasize career exploration. | 8.31 | 9 | 1.84 |
| There is an emphasis on the process of design. | 8.15 | 8 | 1.07 |
| Industrial standards are followed in instruction. | 7.23 | 8 | 2.74 |
| Practical application of knowledge is emphasized in curricula. | 9.69 | 10 | 0.63 |
| Course offerings emphasize engineering elements. | 8.00 | 8 | 0.82 |

Described in Table 12 are data provided by expert panel members describing **quality facilities and equipment elements.** Panelist scores were compiled and mean scores ranged from a low of 7.00 to a high of 9.54. Median scores ranged from a low of 8 to a high of 10 on a ten point rating scale. Standard deviation scores ranged from a low of 0.78 to a high of 3.03.

**Table 12:** Quality Facilities and Equipment Elements.

| Elements | Mean | Median | S.D. |
|---|---|---|---|
| Timely equipment upgrades are critical. | 8.23 | 9 | 2.52 |
| Facilities must be versatile to accommodate a variety of technological studies. | 9.38 | 10 | 0.87 |
| Certain turn key laboratory configurations provide quality learning environments. | 7.00 | 8 | 3.03 |
| Sufficient numbers of network computers are an important part of the classroom environment. | 7.77 | 8 | 2.80 |
| Sufficient supplies are provided for student use. | 9.38 | 10 | 1.04 |
| Instructional modules provide for flexibility | 7.46 | 8 | 2.85 |
| Instructor built - developed learning materials enhance curriculum. | 8.15 | 9 | 2.54 |
| Facilities provide for both clean (design) and dusty (fabrication) activities. | 8.62 | 10 | 2.75 |
| The computer and related hardware are used as tools. | 9.08 | 10 | 1.38 |
| Facilitates are clean, bright and well lit. | 9.54 | 10 | 0.78 |

Table 13 describes expert panel responses to **quality support structure elements**. The mean ranged from a low of 7.77 to a high of 9.85. Median responses ranged from a low of 8 to a high of 10. Standard deviation scores ranged from a low of 0.55 to a high of 1.89.

**Table 13:** Quality Support Structure Elements.

| Element | Mean | Median | S.D. |
|---|---|---|---|
| Administration backs the program. | 9.77 | 10 | 0.60 |
| Community support for the program is important. | 9.46 | 10 | 0.88 |
| A dedicated instructor provides a positive example for students and staff. | 9.85 | 10 | 0.55 |
| Administration is flexible and empowers teachers. | 9.54 | 10 | 0.78 |
| Sufficient local budgetary support for program elements. | 9.46 | 10 | 0.97 |
| Teachers from other curricular areas support the program. | 9.15 | 10 | 1.46 |
| Industrial and private sector donations contribute to the program. | 7.92 | 8 | 1.85 |
| Grant funding support for program elements. | 7.77 | 8 | 1.83 |
| Long range planning is inherent in facility and curricular needs. | 9.00 | 9 | 1.22 |
| Student clubs and organization are active. | 7.92 | 8 | 1.89 |