A COMPARISON OF CHARACTERISTICS ASSOCIATED WITH TECHNOLOGY EDUCATION

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CHAPTER I

INTRODUCTION

In March 1990, President Bush and the nation's 50 Governors established a set of six national education goals for the United States to reach by the year 2000 (Miller, 1990). These national goals addressed major problems in the country's educational systems. One of these six goals calls for a concerted effort to increase the math and science proficiency of America's student body (Stern, 1991). Barry Stern, Deputy Assistant Secretary of Vocational and Adult Education of the U. S. Department of Education, reported that: "If the U. S. is to achieve these goals, especially the goal on math and science, technology education is likely to play an important role" (p. 3). Stern continued, "If we are serious about improving math and science achievement, and indeed, the overall educational performance of our students, we must explore different ways of teaching and organizing curricula. Technology education is one of those ways . . . ." (p. 3).

The technology education discipline has undergone revolutionary changes in the past decade (e. g., The Jackson's Mill Curriculum Theory, 1982, Jackson's Mill Revisited, 1990). Professionals within the field have called for a discipline that is more closely aligned with technology as well as the disciplines of mathematics and science (Maley, 1989; Welty, 1989; Lauda, 1988). Maley (1984) suggested that there must be strong linkages with math and science if integration is a goal to be achieved in the study of technology and technological innovation. In the Project 2061 Panel Report, F. James Rutherford (1989), Project Director, stated that: "America has no more urgent priority than the reform of education in science, mathematics, and technology" (p. vii). Rutherford further implied that the task ahead for the United States is to develop a new system of education that will prepare young people who are literate in science, mathematics, and technology. Integrated conceptual and experiential learning is the key to providing the necessary framework for individuals to understand and benefit from rapidly changing technology (Rutherford, 1989). Rutherford concluded that sciences and mathematics are important to the understanding of the processes and meaning of technology and their integration with technology education is vital. Technological literacy is an important aspect of the technology education discipline.

Fagan (1987) suggested that the technology education curriculum should be guided by the technological literacy needs of students instructed within a interdisciplinary setting. The International Technology Education Association (ITEA) strategic plan outlines, as one of the association's major goals, the establishment of technology education as the primary discipline for integrating curriculum towards the advancement of technological literacy (ITEA, 1990). While many authors support this notion (Boyer, 1985; Selby, 1988; Renzelman, 1989; Roy, 1989), it is apparent that the shift in emphasis within the profession must be matched by emphasis from complementing disciplines (Renzelman, 1989).

Recent research indicates that there is considerable confusion outside the discipline as to what characteristics exemplify technology education (Maley, 1989; Siciliano, 1989; Wenig, 1989). The past decade has been marked by many changes and reforms in the technology education discipline, however, establishing technology education as a viable school subject within the public schools will be a major challenge facing technology education (Maley, 1989). If technology education is to assume its stated role of providing interdisciplinary settings for the application of knowledge, efforts must be made to understand and inform those disciplines with which we choose to associate (e. g., mathematics, science, etc.) as to the characteristics that exemplify technology education. Wenig (1986) suggested that for the discipline of technology education to survive and thrive moves must be made to clear up any confusion adjoining disciplines have about technology education and proceed towards a coordinated curriculum of complementing subject matter.

Statement of the Problem

Technology education has an image problem and this problem restricts the profession from effectively integrating technology education into the secondary education school curriculum.

Need for the Study

While technology education has made considerable strides in curriculum and program development in the past decade, it is not clear whether the impact of this evolution has been felt or understood by the educational decision makers and the members of complementing disciplines. Betts, Yuill and Bray (1989) pointed out that: "The problem appears to be that those who make decisions affecting our program do not have a positive image of our program" (p. 27).

Starkweather (1990) suggested that the leaders within technology education have a responsibility to help influence the development of a positive image for the field. In order to accomplish this influence it is necessary to determine how technology education is currently perceived by other disciplines. Determining the characteristics that complementing disciplines associate with technology education and comparing those perceptions with views held by technology education professionals will lead to a greater understanding of how technology education may become more integrated into the mainstream of general education. Selby (1988) indicated that outmoded ideas and misguided perceptions are the common enemy of all disciplines. Similarly, Dyrenfurth (1987) suggested that while technology education is considered an essential characteristic of quality education, there are often misinterpretations and misrepresentations associated with technology education. Throughout the literature on technology education, misrepresentations and stereo-typical perceptions of technology education can be found. Boyer (1983), in his study of technology in schools, found a disturbing trend of equating technology education with computer literacy programs. Stone (1989) indicated that one serious misconception is the mistaking of technology education with educational technology. He concluded that the technology education discipline must move to clear up these often held misconceptions.

Purpose of the Study

The purpose of this study was to determine the perceived characteristics affiliated with the technology education discipline as discerned by technology education professionals and associated secondary education faculty (i. e. mathematics and science teachers). The efforts to integrate technology education into secondary education school curriculum can not be effectively implemented until there is a clear understanding of the purpose of technology education by all members of the technology education, mathematics, and science faculty.

The purposes of this study were achieved through surveying technology education professionals and comparing the characteristics they associate with the discipline with the characteristics as perceived by program associated faculty in mathematics and science.

Methodology

A comparison of the perceived characteristics of technology education was then analyzed within and between groups in order to determine similarities or differences. These perceived characteristics of technology education were used to determine the difference between the perceptions held by technology education professionals and the faculty members associated with technology education programs. Upon discerning these perceptions, strategies for effecting any needed change in stereo-typical perceptions were investigated.

Research Questions

Based on the purpose of this study, the following research questions were developed for investigation:

1. What are the characteristics that exemplary technology education classroom teachers identify with technology education?

2. What are the characteristics that associated secondary education faculty (mathematics and science) identify with technology education?

3. Is there a significant difference between the perceptions of the exemplary technology education classroom teachers and the perceptions held by associated secondary education faculty (science and mathematics)?

Assumptions of the Study

The following assumptions were made concerning this study:

1. It was assumed that the responses to the questions asked on the survey were independent expressions of perception.

2. It was assumed that the responses were honest and true representations of the perceptions of the surveyed groups.

Limitations of the Study

The following limitations were made for this study:

1. The technology education program experts were identified outside the context of this study (Wicklein, 1991).

2. The study was limited to defining the perceived characteristics of the technology education discipline only.

3. The technology education and program associated faculty participants were selected from populations associated with technology education programs only; excluding industrial arts programs.

4. The technology education and program associated faculty were identified by various governmental entities and their accuracy is not verifiable.

Definition of Terms

The following terms were used in this study:

Technology: The application of knowledge, tools, and skills to solve practical problems and extend human capabilities (Rutherford, 1989).

Technology Education: A comprehensive action based educational program concerned with technical means, its evolution, utilization, and significance in specific; and technological literacy in the broad perspective (ITEA, 1988).

Program Associated Faculty: Science and mathematics faculty members who are locally associated with on-site technology education programs.

Interdisciplinary: Involving two or more disciplines, or branches of learning (Webster, 1983).

Perceived Characteristics: An opinion, belief, or idea one uses to typify or distinguish between entities.

CHAPTER II

REVIEW OF LITERATURE

Introduction

The nature of our technological society has been marked by unrelenting change and adaptation, so much so that some critics question the ability of mankind to cope (Savage & Sterry, 1990). Undoubtedly, technology creates problems as well as solving problems in society. However, the necessity for understanding and staying abreast with advancing technology in society is clear and present. Sprague and Bies (1988) pointed out that many American industries, as well as individuals, have forgotten how to be competitive and profitable. In most cases this failure has been due to the lack of insight, innovation, and the proper understanding of technology. Sprague and Bies (1988) further suggested that industry has begun to realize the advantages of having a work force that possesses a broad understanding of technology. Similarly, Wiens (1985) suggested that the impact of technology is so great that the responsibility for weighing the repercussions of technology must be held by the whole of society. As technology continues to permeate society, those persons responsible for educational leadership are faced with the responsibility of finding methods of preparing students for this ever dynamic technological society.

Maley (1985, p. 3) stated:

> There has never been a more appropriate time than the present for aggressive, imaginative, and concerted action aimed at establishing technology education as an integral and valid component of education for all youths and adults. That must be the central mission or goal toward which the profession must work.

Many state and national curriculum initiatives have stressed the importance of including technology education and related content in all high school curriculum (Galey, 1989; Johnson, 1989; National Commission on Excellence in Education, 1983; Boyer 1983). When asked which area of the school curriculum was in the greatest need of thorough curriculum revision, Boyer (1983) suggested that the integration and relating of technology to science was the most critical. Galey (1989) implied that in order for our students to become the effective citizens outlined in the numerous reports on education, they must be able to recognize technology-based problems and identify alternative solutions to those problems. Johnson (1989) added that the school curriculum cannot advance without technology education. Because of these and other such initiatives, an overriding call for a technologically based discipline that allows for the application of knowledge, skills, and tools appeared. As one carefully examines the comments made by experts on educational reform, it becomes obvious that the call for technology education is coming from outside the discipline as well as within the discipline. Siciliano (1989) recognized that technology education provides an excellent vehicle for the development of interdisciplinary studies. Siciliano also suggested that all curriculum areas can be related through technology education. The repeated call for technology education and a more integrated curriculum have met with some resistance at the "grassroots" level. This resistance may be due to the common human need to resist change. However, it is more likely due to misguided perceptions of the technology education movement (Sprague & Bies, 1988).

Stone (1989) indicated that in most cases the curriculum decision makers, if they include technology education at all, will include the discipline with a flawed perception of what technology education is and what its role should be. Stone (1989) emphatically pointed out that: "Unless there can be an awakening of the true role of technology education in the minds of these decision makers, there will not be any shift in the focus of education. Instead there will be old wine in new bottles" (p. 40). Thus, emphasizing the critical need for a concerted action to develop understanding and inform the people who will actually make decisions concerning implementation. Stone went on to suggest that the technology educator needs to assume the task of educating the masses about the role and function technology education plays in the total educational curriculum. Implying that even though educational initiatives have called for technology education, it is the people within the technology education discipline who must push for real implementation and integration of technology education within the educational community. It is obvious that technology education is important in today's society and is being called for by numerous authors, but as Mooney (1989) pointed out, the technology education image often gets in the way of real progress. Mooney also recognized that many professionals who are affiliated with technology education are either unaware of the new emphasis on technology and technological literacy within the discipline or unaware of the necessity and urgency for change. Maley (1985) indicated that numerous factors such as: public relations, image change, and a lack of image building data and strategies provide challenges to the profession as we strive to increase the awareness of the public in general and the decision makers in specific regarding the future role of technology education. Likewise, Volk (1989) suggested that the study of technology education is a critical and vital aspect of education and technology education must begin to act as a change agent toward improving educational curriculum.

Establishing technology education as a viable school subject will be a major challenge facing the profession (Maley, 1985). However, as Stone (1989) pointed out: "If we do not take the initiative now, the opportunity will be lost to us for a hundred years" (p. 42).

Integration

There is increasing concern, by many experts and a growing segment of the general public alike, that America's economic and social ill's might be cured if the educational system were improved (McCrory, 1985). Sprague and Bies (1988) stated that: " Over the last decade, many industries have realized the advantages of high technology within the work place" (p. 17). Sprague and Bies (1988) pointed out that these industries realize that education is the key to their economic survival. Calls for change in education, have been brought about by a number of factors affecting education and society. These include, among other things, a new emphasis on technology as the nucleus of economic prosperity; national reports on the state of

American education such as the report entitled, A Nation at Risk, (National Commission on Excellence in Education, 1983); and the perceived inadequacy of completing students. Benson (1984) suggested that education, as an institution in our society, is receiving attention of a magnitude not seen since the Sputnik Era. Similarly, Welty (1989) stated that: "It would seem that the times of 'Sputnik' (1957) and A Nation at Risk may have something in common. Both events put education in the forefront of attention and initiated education reform movements in our nation" (p. 26). This new attention on educational institutions increased the focus on the need to develop a populace of citizens with higher levels of academic competencies and broader understandings of the effects and impacts of technology. Maley (1989) proposed that relationships within the school aimed at a broader holistic integration of disciplines will lead to a more effective curriculum. Similarly, Welty (1990) emphasized the need to restructure the secondary school curriculum so that students recognize the basic disciplines as pieces of a greater whole instead of disjointed entities. Mark Musick (1989), President of the Southern Regional Education Board, suggested that the need for improvement in educational requirements and expectations is apparent when the achievements in mathematics, reading, and science of American youth are compared with those of youth from other technologically advanced countries. Roy (1989) suggested one approach for raising the competencies of students is to establish working relationships between the disciplines. Musick (1989) provided this succinct comment:

> Recent studies suggest concepts are taught more effectively when learning to know and learning to do are linked.

> Allowing students to use academic materials to perform 'real life' tasks or address 'real life' problems is appealing as a method for increasing students' motivation to learn higher level academic concepts in high school (p. 2).

Special emphasis was placed on the need to have students investigate the linkages between and across academic and applied disciplines. Roy (1989) also emphasized the creation of new connections between academic skills and their uses. Boyer (1988), expressed concern with the practice of offering segregated course work, "Asking students to take an isolated course in biology or chemistry, without placing that study in a larger context, does not fit the bill" (p. 5). Maley (1988) added that, "Scholarship does not reside in a subject" (p. 8). Emphasizing his belief that educators should prepare the whole student for a complex and dynamic world by developing links between courses of study.

Welty (1990) suggested that since technology touches almost every aspect of life, it is the perfect tool for bridging the gap between abstract concepts and concrete life experiences. Similarly, Roy (1989) contended that only a few of the students enrolled in our schools have enough "want" to learn purely abstract sciences. However, most students generally flourish when given the opportunity to incorporate life experiences into their studies. He concluded that educators must strive to prepare all students for an increasingly complex world by working together even though there may be some differences in conceptual beliefs between disciplines. Parnell (1991) estimated that schools only deliver the hard sciences in a comprehendible fashion to about 30 percent of the students in the public schools.

Technology education, as a content area of the public school curriculum, has the potential to positively influence all other parts of the curriculum (Todd, 1990). Technology education is a discipline that has been derived, through numerous curriculum reform measures (e. g., The American Industry Project, The Industrial Arts Curriculum Project, The Maryland Plan, and Jackson's Mill Industrial Arts Curriculum Theory) from a discipline based on traditional industrial arts subject matter (i. e., woodworking, metalworking, and drafting) to one that reflects the broader context of technology. The body of knowledge for technology education is based on the study of the human-made world. The organizers that are used to shape the curriculum consider living and non-living content, the shaping of those entities into useful products, and the ability of users to access those products (Savage & Sterry, 1990). Starkweather (1987) offered this, somewhat less complex definition of technology education, "Technology education is applying math, science, and technology; solving practical problems; using knowledge, tools and skills, action based; exploring careers; and increasing potential" (p. 1). Starkweather goes on to indicate that technology education is the discipline concerned with application. Similarly, Siciliano (1989) stated that: "Technology education as the nucleus for interdisciplinary instruction is an essential element of an educational environment structured to prepare individuals to operate within a world permeated by technological phenomena" (p. 89).

Technology plays an increasingly important part in American society; it touches almost every aspect of life; it can be used to bridge the gap between abstract concepts and concrete life experiences (Welty, 1989). Welty stated that: "It is safe to say that one of the most salient aspects of ordinary life in our society is technology" (p. 20). Welty goes on to suggest that when the study of technology education is integrated into the curriculum, numbers in mathematics have identity, messages in English are transmitted beyond the classroom, and students begin to understand that these subjects do relate to something beyond the classroom. Renzelman (1989) contended that technology is the connecting link in our society and in our technologically advancing world. Renzelman's point of view was supported by Welty (1989) when he stated: "When the skills and concepts introduced in academic subjects are applied to problems in everyday life and the world of work, the curriculum intrinsically enters the realm of technology" (p. 21), undoubtedly, suggesting that technology education offers the practical side of abstract concepts. Technology education, linked with science and math, represent experiences that many people have, but do not really understand (Todd, 1990). Todd also indicated, conversely, that curriculums that are without technology education suffer greatly due to a lack of avenues for student application.

Many educational leaders have recognized the need to develop interdisciplinary curriculums that build upon the strengths of each individual subject. In a study conducted by the Modern Language Association, Kinneavy (1985) found that 47 percent of colleges and universities in the United States had interdisciplinary programs in force. Neden (1990), Technology Education director for Delta County

Public Schools, Delta County Colorado, suggested that one of the major benefits technology education has offered the Delta County School system is the unique opportunity for building interdisciplinary relationships between all the disciplines involved in the curriculum. Neden (1990) also suggested that the technology education programs in Delta County acted as a melting pot where students found opportunities for exploring and applying the abstract concepts found in adjoining disciplines, as well as providing the teachers with innovative methods and application approaches for each of their subject areas. Similarly, Welty (1989) indicated that technology education, being an applied science, can be used to establish interdisciplinary linkages between disciplines, thus, providing immeasurable opportunities for the reinforcement of subject specific concepts.

Perceptions

Through various means, thousands of administrators, educators, and ancillary staff members have been exposed to technology education in recent years. However, the discipline is still often referred to and thought of as "shop" (Clark, 1989). Clark (1989) further stated that: "This serves to accentuate the scope of the crisis, and the professional reaction (or lack thereof) to it" (p. 7). Many efforts in the movement toward integrating technology education into the public schools have met resistance or failed because the administrators, educators, and ancillary staff members do not perceive technology education as being different from traditional industrial arts (Clark, 1989). Despite the commonly held perception of technology education leaders that the discipline should offer integrative technological literacy based activities for all secondary public school students, misconceptions outside the discipline abound (Starkweather, 1990). According to Roy (1989) misguided perceptions of technology education have caused considerable damage to the discipline. Roy (1989, p. 13) stated:

> Technology education has suffered from a linguistic body blow (whereby 'science' was inserted whenever science and technology was meant) followed by an incredible cultural bias (which holds that science is 'superior' to technology) created by the science community aided and abetted by the media.

The significance of Roy's comments was further explicated by Stone (1989) as he stated: "Just as blacks, women, and other minorities have been discriminated against, so too have technology education studies, teachers, and programs been victims of discrimination" (p. 41). Stone believed that uninformed perceptions can cause severe damage to the discipline unless quick and decisive steps are taken that cause people to reconsider previously held misconceptions. Undoubtedly, representative perceptions of the characteristics embodying a discipline can become concrete without efforts to alter those perceptions.

Perceptual Impacts on Education

The significance of perceptual opinion was detailed by Ward (1984) in a study conducted at the University of North Dakota. Ward assessed the effectiveness of basic skills programs at Cleveland Public Elementary Schools by determining the perceptions of teachers, principals, parents, and students associated with those programs. Ward found that principals and teachers perceived that the schools were doing an adequate job of addressing basic skills, while parents did not make this perception. Further, Ward (1984) concluded that the significant differences between the groups suggested an apparent lack of communication between the school based programs and the parents. Access to this information could assist parents in making decisions about supporting school programs. The perceptions of individuals, regarding the characteristics of a particular program, reflect the quality of support and involvement those individuals will provide for the program. Later, Hite (1985) supported Ward's contentions following a study he conducted to gain insights into the perceptions held by Ohio's public school superintendents and school board presidents regarding the characteristics of effective schools. In this study, Hite found that there was a significant difference between the perceptions of superintendents and school board presidents. The superintendent's found the schools to be practicing many of the items associated with effective schools, while the school board presidents did not. Hite attributed this difference between the perceptions of the two groups to the amount of direct involvement the individuals had with the schools in question. Thus, pointing out his contention that individuals who lack direct involvement sometimes have ill informed perceptions.

In a related study on perceptions, Weeks (1988) addressed the perceptions held by educators on the quality of secondary vocational agriculture programs. Weeks' research sought to determine the perceptions of selected educators toward the effectiveness and quality of instruction in vocational agriculture. Significant differences were found between the perceptions of the agriculture teachers and the three other groups of faculty members. Weeks (1988) concluded that a large percentage of administrators and counselors had a poor perception of the quality of secondary vocational agriculture programs. He attributed this difference in perception to a lack of accurate representations of reality among the administrators and counselors. As a result of this study, Weeks recommended that professionals within the discipline should recognize the necessity for making concerted efforts to educate adjoining professionals and disciplines.

In a study conducted by Browning (1989), teachers and administrators perception of clinical supervision used for the improvement of the teaching was analyzed. Browning (1989) utilized information gathered from secondary and elementary school groups to determine differences in perception. Browning noted at the outset of the research that all of the participants had similar interest and stakes in the clinical supervision process. It was not a surprise to Browning that there was general agreement concerning the acceptance of clinical supervision among the groups. Undoubtedly, this equal stake and equal access to information concerning the discipline in question may tend to stabilize and blend perceptions.

Additionally, Ostwald (1988), in a dissertation conducted at Michigan State University, found that students and teachers perceptions varied little on the role and function of guidance counselors. However, Ostwald concluded that those individuals who had higher levels of interactions with guidance counselors tended to place higher value on their role and function within the school system. Buckland (1989) supported the conclusions arrived upon by Ostwald and agreed that interaction is the key to accurate perceptual information. In her dissertation Buckland studied the roles and goals of freshman composition at five private colleges in Southern Appalachia as perceived by individuals from within the English Departments and from non English teaching faculty. The results indicated that both groups had an accurate (similar) idea of the role and goals of their Freshman Composition programs. The similarity of the perceptions is most likely due to the nature and scope of the discipline of English, thus, indicating that all of the participants had some background with the English Departments as well as some knowledge of the discipline.

As a result of these studies relating to the perceptions of associated faculty, clearly, the technology education discipline may need to recognize the great influence faculty members from associated disciplines have on the success or failure of the discipline. Hacker (1990) stated that: "Technology education can be strengthened through a collaborative process that builds coalitions" (p. 9). Hacker (1990) further implied that these coalitions will not only strengthen technology education, but all components of education. Another expression of the urgent need for building coalitions and developing understanding among associated faculty was expressed by Larkin (1989) as he implied that there exists a desperate need to familiarize public school faculty with the technology education curriculum and its' purposes.

Characteristics of Technology Education

The technology education discipline has made significant changes in format and curricula in the past few years and is the matter of active debate in educational circles around the United States. Maley (1989) suggested that very few disciplines have been debated as heavily in the literature and through national reports as has technology education. The National Science Foundation (1983), in the report Educating Americans for the Twenty First Century, called for an immediate integration of technology education into the present secondary public school curriculum.

Technology education has evolved through numerous curriculum projects and years of reform and research projects from a discipline called industrial arts. Industrial arts programs were based on the study of materials (i. e., wood, metal) and the processes used to produce products from those materials (Lauda, 1989). In the 1960's several curriculum reform projects were undertaken in an effort to change the discipline to more accurately reflect technology (Industrial arts curriculum project, American industry project, and others). Warner's publication of: A Curriculum to Reflect Technology (1965) also increased the emphasis the discipline began to place on the study of technology. Although these projects and publications did not see widespread support from within the discipline and all of the curriculum projects eventually ended in failure, they did lay the foundation for technology education to be built upon. The technology education curriculum as it exists today is largely the result of the Jackson's Mill Industrial Arts Curriculum Project (Snyder & Hales, 1981). This project clarified the extremely diverse interpretations of what the discipline should be concerned with and charted a direction for future curriculum projects. Snyder and Hales (1981) through the Jackson's Mill Industrial Arts Curriculum Project, pointed out that technology education is the study of technology and industry organized around the systems of communications, construction, manufacturing, and transportation; while, recognizing the Universal Systems Model of input, process, output, and feedback as the appropriate means toward accomplishing the goals of a system. This was acknowledged as a marked venture from the study of materials common to industrial arts.

The reform movements in the decade of the 1980's have impacted the technology education discipline greatly, most notably in the acceptance and support of members of the technology education discipline (Dugger, French, Peckham & Starkweather, 1991). Maley (1989) implied that the changes within the discipline are in a large part due to responses to changing times. There now seems to be widespread support of the move to technology education from within the discipline and the dissenting factions of the 1960's seem to have been appeased. In a national survey of the profession Dugger et al. (1991) found that the most often given response in rating the strengths of the technology education discipline was the strength of the technology education curriculum. Technology education is still in a state of transition and has in some cases been accepted with varying degrees of resistance and reluctance. However, great strides have been taken toward a curriculum that reflects technology (Mordavsky, 1990).

Mordavsky provides this picture of progress the discipline has made in the last few years:

> Several years ago, we called the discipline industrial arts, drafting machines were a big deal, breadboarding was in and wood chips made on a quiet one [sic] saved our hearing. Today, technology education is the name, computer assisted drafting is dominant, computer assisted instruction is fundamental, and we spend more time with silicon chips than we do wood chips (p. 3).

The new emphasis in technology education has also begun to be recognized outside of the discipline by education professionals as well as public figures. Rustom Roy (1989), a science educator, pointed out that technology education is the key to the advancement of science, while Elizabeth Dole (1989), United States Secretary of Labor, specifically recommended that a stronger emphasis should be placed on the study of technology in primary and secondary grades. Barry Stern (1991), Assistant Secretary of the United States Department of Education, referred to technology education as:

> A bright new hope in curriculum reform. It provides school children with important content and contextual information about technology, while using successful teaching methods which emphasize integrated, holistic, multi-disciplinary, multi-sensory, hands-on learning (p. 11).

Galey (1989) suggested that the educational community has become acutely aware of technology education through many well recognized reports on education issued since A Nation At Risk was published (National Commission on Excellence in Education, 1983). She pointed out that each report has called for changes in the schools to prepare our students to live in a technological society. Galey (1989) provides the following example, Educating Americans for the 21st Century (National Science Board Commission on Pre-college Education in

Mathematics, Science, and Technology, 1983) specified that technological literacy should be a goal of all education as well as declaring technological literacy as a "new basic" for public education.

As a result of these and other reports, the technology education discipline has begun to be characterized as a national imperative towards the improvement of public education. Ritz (1991) stated: "It appears to be the right time for our discipline to position itself as the subject area that can provide technological literacy to our society" (p. 3). Ritz (1991) further suggested that if we continue to adapt our programs to the changes in technology and the needs of society, the discipline should become recognized as the new basic of education. However, Bray (1989) warned that the technology education discipline must be careful to portray itself as a program where the sharing of ideas, strategies, and successes with other disciplines of education is paramount. Similarly, Mordavsky (1990) implied that the technology education discipline must take great strides to ensure that it is preparing students to live in and contribute to a competitive and technologically based society. He implied that failing to do this will create a backlash in the acceptance of the discipline. Welty (1989) expressed similar sentiments when he suggested that the discipline cannot merely go through a wave of curriculum projects and continue teaching the same things in the same manner. Lacroix (1989) provided a concise summary of these comments when he stated: "Indeed, technology education's continued acceptance by the educational community is directly dependent upon the quality of its curriculum, and this curriculum is dependent upon the quality and effectiveness of the instruction" (p. 32).

CHAPTER III

METHODOLOGY

Introduction

The purpose of this study was to compile and compare the characteristics associated with technology education. These discerned characteristics were collected among technology education, mathematics, and science teachers. From the compiled characteristics that were identified, a comparison of the perceived characteristics was then analyzed in order to determine similarities and differences in perception. This chapter will provide a detailed description of how the study was conducted and will be divided into the following sections: (1) Descriptive research, (2) Population, (3) Development of instrument, (4) Data collection, (5) Statistical analysis, and (6) Summary.

Descriptive Research

Descriptive statistics are methods used to derive from raw data certain indices that characterize or summarize the entire set of data or population (Huck, Cormier & Bounds, 1974). Huck et al. (1974) further stated that: "Descriptive statistics transform large groups of numbers into more manageable form" (p. 19). By using descriptive research, the researcher can describe the results of a particular sample of behavior (Bartz, 1988). Key (1974) defined descriptive research as: "Descriptive research is used to obtain information concerning the current status of the phenomena. The purpose of these methods are to describe 'what exists' with respect to variables or conditions in the situations" (p. 124). Thus, suggesting his contention that descriptive research can aid the researcher in obtaining the true status of the current conditions. Obtaining the current picture of the phenomena as it exists then is the intent of this research. Van Dalen (1979) stated that:

> Before much progress can be made in any field, scholars must possess descriptions of the phenomena with which they work. Early developments in educational research, therefore, as in other disciplines, have been concerned with making accurate assessments of the incidence, distribution, and relationships of phenomena in the field . . . . Investigators ask the question: What exists?, What is the present status of the phenomena? . . . (p. 284).

Fink and Kosecoff (1985) suggested that there are many methods of gathering descriptive research. However, surveys are the most appropriate method for obtaining perceptual information directly from individuals. These surveys aid the researcher in determining the current patterns of thought among those individuals being questioned. Van Dalen (1979) explained:

> When trying to solve problems, researchers in educational, governmental, industrial, and political organizations often conduct surveys. They collect detailed descriptions of existing phenomena with the intent of employing the data to justify current conditions and practices or to make more intelligent plans for improving them. Their objective may be not only to ascertain status, but also to determine the adequacy of status by comparing it with selected or established standards (p. 286).

Population

The population for this study consisted of two primary groups (1) Exemplary technology education teachers and (2) Associated secondary education faculty (i. e., mathematics teachers, science teachers). A sample of exemplary technology education teachers were identified through two national surveys (Wicklein, 1990). Wicklein sought to identify 20 exemplary secondary technology education teachers to participate in the development of a curriculum framework for secondary technology education. Through the use of a mailed questionnaire, Wicklein surveyed representatives from all 50 of the United States. These representatives consisted of 64 university professors and department heads of technology education as well as 50 State Supervisors of technology education. From these national surveys, a sample of 187 exemplary technology education teachers were identified.

The associated secondary education faculty participant sample was drawn from representatives of the disciplines of mathematics, and science. Each of these participants were selected due to his/her association with the previously identified exemplary technology education teacher.

Development of the Instrument

Due to the relatively large size of the population, the instrument chosen for the study was a mailed questionnaire. Fink and Kosecoff (1985) suggested that the mailed questionnaire is the most reliable and valid method of obtaining large amounts of information from people economically. The study utilized a mailed questionnaire (See Appendix A) developed by the researcher with assistance from the researcher's major advisor, and was based on the content model for the study of technology, A Conceptual Framework for Technology Education (Savage & Sterry, 1990).

The objective of the questionnaire was to allow all respondents the opportunity to express their perceptions of the characteristics exemplifying the technology education discipline, in regard to the following categories: (1) Methodological characteristics, (2) Content characteristics, and (3) Personal perceptions. The methodology category was utilized to collect data concerning the methodological approaches perceived to characterize the technology education discipline, while the content characteristics category was utilized to identify course content for technology education. The third section of the questionnaire sought to identify and isolate any stereo-typical perception that might be held by the participant. Appendix A contains a copy of the instrument. The demographic information, necessary to form the basis for a comparative analysis of the respondent perceptions, was placed on the first page of the instrument in order to allow the respondent an opportunity to answer the more objective questions prior to answering questions requiring more subjective analysis (Fink & Kosecoff, 1985). The demographic information requested included: age, level of education, years of experience, number of years at present school, and professional discipline area of expertise.

On the final page of the instrument, a brief statement was made proclaiming the researcher's intent to make available the results of the study to all persons requesting them, thus allowing interested participants an opportunity to obtain the findings of the study. The cover letter (See Appendix B) which was attached to the questionnaire, provided overview information concerning the purpose of the study, an assurance of anonymity, and information addressing the procedure for returning the completed questionnaire.

A pilot study of the questionnaire and accompanying materials was conducted during March of 1991. The subjects of this pilot study were the technology education teachers and associated secondary education faculty (i. e., mathematics, science) in 18 selected secondary schools located in Oklahoma. The participants in this pilot study were mailed a prototype cover letter and questionnaire (See Appendixes C and D) with instructions to complete the instrument as well as make comments concerning the structure and content of the materials. This mailing was followed by a telephone interview concerning reactions from the participants. A Cronbach Coefficient Alpha test was conducted on the returned pilot study questionnaires in order to establish reliability and validity for the instrument. The coefficient alpha, developed by Cronbach (1951), provided a generalizable estimate of the internal consistency and reliability of the test items on the questionnaire. Popham (1981) suggested that the coefficient alpha should be used to compute the internal consistency of a set of test items where each of the items could receive a range of points. Popham (1981) further implied that the coefficient alpha provides consistent methods of calculating reliability and validity with data from a single pilot test administration. Adjustments to, and corrections of the questionnaire were made after completion of the pilot study and follow-up analysis. Eight statements, numbered 16, 28, 29, 34, 35, 36, 37, and 38, were removed in order to increase the reliability quotient of the instrument. Three statements were added in order to discern possible actions for the technology education discipline, if indeed actions were necessary. A reliability index of .82 (Appendix C) was established for the questionnaire after completing the coefficient alpha follow-up tests.

Data Collection

The instrument for this study was mailed during the second week of April, 1991; a return date of April 25, 1991, was requested. The previously mentioned questionnaire and accompanying cover letter (See Appendixes A and B) were sent by mail to 154 technology education teachers and 308 associated secondary education faculty members representing mathematics and science in the United States, for a total of 462 participants.

The population of 154 exemplary technology education teachers was used to identify the populations from which the mathematics and science samples were drawn. One hundred fifty-four participants were drawn from each of the identified population groups.

The cover letter which clarified the purpose and significance of the study, also explained to the participants that the answers they provided were voluntary and would be held in the strictest of confidence. A numbering system on the instrument that coded the participants was destroyed at the completion of the study. The participants were allowed an opportunity to request that they be sent the results of the study, as an incentive for completing the questionnaire. In further attempts to increase the return rate, a post card was mailed to the participants prior to the questionnaire, asking for their cooperation in the research. A stamped self-addressed envelope (See Appendix E) was included within the questionnaire mail-out package.

In the cases where the questionnaire was not returned by the requested return date, a post card was mailed reminding the participants of the importance of their participation in the study (See Appendix F). These follow-up cards were succeeded by personal telephone calls reminding the non-respondents of the importance of completing the questionnaire.

Statistical Analysis

The questionnaire (See Appendix A) was comprised of 38 questions that fit within four categories concerning characteristics of technology education. A Likert scale with five possible choices ranging from strongly agree to strongly disagree was used on the questionnaire. The scale that was used required the respondent to evaluate each characteristic according to their perception of the amount it was practiced locally.

Each of the five possible choices used on the Likert scale was assigned a value. Statistical tests for all data were computed on a personal computer utilizing the software package SYSTAT, Version 5.0. The raw scores for each of the five possible choices were calculated to obtain a mean and then multiplied by the number of respondents to obtain a weighted mean. This procedure was conducted for each of the 38 questions included in the three categories.

A two-way and a one-way analysis of variance (ANOVA) was used to analyize the perceptions of the associated secondary education faculty and the perceptions of the technology education faculty. These data were presented in an ANOVA summary table where the F values of the groups could be compared to the tabled critical values in order to determine whether there was a significant difference between the scores of the groups. The analysis of variance is based on the assumption that the scores in each of the various groups have approximately the same variance (Huck, Cormier & Bounds, 1974). Since there was not an equal number of respondents in each group, the researcher tested this assumption using Bartlett's chi-square. A multiple comparison procedure (Tukey's HSD test) was used to locate the cause of all significant results. The Tukey HSD test was used to compare the results of the two groups of associated secondary education faculty and the technology education group.

Summary

This chapter described the design and methodology used in the preparation and completion of the study. The population for this research consisted of 187 exemplary technology education teachers identified by Wicklein (1990) and 374 secondary mathematics and science teachers associated with those exemplary technology education teachers. The methods used to survey these populations was a mailed questionnaire. The questionnaire was evaluated for validity and reliability after the completion of the pilot study conducted on 54 secondary technology education, mathematics, and science teachers throughout the State of Oklahoma (See Appendixes C and D). A two-way and a one-way analysis of variance were used to analyize the perceptions of mathematics and science teachers and the perceptions of the technology education teachers. A Tukey HSD multiple comparison technique was utilized to locate and isolate the cause of all significant results.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

Introduction

The purpose of this study was to determine the perceived characteristics affiliated with the technology education discipline as discerned by technology education professionals and associated secondary education faculty (i. e. mathematics and science teachers) and to determine whether differences exist between the teacher groups. This chapter is devoted to the presentation and analysis of data relating to the three research questions stated in Chapter I. The accumulated data in this study are based on the responses of exemplary technology education, secondary science, and secondary mathematics teachers. These responses were stratified into two parts: the demographic information, and perceptual data relating to the research questions. The presentation and analysis of the data has been organized as follows: (1) Response data, (2) Summary of data, and (3) Results of the data analysis.

Research Questions

Based on the purpose of this study, the following research questions were developed and utilized for investigation:

1. What are the characteristics that exemplary technology education classroom teachers identify with technology education?

2. What are the characteristics that associated secondary education faculty (mathematics and science) identify with technology education?

3. Is there a significant difference between the perceptions of the exemplary technology education classroom teachers and the perceptions held by associated secondary education faculty (science and mathematics)?

Response Data

A questionnaire (See Appendix A) based on the results of a state-wide pilot study (See Appendix C), with an appropriate cover letter (See Appendix B) was mailed to selected secondary education teachers throughout the continental United States during the second week of April, 1991. The secondary education teacher sample consisted of 154 teachers in technology education, 154 mathematics teachers, and 154 science teachers for a total of 462 teachers. Seven of the instruments were returned as undeliverable. Initially, 41 percent of the remaining 455 questionnaires were returned for use in the study. A follow-up postcard was mailed to the non-respondents two weeks after the initial mailing. This increased the total returned instruments to 245 respondents or a 52 percent return rate. The returned instruments represented 40 percent of the mathematics, 45 percent of the science, and 70 percent of the technology education teachers surveyed. Group response rates, frequency distributions, and percentage breakdowns are outlined in Table I.

Part one of the instrument was utilized to ascertain demographic

TABLE I

QUESTIONNAIRE RESPONSES

Sample Group	Total Population	Number Responses	Group Response Percentage	Total Response Percentage
Technology Education	154	108	70*	45*
Science	154	69	45*	28*
Math	154	61	40*	25*
Unusable Responses	462	7		2
Total	462	245	53*	100

*rounded off to the nearest whole percentage data pertaining to personal and professional characteristics of each participant. Tables II-V are presented to detail the frequency distribution for technology education, mathematics, and science teacher responses within the categories of age, years employed within the school, years in the education profession, and the level of educational attainment.

Summary of Data

To obtain the data necessary to discern the perceptions of secondary mathematics, science, and technology education teachers concerning the characteristics associated with technology education, the participants were asked to respond to statements contained in parts two through five of the instrument (See Appendix A). The perceptually based questions were organized into the following areas: technology education teaching methodology, technology education curriculum content, need to integrate technology education with mathematics, and science; and actions the technology education discipline should take to overcome stereo-typical perceptions.

In order to determine the perceptions of the sample groups and subsequently answer the research questions, three sets of comparisons were made for each part of the perceptually based questions contained in the instrument. These comparisons included: (1) a comparison of mathematics, science, and technology education teacher perceptions of the methods utilized in technology education; (2) a comparison of the mathematics, science, and technology education teachers perceptions of

TABLE II

FREQUENCY DISTRIBUTIONS AND RESPONSE PERCENTAGES TO PERSONAL AND PROFESSIONAL CHARACTERISTICS BY AGE

	Years of Age (Question 1)								
	21-30	%	31-40	%	41-50	%	Over 50	%	Total
Technology Education	5	4	46	43	40	37	17	16	108
Science	8	12	19	27	27	39	15	22	69
Math	5	8	17	28	25	41	14	23	61

TABLE III

FREQUENCY DISTRIBUTIONS AND RESPONSE PERCENTAGES TO PERSONAL AND PROFESSIONAL CHARACTERISTICS BY CURRENT SCHOOL EMPLOYMENT

	Years Employed with Current School (Question 2)								
	1-3	%	4-8	%	9-15	%	Over 15	%	Total
Technology Education	12	11	20	19	25	23	51	47	108
Science	8	11	17	25	13	19	31	45	69
Math	6	10	12	20	13	21	30	49	61

TABLE IV

FREQUENCY DISTRIBUTIONS AND RESPONSE PERCENTAGES TO PERSONAL AND PROFESSIONAL CHARACTERISTICS BY TEACHER EMPLOYMENT

	Years Employed as a Teacher (Question 3)								
	1-3	%	4-8	%	9-15	%	Over 15	%	Total
Technology Education	6	5	11	10	33	31	58	54	108
Science	4	6	12	17	13	19	40	58	69
Math	2	3	8	13	13	22	38	62	61

TABLE V

FREQUENCY DISTRIBUTIONS AND RESPONSE PERCENTAGES TO PERSONAL AND PROFESSIONAL CHARACTERISTICS BY LEVEL OF EDUCATION

	Attained Level of Education (Question 4)								
	Bachelors	%	Masters	%	Doctorate	%	Other	%	Total
Technology Education	29	27	76	70	2	2	1	1	108
Science	12	17	54	78	2	3	1	2	69
Math	16	26	42	69	1	2	2	3	61

the curriculum content of technology education; and, (3) a comparison of the mathematics, science, and technology education teachers perceptions of need to integrate the three disciplines. Five (5) additional responses were solicited in order to compare the mathematics, science, and technology education teachers perceptions of appropriate actions for the technology education discipline to take in order to affect change in overcoming stereo-typical perceptions of technology education.

Results of the data pertaining to the three research questions are presented in the following paragraphs:

Research Question One: What are the characteristics that exemplary technology education classroom teachers identify with technology education?

In order to satisfy this question and determine the perceived characteristics identified with technology education by exemplary technology education teachers, a frequency distribution of ranges, group mean scores, and standard deviation was used to search for and identify differences in perception within this group. The participants in this study were asked to respond to 33 statements categorized into four characteristic groupings. These statements were identified through an exhaustive review of literature and were recognized as the characteristics exemplifying technology education. These four categories of characteristics were further validated through a pilot study conducted during an earlier phase of the study.

The three groups of participants responded to identical statements concerning technology education characteristics presented on the instrument. The responses were made by marking each statement according to a five point Likert scale. Participant agreement or disagreement with each statement was coded on a Likert scale as follows: Strongly Disagree (1), Disagree (2), No Opinion (3), Agree (4), and Strongly Agree (5). The mean group score ranking of each statement was based on the following breakdown of the Likert scale: 1.000 to 1.499 - Strongly Disagree; 1.500 to 2.499 - Disagree; 2.500 to 3.499 - Neutral; 3.500 to 4.499 - Agree; and 4.500 to 5.000 - Strongly Agree. The statements were categorized into four parts for organizational purposes. The categories were methods, curriculum content, need for integration, and actions. The exemplary technology education teacher responses to the statements contained in the categories are summarized in Table VI.

Table VI describes the number, range, means, and standard deviation of responses of the exemplary technology education teachers through the four categories and across the 33 statements concerning the characteristics of technology education. Each of the four categories was further analyzed by transforming the data into histograms that allowed for a more thorough examination. Figure 1 illustrates the exemplary technology education teacher responses to the methodological characteristics of technology education.

The histogram depicted in Figure 1 illustrates the responses by range and means for statements 6 through 15 of the questionnaire. The mean group scores indicated that the teachers either agreed or strongly agreed with all statements concerning technology education methodology with the exception of statement 14.

TABLE VI

FREQUENCY DISTRIBUTION OF QUESTIONNAIRE RESPONSES FOR EXEMPLARY TECHNOLOGY EDUCATION TEACHERS

Item	Topic	Number Responses	Range	Mean	SD
	Perceived Technology Education Methods				
6.	Emphasis on problem solving	107	1-5	4.617	.654
7.	Provides exploratory activities	107	2-5	4.692	.539
8.	Instruction is goal oriented	107	1-5	4.168	1.032
9.	Cooperative learning encouraged	107	2-5	4.533	.756
10.	Verbal activity emphasized	106	2-5	3.925	1.021
11.	Cognitive strategies developed	107	2-5	3.860	.926
12.	Interdisciplinary activities	107	2-5	4.383	.843
13.	Broad range of assessment strategies	107	1-5	4.439	.815
14.	Lessons are hypothesis driven	106	1-5	3.472	1.007
15.	Activity oriented laboratory instruction	107	1-5	4.121	.605
	Perceived Content Characteristics				
16.	Content is uniquely technological	107	1-5	4.280	.867
17.	Based on knowledge of development of technology	107	1-5	4.430	.790
18.	Based on the use of biological organisms	107	1-5	3.523	1.216
19.	Based on transferring information	107	1-5	4.439	.815
20.	Based on modifying resources	107	2-5	4.561	.569
21.	Based on the study of transportation	107	2-5	4.514	.705
22.	Assists students in developing insight	107	1-5	4.692	.589
23.	Application of tools, materials, processes	107	1-5	4.673	.626
24.	Aids in development of individual potential	107	2-5	4.645	.603
25.	Aids in development of problem solving skills	107	2-5	4.710	.550
26.	Prepares students for lifelong learning	107	2-5	4.682	.576
27.	Utilizes math and science skills	107	2-5	4.542	.619
28.	Allows for connection of math and science	107	2-5	4.495	.744

TABLE VI (Continued)

Item	Topic	Number Responses	Range	Mean	SD
	Need For Integration				
29.	Provides avenue for applying concepts	107	2-5	4.701	.518
30.	Should be available for all math/science students	107	2-5	4.841	.517
31.	Technology education is an applied science	107	2-5	4.542	.756
32.	Curriculum reflects industry and technology	107	1-5	4.430	.741
33.	Guided by Technological literacy needs of students	107	2-5	4.355	.704
	Actions For Technology Education				
34.	Form interdisciplinary committees	107	3-5	4.477	.649
35.	Revise curriculum strategies	107	2-5	4.327	.774
36.	Make presentations at national conferences	107	2-5	4.467	.744
37.	Conduct research on integration	107	1-5	4.336	.835
38.	Develop strategies to overcome perceptions	107	1-5	4.738	.604

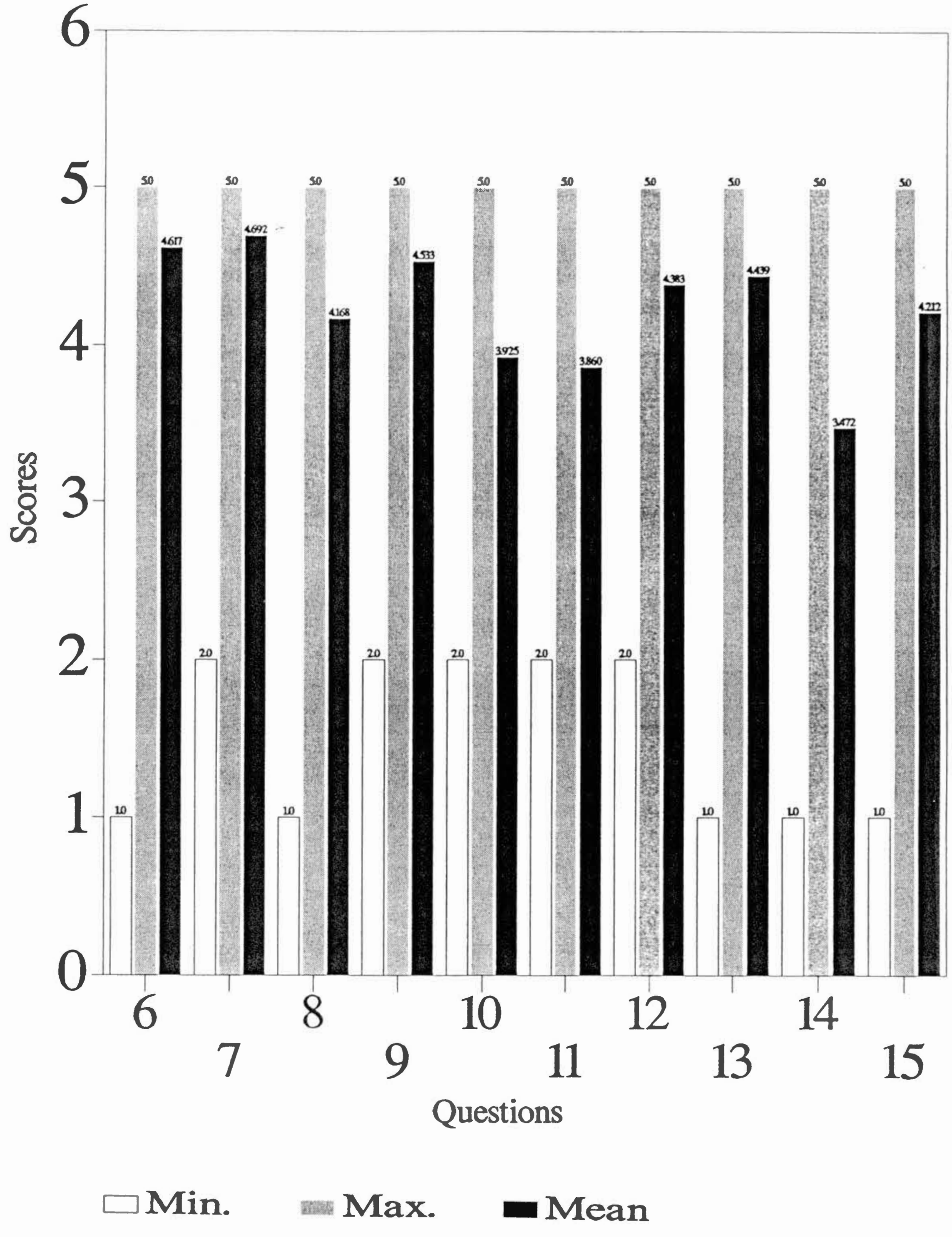

Figure 1. Methods as Perceived by Technology Education Teachers

The mean group scores suggest that statement 14, concerning whether technology education lessons are hypothesis driven, was not agreed or strongly agreed upon. Only three statements in this category had mean group scores of a level high enough to be strongly agreed upon. Those statements, numbered 6, 7, and 9, were worded as follows: item 6, "Technology education emphasizes problem solving," item 7, "Technology education provides exploratory activities that include modeling, graphing, and production," and item 9, "Cooperative learning and small group interaction is encouraged in technology education."

Figure 2 illustrates the exemplary technology education teacher range and group means for questionnaire statements 16 through 28. These statements were categorized as statements concerning the content characteristics of technology education. As shown in Figure 2, the mean group scores indicated that the exemplary technology education teachers either agreed or strongly agreed with all statements contained in this category, with the exception of statement 18. That statement was worded as follows: "A portion of the technology education instructional content is based on using biological organisms to make or modify products." Overall, the respondents expressed a neutral (no opinion) response to this statement. The remainder of statements held in this category received a mean group score indicating that the respondents either agreed or strongly agreed with the statement.

The exemplary technology education mean group scores revealed strong agreement on eight statements within the 13 statements tested. Those statements, numbered 20, 21, 22, 23, 24, 25, 26, and 27, were

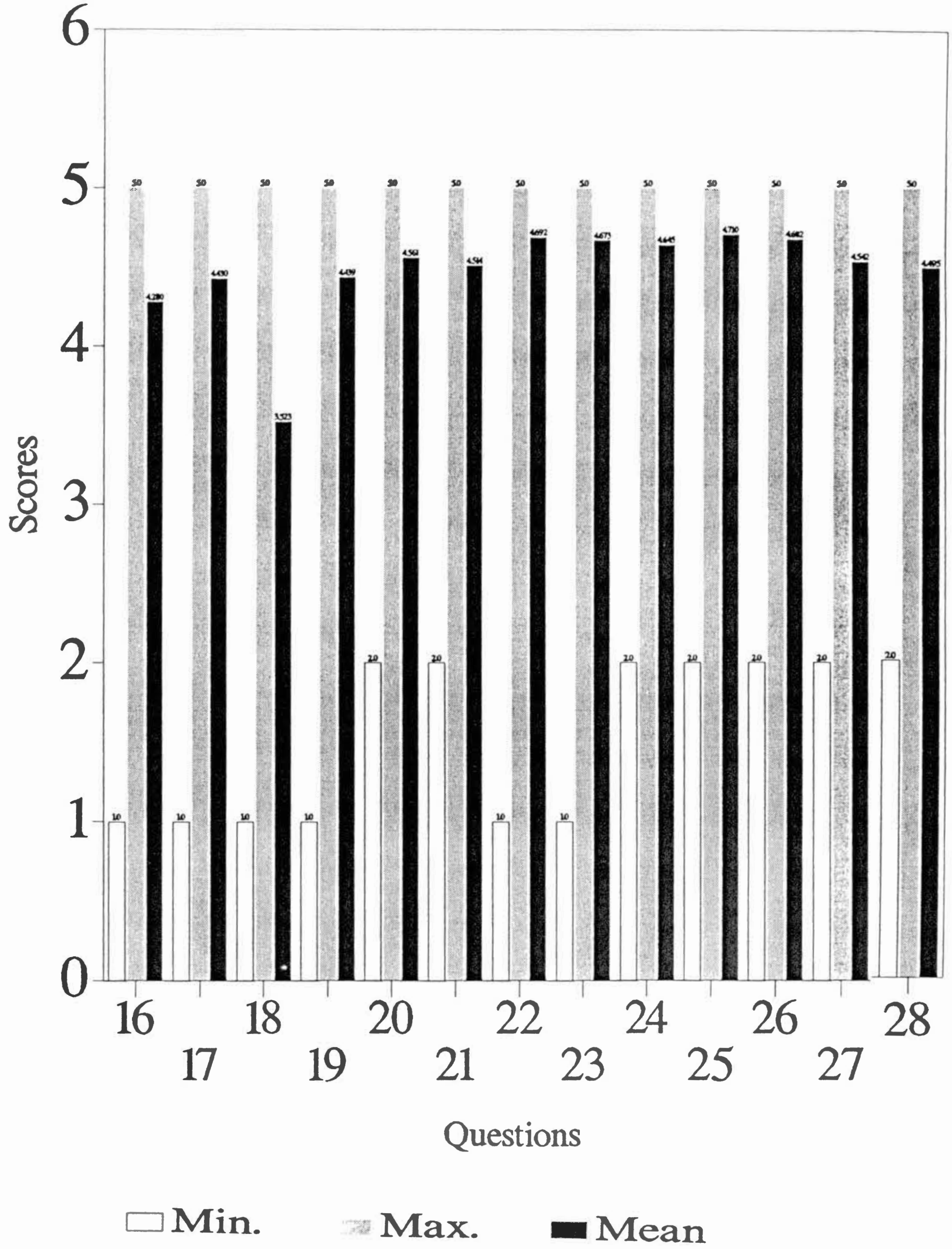

Figure 2. Curriculum Content Characteristics as Perceived by Technology Education Teachers

worded as follows: statement 20, "A portion of the technology education instructional content is based on combining and modifying resources in standard stocks, goods, and structures (production);" statement 21, "A portion of the technology education instructional content is based on the study of transportation systems;" statement 22, "The technology education curriculum assists students in developing insight, understanding, and application of technological concepts, processes, and systems;" statement 23, "The technology education curriculum allows for the application of tools, materials, machines, processes, and technical concepts;" statement 24, "The technology education curriculum aids in the development of student skills, creative abilities, positive self-concepts, and individual potential in technology;" statement 25, "The technology education curriculum aids in the development of student problem solving and decision making skills;" statement 26, "Technology education helps prepare students for lifelong learning in a technological society;" and statement 27, "Students in technology education use math and science skills to perform tasks in class."

Figure 3 further illustrates the exemplary technology education teachers range and group mean scores for statements 29 through 33. These statements were categorized as items concerning the need to integrate math, science, and technology education. As shown in Figure 3, the mean group scores indicated that the exemplary technology education teachers scored this category very high. All five statements were agreed upon and statement 33 received a group mean score indicating that the teachers strongly agreed with this statement.

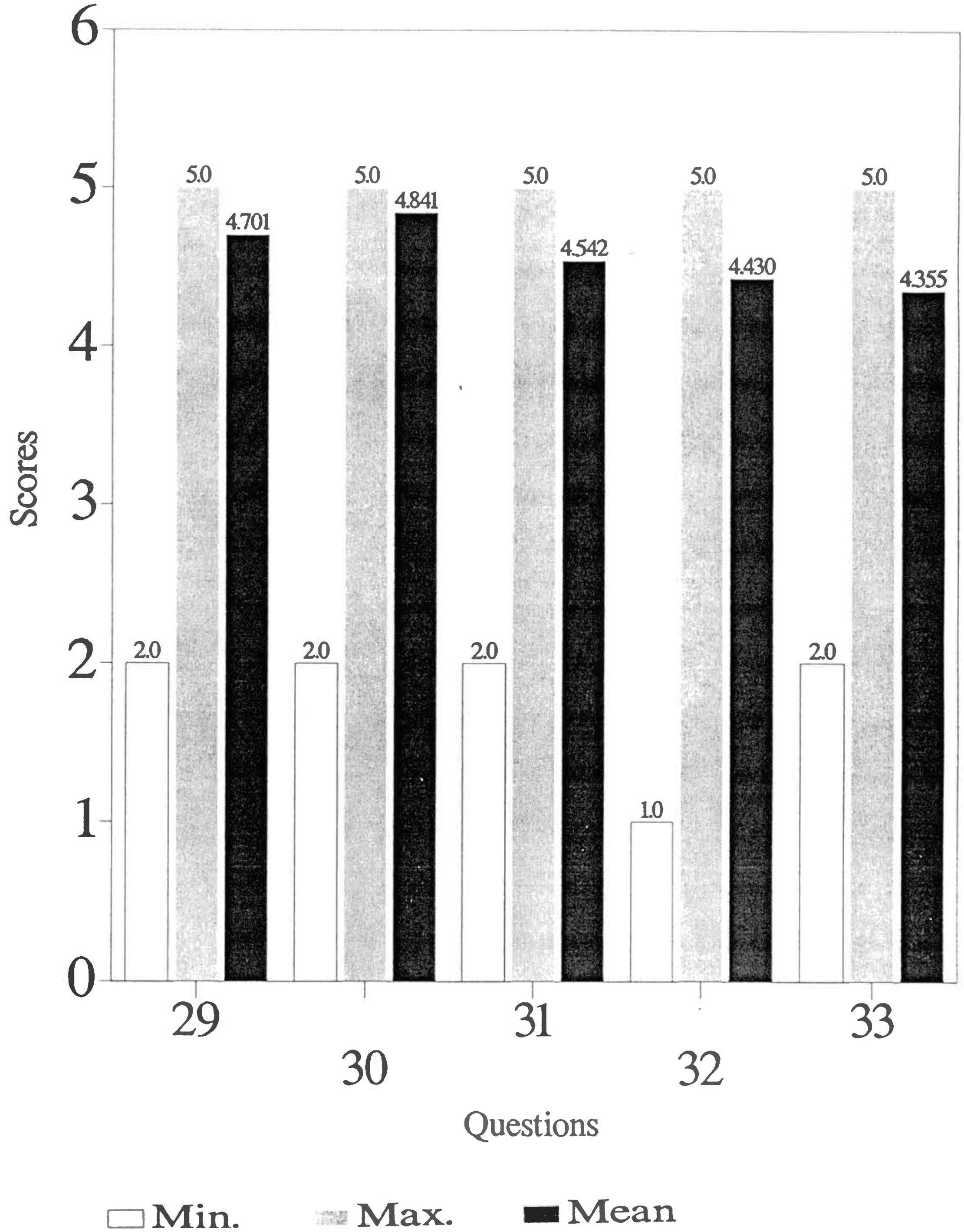

Figure 3. Perception on Integrating Math, Science, and Technology Education by Technology Education Teachers

Statement 33 was worded as follows: "Technology education is guided by the technological literacy needs of students."

Figure 4 further illustrates the exemplary technology education teachers range and group mean scores for statements 34 through 38. These statements were related to actions that the technology education profession can take to improve perceptions of the field. In Figure 4 the group mean scores indicate that the exemplary technology education teachers agree with each of the five statements concerning actions the discipline should take to improve perceptions of technology education and strongly agree with statement 38, which was stated as follows: "The technology education discipline should develop strategies for overcoming stereo-typical perceptions often held by administrators and secondary education faculty members."

Research Question Two: What are the characteristics that associated secondary education faculty (mathematics and science) identify with technology education?

In order to satisfy this question the 33 perceptual responses of the participating mathematics and science teachers were combined and analyzed as a group. The participants responded to the technology education characteristics presented on the instrument by marking each statement according to a five point Likert scale. The Likert scale for each statement read as follows: Strongly Disagree (1), Disagree (2), No Opinion (3), Agree (4), and Strongly Disagree (5). The statements were categorized into four parts for organizational purposes. The categories were methods, curriculum content, need for integration, and actions.

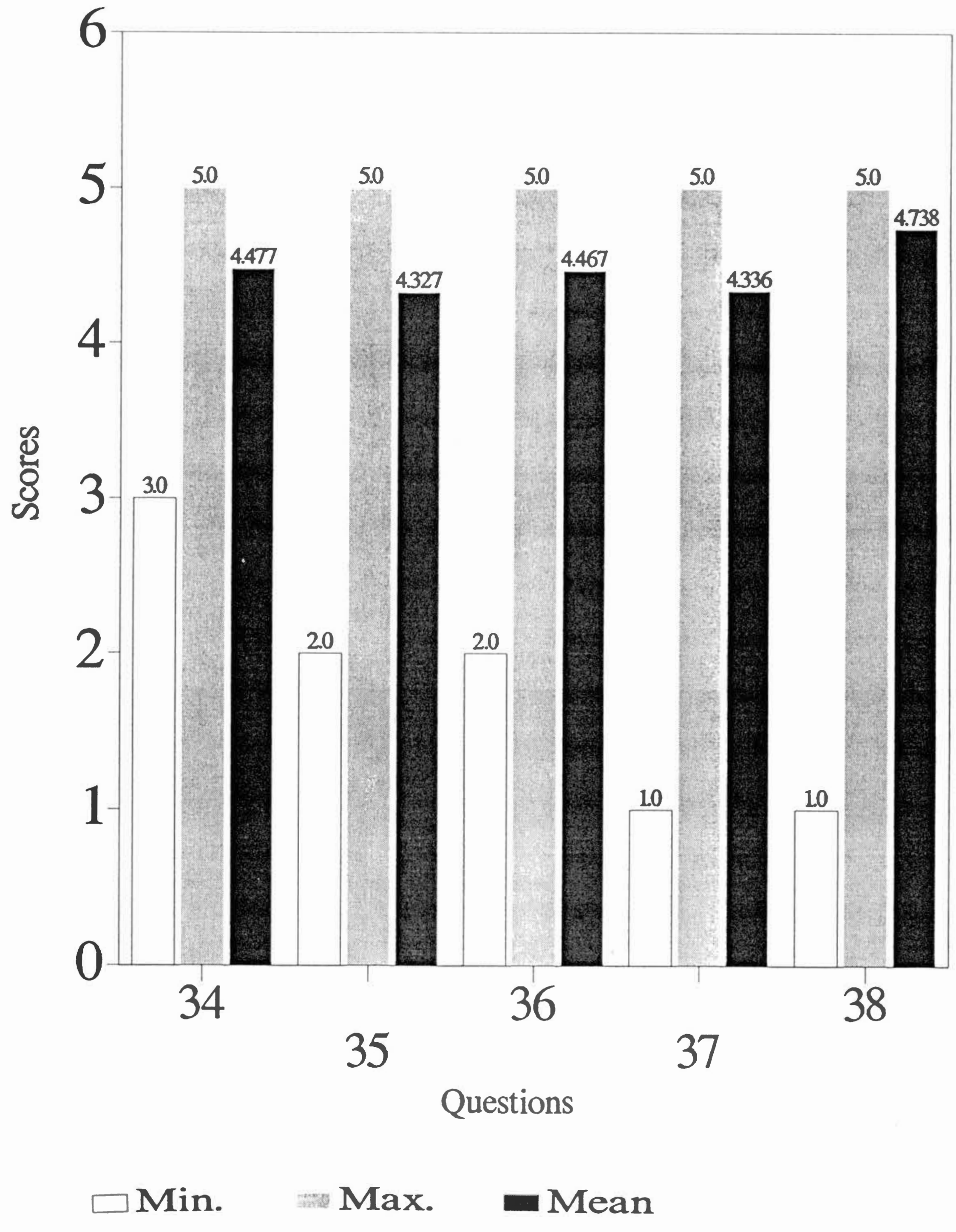

Figure 4. Perceived Actions for the Technology Education Discipline by Technology Education Teachers

As reflected in Table VII, the range and group means revealed the responses of the combined mathematics and science teacher groups for each of the 33 statements. The separate mathematics and science teacher range and group mean scores were revealed in Tables VIII and IX. These results were more fully analyzed and illustrated by transforming the data to form histograms for each of the four categories of responses.

Figure 5 further illustrates the mathematics and science teachers range and group mean scores for statements 6 through 15. This category of statements concerned methodological characteristics associated with technology education. The pattern of the distribution in this category illustrates a symmetrical concentration of scores toward the third and fourth Likert scale level, suggesting moderate agreement. The histogram revealed strong agreement with only three of the statements within the 10 listed. Those statements, numbered 12, 13, and 15, were worded as follows: statement 12, "Technology education emphasizes interdisciplinary activities," statement 13, "A broad range of assessment strategies (design portfolios, project work, performance testing) are used in technology education," and statement 15, "Technology education provides activity-oriented laboratory instruction that reinforces abstract concepts with concrete experiences." Statement 15 was also strongly agreed upon by the exemplary technology education teachers. The mathematics and science teacher group mean scores indicated that the teachers expressed a neutral ranking (no opinion) on three of the 10 statements. Those statements, numbered 10, 11, and 14 were stated as follows: statement

TABLE VII

FREQUENCY DISTRIBUTION OF QUESTIONNAIRE RESPONSES FOR MATHEMATICS AND SCIENCE TEACHERS

Item	Topic	Number Responses	Range	Mean	SD
	Perceived Technology Education Methods				
6.	Emphasis on problem solving	131	1-5	3.847	1.078
7.	Provides exploratory activities	131	1-5	4.206	.811
8.	Instruction is goal oriented	131	1-5	3.794	.901
9.	Cooperative learning encouraged	131	1-5	4.008	.873
10.	Verbal activity emphasized	131	1-5	3.229	1.020
11.	Cognitive strategies developed	131	1-5	3.099	.999
12.	Interdisciplinary activities	131	1-5	3.672	1.056
13.	Broad range of assessment strategies	131	1-5	3.603	1.043
14.	Lessons are hypothesis driven	129	1-5	3.054	.955
15.	Activity oriented laboratory instruction	131	1-5	3.901	1.066
	Perceived Content Characteristics				
16.	Content is uniquely technological	131	1-5	3.305	1.116
17.	Based on knowledge of development of technology	131	1-5	3.450	.986
18.	Based on the use of biological organisms	131	1-5	2.718	1.076
19.	Based on transferring information	131	1-5	3.817	.849
20.	Based on modifying resources	131	1-5	3.580	.813
21.	Based on the study of transportation	131	1-5	3.489	.923
22.	Assists students in developing insight	131	1-5	4.008	.881
23.	Application of tools, materials, processes	131	1-5	4.145	.895
24.	Aids in development of individual potential	131	1-5	3.901	.976
25.	Aids in development of problem solving skills	131	1-5	3.824	.932
26.	Prepares students for lifelong learning	131	1-5	3.763	1.006
27.	Utilizes math and science skills	131	1-5	3.847	1.034
28.	Allows for connection of math and science	131	1-5	3.664	1.093

TABLE VII (Continued)

Item	Topic	Number Responses	Range	Mean	SD
	Need For Integration				
29.	Provides avenue for applying concepts	131	1-5	4.092	.988
30.	Should be available for all math/science students	131	1-5	4.008	1.078
31.	Technology education is an applied science	131	1-5	4.099	.943
32.	Curriculum reflects industry and technology	131	1-5	3.786	1.095
33.	Guided by Technological literacy needs of students	131	1-5	3.511	1.192
	Actions For Technology Education				
34.	Form interdisciplinary committees	131	1-5	4.076	.997
35.	Revise curriculum strategies	131	1-5	4.183	.935
36.	Make presentations at national conferences	131	1-5	4.176	.899
37.	Conduct research on integration	131	1-5	4.229	.873
38.	Develop strategies to overcome perceptions	131	1-5	4.687	.775

TABLE VIII

FREQUENCY DISTRIBUTION OF QUESTIONNAIRE RESPONSES FOR MATHEMATICS TEACHERS

Item	Topic	Number Responses	Range	Mean	SD
	Perceived Technology Education Methods				
6.	Emphasis on problem solving	61	1-5	3.790	1.161
7.	Provides exploratory activities	61	1-5	4.226	.948
8.	Instruction is goal oriented	61	1-5	3.855	.989
9.	Cooperative learning encouraged	61	1-5	3.919	1.045
10.	Verbal activity emphasized	61	1-5	3.081	1.076
11.	Cognitive strategies developed	61	1-5	3.129	1.032
12.	Interdisciplinary activities	61	1-5	3.548	1.097
13.	Broad range of assessment strategies	61	1-5	3.565	1.081
14.	Lessons are hypothesis driven	61	1-5	2.967	1.016
15.	Activity oriented laboratory instruction	61	1-5	3.887	1.147
	Perceived Content Characteristics				
16.	Content is uniquely technological	61	1-5	3.258	1.115
17.	Based on knowledge of development of technology	61	1-5	3.387	.998
18.	Based on the use of biological organisms	61	1-5	2.839	1.162
19.	Based on transferring information	61	1-5	3.726	.944
20.	Based on modifying resources	61	1-4	3.532	.783
21.	Based on the study of transportation	61	1-4	3.742	.808
22.	Assists students in developing insight	61	1-5	3.984	.949
23.	Application of tools, materials, processes	61	1-5	4.000	1.024
24.	Aids in development of individual potential	61	1-5	4.048	.965
25.	Aids in development of problem solving skills	61	1-5	3.871	.966
26.	Prepares students for lifelong learning	61	1-5	3.903	.970
27.	Utilizes math and science skills	61	1-5	3.887	1.118
28.	Allows for connection of math and science	61	1-5	3.677	1.265

TABLE VIII (Continued)

Item	Topic	Number Responses	Range	Mean	SD
	Need For Integration				
29.	Provides avenue for applying concepts	61	1-5	4.145	.973
30.	Should be available for all math/science students	61	1-5	4.016	1.016
31.	Technology education is an applied science	61	1-5	4.081	.980
32.	Curriculum reflects industry and technology	61	1-5	3.710	1.220
33.	Guided by Technological literacy needs of students	61	1-5	3.613	1.164
	Actions For Technology Education				
34.	Form interdisciplinary committees	61	1-5	4.129	1.063
35.	Revise curriculum strategies	61	1-5	4.177	.967
36.	Make presentations at national conferences	61	1-5	4.065	.939
37.	Conduct research on integration	61	1-5	4.290	.948
38.	Develop strategies to overcome perceptions	61	1-5	4.210	.994

TABLE IX

FREQUENCY DISTRIBUTION OF QUESTIONNAIRE RESPONSES FOR SCIENCE TEACHERS

Item	Topic	Number Responses	Range	Mean	SD
	Perceived Technology Education Methods				
6.	Emphasis on problem solving	69	1-5	3.899	1.002
7.	Provides exploratory activities	69	2-4	4.188	.670
8.	Instruction is goal oriented	68	1-5	3.739	.816
9.	Cooperative learning encouraged	68	2-5	4.087	.680
10.	Verbal activity emphasized	69	1-5	3.362	.954
11.	Cognitive strategies developed	69	2-5	3.072	.975
12.	Interdisciplinary activities	69	1-5	3.783	1.013
13.	Broad range of assessment strategies	69	1-5	3.638	1.014
14.	Lessons are hypothesis driven	68	1-5	3.132	.896
15.	Activity oriented laboratory instruction	69	1-5	3.913	.996
	Perceived Content Characteristics				
16.	Content is uniquely technological	69	1-5	3.348	1.122
17.	Based on knowledge of development of technology	69	1-5	3.507	.980
18.	Based on the use of biological organisms	69	1-5	2.609	.988
19.	Based on transferring information	69	2-5	3.899	.750
20.	Based on modifying resources	69	1-5	3.623	.842
21.	Based on the study of transportation	69	1-5	3.261	.965
22.	Assists students in developing insight	69	2-5	4.029	.822
23.	Application of tools, materials, processes	69	2-5	4.275	.745
24.	Aids in development of individual potential	69	1-5	3.768	.972
25.	Aids in development of problem solving skills	69	2-5	3.783	.905
26.	Prepares students for lifelong learning	69	1-5	3.638	1.029
27.	Utilizes math and science skills	69	1-5	3.812	.959
28.	Allows for connection of math and science	69	1-5	3.652	.921

TABLE IX (Continued)

Item	Topic	Number Responses	Range	Mean	SD
	<u>Need For Integration</u>				
29.	Provides avenue for applying concepts	69	1-5	4.043	1.006
30.	Should be available for all math/science students	69	1-5	4.000	1.138
31.	Technology education is an applied science	69	1-5	4.116	.916
32.	Curriculum reflects industry and technology	69	2-5	3.855	.974
33.	Guided by Technological literacy needs of students	69	1-5	3.420	1.218
	<u>Actions For Technology Education</u>				
34.	Form interdisciplinary committees	69	1-5	4.029	.939
35.	Revise curriculum strategies	69	1-5	4.188	.912
36.	Make presentations at national conferences	69	1-5	4.275	.856
37.	Conduct research on integration	69	2-5	4.174	.804
38.	Develop strategies to overcome perceptions	69	1-5	4.116	.506

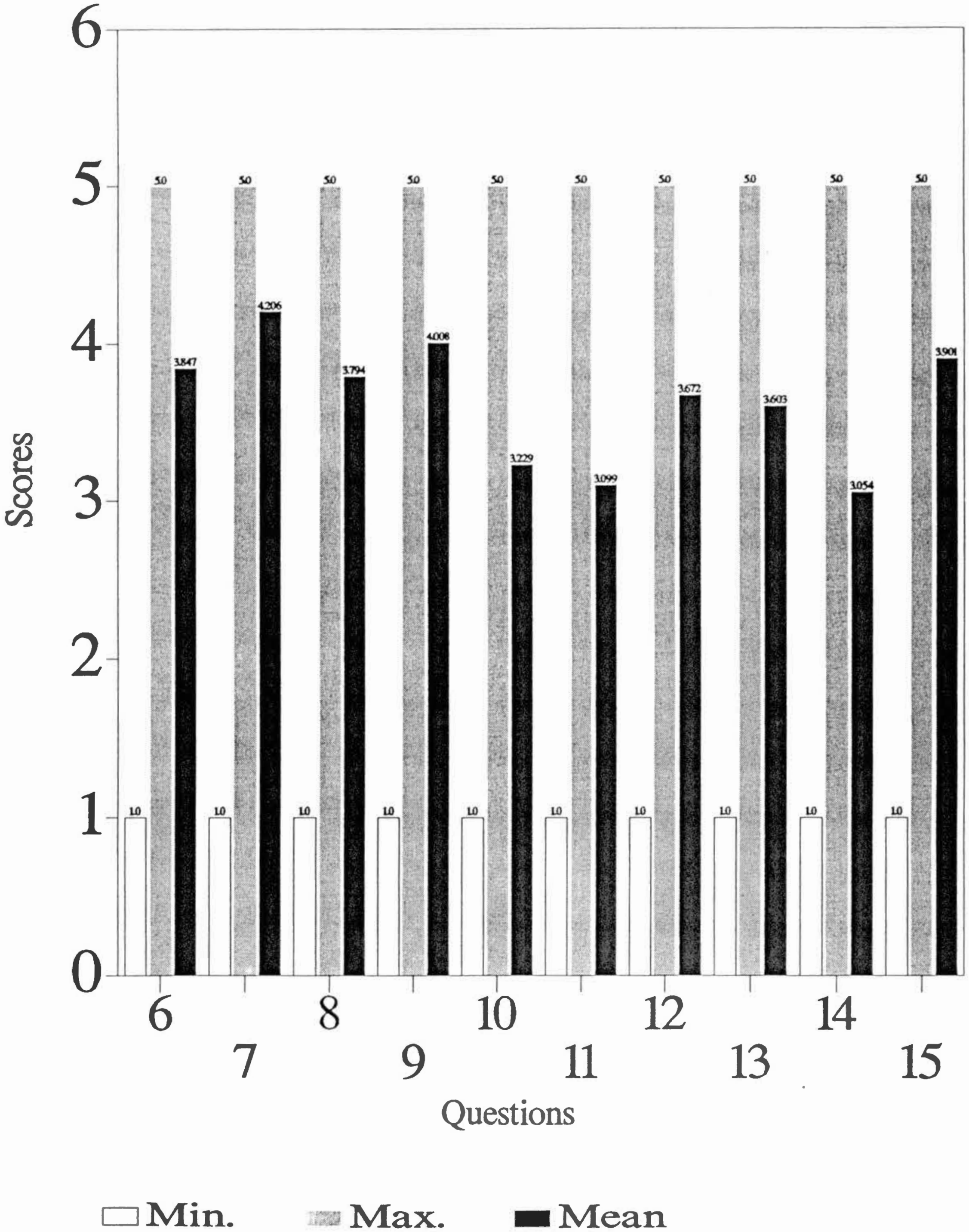

Figure 5. Methods as Perceived by Mathematics and Science Teachers

10, "Verbal activity is emphasized in technology education," statement 11, "Student cognitive strategies have clearly been developed," and statement 14, "Technology education lessons are hypothesis driven." The group mean scores of the exemplary technology education teachers were similarly low on these three questions. The mathematics and science teachers range and group mean scores for the second category, curriculum content characteristics of technology education (statements 16 through 28), were further illustrated in Figure 6.

The pattern of the distribution of group mean scores for this category of statements illustrates a symmetrical concentration of scores toward the third and fourth level of the Likert scale, with 3 representing no opinion and 4 representing an expression of agreement. The mathematics and science teachers as a group did not strongly disagree, disagree, or strongly agree with any of these statements. Four statements within the 13 in this category received a mean group score representing a neutral (no opinion) perception of the statement. Those statements, numbered 16, 17, 18, and 21, were worded as follows: statement 16, "Technology education content is based on an organized set of concepts, processes, and systems that are uniquely technological," statement 17, "Technology education content is based on knowledge about the development of technology and its effect on people, the environment, and culture," statement 18, "A portion of the technology education instructional content is based on using biological organisms to make or modify products," and statement 21, "A portion of the technology education instructional content is based on the study of transportation systems." Similarly, statement 18

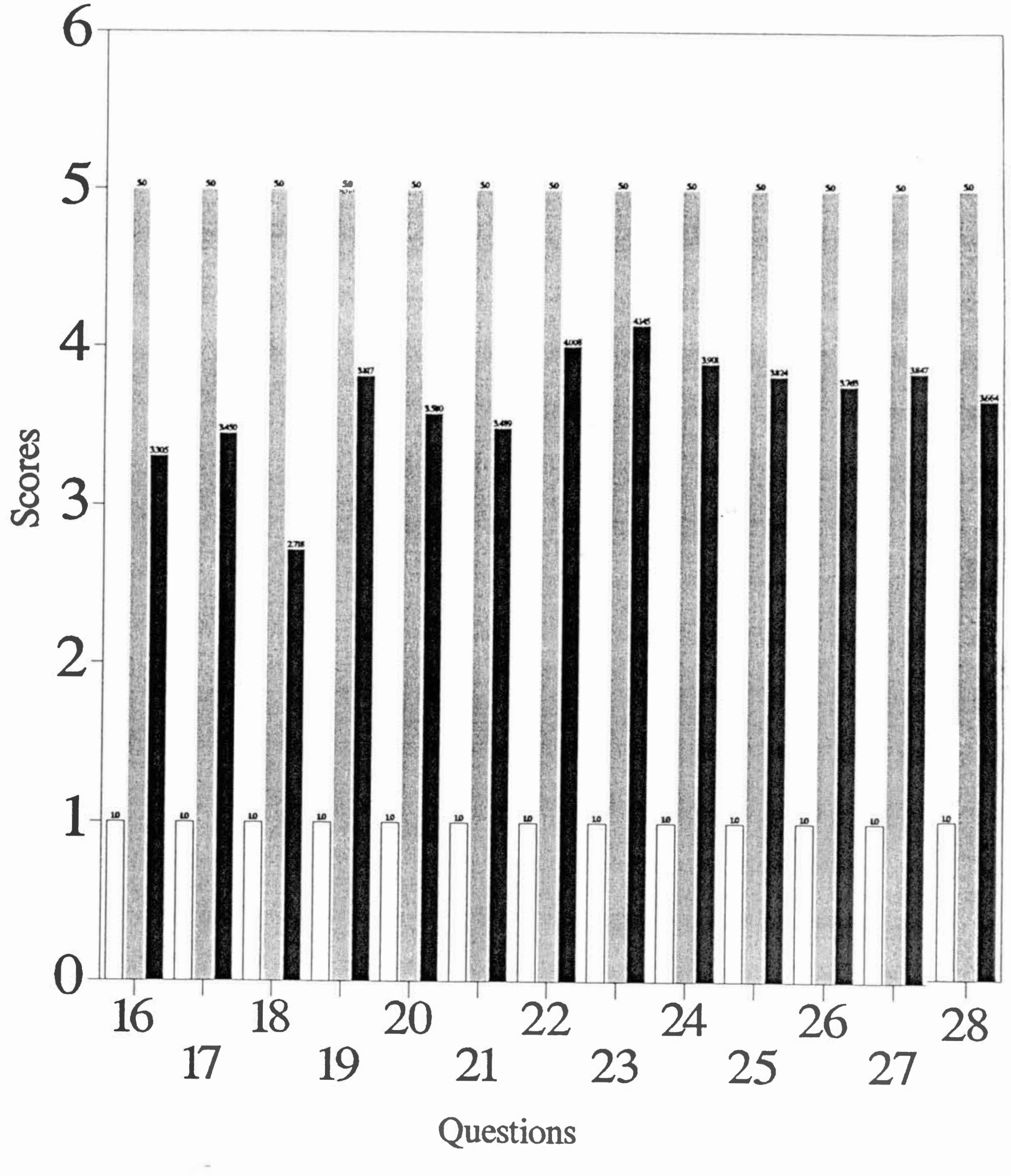

Figure 6. Curriculum Content Characteristics as Perceived by Mathematics and Science Teachers

received a lower Likert scale rating when evaluated by the exemplary technology education teachers, however statement 21 was strongly agreed upon by the exemplary technology education teachers. The remaining nine statements concerning the characteristics of technology education curriculum content each received a mathematics and science teacher group mean score revealing agreement with these statements.

Figure 7 was utilized to further illustrate and compare mathematics and science teacher range and group mean scores for statements relating to the need to integrate technology education, mathematics, and science (statements 29 through 33).

The pattern of the group mean scores for the participating mathematics and science teachers indicated that there was agreement on the need to integrate the disciplines of mathematics, science, and technology education. Of the five statements contained in this category, all received a mean group Likert scale ranking of 4, indicating that the mathematics and science teachers, as a group, agree with these statements. These five statements all received a mean group score Likert ranking of 5, indicating strong agreement, when responded to by the exemplary technology education teachers.

The range and group mean scores for the fourth category were illustrated in Figure 8. The fourth category consisted of five statements relating to actions that the technology education profession should take to improve perceptions of the discipline.

The pattern of the group mean scores for the participating mathematics and science teachers indicated that there was agreement with the five statements concerning actions for the discipline. Four

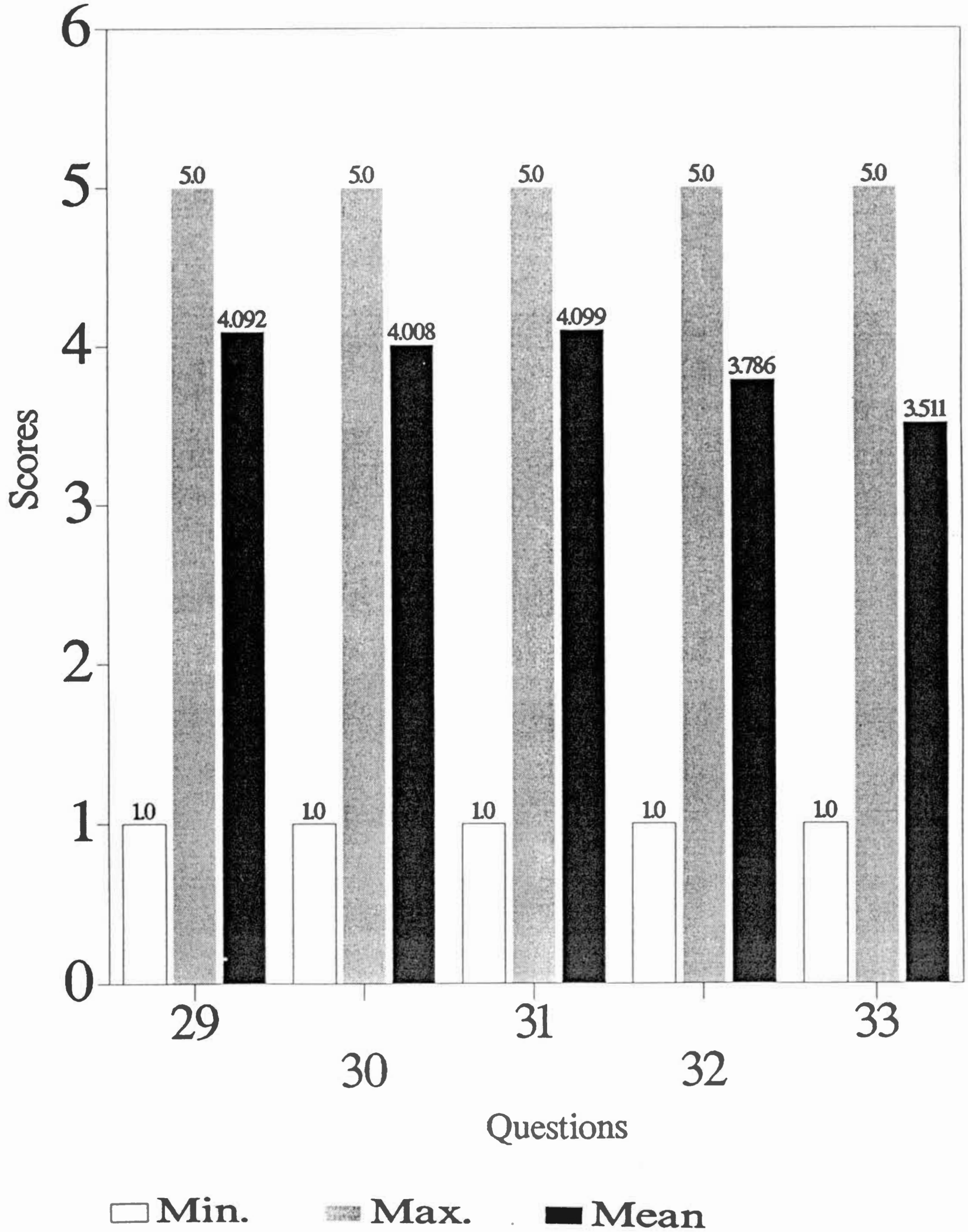

Figure 7. Perception on Integrating Math, Science, and Technology Education by Mathematics and Science Teachers

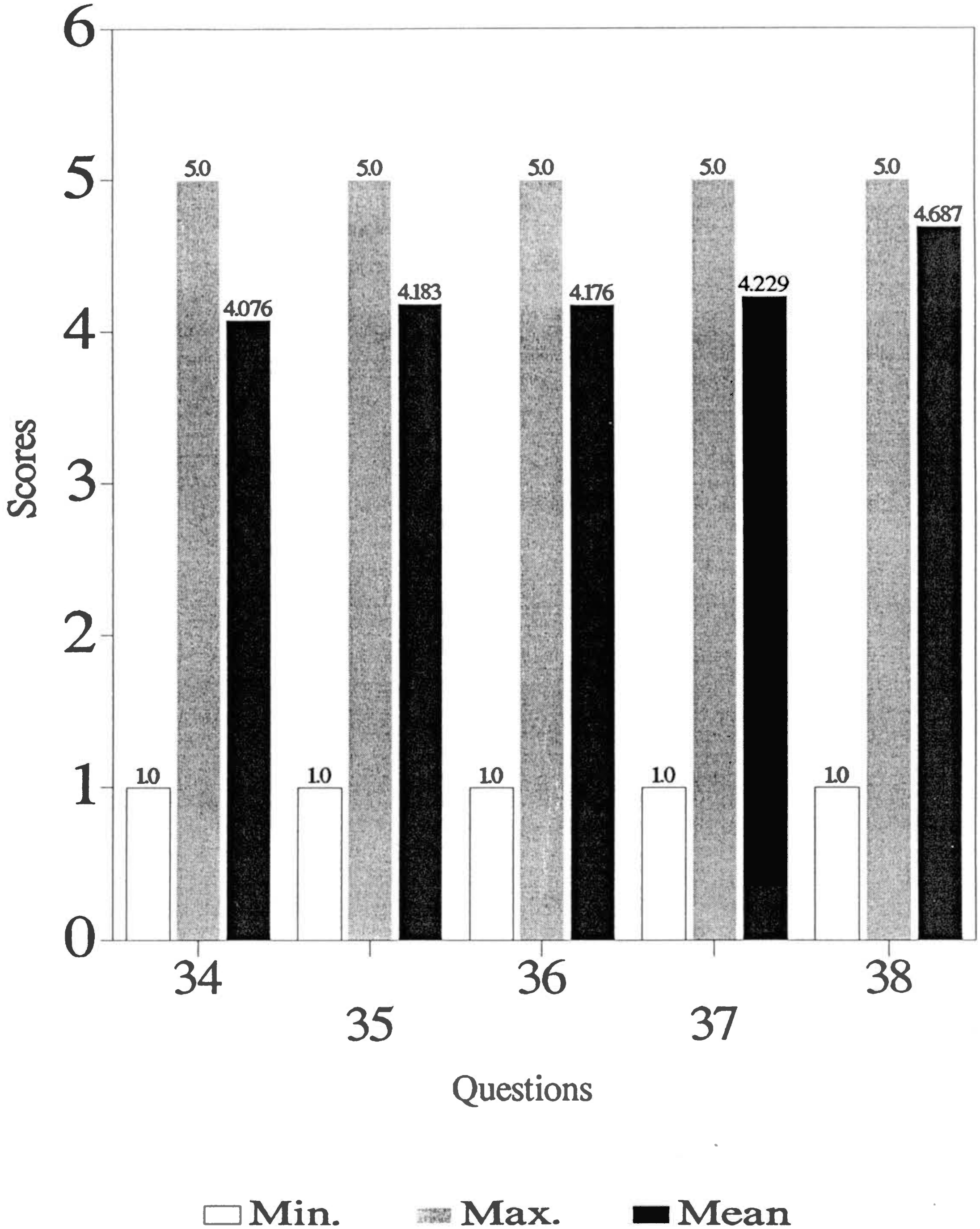

Figure 8. Perceived Actions for the Technology Education Discipline by Mathematics and Science

of the five statements received a mean group score Likert ranking of 4, indicating that the teachers agreed with these statements. Strong agreement was found on only statement 38 which was stated as follows: "The technology education discipline should develop strategies for overcoming stereo-typical perceptions often held by administrators and secondary education faculty members." Statement 38 also received a group mean score Likert ranking of 5, indicating strong agreement, from the exemplary technology education teachers.

Research Question Three: Is there a significant difference between the perceptions of the exemplary technology education classroom teachers and the perceptions held by associated secondary education faculty (mathematics and science)?

To obtain the necessary data to answer this question, the exemplary technology education classroom teachers and the associated secondary education faculty perceptual responses were analyzed using a mixed model analysis of variance (ANOVA). The ANOVA allowed this researcher to search for and identify significant differences in perception within and between teacher responses, as well as investigate possible interactions between the groups.

The mixed model analysis of variance (ANOVA) was used in a 3 x 4 analysis (3 teacher groups x 4 categories of technology education characteristics) of the data. The interaction with the main effect of perceived characteristics was significant at the p.< .01 level. Table X, which summarized the results of the mixed model ANOVA, represented the value of $F = 7.768$, P .01, significant at the p.< .01 level for the interaction variable. There is a significant difference between

TABLE X

SUMMARY OF UNIVARIATE AND MULTIVARIATE REPEATED MEASURES ANALYSIS OF VARIANCE

Source	DF	Sums of Squares	Mean Square	F
Between Subjects				
Groups	2	83.222	41.611	28.114*
Error	235	347.817	1.480	
Within Subjects				
Perception	3	29.836	9.945	32.737*
Interaction	6	14.160	2.360	7.768*
Error	705	214.175	.304	

*Significant at the .01 level

the perceptions of the exemplary technology education, mathematics, and science teachers. The significant interaction effect indicated that part of the significant differences in the main effect was caused by differences between groups of teachers and thus could not be accounted for by sampling error alone.

To better illustrate the patterns of main effect differences in perception, the four categories of technology education characteristics were separated and analyzed using a one-way mixed model analysis of variance (ANOVA).

Table XI summarized the results of an analysis of variance for the teaching methods that are characteristic of technology education. The F value was statistically significant ($F = 26.191$, $p. < .01$), indicating that the technology education methods were perceived differently by at least one of the three groups. A Tukey HSD test of the significant F value indicated that there was a significant ($P = .722$, $p. < .01$) difference between the mean scores of the exemplary technology education teachers and the mathematics teachers. Similarly, the Tukey HSD test indicated that there was a significant difference ($P = .638$, $p. < .01$) between the exemplary technology education and the science teacher mean scores. No significant differences were found between the mathematics and science teacher mean scores.

Table XII summarized the results of an analysis of variance (ANOVA) for the curriculum content characteristics of technology education. The F value was statistically significant ($F = 19.899$, $p. < .01$), indicating that there was a difference in perception between the

TABLE XI

SUMMARY OF TECHNOLOGY EDUCATION METHOD
LOGICAL CHARACTERISTICS

	Analysis of Variance			
Source	DF	Sum of Squares	Mean Square	F
Between	2	27.344	13.672	26.191*
Within	235	122.671	.522	

*Significant at the .01 level

	Tukey HSD Test	
Comparison	Difference	P-Value
Technology Education vs. Math	.722*	p.< .01
Technology Education vs. Science	.638*	p.< .01
Math vs. Science	-8.400	N.S.

*Significant at the .01 level

TABLE XII

SUMMARY OF TECHNOLOGY EDUCATION CONTENT CHARACTERISTICS

	Analysis of Variance			
Source	DF	Sum of Squares	Mean Square	F
Between	2	39.798	19.899	53.633*
Within	235	87.190	.371	

*Significant at the .01 level

	Tukey HSD Test	
Comparison	Difference	P-Value
Technology Education vs. Math	.7950*	p.< .01
Technology Education vs. Science	.8450*	p.< .01
Math vs. Science	4.9999	N.S.

*Significant at .01 level

three teacher groups on the curriculum content of technology education. A Tukey HSD test of the significant F value indicated that there was a significant difference (P = .794, p.< .01) between the mean scores of the exemplary technology education and the mathematics teachers. The test also indicated a significant difference (P = .844, p.< .01) between the mean scores of the exemplary technology education teachers and those of the science teachers, however, no significant differences were found between the mathematics and science teachers. The results of an analysis of variance (ANOVA) for the perceived need to integrate mathematics, science, and technology education were summarized in Table XIII. The F value was statistically significant (F = 26.314, p.< .01), indicating that there were differences in perception between the three teacher groups on the need to integrate disciplines. A post-hoc Tukey HSD test of the significant F value indicated that there was a significant difference (P = .660, p.< .01) between the mean scores of the mathematics and the exemplary technology education teachers on the need to integrate. A significant difference (P = .686, p.< .01) was also found between the mean scores of the science and the exemplary technology education teachers. The Tukey HSD test found no significant difference between the mean scores of the mathematics and the science teachers on the need to integrate mathematics, science, and technology education.

Table XIV summarized an analysis of variance (ANOVA) of the perceived future actions of the technology education profession. The recorded F value was not statistically significant (F = 1.728, p.> .05), indicating that mean scores of the three teacher groups did not differ significantly at the .05 level.

TABLE XIII

SUMMARY OF THE NEED TO INTEGRATE MATH, SCIENCE, AND TECHNOLOGY EDUCATION

	Analysis of Variance			
Source	DF	Sum of Squares	Mean Square	F
Between	2	26.824	13.412	26.314*
Within	235	119.775	.510	

*Significant at the .01 level

	Tukey HSD Test	
Comparison	Difference	P-Value
Technology Education vs. Math	.6609*	p.< .01
Technology Education vs. Science	.6869*	p.< .01
Math vs. Science	2.6000	N.S.

*Significant at the .01 level

TABLE XIV

SUMMARY OF APPROPRIATE PROFESSIONAL ACTIONS TO IMPROVE PERCEPTIONS

	Analysis of Variance			
Source	DF	Sum of Squares	Mean Square	F
Between	2	3.416	1.708	1.728
Within	235	232.356	.989	

Although the general or average differences in the independent variables have been revealed by the marginal means in the main effect evaluation, this will not fully describe the data when an interaction between variables is significant. Instead the independent variables must be interpreted with the levels of the other independent variables.

Table X indicates that the interaction between independent variables is significant ($F = 7.768$, $p < .01$), suggesting that at least part of the differences in the significant main effect were due to differences between the three groups of teachers. After discovering the significant interaction, the four categories of technology education characteristics were plotted across the independent variables of the technology education, science, and mathematics teachers.

The plot line slope is indicative of a significant interaction effect, and, because it is rather flat, a simple main effects comparison was performed. The post-hoc comparison indicated a significant interaction for each line across the four categories of characteristics (See Figure 9). The simple main effects post-hoc comparison is summarized in Table XV.

Table XV indicated that the interaction group means were significantly different across the four categories of technology education characteristics. As illustrated in Table XV, the exemplary technology education teachers ranked three of the four technology education characteristic categories higher than did the mathematics and science teacher groups. The technology education methods and

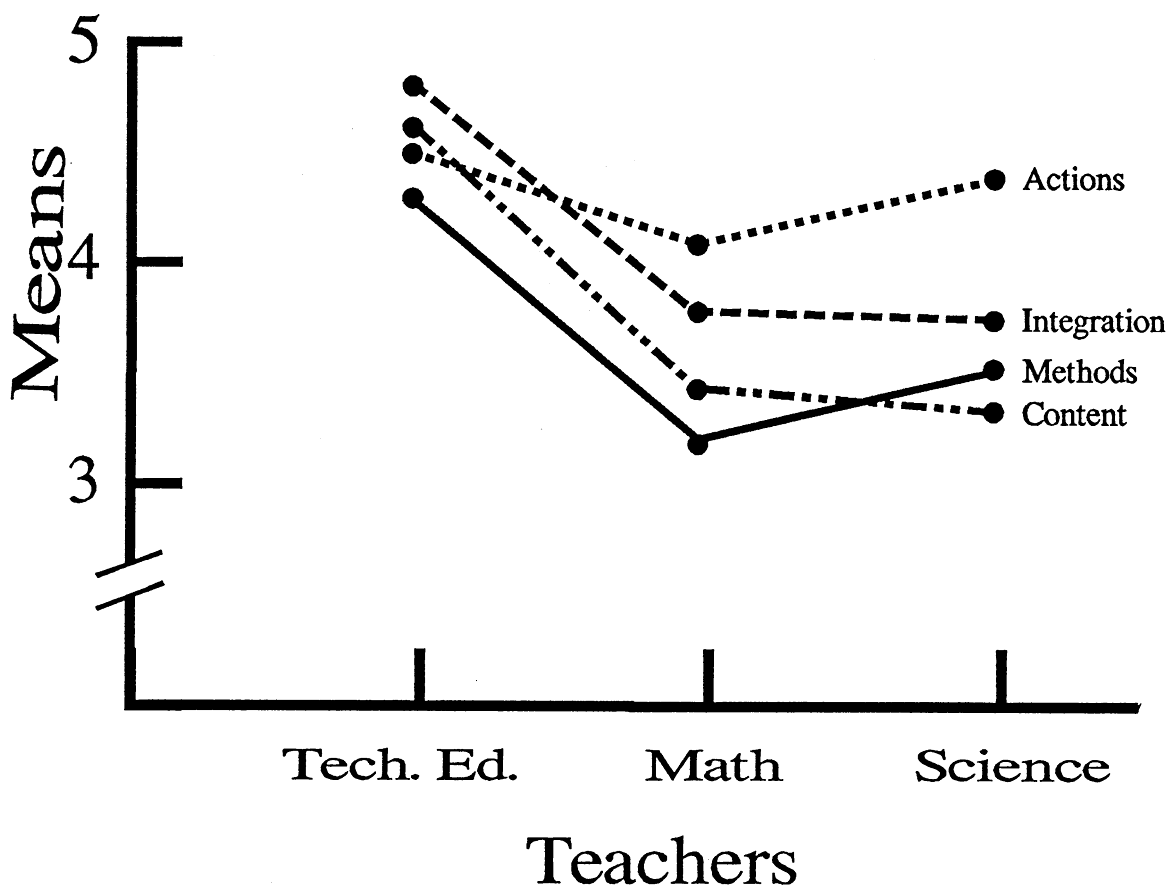

Figure 9. Post-hoc Interaction Comparison

TABLE XV

SUMMARY OF SIMPLE MAIN EFFECTS COMPARISON OF THE SIGNIFICANT INTERACTION BETWEEN MATH, SCIENCE, AND TECHNOLOGY EDUCATION RESPONSES

Comparison	DF	M.S.	F	P-Value
Tech ed & Scie	3	1.1545	3.7979*	.01
Science & Math	3	7.7656	25.5448*	.00
Tech ed & Math	3	11.6847	38.4367*	.00

*Significant at the .01 level

curriculum content were at a disordinal relationship between the mathematics and science groups, with the science teachers ranking curriculum content higher and the mathematics teachers ranking the technology education methods higher. The three categories of technology education characteristics (methods, curriculum content, and need for integration) were all perceived to be less characteristic of technology education by the mathematics and science teachers than they were by the exemplary technology education teachers. The need for the technology education discipline to take action to overcome stereo-typical perceptions received a high ranking by all three teacher groups.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The Purpose

The purpose of this research was to determine the perceived characteristics affiliated with the technology education discipline as discerned by exemplary technology education teachers and associated secondary education faculty (i. e. mathematics and science teachers). The characteristics were categorized into three groups (methodology, curriculum content, and the need to integrate technology into the curriculum) and comparisons were made between the perceptions of mathematics, science, and technology education teachers. The purpose of this analysis was to determine whether the obtained perceptions could be used to affect current and future decisions concerning the integration of technology education with mathematics and science. Information gathered through the use of the questionnaire should provide data useful in ascertaining current teacher perceptions of technology education and should aid in successfully overcoming stereo-typical perceptions which may be effecting the discipline.

Limitations

There were several limitations placed on this study due to the method of data collection. Identifying samples of a population is always a difficult procedure, and identifying three samples of three populations is a significant task to be undertaken. The exemplary technology education teachers were identified outside the context of this research by various governmental entities and their accuracy is not verifiable. Additionally, the mathematics and science teachers were identified due to their school district association with the technology education teacher, therefore the research was limited to the accuracy of the previously identified exemplary technology education teachers. The study was limited to identifying the characteristics of technology education and was not concerned with the perceived characteristics of industrial arts, thus teachers identified as industrial arts teachers were excluded.

Data Collection

The method of data collection used in this study was a questionnaire. A pilot study questionnaire was based on, and developed from, an exhaustive review of the literature. The four page questionnaire was mailed to 54 secondary education teachers. This group consisted of 18 mathematics teachers, 18 science teachers, and 18 technology education teachers. Following the return of the pilot study questionnaire, reliability and validity were established and the questionnaire was modified into a two page, five part instrument that could be used to ascertain the perceptual characteristics of technology education.

The questionnaire was mailed to 462 secondary education teachers nationally. This group consisted of 154 technology education, 154 mathematics, and 154 science teachers. Six of the instruments were returned as undeliverable (representing the mathematics, science, and technology education teachers from two schools). Fifty-two percent of the remaining 456 questionnaires were returned and were used in this study. The returned instruments represented of 40 percent of the mathematics teachers, 45 percent of the science teachers, and 71 percent of the technology education teachers surveyed. Due to the type of information sought within the study, three methods were used for the statistical analysis of the response data. The three methods were (1) a Chrone Bach Alpha analysis, (2) a Scheffe' follow-up analysis, (3) a mixed model analysis of variance, and (4) a frequency analysis of mean responses.

Summary of Findings

The data reported in this study were used to determine the characteristics of technology education as discerned by secondary technology education, mathematics, and science teachers. The Chrone Bach Alpha and Scheffe' analysis were used to establish reliability and internal consistency for the questionnaire and were utilized as a part of the pilot study. A frequency distribution of group means and ranges as well as five mixed model analysis of variances (ANOVA) were used to describe the data and to determine whether or not a significant difference existed within and between the three groups of teachers in response to the three research questions.

Research Question One

1. What are the characteristics that exemplary technology education classroom teachers identify with technology education?

In looking at the findings related to research question one, an analysis of the data revealed that, as a group, exemplary technology education teachers strongly agree that the characteristics identified through the review of literature are characteristics identified with technology education. This result held true for the three categories of characteristics: technology education methodology, technology education curriculum content, and the need to integrate the disciplines of mathematics, science, and technology education.

The data indicated that the exemplary technology education teachers perceive the need for action to overcome stereo-typical perceptions as critical.

Technology education was perceived as providing exploratory activities which emphasize problem solving through the utilization of small and cooperative group activities. Technology education was further perceived as a discipline which develops student insight, understanding, and application through technological study.

The exemplary technology education teachers perceived the utilization of mathematics and science concepts towards the preparation of lifelong learning skills as characteristic of technology education. The respondents indicated a strong need for integrating the discipline as well as overcoming stereo-typical perceptions that may be held by associated faculty and administration.

Research Question Two

2. What are the characteristics that associated secondary education faculty (mathematics and science) identify with technology education?

An analysis of the data revealed that, as a group, associated secondary education faculty moderately agree with the characteristics of technology education as identified through the review of literature. While the associated secondary education faculty agree that these are the characteristics of technology education, they do not strongly agree with any of the four categories of characteristics.

At the same time the mathematics and science teachers perceived interdisciplinary instruction, activity based laboratory instruction, and problem solving to be characteristic of technology education, they did not perceive technology education as a discipline that emphasizes verbal activity or a discipline in which cognitive strategies have been clearly developed, or where lessons are hypothesis driven.

The mathematics and science teachers perceived the curriculum where application of insight and understanding of tools, materials, and processes in production and communication as being characteristic of technology education. Similarly the mathematics and science teachers characterized the development of creative abilities through problem solving and the enhancement of decision making skills as being fundamental to technology education. The use of math and science skills and the connection between mathematics, science, and technology education was also perceived as characteristic of technology education. However, the mathematics and science teachers did not perceive the study of the development of technology, biological systems, and transportation as being characteristic of technology education.

There was agreement for the need to integrate mathematics, science, and technology education, however, the need for integration was not strongly agreed upon. As with the exemplary technology education participants, the mathematics and science teachers perceived a strong need for the technology education discipline to develop strategies to overcome stereo-typical perceptions often held by associated faculty members.

Research Question Three

3. Is there a significant difference between the perceptions of the exemplary technology education classroom teachers and the perceptions held by the associated secondary education faculty (science and mathematics)?

Related to question three, the findings reveal that there is a significant difference between the perceptions of exemplary technology education classroom teachers and associated secondary education faculty $F = 7.768$, $p = .01$. The findings were based on the mixed model ANOVA results and post-hoc examination. The significant interaction implied that the difference between group mean scores was due to difference between technology education, mathematics, and science teacher perceptions.

Discussion

By interpreting the findings as a whole, the results indicate that the characteristics perceived to exemplify technology education are not constant across all disciplines. The findings indicate that exemplary technology education teachers strongly agreed with the identified characteristics of technology education. Conversely, both the mathematics and science teachers had significantly different perceptions of the characteristics exemplifying technology education when compared with the perceptions of exemplary technology education teachers.

Conclusions

Based on an interpretation of data relative to this study, the following conclusions were drawn:

1. The technology education profession should develop strategies to overcome stereo-typical perceptions of the discipline.

2. Integrated courses where mathematics, science, and technology education curriculum content is connected should be developed.

3. Technology education can more effectively emphasize the connections between mathematics, science, and technology when realistic perceptions are present.

4. Technology education potential can not be fully reached until there is clear perceptual understanding across disciplinary boundaries as to the characteristics exemplifying technology education.

5. Coordinated planning that includes professionals from mathematics, science and technology education is a critical component for the future of integrated curriculum.

Recommendations

Based on the findings and conclusions of this study, the following recommendations are suggested:

1. Workshops and presentations should be provided for mathematics and science teachers in an effort to improve their perception of the technology education discipline.

2. Research should be conducted investigating methods of overcoming stereo-typical perceptions often held by associated secondary education faculty members.

3. A similar study should be conducted examining the differences in perception between technology education teachers and public school administrators and guidance counselors relative to the characteristics exemplifying technology education.

4. Further study should be conducted examining the perceived need to integrate the disciplines of technology education, mathematics, and science.

5. Further study should be conducted examining the public perception of technology education as a discipline of study in the secondary school.

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APPENDIX A

PILOT STUDY QUESTIONNAIRE

CHARACTERISTICS OF TECHNOLOGY EDUCATION SURVEY

The purpose of this research is to determine the perceived characteristics of technology education as discerned by teachers of technology education, as well as teachers of mathematics and science.

DIRECTIONS: Please answer the following questions by circling or providing the appropriate answer/response to each statement.

1. Indicate your age (circle one).	21-30	31-40	41-50	Over 50	
2. Indicate the number of years you have been employed with this school (circle one).	1-3	4-8	9-15	Over 15	
3. Indicate the total number of years you have been employed in the educational arena (circle one).	1-3	4-8	9-15	Over 15	
4. Indicate the highest level of education which you have achieved (circle one).	B.S.	M.S.	Ed D.	Ph D.	Other
5. Indicate your current area of affiliation (circle one).	Technology Education	Mathematics	Science		

PART II: The following questions relate to your perception of the teaching methods used in technology education.

1. Strongly disagree	(conflicts radically with my perception)
2. Disagree	(statement is inconsistant with my perception)
3. No opinion	(no perception of this issue)
4. Agree	(statement agrees with my perception)
5. Strongly agree	(exemplifies my perception)

6. Technology education emphasizies problem solving.	1	2	3	4	5
7. Technology education provides exploratory activities that include modeling, graphing, and production.	1	2	3	4	5
8. Technology education instruction is goal oriented.	1	2	3	4	5
9. Cooperative learning and small group interaction is encouraged in technology education.	1	2	3	4	5
10. Verbal activity is emphasized in technology education.	1	2	3	4	5
11. Student cognitive strategies have clearly been developed.	1	2	3	4	5
12. Technology education emphasizes interdisciplinary activities.	1	2	3	4	5
13. A broad range of assessment strategies (design porfolios, project work, performance testing) are used in technology education.	1	2	3	4	5
14. Technology education lessons are hypothesis driven.	1	2	3	4	5
15. Technology education provides activity-oriented laboratory instruction that reinforces abstract concepts with concrete experiences.	1	2	3	4	5
16. Technology education provides a combined emphasis on "know-how" and "ability to do" in carrying out technical work.	1	2	3	4	5

PART III: The following questions relate to your perception if the content characteristics of technology education.

1. Strongly disagree	(conflicts radically with my perception)
2. Disagree	(statement is inconsistant with my perception)
3. No opinion	(no perception of this issue)
4. Agree	(statement agrees with my perception)
5. Strongly agree	(exemplifies my perception)

17. Technology education content is based on an organized set of concepts, processes, and systems that are uniquely technological.	1	2	3	4	5
18. Technology education content is based on knowledge about the development of technology and its effect on people, the environment, and culture.	1	2	3	4	5
19. A portion of the technology education instructional content is based on using biological organisms to make or modify products.	1	2	3	4	5
20. A portion of the technology education instructional content is based on using resources to transfer information and communication.	1	2	3	4	5
21. A portion of the technology education instructional content is based on combining and modifying resources in standard stocks, goods, and structures.	1	2	3	4	5
22. A portion of the technology education instructional content is based on the study of transportation systems.	1	2	3	4	5
23. The technology education curriculum assists students in developing insight, understanding, and application, of technological concepts, processes, and systems.	1	2	3	4	5
24. The technology education curriculum allows for the application of tools, materials, machines, processes, and technical concepts.	1	2	3	4	5

25. The technology education curriculum aids in the development of student skills, creative abilities, positive self-concepts, and individual potential in technology.	1	2	3	4	5
26. The technology education curriculum aids in the development of student problem solving and decision making skills.	1	2	3	4	5
27. Technology education helps prepare students for lifelong learning in a technological society.	1	2	3	4	5
28. Technology education provides activity-oriented laboratory instruction that reinforces abstract concepts with concrete experiences.	1	2	3	4	5
29. Technology education provides a combined emphasis on "know-how" and "ability to do" in carrying out technical work.	1	2	3	4	5
30. Students in technology education use math and science skills to perform tasks in technology education.	1	2	3	4	5
31. The technology education teacher assists students to see the connection between scientific and math skills and its application to technology.	1	2	3	4	5

PART IV: The following questions relate to your perception of the need to integrate math, science, and technology education.

1. Strongly disagree	(conflicts radically with my perception)
2. Disagree	(statement is inconsistant with my perception)
3. No opinion	(no perception of this issue)
4. Agree	(statement agrees with my perception)
5. Strongly agree	(exemplifies my perception)

32. Technology education provides an avenue for applying concepts learned in math and science.	1	2	3	4	5
33. Technology education should be available to all students who enroll in math and science.	1	2	3	4	5
34. Technology education is primarily designed for students who will enter the work force immediately after graduation from high school.	1	2	3	4	5
35. Technology education is designed for students who will pursue a college degree after graduation from high school.	1	2	3	4	5
36. Technology education is most appropriate for students enrolled in special education.	1	2	3	4	5
37. Technology education students develop an avocation by making projects.	1	2	3	4	5
38. The technology education curriculum is based on the development and production of arts and craft projects.	1	2	3	4	5
39. Technology education is an applied science.	1	2	3	4	5
40. Technology education is a class where students learn distinct machine skills.	1	2	3	4	5
41. The technology education curriculum reflects industry.	1	2	3	4	5
42. Technology education should be available to all students who enroll in math and science.	1	2	3	4	5
43. Technology education is guided by the technological literacy needs of students.	1	2	3	4	5

Return to: Michael Daugherty
102B IND BLDG
Oklahoma State University
Stillwater, OK 74078

APPENDIX B

PILOT STUDY COVER LETTER

Oklahoma State University

SCHOOL OF OCCUPATIONAL AND ADULT EDUCATION
COLLEGE OF EDUCATION

STILLWATER, OKLAHOMA 74078-0406
CLASSROOM BUILDING 406
(405) 744-6275

March 14, 1991

Mr. Robert L. Paxton
Wewoka High School
P.O. Box 870
Wewoka, OK 74884

Dear Bob,

First, let me thank you for helping me, by participating in this endeavor. I certainly do appreciate your time and assistance.

The purpose of this pilot study questionnaire is to test the attached questionnaire and determine whether it is reliable and valid. Following the return of the questionnaire, I will evaluate your responses and comments about each question and make a determination concerning which questions need adjustment and/or removal. The overall purpose of this research will be to determine the perceived characteristics of technology education as discerned by teachers of technology education, as well as teachers in math and science.

Please answer each of the questions on the questionnaire as accurately as possible and provide written comments below the question if you believe it to be unclear or misleading.

I have a great need to expedite this process, so please complete the survey within two working days and return it to me in the stamped, self-addressed envelope. Thank you again for your time and consideration.

Professionally,

Michael K. Daugherty

APPENDIX C

QUESTIONNAIRE

CHARACTERISTICS OF TECHNOLOGY EDUCATION SURVEY

The purpose of this research is to determine the perceived characteristics of technology education as discerned by teachers of technology education, as well as teachers of mathematics and science.

DIRECTIONS: Please answer the following questions by circling or providing the appropriate answer/response to each statement.

1. Indicate your age (circle one).	21-30	31-40	41-50	Over 50
2. Indicate the number of years you have been employed with this school (circle one).	1-3	4-8	9-15	Over 15
3. Indicate the total number of years you have been employed in the educational arena (circle one).	1-3	4-8	9-15	Over 15
4. Indicate the highest level of education which you have achieved (circle one).	BS/BA	MS/MA	Ed D/Ph D	Other
5. Indicate your predominant area of affiliation (circle one).	Technology Education	Mathematics	Science	

PART II: The following questions relate to your perception of the teaching methods used in technology education.

1. Strongly disagree	(conflicts radically with my perception)
2. Disagree	(statement is inconsistant with my perception)
3. No opinion	(no perception of this issue)
4. Agree	(statement agrees with my perception)
5. Strongly agree	(exemplifies my perception)

6. Technology education emphasizes problem solving.	1	2	3	4	5
7. Technology education provides exploratory activities that include modeling, graphing, and production.	1	2	3	4	5
8. Technology education instruction is goal oriented.	1	2	3	4	5
9. Cooperative learning and small group interaction is encouraged in technology education.	1	2	3	4	5
10. Verbal activity is emphasized in technology education.	1	2	3	4	5
11. Student cognitive strategies have clearly been developed.	1	2	3	4	5
12. Technology education emphasizes interdisciplinary activities.	1	2	3	4	5
13. A broad range of assessment strategies (design porfolios, project work, performance testing) are used in technology education.	1	2	3	4	5
14. Technology education lessons are hypothesis driven.	1	2	3	4	5
15. Technology education provides activity-oriented laboratory instruction that reinforces abstract concepts with concrete experiences.	1	2	3	4	5

PART III: The following questions relate to your perception of the content characteristics in technology education.

16. Technology education content is based on an organized set of concepts, processes, and systems that are uniquely technological.	1	2	3	4	5
17. Technology education content is based on knowledge about the development of technology and its effect on people, the environment, and culture.	1	2	3	4	5
18. A portion of the technology education instructional content is based on using biological organisms to make or modify products.	1	2	3	4	5
19. A portion of the technology education instructional content is based on using resources to transfer information, and communication.	1	2	3	4	5
20. A portion of the technology education instructional content is based on combining and modifying resources in standard stocks, goods, and structures (production).	1	2	3	4	5
21. A portion of the technology education instructional content is based on the study of transportation systems.	1	2	3	4	5
22. The technology education curriculum assists students in developing insight, understanding, and application, of technological concepts, processes, and systems.	1	2	3	4	5
23. The technology education curriculum allows for the application of tools, materials, machines, processes, and technical concepts.	1	2	3	4	5

24. The technology education curriculum aids in the development of student skills, creative abilities, positive self-concepts, and individual potential in technology.	1	2	3	4	5
25. The technology education curriculum aids in the development of student problem solving and decision making skills.	1	2	3	4	5
26. Technology education helps prepare students for lifelong learning in a technological society.	1	2	3	4	5
27. Students in technology education use math and science skills to perform tasks in technology education.	1	2	3	4	5
28. The technology education teacher assists students to see the connection between scientific and math skills and its application to technology.	1	2	3	4	5

PART IV: The following questions relate to your perception of the need to integrate math, science, and technology education.

29. Technology education provides an avenue for applying concepts learned in math and science.	1	2	3	4	5
30. Technology education should be available to all students who enroll in math and science.	1	2	3	4	5
31. Technology education is an applied science.	1	2	3	4	5
32. The technology education curriculum reflects industry and technology.	1	2	3	4	5
33. Technology education is guided by the technological literacy needs of students.	1	2	3	4	5

PART V: The following questions relate to actions that the technology education profession can take to improve perceptions of the field.

34. Technology education teachers should form interdisciplinary committees to develop integration strategies.	1	2	3	4	5
35. Technology education programs should continue to revise curriculum strategies to more accurately reflect mathematics and science concepts.	1	2	3	4	5
36. Leaders in the technology education profession should make presentations at state and national mathematics and science conferences addressing the need to integrate.	1	2	3	4	5
37. Technology education professionals should conduct research to ascertain the integration needs of math and science teachers.	1	2	3	4	5
38. The technology education discipline should develop strategies for overcoming stereo-typical perceptions often held by administrators and secondary education faculty members.	1	2	3	4	5

Return to: Michael Daugherty
102B IND BLDG
Oklahoma State University
Stillwater, OK 74078

APPENDIX D

QUESTIONNAIRE COVER LETTER

OSU

Oklahoma State University

SCHOOL OF OCCUPATIONAL AND ADULT EDUCATION
COLLEGE OF EDUCATION

STILLWATER, OKLAHOMA 74078-0406
CLASSROOM BUILDING 406
(405) 744-6275

April 18, 1991

Dear Fellow Teacher:

HELP! I need your assistance in determining the perceptions of mathematics, science, and technology education teachers concerning the characteristics that exemplify technology education as well as the perceived need to integrate these disciplines.

It is believed that the results of this research will help determine the prevailing attitude of mathematics, science, and technology education teachers concerning technology education and the need to integrate curriculum. By completing and returning this questionnaire, you will provide me with the necessary data to complete the study, which may result in the development of strategies for improvement in the educational system.

For purposes of comparison and evaluation, a similar questionnaire has been sent to the science and technology education departments in your school. Your promptness in completing and returning this questionnaire will be greatly appreciated. Please help me by returning the questionnaire by **May 3, 1991** using the enclosed pre-addressed, postage-paid envelope.

Results of this research will be available upon request. However, to ensure complete anonymity, you are asked not to write your name or the name of your school on the questionnaire. Thank you for your time and consideration.

Sincerely,

Michael K. Daugherty
Research Coordinator

Approved by:

Dr. Robert Wicklein
Technology Education
Program Area Leader

VITA

Michael K. Daugherty

Candidate for the Degree of

Doctor of Education

Thesis: A COMPARISON OF CHARACTERISTICS ASSOCIATED WITH TECHNOLOGY EDUCATION

Major Field: Occupational and Adult Education

Biographical:

Personal Data: Born in Clinton, Oklahoma, October 17, 1959, the son of Larry K. and Carolyn Daugherty.

Education: Graduated from Seiling High School, Seiling, Oklahoma, in May 1977; received Bachelor of Science Degree in Industrial Education from Oklahoma State University in July, 1981; received Master of Science Degree in Industrial Technology Education from Oklahoma State University in May, 1989; completed requirements for the Doctor of Education Degree at Oklahoma State University in July, 1991.

Professional Experience: Industrial Arts/Technology Education Teacher, Carrier Junior High School, Carrier, Oklahoma, August, 1981, to July, 1987; Technology Education Teacher, Chisholm High School, Enid, Oklahoma, August, 1987, to July, 1988; Instructor, School of Occupational and Adult Education, Oklahoma State University, Stillwater, Oklahoma, August, 1988, to August, 1991.

Professional Organizations: International Technology Education Association, Oklahoma Technology Education Association, American Vocational Association, Oklahoma Vocational Association, Oklahoma Council of Technology Teacher Educators, Iota Lambda Sigma.