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A Study of the Impact of "Interconnections 90": Scientific and Applied Technology and the Corporate Workplace on Curriculum Change

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A STUDY OF THE IMPACT OF "INTERCONNECTIONS 90:" SCIENTIFIC AND APPLIED TECHNOLOGY AND THE CORPORATE WORKPLACE ON CURRICULUM CHANGE

by

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PREFACE

"Interconnections 90:" Scientific and Applied Technology and the Corporate Workplace is a three year school business partnership staff development program designed to bring school district teams into corporate sites to develop an integrated curriculum module for classroom use. The Corridor Partnership for Excellence in Education, (CPEE), has received a multi-year Illinois State Board of Education Scientific Literacy grant to implement and evaluate the "Interconnections" staff development program.

The major objective of this study is to explore the impact of "Interconnections 90:" Scientific and Applied Technology and the Corporate Workplace, a current program initiative of the CPEE. Specifically, this study is designed to examine these research questions: Does change occur in teachers', counselors', and administrators' knowledge and attitudes relative to integrated curriculum development as a result of program participation? Does change occur in teachers', counselors', and administrators' knowledge and attitudes regarding the corporate sector's workforce employment needs? Do curriculum changes occur at the local school district level after participants complete the "Interconnections" training?

It is the author's view that school-business partnership staff development programs are a catalyst for curriculum change at the local school district level. Additionally, to test this model for curriculum change the author notes that as a result of participation in the "Interconnections" program, it was expected that: 1) teachers', counselors', and administrators' attitudes and knowledge relative to integrated curriculum development would change in a positive direction; 2) teachers', counselors', and administrators' attitudes and knowledge of the corporate sector's work force employment needs would change in a positive direction; and 3) curriculum change would be initiated at the local district level.

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Special appreciation is extended to the members of the CPEE Board of Directors, especially Mr. Gary Jewel, Chairman of the CPEE Board, and Mr. Carl Ball, Chairman of the Board, Geo. J. Ball, Inc., who have taught me the essence of leadership, collaboration and partnerships. To Dr. Howard Smucker, teacher and mentor, for his guidance.

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I am most grateful to my parents, Frank and Ethel Hollis, who have loved, encouraged and supported me in all my endeavors, and have taught me to work hard and reach for a dream.

To my husband, Rob, and my children, Becky and Bryan, I owe special thanks. I am thankful for their tolerance for the necessary time and energy that this research required and always for their unfailing support and encouragement. I have learned most about partnerships from living with Rob and our children, Becky and Bryan.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY

Collaboration: Relationships between organizations, involving sustained interaction between members of each organization and including the identification of shared and agreed upon goals (Levine, 1983, p. 4).

Corridor Partnership for Excellence in Education (CPEE): A unique partnership between elementary and secondary education schools, colleges and universities, research and development laboratories, business and industry, government and labor. The Partnership serves the Northern Illinois region and the I-88 Research and Development Corridor. The mission of the Partnership is to enhance and promote excellence in elementary and secondary education for students at all levels of ability and achievement, primarily in the areas of mathematics, science and technology.

Elementary School Level: A school composed of any span of grades not above grade 8.

High School Level: A secondary school offering the final years of high school work necessary for graduation (National Association of Partners in Education, Inc., 1991, p.11).

Interdisciplinary Curriculum: A knowledge view and curriculum approach that consciously applies methodology and language from more than one discipline to examine a central theme, issue, problem, topic, or experience (Jacobs, 1989 p. 8).

Middle School Level: A school whose grades range from a low of 4 to 7 to a high of 4 to 9.

Partnership: A cooperative, systematic, mutually beneficial collaborative between two or more entities, such as a school and a business, with established goals and distinguishable boundaries (Ash, 1989, p. 7).

Rural District: A district serving an area that is not included in the definition of urban or suburban. (National Association of Partners in Education, Inc., 1991 p. 6).

Scientific Literacy: The capacity to formulate questions; to seek, comprehend and use available information; to gather and interpret data, and to draw logical inferences in relation to an area of investigation. The ability to comprehend and communicate the language concepts, theories and practices of science, mathematics and technology in ways to promote mutual understanding, cooperative problem-solving and shared vision. The awareness that science, mathematics and technology are ongoing processes and growing disciplines, constantly evolving and being refined through inquiry and open-ended investigation. The awareness that science, mathematics and technology are interdependent; that the tools and methods of each are interrelated and mutually supportive. The understanding that science, mathematics and technology have strengths and limitation, in both theory and application, particularly as they relate to societal and ethical issues. (Illinois State Board of Education Center on Scientific Literacy, 1989 p.1).

Staff Development: Any activity or process intended to improve skills, attitudes, understandings, or performance in present or future roles (Fullan, 1990, p.3).

Suburban District: A district that serves a metropolitan statistical area but not its central city.

Technology Education: The study of the application of knowledge, creativity, and resources to solve problems and extend human potential. (Technology Education Advisory Council, 1988, p. 16).

Urban District: A district that primarily serves a central city of a metropolitan statistical area which is defined as an area that has a city of at least 50,000 population or an urbanized area of at least 50,000 with a total metropolitan population of at least 100,000.

CHAPTER I

INTRODUCTION

Business Calls For Educational Reform

American business and industry leaders lament the shortage of skilled workers and the growing number of high school graduates who cannot function in entry-level positions. In order to remain economically competitive in the world marketplace, leaders in American business and industry continue to call for more effective school improvement efforts that result in world-class student performance. Business demands that schools be more responsive to the needs of the workplace.

Demand for reform heightened as a result of A Nation At Risk, the 1983 landmark report on education in America, which stated that: " If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed it as an act of war" (National Commission on Excellence in Education, 1983, p. 1). A plethora of national and state reports, federal and state legislation, and 2000 school-business partnerships followed A Nation At Risk designed to "stem the rising tide of mediocracy."

School business partnerships such as the Corridor Partnership for Excellence in Education (CPEE) grew out of the need for school reform. Ash (1989, p. 7) defines a partnership as ". . .a cooperative, systematic, mutually beneficial collaborative between two or more entities, such as a school and a business, with established goals and distinguishable boundaries." CPEE, a unique partnership between elementary and secondary schools, colleges and universities, research and development laboratories, business and industry, government and labor, serves the Northern Illinois region and the

I-88 Research and Development Corridor. The mission of CPEE is to enhance and promote excellence and thus reform in elementary and secondary education for students at all levels of ability and achievement, primarily in the areas of mathematics, science and technology.

"Reform" was the in-vogue word of the 1980's for business itself. The chronicles of the 1980's recorded an era of "excellence", when Americans were in search of it (Peters & Waterman, 1982), attempted to "create it" (Hickman & Silvia, 1984) and once having found it, were consumed by a "passion for excellence" (Peters & Austin, 1985). Business leaders felt this "passion for excellence" was needed in the schools that produced its future workers.

The involvement of business in education is not new. For the first half of the century, almost all school board members were business or professional men, and public school management was modeled on business management. Levine states: "From an historical perspective, school/business relationships have ebbed and flowed over the past seventy-five years, driven largely by industry's need for trained, skilled workers" (Levine, 1983, p. 9). Historically, business and education have been linked since the late 1800's as business demands required educational programs to respond to the changing needs of the workforce. Usdan (1986) cites the following reasons for business involvement: corporate citizenship, financial investment, and employee supply.

Educational reform movements came in two waves in the 1980's according to Murphy (1990). Initial attempts at educational reform in Wave I (1982-1986) focused on restoring quality by fixing the existing educational system. First wave reform efforts sought to raise standards, increase accountability, lengthen school days and years, and generally raise academic standards. This "first wave" of reform raised academic standards, but did not substantially improve student outcomes. To many in corporate America, the anticipated changes resulting from this first wave of reform have been too

slow and inadequate. Many educational researchers were critical of the billions of national dollars wasted on poorly conceived but politically popular educational reform movements (Orlich, 1989).

Wave II efforts, in the period 1987 to the present, have focused on restructuring the total educational system with a greater emphasis on outcomes. According to recent authors Murphy (1990) and Schelchty (1990), restructuring involves changing the structure of the schools. "To change an organization's structure, therefore, one must attend not only to rules, roles, and relationships but also to systems of beliefs, values, and knowledge as well" (Schlechty, 1990, p. 7).

Government Response

At the national level in September 1989, President Bush and the nation's governors agreed to six national goals in education to be achieved by the year 2000. By April 1991, a four-part strategy to attain these six goals was announced by President Bush and Secretary of Education Lamar Alexander in the report, America 2000 (1991). While there is general agreement to the six national goals among the major stakeholders including education, government, business and industry leaders , there is concern regarding how to implement each broad goal at the local school level.

School Improvement Through Partnerships

Through a series of conferences and printed reports, national and state leaders in business, government, and education have stressed the need for collaborative partnerships between private and nonprofit sectors, local education systems, and government in order to achieve excellence and world-class student performance (National Goals, 1990; America 2000). For example, Governor Romer of Colorado, Chair of the National Education Goals Panel, for 1990-1991 underscored the importance of partnerships in the

school improvement effort in his introduction to the Executive Summary of the National Goals Report in October 1991:

> If the nation is to measure up to the technical and economic demands of the next century, we must all get involved--public officials, educators, parents, business and community leaders and students alike--to meet this challenge." "Achieving these Goals requires a sustained partnership of government policy and individual commitment. Such a partnership requires that we make education the most important business in the nation, in our states, and in our individual lives. (National Association Partners in Education, 1991, p. 16)

Reform of Partnerships

Today, leading experts in the field of school-business partnerships are calling for greater measures of accountability for the estimated 200,000 partnerships that exist in the United States. Partnerships are being criticized for not producing the systemic change demanded by second wave reformers. In defense of partnerships, the National Association of Partnerships in Education (NAPE, 1992) noted that partnerships were designed in the 1980s to enrich, to enhance and to support existing educational programs and not for the purpose of restructuring schools. If partnerships in the 1990's are to assume the role of agents for systemic change, a major paradigm shift is required of administrators and teachers. For systemic change to occur, curriculum needs to be the focus of partnership efforts.

Curriculum changes that are more focused on the needs of business and industry are crucial in the 1990's. All of the major reports in mathematics, science and technology call for curriculum reform which stress interdisciplinary and integrated curriculum strategies with real world applications. These major reports are: Project 2061: Science for All Americans, American Association for the Advancement of Science (1989); Everybody Counts: A Report to the Nation on the Future of Mathematics Education, National Research Council (1989); Technology: A National Imperative, International Technology Education Association (1988).

Several authors see integrated curriculum as the means of improving student achievement and understanding of the work world. Jacobs (1989, p. 8) defines interdisciplinary curriculum as". . .a knowledge view and curriculum approach that consciously applies methodology and language from more than one discipline to examine a central theme, issue, problem, topic, or experience." Jacobs (1989) cites the following reasons for this heightened interest in integrated curriculum: growth of knowledge; fragmented student schedules; and irrelevant course work, which is a common concern expressed by significant numbers of school drop-outs each year. Murphy (1991, p. 53) notes "There is a need to actively show students how different subject areas influence their lives, and it is critical that students see the strength of each discipline in a connected way."

Although there is no clear consensus yet on what it is students should learn, discussions of national standards are under way (Cramer & Landsmann, 1992). For example, mathematics educators have set forth standards in Curriculum and Evaluation Standards for School Mathematics Education, (National Council of Teachers of Mathematics, 1989).

Today, the needs of business and industry are critical in defining what it is students need to learn and the outcomes for schooling. From all the reform efforts discussed, it is clear that in developing curriculum, educators need to address this key question: What are the needs of business and industry today? Responses to this critical question will need to be addressed at the national, state, and local community levels.

International/Global and National Concerns

The need for skilled workers is increasing while the total number of young people ages 20-34 available for the workforce in the year 2000 is declining. This smaller pool of entry-level workers is also more poorly prepared. U.S. Department of

Labor (1992) figures show that nationally there is a projected decline in the total civilian labor force of 600,000 jobs for the year 2000. It is estimated that by 1995, 14 million Americans will be unprepared for the jobs that are available (National Alliance of Business, 1989). By 1995, fully 17.2 percent of the United States' civilian workforce will be employed in professional and technical occupations, compared to only 15.6 percent in 1979, an increase of six million jobs. Futurists such as John Naisbitt suggest that, by the year 2000, the United States will need two million robotics technicians and 2.5 million laser technicians, positions unheard of ten years ago (Preparing Now for the Future Decade, 1989, p. 17).

The increasing sophistication of our technological world is the main reason why workers are underprepared. Between now and the year 2000, a number of powerful economic forces will reshape American jobs and industries, the most important trends being:

- Continued integration of the world economy
- Further shifts of production from goods to services
- Faster gains in productivity, particularly in services
- Disinflation or deflation in world prices
- Increased competition in product, service, and labor markets

A concentrated effort is essential by the United States to educate its citizens to understand technology and its impact on their lives. This endeavor must begin at the primary level, continue in an articulated manner with secondary schools, and continue at the post-secondary and continuing education levels (International Technology Education Association, 1988).

The global marketplace will focus on a much different type of worker. The skills required of future workers will be intellectual and interpersonal skills rather than repetitive physical skills. The economy will be increasingly dependent on people who

have a good intuitive grasp of the ways in which all kinds of physical and social systems work. Future workers must possess a feeling for mathematical concepts and the ways in which they can be applied to difficult problems. Some of the additional skills experts have recommended for future workers are ". . . an ability to see patterns of meaning where others see only confusion; a cultivated creativity that leads them to new problems, new products and new services. . .; and in many cases, the ability to work with other people in complex organizational environments. . ." (Carnegie Forum on Education and the Economy, 1986, p. 20).

The Secretary's Commission on Achieving Necessary Skills (SCANS, 1991, p. 12) has identified five competencies needed for solid job performance by future workers.

Effective workers must be able to productively use these skills:

- Resources: Identifies, organizes, plans and allocates resources. Allocates time, money, material and facilities, human resources.
- Interpersonal: Works with others. Participates as member of a team, teaches other new skills, serves clients/customers, exercises leadership, negotiates, works with diversity.
- Information: Acquires and evaluates information, organizes and maintains information, interprets and communicates information, uses computers to process information.
- Systems: Understands complex inter-relationships, understands systems, monitors and corrects performance, improves or designs systems.
- Technology: Works with a variety of technologies, selects technology, applies technology to task, maintains and troubleshoots equipment.

The Secretary's Commission on Achieving Necessary Skills (SCANS, 1991, p. 16) research identified a foundation of intellectual skills and personal qualities that comprise each of the five competencies.

SCANS found competent workers in the high-performance workplace need:

- Basic Skills: Reading, writing, arithmetic/mathematics, listening, speaking.
- Thinking Skills: Creative thinking, decision making, problem solving, seeing things in the mind's eye, knowing how to learn, reasoning.
- Personal Qualities: Responsibility, self-esteem, sociability, self-management, integrity/honesty.

State

Illinois employment trends reflect the national shift from a manufacturing to a service economy. In Illinois, there has been a decline in the number of people employed in manufacturing with an increase in the number of professional and technical jobs. For example, employment in the manufacturing sector of the economy dropped from a 38.2 percentage share in 1950 to a 24.9 percentage share in 1980 and is expected to decline still further to a 22.1 percentage share by 1990. By the year 2000, the Illinois Department of Employment Security (1992, p. 14) projects a 24.6% growth rate for services, and a -3% growth rate for manufacturing. As the number of operative and laborer jobs declines, the number of professional and technical jobs will increase.

The Illinois Council on Vocational Education (ICOVE) and State of Illinois conducted a survey in 1990 which involved 1,200 Illinois businesses and 26 labor organizations, representing 1.2 million Illinois workers. Roundtable discussions were held with 90 business and labor representatives. These discussions identified math as a top priority, along with reading and writing. Problem-solving, critical thinking, and decision making skills were ranked of importance.

Local Community

The need to demonstrate improvements in student academic achievement in scientific literacy areas of problem-solving and mathematics is an ever increasing demand among area employers in the DuPage and Kane County region of Illinois. Scientific literacy is defined by the Illinois State Board of Education Center on Scientific Literacy as the following:

> The ability to formulate questions; to seek, comprehend and use available information; to gather and interpret data, and to draw logical inferences in relation to an area of investigation. The ability to comprehend and communicate the language concepts, theories and practices of science, mathematics and technology in ways to promote mutual understanding, cooperative problem-solving and shared vision. The awareness that science, mathematics and

> technology are ongoing processes and growing disciplines, constantly evolving and being refined through inquiry and open-ended investigation. The awareness that science, mathematics and technology are interdependent; that the tools and methods of each are interrelated and mutually supportive. The understanding that science, mathematics and technology have strengths and limitation in both theory and application, particularly as they relate to societal and ethical issues (Illinois State Board of Education Center on Scientific Literacy, 1989, p. 1).

Regional educational needs were identified in 1987 by the West Suburban Regional Academic Consortium (WSRAC) . This ten-month study was conducted for WSRAC by the Higher Education Strategic Planning Institute (HESPI) (1987) and the Center for Governmental Studies at Northern Illinois University. The study revealed that the following seven major industrial sectors to witness the most growth and opportunity for future employment were information technology, research and development, manufacturing, finance and insurance, wholesale trade, business, and community health. Local employers' requirements for a quality workforce continue to be identified by surveys and roundtable discussions in the Chicago west suburban area.

For example, in 1991, members of the Partners in Industry and Education initiative (PIE) of CPEE formed a Basic Skills Study Team to survey Aurora area employers and to define workplace needs and recommend educational strategies that will meet the needs of the workplace and the preparation of students for the world of work. A second questionnaire, prepared for ICOVE (1991) by Northern Illinois University, was also used by area employers.

Of the 37 employers surveyed by CPEE in 1991, about 65% of workers hired were viewed as only somewhat prepared for work or not prepared at all by employes. In evaluating new entry-level hires, employers rated the workers as marginal in the scientific competencies of calculating accurately and working with data and figures. In response to the ICOVE questions concerning the importance of basic skills, local employers rated basic skill areas of math, reading, writing, communication skills, critical

thinking and group/teamwork skills more important than employers in the statewide study.

Responses to Concerns

Responses to these national, state, regional and local needs require new approaches that result in systemic educational changes. The major focus of these changes for CPEE are curriculum, staff development and collaboration among all major stakeholders. School-business partnerships, such as CPEE, are a logical answer to these needs, and partnerships create a formal structure for changes in curriculum resulting in improved student performance.

In Northern Illinois, CPEE facilitated meetings in Spring 1989 between leaders from local business and industries located along the I-88 Research and Development Corridor and education leaders from K-12 schools, and higher education. These discussions led to consensus that business and education work collaboratively to reduce the gap between the skills needed in business today with the skills taught in the classroom.

These discussions identified a unique staff development program as the vehicle to link educators with local business representatives in order to better integrate the needs of the corporate sector into classroom instruction. The program was named, "Interconnections 90: Scientific and Applied Technology Literacy and the Corporate Workplace" and became the vehicle for educational reform in CPEE's service area.

The discussions between educators and business at the local level have prompted CPEE to pursue active curriculum reform. New approaches to curriculum, staff development and the school-to-work transition are the essence of the "Interconnections" program. If today's students are to acquire the workforce skills needed, curriculum

changes must be made that are reflective of the mathematics, science and technology applications used in the corporate workplace.

New Approaches - Curriculum

Educators, such as Boyer (1983), Sizer (1984), and Goodlad (1984) have called for major changes in the school curriculum. Boyer (1983) has called for a "new interdisciplinary vision". All these educators have argued that true reform must start on the local level in schools and districts responding to the needs of the people they serve. Ash notes that researchers including Darling-Hammond, Wise and Pease (1983), Raiche (1983), and Stanley and Popham (1988) underscore the importance for school districts to systematically study their own needs and to identify intrinsically sound modifications to improve school curriculum and increase student achievement. In order for educators to improve local school curriculums that are reflective of workplace needs, greater collaboration between the schools (the supplier of the product) and their customers (business and industry) is needed at the grassroots level. CPEE's involvement is curriculum design is focused at the local grassroots level.

New Approaches - Staff Development

Educators are confronted with many challenges to prepare future members of the technological workforce appropriately and in numbers adequate to meet the needs of the marketplace. The first challenge for educators is to keep abreast of changes in commerce and industry, changes both in technology and in the knowledge and tasks expected of future employees. A second challenge is for educators to design entry level programs, and upgrade job opportunities. A third challenge is for educators to identify the basic educational skills needed by students for entry into these new programs and articulate the high school curriculum with later technical training. A final challenge is for educators to

inform youth and their parents of the requirements for technical programs, and career possibilities in technological fields (Illinois Community College Board Report of the Tech Prep Articulation Task Force, 1987).

Since educators as a whole have been isolated from workplace needs, training for teachers is needed to develop integrated curricula, assess skills and provide career information to both students and their parents. Staff development undertaken by CPEE is conceived broadly to include any activity or process intended to improve skills, attitudes, understandings, or performance in present or future roles. (Fullan, 1990, p.3)

New Approaches - Partnerships

Employers and educators need to become more closely linked and accountable to one another in their search for ways to close the gap between knowledge-and-skills and school-to-work. CPEE has provided both employers and educators opportunities to review recent national, state and local reports to determine employment trends, skill competencies, career opportunities required for high school graduates. Some of the reports examined by CPEE members include: What Work Requires of Schools A SCANS Report for America 2000, SCANS, (1991); America's Choice: High Skills or Low Wages, National Center on Education and the Economy (1990); Illinois Council on Vocational Education (ICOVE), Northern Illinois University Center for Governmental Studies, (1991). CPEE has been the vehicle for business, labor, government, and education to work together to ensure that every high school graduate is prepared to effectively enter employment, either immediately or after completing post-secondary education in the Northern Illinois region.

Partnerships such as CPEE produce lasting changes in the relationship between educators and employers. Wise (1981) reports that traditionally two questions have been

the focus of discussions about school-business partnerships: How can business help schools, and how can schools be more responsible to the needs of employers?

The "Interconnections" staff development program was the local answer to these two questions. Wise (1981) also suggests a third question should be considered in addressing the educational needs of youth: How can the two educational environments of school and business be better coordinated? The CPEE created and implemented "Interconnections 90: Scientific and Technology Literacy and the Corporate Workplace" as the vehicle to more effectively coordinate educators with employers in the region.

In conclusion, school-business partnership programs are vital for curriculum changes. Today's students must be better prepared with workskill competencies needed in the workforce. Wise (1981, p. 80), notes: "A key, therefore, to effective school-business collaboration will be to find that intersection of local public and private educational interests which will permit the school to teach toward the competencies that equip every youth for handling the responsibilities of work, citizen, and family life, and will permit the employer to deepen those competencies for productive and satisfying employment ."

"Interconnections 90: Scientific and Applied Technology Literacy and the Corporate Workplace" is the intersection of local interests, developed to address the universal need for a skilled workforce. The "Interconnections 90" program represents the inter-institutional collaboration of K-12 public and private schools, higher education, and business and industry through CPEE in improving the skills of future workers. First initiated in May, 1990, "Interconnections 90" was designed to enhance science, mathematics, and technological instruction through professional development of teachers, counselors, and adminstrators through staff development activities including principles and "hands-on" techniques utilized in the corporate sector.

Purpose of the Study

The purpose of this study to explore the impact of "Interconnections 90:" Scientific and Applied Technology and the Corporate Workplace, a current program initiative of the CPEE. This study examines:

1) The "Interconnections" program and the team-building process that occurred between members of the school teams and between the teams of business.

2) Any attitudinal changes that resulted concerning corporate workforce needs and integrated curriculum by school team members.

3) Any knowledge gains that resulted related to corporate workforce needs and integrated curriculum by school team members.

4) The impact of the "Interconnections" staff development program at the local school district level.

Program Evaluation

Survey data was collected over a three year period, 1990-1992 to study attitude and knowledge changes in participating school teams. The program impact was studied through a follow-up survey after the teams returned to the local school district. Phone interviews were conducted with several teams that successfully implemented integrated curriculum modules in their district.

Research Assumptions

As a result of participation in "Interconnections 90" staff development program, it was expected that:

1. Teachers', counselors', and administrators' knowledge and attitudes relative to integrated curriculum development would change in a positive direction;
2. Teachers', counselors', and administrators' knowledge and attitudes regarding the

corporate sector's workforce employment needs would change in a positive direction; and

3. Curriculum changes would be initiated at the local district level.

Research Questions

The specific research questions addressed in this study are:

1. Does change occur in teachers', counselors', and administrators' knowledge and attitudes relative to integrated curriculum development as a result of participation?
2. Does change occur in teachers', counselors', and administrators' knowledge and attitudes regarding the corporate sector's workforce employment needs?
3. Do curriculum changes occur at the local district level after participants complete "Interconnections" training?

Limitations of the Study

The study is limited to volunteer school district teams, which included teachers, counselors, and administrators, that chose to participate in the program. These voluntary educational teams came from elementary, secondary and unit districts in Northern Illinois. The sample is therefore not random. Corporate participants included businesses and industries located along I-88 (Illinois Research and Development Corridor) in Northern Illinois. The data was gathered over a three year period of program operation 1990, 1991, and 1992.

Knowledge and attitudes regarding integrated curriculum were measured based on the topics covered in "Interconnections 90: Scientific and Applied Technology Literacy and the Corporate Workplace." It was therefore necessary to develop survey instruments which were directly related to the ideas addressed in the "Interconnections 90" staff development program. To develop the surveys, the content of "Interconnections 90" was carefully outlined to specify major issues related to knowledge and attitude

development regarding corporate workforce employment needs and integrated curriculum. The instrument has construct validity which means conclusions are not generalizable.

The impact of "Interconnections" as a catalyst for curriculum change was measured by a survey mailed to all participants over the three year period. The effect of integrated curricula on student outcomes was not directly measured in this study.

Organization of the Study

This study is divided into seven chapters. Chapter One presents the introduction to the study including the purpose of the study, the research questions, and limitations of the study. Chapter Two presents a review of the related literature. Chapter Three presents a case-study of the CPEE as a model school-business partnership, and provides the sequence of events and chronological development of "Interconnections 90:" Scientific and Applied Technology Literacy and the Corporate Workplace Staff Development Program. Chapter Four describes the methodology of the study, design of the study, participant selection, subjects, instruments used, administration of the survey, methods of data analysis, and summary. Chapter Five presents a discussion of the results of the study, analysis of the data pertaining to the research questions, and summary. Chapter Six examines the results and discussion. Chapter Seven presents the conclusions, implications for practice, recommendations for further research, and summary.

CHAPTER II

REVIEW OF THE LITERATURE

This review of the literature summarizes educational reform initiatives that have led to greater collaboration between business and industry and the schools. The review shows that the focus of school-business partnerships has shifted from partnerships as providers of enrichment programs and services to partnerships as agents of systemic educational change. The literature review will highlight how authors have seen school-business partnerships as a solution to serious educational, economic, and social problems. The process of school-business collaboration is a vehicle for staff development leading to curriculum change at the local school level. The goal of this curriculum change is for students to be better prepared with the workskills needed for participation in the work force. A brief discussion of the following areas will be provided: educational reform initiatives, change models, schools as open systems, evolution of school-business partnerships, changing roles through collaboration, changing curriculum to meet business needs, and staff development for school improvement.

Educational Reform Initiatives

It is widely believed that schools as they exist today will not meet the needs of the post-industrial, post-bureaucratic society of the twenty-first century (Murphy, 1991). In order to meet the demands and expectations of society, different political, economic and social groups are pressing for systemic reform of the present educational system. The decade of the 1980's produced a plethora of national and state reports, federal and state

legislation, and the 2000 school-business partnerships summarized in Chapter One that offered solutions to stem the "rising tide of mediocracy."

In analyzing these reports, Murphy (1991) found two predominant beliefs. First, the belief that the United States was on the verge of being displaced as a major player in the world economy was apparent in the schools. Second, the belief that the United States was falling behind other industrial powers in development, productivity, and quality was clear. Murphy notes that once the link between the failure of schools to produce literate and numerate graduates was made to America's declining economic position in the world marketplace, educational reform initiatives began to emerge. Timpane (1984, p. 390) also states: "Business leaders have come to realize that the emerging labor supply is essentially an education problem."

During the early 1980's, Murphy (1991) reports schools were characterized by intellectual softness, a lack of expectations and standards, conditions of employment inconsistent with professional work, and the absence of any meaningful accountability. In the early and mid 1980's, reform proposals focused primarily on raising standards by expanding centralized controls. A bureaucratic "top-down" model of change was employed, characterized by "more of the same." Reforms sought mainly to expand or improve educational inputs such as longer school day, increased graduation requirments and competency testing in basic skills. Smith & O'Day (1990), in evaluating these reforms, indicate that only minor changes in classroom practices or student achievement occurred in the typical school. Numerous critics of these early reform measures argue that fundamental revisions were needed in the ways that the educational systems were organized and governed, in the roles adults played in schools, and in the processes used to educate America's youth. These concerns paved the way for a second wave of

educational reform in the middle to late 1980's to the present time in which a reanalysis of the basic structure of schooling is occurring (Murphy, 1991).

New Purpose for Schools

Recent authors on restructuring schools for the 21st century report that the new information age requires a shift in the fundamental purpose of schools initially designed to meet the needs of an agrarian rural society, but now serving an urban industrial society. Murphy (1991) concludes that the purpose of schooling parallels the needs of society, especially the economy. Business needs have changed, and the level of skills required has risen from students with basic skills to students who can think, from docile students to active students who must work cooperatively in teams. As the level of skills has risen and as the number of surplus students has fallen, the economy is demanding that schools restructure.

Futurists report our society is already mid-way through the information age, yet our school system continues to be entrenched in agricultural and industrial models. Dr. Willard Daggett (1991) refers to the present schools as "dinosaurs" teaching a curriculum based on the needs of our grandparents. Daggett challenges schools to change the curriculum to more accurately reflect the job marketplace and to keep pace with the rapidly changing needs of society and technology.

The purpose of schools in the information age should be to develop "knowledge workers." Keeping pace with society's rapid changes require schools to help students become life-long learners. In preparing "knowledge workers" for the 21st century, teachers must help students use their intellectual tools to know how to learn. Schlechty (1990, p. 35) defines the term knowledge work as "putting to use ideas and symbols to produce some purposeful result. Work is simply physical or mental effort expended to produce something".

Ed Bales, Director of Education External Systems Motorola, Inc., underscores the need for schools to change in order to develop students with skills needed for the 21st century. Bales (1992) reports that the 1980's was the decade of improvement in the quality of products and services. The 1990's will be the decade of improvement in the quality of people. The competitive edge will now go to the corporations who have the best people or "mind-ware" managing the technology. Bales defines the role of education in the development of mindware into the following areas: develop social responsibility, prepare students for employment, and develop the skills required for life-long learning (Bales, 1992).

Bales (1992) distinguishes between characteristics of today's schools and the characteristics of the schools of tomorrow into four areas of focus: strategy, learning environment, management, and outcome. The primary strategy of the schools today is to focus on the development of basic skills. In the schools of tomorrow, the primary strategy is to focus on the development of thinking skills.

Bales (1992) reports in today's schools, the learning environment is characterized by: 1) recitation and recall from short-term memory; 2) students working as individuals; and 3) a hierarchically ordered sequence of basics before higher order. In contrast, in the schools of tomorrow the learning environment is characterized by students actively constructing knowledge for themselves, cooperative problem solving, and skills learned in context of real problems.

Bales (1992) reports today's schools are managed with supervision by administrators. In contrast, the management of schools of tomorrow is learner-centered and teacher directed. Finally, the outcome of today's schools is the production of some students who learn to think. The outcome for schools of tomorrow is that <u>all</u> students learn to think.

Change Models

Many models of change are presented in the literature. Waugh and Punch (1987) developed a recent synthesis of systemwide planned change literature which presents four change models: the problem-solving model, the social interaction model, the research-development-diffusion model, and the linkage model. Recently organizational change theorists, such as Senge (1990), discuss a change model based upon systems thinking. Researchers Waugh and Punch also indicate that planned educational changes have a life cycle that can be divided into three stages: adoption, initiation, implementation, and incorporation as a permanent feature of the system. This study focuses on the adoption of planned educational change through the implementation of the "Interconnections" curriculum module at the local school district.

The change process used by the CPEE in the "Interconnections" program is based upon Rogers and Shoemaker's (1971) social interaction model and the systems thinking model which includes these major components of change:

1) Change occurs at two levels. Change occurs at the individual level, (microanalytic level) where the individual is the adopter or rejector of the innovation. Change also occurs at the social system level, (macroanalytic level).

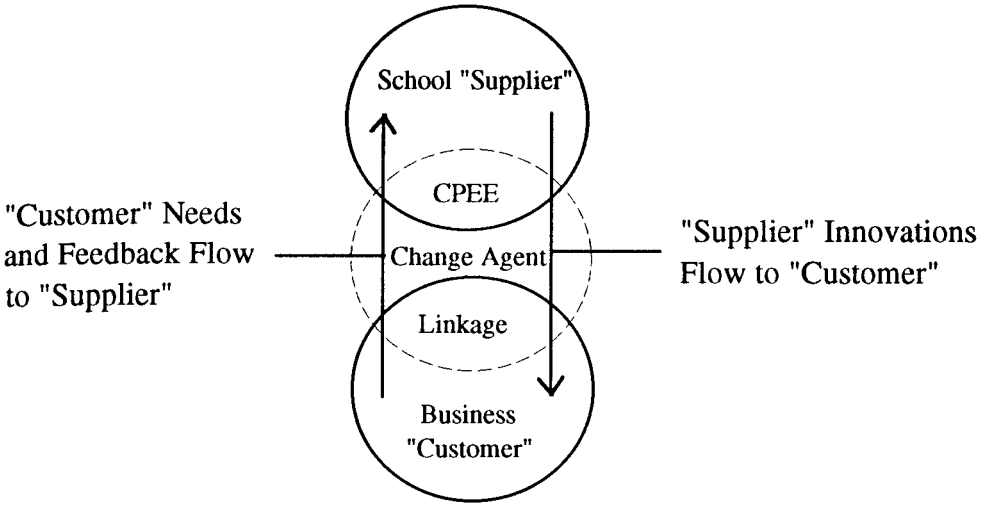
2) Communication of the change or new ideas is the critical component in the change process. Change occurs in a social system in three sequential stages: invention, the process by which new ideas are created or developed; diffusion, the process by which the innovation is spread to the members of the social system; consequences, the changes that occur in the social system as a result of the adoption or rejection of the innovation.

3) A change agent functions as a communication link between two or more social systems.

CPEE serves as the change agent and communication link between the schools (suppliers) and the businesses and industries (customers) in the northern Illinois region.

Figure 1 depicts the change model adopted from Rogers & Shoemaker's (1971, 228) change agent model as used by CPEE in the "Interconnections" program.

Figure 1. CPEE as Change Agent



Change at the Individual Level

After examining numerous unsuccessful attempts to change education, Combs (1988) advocates that truly effective change can only be accomplished by effecting changes in people. Secondly, Combs notes that experimentation needs to occur at the local level rather than from changes imposed from the top. Education is a people business. Combs (1988) argues that educational reform must concentrate on altering the belief systems of the people who make the decisions and who do the work. Combs reports, " Recent studies have demonstrated that what makes good teachers is not their knowledge or methods, but the beliefs teachers hold about students, themselves, their goals, purposes, and the teaching task" (Combs, 1988, p. 39).

The belief that, in order for people to change, they have to change their attitudes and belief system is derived from humanistic and cognitive psychologists such as Carl Rogers, Alfred Adler and Albert Ellis. Adler writes in Superiority and Social Interest that a person's behavior springs from his ideas, and that a person's attitude determines behavior. Albert Ellis developed Rational Emotive Therapy, a method of psychotherapy. A major premise of Ellis' theory is that behavior change will occur as a result of changing a person's belief system (Ellis, 1977).

The focus of these change theories is on the individual as the unit of analysis. Recently, there has been a paradigm shift in scientific models to a more holistic focus recasting the individual as a unit of a larger system. Organizational change theorists support the notion that organizational change results from changing a person's belief systems. Peter Senge, author of The Fifth Discipline, refers to these belief systems as "mental models." Senge defines mental models as ". . .assumptions, generalizations, or pictures and images that influence how we understand the world and how we take action" (Senge, 1990, p.8).

Large organizations develop barriers to change. Such barriers to change have been well documented in the literature. Combs (1988) notes some of these barriers in large organizations include: lack of resources, administrative regulations and procedures; philosophically differing opinions about desired goals and objectives; and psychologically, in personal feelings, attitudes, and beliefs. Changing belief systems within an organization calls for a new way of thinking,--systems thinking.

Change at the Social System Level: Schools As Open Systems

Kuhn (1962) described the "positivistic" scientific paradigm that was the dominant world view. This way of thinking assumes linear cause-effect relationships and operates in a reductionistic mode that a whole is understood by examining its parts. In

education, this way of thinking assumes that teaching causes learning, and that by teaching facts (parts), knowledge (the whole) results. Systems thinking represents a shift in this positivistic scientific paradigm. Systems thinking, also known as "post positivism," is based on a completely different set of assumptions. Systems thinking assumes mutual causation and recognizes the whole is greater than the sum of its parts.

General systems theory was developed by physicist Ludwig von Bertalanffy (1967) who viewed a system as a complex of interacting elements and the relationships which organize them. All systems, regardless of their content or function, share the same properties of organization and operation. These properties include: hierarchy, subsystems, rules and regulations, boundaries, circular causality, feedback, and homeostasis. Homeostasis is the tendency of a system to maintain its equilibrium or steady state. A self regulating cybernetic system maintains its homeostasis via feedback from its component parts. Fishman (1979) indicates that cybernetics is a term coined by Norbert Weiner in 1948 to describe systems which regulate themselves by means of feedback loops. A system may be either open or closed depending on the permeability of its boundaries. A closed system has impermeable boundaries and allows for little or no exchange of information across its boundaries. The closed system model that has traditionally characterized schools.

An open system, in contrast, is one with relatively permeable boundaries which allows for exchange of information, materials, or energies with the environment. Open systems are regulated by feedback. Input from the environment is acted upon and modified by the system. Feedback can be either positive or negative. Negative feedback is information about the system's output which is fed back into the system and has the aim of protecting the existing balance or equilibrium of the system. Information received

by the system is used to amplify the output deviation, and this acts as a positive influence on the trend toward change.

Because open systems behave as wholes, change in one part will cause change in the entire system. Change is governed by the concept of circular causality. Change in an open system is a circular chain with constantly recurring patterns of actions and reactions. All open systems possess growing, fluid and changing processes. Systems thinking suggests that for organizations the way these parts are connected affects performance.

After an analysis of these theoretical models it is apparent that the model of the schools of the future is the school as an open system. Schools can no longer be characterized in the industrial model of "closed" systems, organized by values of standardization and centralization and rigid procedural rules as articulated by Weber (1952) in his bureaucratic model. The closed system paradigm of the industrial age had physics at its core and assumed linear cause and effect relationships. The paradigm of the schools of tomorrow in the information age is biology which is organized around "open systems" characterized by mutual causality and a feedback system based on input and output exchanged with the external environment. From this "open system" model, the boundaries of the current school system are seen as fluid and reflect ongoing interaction between the school and the external environment.

The "open system" model of schools not only shifts the external boundary between the school with the community, but also shifts the internal boundaries between the teacher and student, teacher and teacher, teacher and administrator. These boundary shifts create new roles which Murphy (1991), Schlechty (1990), and Combs (1982) describe in new metaphors. They refer to these new metaphors as a role shift from administrators as managers to administrators as facilitators; from teachers as

directors/leaders to teachers as facilitators/consultant, and models/coaches; from students as passive learners to students as thinkers and "knowledge workers;" from schools as isolated and "closed" in relation to the community to schools as "open" in partnerships with the community.

If schools are to meet the challenging needs of the information age, then schools must become "open systems". This will require: 1) changes in the purpose of the schools today, 2) changes in the belief systems of teachers and administrators, 3) changes in the boundaries between the roles of adults within the system, 4) changes in the external boundaries of the system between the school and the community, and 5) changes in what is taught and how it is taught in schools.

In order for these significant changes to occur in schools, it is apparent from the literature review that: 1) a market philosophy must redefine the business of schooling to include greater collaboration between the school and its customer (business and industry); 2) teachers and administrators within the system must have greater contact with their customers (business and industry) in order to learn what their customer's needs are today and in the future; 3) teachers and administrators will have to confront their own "mental models", values, attitudes and belief systems in response to their customer's needs regarding what is taught and how it is taught 4) teachers and administrators need to create more opportunities to work together to review, revise and redesign present curriculum to better meet work force needs; 5) change needs to occur at the local level; and 6) partnerships need to foster greater collaboration between educators and employers and are a tool for educational change.

What are Partnerships?

The role of partnerships in the 1990's shifted from partnership programs developed between schools and the community to enrich and enhance existing

educational programs to partnerships armed with strategies for systemic change in schools and communities. Partnerships as an institution create the context for business and education to collaborate in new ways to promote reform in local schools. Partnerships provide the context in which educators can learn what their customers (business and industry) want students to know. Partnerships provide the context in which educators can learn how classroom skills are applied in the context of real-life problems over the past decade. Over the last decade, the role of partnerships has evolved from providers of enrichment programs and services to advocates for reform and change of the schools. A plethora of articles, books, reports and project descriptions attest to the increased activity and growing sophistication of business-education partnerships from the late 1970's when "partnering" became a popular concept and term (Grobe, Curnan, & Melchior,1990).

The term "partnership" is widespread and broadly used to describe any number of relationships and activities including:". . .the state or condition of being a partner...participation..joint interest..the relation subsisting between partners..the contract creating this relationship..an association of persons joined as partners in business Otterbourgh (1990, p. 9) distinguishes "partnership" as the active participation of all involved in a relationship which is distinct from "philanthrophy" defined as" . . .the donation of money, property, or work to needy persons or to socially useful purposes."

School-business partnerships are defined as mutually collaborative efforts in which the partners involved are committed to the use of resources in support of school improvement. Ash (1989, p.7) defines partnership as ". . .a cooperative, systematic, mutually beneficial collaborative between two or more entities, such as a school and a business, with established goals and distinguishable boundaries." The National Association of Partners in Education, Inc., define partnerships as " a mutually supportive

arrangement between individual volunteers, businesses, government agencies, and community organizations with a school or school district often in the form of a written contract in which partners commit themselves to specific objectives and activities intended to benefit students" (NAPE, 1991, p. 6).

Increasing Collaboration

The 1980's saw an unprecedented increase in public-private sector collaboration. As Timpane observed: "Of all the recent changes in the landscape of American education, none has been more dramatic and swift than the reappearance of the business sector" (Timpane, 1984, p. 389). The emergence of school-business partnerships paralleled the excellence movement that originated in the private sector. Numerous commission reports including A Nation at Risk, and Educating Americans for the 21st Century, recommended school-business collaboration as a way to improve schools. These national reports called for sweeping changes in the schools.

President Reagan, in his 1983 State of the Union Address, focused on the growing national concern following the A Nation at Risk report. President Reagan stated,: "We must join together-parents, teachers, grassroots groups, organized labor, and the business community to revitalize American education by setting a standard for excellence" (Akers, 1991, p. 9). President Reagan declared the "year of partnerships in education" and urged business and education leaders to collaborate together.

The rejuvenation of an enduring commitment to excellence in education on the part of American business was not only a matter of philanthropy, nor altruism but enlightened self-interest rooted in a concern for the quality of the current work force (McKenzie, 1985; Ward, 1983). A constellation of factors in the 1980's including the decline in the scholastic level of public schools, stronger foreign competition, increased technological innovation, reduced governmental support of resources for public schools,

and a shift from an industrial-based information-based society intensified the need for collaboration between public schools and business (Ash, 1989). In the 1980s, business helped shape the debate over educational policy at the state level and at the national level. At the same time, business groups and individual businesses began to take a more active role in educational policy at the local level.

Partnership Activities

Partnerships between business and the public sector became increasingly widespread during the 1980's fueled by the dual concerns of crisis in public education and the increased demands of a service driven economy. During the period of 1983-84 and 1987-88, (Grobe, et al. 1990, p. 3) report that the number of educational partnerships between elementary and secondary schools and community/business organizations grew from 42,000 to 140,800. During this period, the rate of participation in partnerships grew from 17 percent of the schools to 40 percent, directly involving more than nine million (24 percent) of all public school students.

Activities varied enormously from small scale projects to city-wide partnerships that developed long term goals for school improvement in exchange for businesses' pledge of employment opportunities for graduates. Principals involved in partnerships reported a wide variety of business support to schools, including providing guest speakers or demonstrations; donating computers, books, or other equipment; contributing employees as teachers; providing grants to teachers and staff development opportunities; tutoring special needs students; providing special awards for teachers, students, or schools; and use of partner's facilities.

The National Association of Partners in Education (NAPE) confirmed earlier reports of growing involvement in partnerships. In a 1990 National School District Partnership Survey, NAPE found that partnerships are rapidly becoming a significant

component of elementary and secondary schools throughout the United States. Over half of America's school district (51 percent) have active partnership programs involving an impressive total of 2,598,296 volunteers. An estimated 29.7 million students, or 65 percent of the total number of American students, attend school districts that have educational partnerships. Partnerships exist in 19 percent of urban school districts, 58 percent of suburban districts, but in only 45 percent of rural districts. The combined value of the goods and services contributed by the partners in these programs is approximately $924,514,184 which represents a substantial asset available to students and faculty where partnership programs exist.

School districts participating in the NAPE survey identified the content of their partnership programs within four areas: direct student support, curriculum and instruction, professional development, and district-wide policy/program initiatives. Overall, partnership programs focus heavily in the areas that affect students directly. More than half of the districts have partnerships involved in areas of direct student support and curriculum and instruction. Additionally, a heavy emphasis in the areas of math/science, and literacy achievement were cited. Survey results, however, show only 14 percent of districts reporting partnerships are involved with the professional development of teachers and administrators (NAPE, 1991, pp. 9-15). This is an underdeveloped area of need for partnership programs which the "Interconnections 90" program was designed to address.

Research regarding the effectiveness of partnerships is emerging. Recent evaluation studies, including the Finish for the Future Project (NAPE, 1992) and the 1990 National Research Council Study, have documented that partnerships have been judged as a valuable response to serious educational problems. The 1992 NAPE Board of Directors' White Paper reports its most recent survey of exemplary partnerships

provides strong evidence that partnerships are making a "profound difference in the academic and personal growth of school youth, along with the development of employment skills and meaningful job placement for students" (NAPE, 1992, p. 2). Additionally, NAPE reports, "this has been accomplished through a wide array of programs and partners who work with students as tutors, mentors and classroom lecturers, in addition to making valuable contributions to teacher training, curriculum development, and school governance" (NAPE, 1992, p. 2). The 1990 study of the National Research Council reports partnerships did contribute to important educational outcomes for many students (NAPE, 1992).

Models of School-Business Partnerships

Recently, there has been an effort to categorize partnerships into models or types depending upon the level of business involvement and the nature of the partnership activity. The following school-business partnership categories have been identified in the literature by the Council for Aid to Education (1991); the National Alliance of Business (1987); the National Association of Partners in Education (1989). The following three basic types of partnerships have been identified: adopt-a-school model, project -driven model, and reform-model (Council for Aid to Education, 1991). The characteristics of each of these partnership models will be discussed.

An Adopt-A-School partnership is a formal collaboration between school and business representatives, based on a minimum one-year contract to enhance specific areas of school needs (Ash, 1989). An implementation plan is developed which may focus on one aspect of the school program or several projects depending on the school needs. Adopt-A-School partnerships are the most frequently cited and least formally studied partnership models in the literature (Ash, 1989). Rigden of the Council for Aid to Education (1991) notes that many partnerships begin this way and focus on providing

resources and volunteers for schools. The Adopt-A-School model has been criticized for being paternalistic and creating dependency between schools and business. Additionally, limitations of the Adopt-A-School model include a focus on symptoms rather than causes related to educational problems.

The second type of partnership is the project-driven model. Rigden of the Council for Aid to Education (1991) characterizes this model as enhancing course work for students, expanding teacher expertise, and being relatively short-term. Project-driven partnerships often develop out of Adopt-a-school relationships. This model is noted for being isolated from the rest of the school activities and rarely transferred from classroom to classroom or from school to school.

The third type of partnership is the reform-model. This model focuses on changing the learning and teaching environment through: 1) changes in the responsibilities and roles of students; 2) changes in improved teaching practices and the empowerment of teachers; 3) changes in school organizational and management structure; and 4) changes in assessment tools. The reform-model of partnerships seeks changes to become embedded in the system, It demands long-term commitment. Companies serve as the advisors and facilitators.

CPEE is an example of a reform-model partnerhip as discussed by Ridgen (Council for Aid to Education, 1991). Since 1982, the Partnership has focused its regional efforts on promoting systemic change in education through strong partnership activities. CPEE's nationally recognized programs are organized into three interrelated strands: expanding learning opportunities for students and educators in science, mathematics and technology; enriching student education in the classroom; and bridging school and work. CPEE's programs are aligned with national partnership models that

strive to achieve outcomes resulting in educational improvements with the highest impact.

The National Alliance of Business (1987, p. 13) has also developed a conceptual framework of education-business collaboration by dividing partnerships into six broad levels of impact on the educational system. Each level of the continuum, from bottom to top, represents an increasing amount of business involvement and investment, and an increasing impact on total system improvement:

Level 1. Partners in Policy

Level 2. Partners in Systemic Educational Improvement

Level 3. Partners in Management

Level 4. Partners in Teacher Training and Development

Level 5. Partners in the Classroom

Level 6. Partners in Special Services

The higher the level of involvement and investment in education, the greater the opportunity to bring about lasting improvements in education, and the greater the likelihood of significantly improving the workforce readiness of our nation's youth. While there are varying levels of involvement, and all are important, the large-scale, more intensive levels are what are needed in order to bring about systemic educational improvement and policy changes.

"Interconnections 90: Scientific and Applied Technology Literacy and the Corporate Workplace" was designed for business involvement at Level 2: Partners in systemic educational improvement. Local systemic change initiatives involve business, education, and community leaders as they cooperatively identify the need for improvement in the educational system, and work over the long term to make those changes happen (National Alliance of Business, 1987).

Changing Roles Through Collaboration

If partnerships create the context or structure for business and education to work together in new ways to promote enduring educational reform, then collaboration is the vehicle or the process for successful partnership activities. A review of the literature provides an interesting array of definitions on collaboration (Digate & Bollendorf, 1989, p. 61). The standard definition appearing in the dictionary asserts that . . ."collaboration is the act of working together, especially in joint intellectual effort" (American Heritage Dictionary, 1981, p. 202). Essentially, collaboration is typified by joint planning, joint implementation and joint evaluation (New England Program in Teacher Education, 1973). Collaboration implies that the parties involved share both responsibility and authority for the basic policy decisions (Hoyt, 1978).

With a view toward educational institutions, Schaffer and Bryant (1983, p. 3) concluded that collaboration is"...shared decision-making in governance, planning, delivery, and evaluation of programs." In a pluralistic society, where people of dissimiliar backgrounds with equal status work together, collaboration may be viewed as working "with" rather than "on" a person.

Digate and Marshall (1988, p. 7) notes that collaboration functions to build a structure for more permanent relationships between different constituencies characterized by mutual trust and open communication. Hord (1986) offered the following recommendation that clearly articulated, mutual goals will aid collaboration. Hord also noted that achieving short term goals will encourage a positive view of the collaborative effort and encourage the process further. Hutchinson (1983) suggested six factors which create the environment necessary in order for collaboration to emerge: trusting civic culture; community vision (the community's view of itself and where it ought to be going; building an environment conducive to collaboration is essentially having civic

organizations that bind the community together; a network for communication and media participation; leadership, and continuity.

Collaboration facilitates communication between the public schools and the private sector. Identification of the skills and knowledge required by employers today for a world-class workforce is one of the most important linkages in bridging the gap between industry's needs and educational outcomes. Wise (1981, p. 6) notes,". . . with the establishment of strong communication links between schools and the private sector can lead to significant changes in both education and industry."

Partnerships provide the context in which meaningful dialogue between the public schools and the private sector can flourish. Peter Senge, in his recent book The Fifth Discipline, distinguishes between the two primary types of discourse: discussion and dialogue. Senge states,

> . . .discussion has the same root as percussion and concussion and it suggests something of a ping-pong game where we are hitting the ball between us with the intended purpose to win. The original meaning of dialogue was the meaning passing or moving through. . .a free flow of meaning between people, in the sense of a stream that flows between two banks. The purpose of dialogue is not to win but to go beyond any one individual's understanding. In dialogue, a group explores complex difficult issues from many points of view. (Senge, 1990, p. 10).

CPEE fosters both discourse and dialogue in its planning and program implementation efforts.

Researchers note that successful collaborative organizations evolve through critical developmental stages. Trubowitz (1986) described eight critical stages in the genesis of school-business collaboration: hostility and skepticism, lack of trust, truce, mixed approval, acceptance, regression, rebuilding and renewal, continuing progress. A review of the development of successful partnerships, such as CPEE, support Trubowitz's research that successful collaborative organizations evolve through developmental stages.

Changing Curriculum to Meet Business Needs

One of the difficult issues that educators and employers need to discuss together is what students need to know. In order for all students to acquire the workforce skills needed, changes are needed in what is taught and how it is taught. Decisions are made at the local school level, which impact student learning outcomes. The Secretary's Commission on Achieving Necessary Skills (SCANS, 1991, p. 40), report argued that learning in order "to know" should not be separated from learning in order "to do." In the 1992 SCANS report Learning a Living: A Blueprint for High Performance, the authors argued that learning "to know" and "to do" should be combined with teaching "in context." Teaching in context requires more complex integration of teachers with real-world experience. Additionally, teaching in context requires that the curriculum be integrated across subject areas in activities that require students to read, write, compute, apply scientific or statistical problems, integrate, and reason about specific problems.

Beauchamp (1983) reports that integration not only facilitates student learning, but also facilitates the transfer of student's knowledge, skills and attitudes in post-school life. Glatthorn (1989) reports there is limited research on integrated curriculum; however, Glatthorn provides excellent arguments in favor of integrated curriculum. He notes that the real world is integrated. Students learn best when learning is connected to the real world. Integrated curricula facilitates the introduction of student-related issues. Finally, integrated curricula saves time in the school day by requiring less transitions between disparate activities (Glatthorn, 1989).

Integrated curriculum for purposes here is defined as ". . .a knowledge view and curriculum approach that consciously applies methodology and language from more than one discipline to examine a central theme, issue, problem, topic or experience" (Murphy, 1991 p. 8). Many of the national reports in mathematics, science and technology call for curriculum reform which stress integrated curriculum strategies including: Americans,

American Association for the Advancement of Science (1989); Everybody Counts: A Report to the Nation on the Future of Mathematics Education, National Research Council (1989); Curriculum and Evaluation Standards for Mathematics Education, National Council of Teachers of Mathematics (1989); Technology: A National Imperative, International Technology Education Association (1988). The Illinois State Goals for Learning: Mathematics, Biological, and Physical Sciences adopted by the Illinois State Board of Education 1986 underscore the importance of student's understanding concepts and this application to life and work in contemporary technological society. It was this integrated approach to curriculum that became the focus of "Interconnections 90."

Staff Development for School Improvement

Numerous authors have included staff development as a critical component for school improvement. Staff development is conceived broadly to include any activity or process intended to improve skills, attitudes, understandings, or performance in present or future roles (Fullan, 1990, p. 3). Smylie (1988) notes staff development activities are designed to advance teachers knowledge, skills, and understandings that "lead to changes in their thinking and classroom behavior" (Smylie, 1988, p. 1). While staff development intends to change what teachers and administrators think (i.e knowledge base, attitudes, beliefs) and what teachers and administrators do (i.e. new materials, new skills, and new behaviors), too often no real lasting change occurs.

Shroyer (1990, p. 2) reports that critics have called staff development the "greatest spectator sport in America." Shroyer's (1990, p. 2) recent synthesis of the literature on staff development revealed staff development programs failed to change teachers and administrators behaviors or support school improvements because: 1) programs were "one-shot" workshops rather than comprehensive programs; 2) programs were not developed to support district, school, or classroom goals; 3) administrative

commitment was low, and follow-up support and implementation assistance rare; 4) activities are not consistent with adult learning theory and effective instructional practices.

Scarborough (1989) reports researchers note for teachers to keep current, there must be "internal" and "external" professional development opportunities. "External refers to opportunities to learn from outside the school system such as business and industry sources, to keep current with the "real" world. "Interconnections 90" is an example of an "external" professional development opportunity.

"Internal" opportunities foster growth by improving programs through cooperation within and accross disciplines. "Interconnections 90" also focused on this type of opportunity via its team approach. Both types of professional development opportunities are needed.

Scarborough also notes that developmental professional opportunities for teachers are generally not provided, or funded. Most teachers participate in only one, if any, professional activity a year. Scarborough argues that through the continuous professional development of teachers, the content of educational programs will continue to become better academically, and through innovation better models for more effective and efficient delivery will result (Scaarborough, 1989, p. 2).

Teaching is frequently characterized in the literature as an "isolated" and "individualistic" activity. The importance of teachers in staff development cannot be emphasized enough. Sizer (1983) notes that staff development rarely includes teams. Recent research on school improvement supports the view that the teacher is the pivotal force in the change process (National Society for the Study of Education, 1983). Courter and Ward (1983) note that researchers who have studied school change, indicate that

awareness of and attention to teachers' concerns are important aspects of any change process.

Gross, Giacquinta, and Bernstein (1971) look at the role of the teacher as a catalyst for implementation of school improvement. These authors indicate that successful improvement depends upon several factors including: the innovation be clearly specified; the role requirements of the teachers be clearly specified; teachers must be given experiences necessary to develop any new skills and competencies; teachers need to be committed to the improvement; teachers need to be given whatever materials are needed; and school administrators must be committed and supportive of the school improvement process. "Interconnections" was designed to provide teachers and administrators with the tools necessary for successful change.

School culture is recognized as an important element in school reform. Killion and Harrison (1990) confirm that organizational climate plays a critical role in whether and how implementation of educational changes occur. Researchers Clift, Holland and Veal (1990) confirm that administrators play a critical role in staff development. The administrators' role centers on creating structures for collaboration and problem solving and facilitating personal interactions between themselves and teachers. Courter and Ward (1983) confirm the need for collaboration between faculty and administrators in staff development activities. Berman and Pauly (1975) confirm that staff development is less a question of individual development and more a question of organizational change at the school level. Berman and Pauly (1975) also confirm the need for teacher participation in decision making and development of organizational goals.

Shroyer (1990), in reviewing organizational development literature, reports that effective schools and organizations utilize management strategies that support educational improvement through staff development practices. Leaders in effective

organizations support collaboration, collegiality, and interactive development. Leaders also provide positive supportive climates and access to the time, resources and assistance necessary for school improvement (Shroyer, 1990, p. 3).

Purkey and Smith (1982), in reviewing effective schools research, describe school effectiveness in terms of: strong administrative leadership, high expectations for student's achievement, an orderly atmosphere conducive to learning, high expectations for students' achievements, emphasis on basic skills acquisition, and frequent monitoring of student achivement. Other characteristics of effective schools, identified by Purkey and Smith (1982), are: high levels of parent-teacher and parent-principal contact and ongoing inservice training of teachers in areas related to better achievement of the school's instructional goals. These authors argue that the imposition to change from the top-down will not produce change at the school and classroom level.

These research findings suggest several guidelines for designing school improvement efforts and restructuring: 1) teachers are a central figure in the school improvement; 2) administrators need to recognize differences in instructional orientation and skill and knowledge levels among teachers; 3) approaches should be collaborative; 4) change must be focused at both the individual and school level; and 5) support elements need to be provided, such as time, materials, and expert guidance and assistance. "Interconnections" was designed to incorporate the strategies summarized in these research findings: 1) team participation was required for teachers, counselors and administrators; 2) strategies specifically outlining administrative support were built into the short term and long term goals which "Interconnections" teams completed; and 3) change was focused at both the individual and school level.

An excellent example of a staff development activity similar to "Interconnections" was developed by the National Center for Science Teaching and Learning (NCSTL).

Three research projects by NCSTL focused on school-business partnership initiatives in Science education reform. The first research project teams middle school teachers with university scientists and engineers to develop six-week science units. The research project goal is to determine the affects of this type of partnership activity on the professional status of teachers. The second research project involves elementary school teachers and scientists from business and industry. The research project goal is to determine the factors that define and help insure successful school-business partnerships. The third research project teams teachers with Ohio State faculty with the goal of initiating action research into the classroom.

NCSRL reports the following common threads emerging from these yet to be completed research projects. When K-12 teachers are provided with a minimum of financial and personal support, they can develop creative curriculum units for classroom use. NCSTL also reports the professional status of teachers, as perceived by the teachers and others, is enhanced through these activities. Teachers who participate in these activities tend to involve other teachers from their school buildings in initiating interdisciplinary activities in the school. Finally, participating teachers become more involved in structural changes within the school. These preliminary research results confirm that partnership activities do stimulate change in curriculum at the local school level.

Conclusions

This literature review supports the following conclusions:

1) Schools are open systems the products of which (students) are utilized as workers in local business and industry.

2) To be market driven, schools need to redesign curricula to better meet the needs of their customers- - employers in business and industry.

3) Change needs to occur at the local level.

4) Curricula needs to be integrated to foster the growth of students as thinkers.

5) Teachers and administrators need to be retrained to understand their new roles in the change process.

6) Partnerships serves as a vehicle for educational change to occur. The literature shows that staff development programs are an area for growth in school-business partnerships.

7) CPEE has adopted a reform-model with partners committed to systemic educational improvement.

8) For systemic change to occur, teachers must be the focus of staff development efforts.

9) "Interconnections 90" was developed to serve as a catalyst for curriculum change to occur at the local school level by including business directly in a staff development program.

The literature review points to the need to formulate effective models of school business programs so that local school district curriculum change will result. This study describes a school-business partnership program that did stimulate curriculum change at the local school level. Chapter III will describe a model school-business partnership, CPEE, and the sequence of events that lead to the development of one of it's important programs, "Interconnections 90: Scientific and Applied Technology and the Corporate Workplace."

CHAPTER III

CORRIDOR PARTNERSHIP FOR EXCELLENCE IN EDUCATION: A MODEL REGIONAL PARTNERSHIP

Partnerships such as the CPEE are an important means to achieve an important end, that is educational reform. Dr. Kenneth Hoyt, served as the Associate Commissioner of Education for Career Education in the U.S. Office of education, Hoyt drafted a U.S. Office of Education policy paper in November 1974, which proposed career education to be a response to the call for educational reform. Hoyt (1974) emphasizes the goal of education should be preparation for work, rather than preparation for more education. Work is defined as "conscious effort, other than that involved in activities whose primary purpose is either coping or relaxation, aimed at producing benefits for oneself and / or for oneself and others" (1974, p. 19). Hoyt proposes that all education is career education. Hoyt defines career education as". . . the totality of experiences through which one learns about and prepares to engage in work as part of her or his way of living (1974, p. 21).

Hoyt (1974) argues that career education seeks to address two primary criticisms: " 1) too many students leave the educational system deficient in the basic academic skills required for adaptability in today's changing society; 2) too many students fail to see meaningful relationships between what they are being asked to learn in school and what they will do when they leave the educational system..." (1974, p. 17).

CPEE has responded to these needs for educational reform through its development as an exemplary school-business partnership and through its programs and

services. This chapter will first describe the evolution of CPEE and describe how it responded to the need for educational reform. Secondly, this chapter will describe the evolution of "Interconnections 90: Scientific and Applied Technology Literacy and the Corporate Workplace," a current CPEE program initiative, as a response to the need for educational reform .

What is CPEE?

CPEE is a unique partnership between elementary and secondary schools, colleges and universities, research and development laboratories, government and labor. The mission of CPEE is to enhance and promote exellence in elementary and secondary education for students at all levels of ability and achievement, primarily in the areas of mathematics, science and technology.

CPEE serves the Northern Illinois region and the I-88 Research and Development Corridor. The CPEE's members include: 93 school district, 12 colleges and universities, 50 businesses, 25 individuals, 15 municipalities and associations. According to the Triangle Coalition for Science and Technology Education, (1991, p.7), CPEE is by definition, geographic scope, membership, structure and responsibilities a model comprehensive regional school- business partnership.

CPEE has been recognized at the national and state levels as an exemplary school-business partnership. CPEE is currently listed in the "100" Best Partnerships by the *Partners in Industry and Education Journal*, and in 1992, was awarded as one of 14 exemplary partnerships in Illinois.

Since 1982, CPEE has served as the regional catalyst for stimulating private-public sector collaboration. 1992-1993 marks the tenth anniversary of the incorporation of CPEE. CPEE's nationally recognized programs and services have expanded opportunities for students, teachers, and school leaders in science, mathematics, and

technology. These multi-faceted programs are organized into three strands: expanding learning opportunities for students and educators in science, mathematics and technology; enriching student education in the classroom; and bridging school and work.

Historical Background on the CPEE 1982-1989

Trubowitz (1986) has noted that successful collaborative organizations evolve through developmental stages. Additionally, partnership models such as the National Alliance of Business (1987) suggest, that as a partnership matures developmentally, the focus of the partnership shifts from providers of enrichment and enhancement programs to strategies for systemic change. CPEE's evolution will be described in this chapter using the model developed by the National Alliance of Business (1987). CPEE's development provides a case history of a partnership that has evolved developmentally from a program provider to an agent for change. The critical factors in coalition building cited by the National Alliance of Business (1987) are: positive impatience with current reality; a crisis-mandate-or vision in existence; comprehensive-visionary leadership; personal and organizational networks; issues of mutual salience; understanding that interdependence is the value add; a brokering or driving organization; a set of existing or the potential for new communication networks;and a civic entrepreneur.

Positive Impatience with the Current Reality

CPEE emerged as an idea from the private sector in 1982. The national reports and state commission findings that linked the nation's economic strength to the quality of its public schools created a positive impatience by business with the current reality in local schools. CPEE began as an active response to the 1983 Report by the National Science Board Commission (1983) which found that America's youth were generally

unprepared to meet the challenges of the 21st century. Local business leaders saw their future company growth tied to a better prepared workforce.

During the 1980's the economy was in a state of rapid change. In Illinois and particularly in the Fox River Valley, the traditional heavy manufacturing industries were in a deep recession. Even though positive signs of recovery were occurring, it was clear that employment in these industries would never reach former levels. This exemplified the employment trend throughout the country in which employment opportunities for Americans were shifting from manufacturing and industrial jobs to service and high technology jobs. Many of the important firms in Aurora, IL. were manufacturing firms being impacted by these major changes creating a crisis in the the area.

A Crisis-Mandate-or Vision in Existence

In an address to the Valley Industrial Association, Walter Massey, then director of Argonne National Laboratory, challenged the Northern Illinois business community to broaden its support of elementary and secondary education. Massey proposed the establishment of, what he termed, "An easily accessible network (to bring together in a broad-based constituency) entrepreneurs with ideas, businessmen with management expertise and capital, and state and local government officials with a variety of resources to offer" (Massey, 1982). His remarks set into motion a series of events in the Fox Valley area. Massey (1982) further suggested, ". . .we can timidly accept a philosophy that dooms our future growth or we can muster the resources. . .to forge our own future."

Dr. Leon Lederman, then director of Fermi National Accelerator Laboratory. extended the challenge. Again speaking to the members of the Valley Industrial Association, Lederman encouraged the business community to take action to revitalize itself and influence the future direction of public education by forming such a partnership. Dr. Lederman suggested that this partnership could perform three very

important functions for the Northern Illinois area: 1) assess the status of mathematics and science education in the schools of DeKalb, Dupage, Kane, and Kendall counties; 2) sponsor and support institutes for advanced teacher training, utilizing the resources of research facilities, business, industry, and higher education; and 3) promote the concept of an academy.

In collaboration with the Valley Industrial Association, a task force was formed in 1983 to study the educational delivery systems in the four-county region. Researchers Dr. Jon Miller and Dr. Alan Voelker of the Public Opinion Laboratory at Northern Illinois University were commissioned to provide a comprehensive regional assessment of science, mathematics and computer education. The region included in this study covered the general geographical area of the Illinois Research and Development Corridor (I-88) as well as portions of Cook, Lake, McHenry and Will counties. A total of 209 high school science teachers and 43 secondary level principals, and 266 mathematics teachers were interviewed. Results from this survey suggested several important directions for elementary and secondary programs:

> If excellence is to be preserved and fostered in other schools, it will require the resources and assistance of the full range of institutions in our communities that are committed to the advancement of learning-universities, research centers, corporations and local school districts.
>
> From the data, it is apparent that the science and mathematics faculty have a good track record in continuing education, but it is also clear that increasing amounts of continuing learning opportunities will be needed. Some of this training will have to come from institutions outside the schools themselves (Miller, & Voelker, 1984, p. 78).

Moreover, the data showed clearly there were wide disparities between the best and worst science and mathematics curricula and levels of student achievement. Additionally, a significant portion of secondary students, in the four-counties graduated from high school with only one year of science and one year of mathematics.

The task force recommended that a consortium be organized to address two major concerns:

1. The need to promote, encourage, and foster high quality education in area institutions with an emphasis on mathematics and science at all levels; kindergarten through high school; and
2. The establishment of a regional magnet school for gifted high school students in math and science education.

With the mandate from leading scientific researchers, Massey and Lederman and the VIA taskforce, the vision of a partnership emerged.

Comprehensive-Visionary Leadership: Putting Vision into Action

Early in 1984, a seminar was convened by Dr. John Swalec, President of Waubonsee Community College, to put into action the goals proposed by the task force. The conference generated the philosophy, goals, and action plan which formed the cornerstone of the emerging partnership organization. Representatives from the Valley Industrial Association, Northern Illinois University, Waubonsee Community College, Argonne National Laboratory, Fermi National Accelerator Laboratory, the DuKane Valley Council, and area school officials christened the unfolding collaborative effort as the CORRIDOR PARTNERSHIP FOR EXCELLENCE IN EDUCATION (CPEE).

CPEE's Board of Directors delineated five specific objectives to guide the organization in meeting its goals: 1) encourage "hands-on" practical mathematics and science experience through specialized programs; 2) enhance the mathematics and science preparation of teachers through innovative institutes; 3) develop shared resources for the education and business communities; 4) coordinate advanced internships for teachers and students in research and business environments; and 5) promote the concept of a statewide mathematics and science academy, a residential

school designed to offer a liberal arts education with a corresponding focus on mathematics and science.

CPEE's initial business members in the business community were major corporations concentrated in the geographic region of Northern Illinois commonly referred to as the Illinois Research and Development Corridor (I-88). This area is home to many of the nations preeminent research and development organizations such as AT&T Information Systems, Argonne National Laboratory, Fermi National Accelerator Laboratory, Geo. J. Ball, Inc.. These firms were charter members in CPEE.

The CPEE is recognized by the Internal Revenue Service as a tax-exempt, 501 (c)(3), not-for-profit organization and is governed by a board of directors that represent the various membership constituencies including education, business, government, labor. CPEE is also administered by an executive director and professional staff, all of whom are independent of any single corporation, school district, university, laboratory, governmental body or association.

Personal and Organizational Networks

Under the leadership of CPEE's Legislative Committee, headed by Jim Pearson, President of Aurora Industries, the concept of the academy was shared with area legislators, in particular Senator Forest Etheredge and U.S. Representative Dennis Hastert. In July, 1985, the Illinois General Assembly approved the establishment of the Illinois Mathematics and Science Academy (IMSA) as an integral part of the State's major educational reform package, commonly known as Senate Bill 730. In addition to mandating that IMSA serve as "a preparatory institution" which offers a "uniquely challenging education for students talented in the areas of mathematics and science" (Article III: Section 1), the General Assembly also required that the Academy "stimulate further excellence for all Illinois schools in mathematics and science" (Article III:

Section 1; 430-432). The legislation also stipulated that the Academy would be located in the Fox Valley area.

On October 17, 1985 Governor James Thompson announced the appointment of a Board of Trustees for IMSA. Of the thirteen voting members of the Board, eight were nominated by CPEE. The Governor also named the vacant North Campus of the Aurora West District 129 as the site for the school with an anticipated opening date of fall 1987.

Issues of Mutual Salience and Understanding that Interdependence is the Value Add

The CPEE worked collaboratively with IMSA in two important ways. CPEE served in the capacity of an Advisory Council, using the organizational structure already in place. CPEE acted as a conduit in disseminating information about innovations and developments in mathematics and science instruction emanating from the Academy across the State, but particularly in the northern Illinois area. Through collaboration between IMSA and CPEE, local business and educational leaders felt educational improvements in the northern Illinois region and throughout the state of Illinois could be maximized.

A Brokering or Driving Organization

After CPEE successfully insured the creation of the Illinois Mathematics and Science Academy (IMSA), CPEE continued to recognize the need for bringing the area's business and industrial resources to the local classroom. While IMSA is intended to serve the top 1/2 of one percent gifted high school students in the state, the CPEE Board of Directors redirected its focus to services and programs for the remaining 99-1/2 percent. in the northern Illinois region. CPEE inaugurated new programs for students, teachers, and school leaders including: " Achieving Excellence in Our Schools" seminar series, "Aptitude-Based Career Planning Workshops(with Ball Foundation),"Micro-Based

Information Systems for Building Level Administrators (with the School Administrator Service Associates and IBM Corporation), Saturday Scholars (with Illinois Bell Educational Relations), Laboratory Partners, and a data resource bank, linking individuals with student and school needs. Through these school-business partnership programs the communication network in the northern Illinois region betwen employers and educators was enhanced.

A Set of Existing or the Potential for New Communication Networks

CPEE received high marks from a national expert in the field of school/business partnerships in its ability to sustain school-business collaboration . Dale Mann, a noted researcher on school-business partnerships and faculty member with Teachers College/Columbia University, assessed CPEE's work in bringing schools and businesses together in an effort to improve mathematics and science education. Dr. Mann told the CPEE Board of Directors that the most successful partnerships exhibit four important characteristics: vision; endurance; a broad-based constituency of support; and a commitment to a wide range of programs rather than a focus on a single episodic project. After studying CPEE for several months, Mann informed the Board that CPEE exemplifies the first three marks of excellence. Since the organization was founded only three short years ago, he observed ". . .it is still too early to say that CPEE has endured; but all indications definitely are pointing affirmatively in that direction. On the national landscape of school/business partnerships, CPEE certainly is carving out a significant piece of the territory" (Digate & Marshall, 1986, p.5).

A Civic Entrepreneur

The critical role of the individual in the development of successful school-business partnerships has been well documented in the literature (Mann, 1984; Levine,

1983). Grobe, et al. (1990) note the "civic entrepreneurs" role results in a commitment to "do something" about an issue. This individual leader is an important player, yet few partnerships survive unless this leadership expands beyond a single individual. First, individuals create partnerships; institutions do not. Second, successful partnerships require an advocate or "champion" who plays a vigorous, visible, and persistent role in the process of initiating, planning, and implementing collaboratives. The Committee for Economic Development calls such individuals "civic entrepreneurs."

Civic entrepreneurs arose from the school and business sectors. Dr. John Swalec, President of Waubsonsee Community College, served as the first "civic entrepreneur" from the education sector.

Gary Jewel, CPEE Chairman of the Board from 1991-1993 and Superintendent of Aurora West School District 129 states:" Any fledgling organization like this one must have some "civic entrepreneur" step forward to move it to another level. In the early '80s, John Swalec was the person for CPEE. He drove the rest of us without letup until our partnership reached a point where its development was assured."

From the business sector, G. Carl Ball, Chairman of the Board, Geo. J. Ball, Inc., an international seed manufacturing and research company whose corporate offices are located in West Chicago, Illinois, arose as the next significant leader for CPEE. Ball served as the second Chairman of CPEE from 1987-1990. Ball was instrumental is getting other leaders in business and industry interested and involved.

Carl Ball (1988) stated: "Our partnership works because the participants seriously believe that, by investing our resources, we can work together to help make schools better." Carl Ball, in an address to the Mathematics Education Board in 1988, referred to the Reuben Gutoff 80/20 law and encouraged business and education leaders to focus on the commonalities and work together for the common good. Gutoff's law states that between any two organizations, 80 percent is commonality and 20 percent is

difference. Ball (1988) saw the 80/20 law as being a strong base for common good in developing effective educational programs.

The Evolution of "Interconnections 90:" Scientific Technology Literacy and the Corporate Workplace

Partnerships are creatures of their context and environment (Grobe, et al., 1990). In 1989, CPEE's focus shifted to respond more directly to the needs of the businesses and industries located in the I-88 Research and Development Corridor in Northern Illinois. Because business sought reform in education, CPEE refocused from providing enrichment services and programs to serving as an agent for educational change in its service region.

Caterpillar, Inc. located in Aurora, Illinois, expressed the views of many of the national manufacturing companies and those located regionally in the I-88 Research and Development Corridor in a 'white paper' "Education: Business' New Challenge" the concerns about public education and the long-range need for a high quality, technically competent workforce. " The available workforce is shrinking while the need for higher skilled employees is increasing. Business and education must work together to develop programs that prepare students for current and future jobs" (Caterpillar, 1990, p. 1).

In Spring 1989, CPEE facilitated meetings between local business and industries located along the I-88 Research and Development Corridor and education leaders from K-12 schools, and higher education. These discussions led to consensus that business and education work collaboratively to reduce the gap between the skills needed in business today with the skills taught in the classroom. One result of these collaborative discussions was the initiation of a new school/business partnership staff development program called "Interconnections 90: Scientific and Applied Technology and the Corporate Workplace."

The name "Interconnections," chosen for the staff development program, is a metaphor representing the multiple, interconnected levels of involvement by all participants. The "Interconnections" program reflects the inter-institutional ties between area public and private schools, business and industry, and higher education representatives from Waubonsee Community College and Northern Illinois University. District teams receive instruction from university faculty regarding integrated curriculum methodology.

"Interconnections" also reflects the intersection of school district teams consisting of teachers, counselors and administrators from various subject disciplines in the program activities. District team participation required the educators to work in problem solving teams which mirrored corporate workplace teams. Team participation ensured that members developed a local support network for the implementation of "Interconnections" curriculum improvement activities.

The name "Interconnections" highlights the opportunity for teams of educators to interact with leading corporate sector representatives that included: corporate chief executive officers, vice-presidents for research and development, human resource managers, skilled technicians, professional engineers and scientists, and entry level workers. Corporate sector representatives also have the opportunity to interact and be "connected" to teachers from grade levels K-12, counselors, and district administrators.

Finally, the name "Interconnections" focuses on the final product of the team approach. District teams produce a curriculum module which integrates mathematics, science, and technology and workplace skills into the K-12 curriculum.

Gary Jewel (1989), Superintendent of District 129 West Aurora Schools and Chairman of the Board of CPEE, stated at the time:

> For many parts of our country, the interest in school reform spawned by the national studies in the mid-80's was short lived. Something unique, however, has occurred in our region of Illinois allowing us to extend the enthusiasm for school

improvement through the 80's and well into the 90's. That something is the emergence of a strong collaborative partnership among the business, education and governmental interests in our region. The Corridor Partnership for Excellence in Education has given school improvement in our area a life of its own. Our current program initiatives take us directly to the workplace and permit us to expand our vision of what American Education can become. It is an exciting picture.

Description of the "Interconnections 90" Program

"Interconnections 90" has developed into a multi-year staff development program funded by the Illinois State Board of Education Scientific Literacy Program. "Interconnections" has been offered since spring, 1990-1992. Each year, approximately 20 school district teams, comprised of 4-5 teachers, a counselor, and a school administrator, participate in a series of staff development activities:

Kick-Off Session

- A one-day introductory seminar is held for district teams in May, of each year at Motorola Inc., in Schaumburg, IL. The day's activities include:
- Large group presentation on scientific literacy from representative of the Illinois State Board of Education Center on Scientific Literacy.
- Large group presentations by corporate representatives defining the needs of the workforce.
- Small group presentations by curriculum consultants from area universities on methods of curriculum integration.
- Small group sessions for district teams to complete short term and long term goals.

Summer Training Sessions

- A five-day summer training session is held in June of each year at selected corporate facilities: A T & T Bell Laboratory; Amoco Research Center; Geo. J. Ball, Inc.; Caterpillar, Inc.; Chemical Waste Management, Inc.; Fermi National

Accelerator Laboratory; Furnas Electric Company; Sears Training Center; Metropolitan Insurance Companies; and Motorola, Inc.

Corporate Site Team Visits

During the summer training week, participants attend day-long sessions at the selected corporate sites. District teams receive on-site corporate tours which include an overview of the company's products and services; heard panel presentations from company presidents, human resource managers, scientists and technicians, and entry-level workers regarding work skills necessary, career paths, and employment opportunities; learned about corporate training. "Interconnections" participants observe the corporate applications of mathematics, science and technology used in corporate work environments.

District teams develop, with the assistance of corporate partners, an integrated curriculum module for local use at elementary, junior high, or secondary levels of instruction which utilize math, science, and applied technology principles observed at work in the corporate workplace. Visits to corporate sites provided a structured opportunity for "Interconnections" participants to obtain information to incorporate into the curriculum module. District teams were instructed to consider the following industry themes related to attitudes, skills, and knowledge in the workplace. The following critical questions were suggested to the "Interconnections" participants when they went to the corporate site visits: What does the industry produce? (services, products, processes); What does an employee need to know? be able to do?; What are the attitudes, skills, knowledge needed?; What does an employee do to prepare: for entry? on the job? at the task?

Integrated Curriculum Training

During the summer training, large group sessions were provided on methods of integrated curriculum by curriculum consultants from Northern Illinois University. The ideas and strategies used by "Interconnections" teams relect the Jacobs model in developing an integrated unit of study (Jacobs, 1989). Each team went through the following steps:

Step 1: Selecting an organizing center

The team selected an organizing center as the focus for curriculum development. Each team was informed that the organizing center can be a theme, subject area, event, issue or problem and should neither be so broad that it is beyond the scope of definitive investiation, and be clearly defined but not to specific. Teams learned that student investigation is promoted by a clearly defined and flexible organizing center.

Step 2: Brainstorming Associations

Brainstorming with other teachers and or students to generate ideas related to the theme. The associations may include questions, topics, people, ideas and materials that relate to the topic.

Step 3: Establish guiding questions to serve as a scope and sequence

The teams developed questions that are cross-disciplinary and analogous to chapter headings in a book.

Step 4: Writing activities for implementation

Writing activities allow students to demonstrate what they've learned and let them generalize or apply this learning in a meaningful way.

Integrated Curriculum Module Development

During the summer training session, district teams work in small group sessions to develop their integrated curriculum modules. The curriculum module produced identifies both long term and short term goals and these components: theme, learner

goals and objectives, rationale, target audience (i.e. elementary, middle school high school), title, background information, materials list, procedures including classroom activities, physical requirements, suggested pedagogical strategies, topics for classroom discussion and suggested questions, evaluation, methods of reinforcement, supplemental exercises, student materials and handouts, optional extensions, references/bibliography.

To ensure successful module implementation, the "Interconnections" teams outline strategies for administrative support, and career development strategies for teachers and counselors to support the district long-term and short-term goals. Administrators are required to sign off on the completed curriculum module to ensure that each module had all of the required components. Curriculum modules are printed in a report and distributed to all "Interconnections" participants who shared in the program experience.

Follow-up Session

A one-day follow-up session is held in the fall of each year for participating "Interconnections" teams to finalize the curriculum module, to refine the short-term plan of action for implementation of the curriculum module, and to share their curriculum modules with other "Interconnections" participants.

Summary

The CPEE is an exemplary school-business partnership which has responded to the need for educational reform during the past decade. CPEE's partnership development parallels the paradigm shift in partnership activities and educational reform inititiatives moving partnerships from exclusively providers of programs and services to agents of change in teacher training and catalysts in curriculum change. "Interconnections 90: Scientific and Applied Technology Literacy" is a staff development program designed to

bring school district teams into corporate sites to develop integrated curriculum modules for classroom use.

Chapter IV describes the methodology of the study, design of the study, participant selection, subjects, instruments used, administration of the survey, methods of data analysis, and summary.

CHAPTER IV

METHODOLOGY

Design of the Study

This study is based on program evaluation of "Interconnections 90:" Scientific and Applied Technology and the Corporate Workplace staff development program, a current program initiative of the CPEE for a three year period. This study utilizes data collected from three independent non-random samples over the three year period, 1990-1992.

Research Questions

The specific research questions addressed in this study are:

1. Does change occur in teachers', counselors', and administrators' knowledge and attitudes relative to integrated curriculum development as a result of participation?
2. Does change occur in teachers', counselors', and administrators' knowledge and attitudes regarding the corporate sector's workforce employment needs?
3. Do curriculum changes occur at the local district level after participants complete "Interconnections" training?

Hypotheses

The following hypotheses were tested: 1) it was expected that teachers', counselors', and administrators' knowledge and attitudes relative to integrated curriculum development would change in a positive direction; 2) it was expected that teachers',

counselors' and administrators' knowledge and attitudes regarding the corporate sectors' workforce employment needs would change in a positive direction; and 3) it was expected that integrated curriculum models would be incorporated into the curriculum at the local district level.

This study examines change from two levels of analysis, the individual and organizational unit of analysis.

Individual Unit of Analysis

In order to evaluate the individual change in teachers', counselors' and administrators' attitudes and knowledge of the corporate sectors' workforce needs, and knowledge and attitudes relative to an integrated curriculum a pretest/posttest survey design was utilized. Information was gathered at set interals throughout the workshop through a survey. The same survey also measured teachers', counselors' and administrators' attitudes and knowledge of integrated curriculum. Additional qualitative information was obtained regarding participants' knowledge of the concepts and feasibility of integrated curriculum developement through the open-ended survey. Additional attitudinal data was gathered during the "Interconnections" Industry and Training Component through the survey "Corporate Workplace Tour Evaluation."

Organizational Unit of Analysis

In order to evaluate the impact of change on the organization a follow-up IMPACT survey was developed. The IMPACT survey was mailed to all "Interconnections" participants in September, 1992. Phone interviews were conducted with selected school teams to evaluate impact at the local school district level.

Figure 2 delineates the data collected for the "Interconnections 90" program.

Figure 2. Variables Measured in "Interconnections"

VARIABLES Measured	**YEAR 1 - 1990 Pilot**		**Year 2 - 1991**		**Year 3 - 1992**	
1. PEOPLE A. DISTRICT TEAMS CHARACTERISTICS Gender: Male/Female	X		X			
Ethnic Group	X		X			
Position in School District: Teacher/Counselor/Administrator	X		X			
Years in Profession: 0-3/4-7/8-11/12-15/16+	X		X			
Field of Study: Math/Science/Vocational	X		X			
Guidance/Administration	X		X			
Type of District: Urban/Suburban/Rural	X		X			
School Level: Elementary/ Middle School/High School	X		X			
District Team Participants Expectations	Pre-/Post Survey Completed		Pre-/Post Survey Completed			Pre-/Post Survey:
District Team Participants Attitudes, Skills, Knowledge of Integrated Curriculum	Pre-/Post Survey Completed		Pre-/Post Survey Completed			Pre-/Post Survey:
District Team Participants Readiness for Integrated Curriculum Development	Pre-/Post Survey Completed		Pre-/Post Survey Completed			Pre-/Post Survey:
District Team Participants Attitudes, and Knowledge of Corporate Sector Employment Needs	Pre-/Post Survey Completed		Pre-/Post Survey Completed			Pre-/Post Survey:
Workshop Structure, Events, Products	Post Test		Post-Test Completed			Post Test:

VARIABLES	YEAR 1 - 1990 Pilot		Year 2 - 1991		Year 3 - 1992	
B. OTHERS Teachers (non-participants) in School District		Survey, Interviews		Survey, Interviews		Survey: June, 1992
Administrators (non-participants) in School District		June, 1992		June, 1992		Survey: June, 1992
Corporate Sector Participants Attitudes Regarding Teachers, Instruction, Curriculum Change		June, 1992		June, 1992		Survey: June, 1992
2. CURRICULUM Module	20 Modules Completed		22 Modules Completed			20 Modules (August, 1992)
Characteristics - Instructional Level				Artifacts		Artifacts/ Anecdotes
Interdisciplinary Subjects		Artifacts		Anedotes		
Faculty Teaching		Anecdotes				
Content						
Structure						
District Needs						
District Goals						
3. INSTRUCTION Module`	20 Modules Completed	Interviews	22 Modules Completed	Interviews		Modules (August, 1992)
Instructional Level		Artifacts		Artifacts		Artifacts/ Interviews
Pedagogical Strategies						
Method of Instruction						

VARIABLES	YEAR 1 - 1990 Pilot		Year 2 - 1991		Year 3 - 1992	
4. STAFF DEVELOPMENT		Impact Survey		Impact Survey		Impact Survey
Teachers in Building		X		X		X
Dist. - Teachers/Administrators/Board of Ed.		X		X		X
Community - Parents/Business and Industry		X		X		X
5. CHANGE PROCESS		Impact Survey		Impact Survey		Impact Survey
CHANGE BARRIERS - FACTORS						
Lack of Funding		X		X		X
Lack of Planning Time		X		X		X
Faculty Resistance		X		X		X
Administrative Support Central Office		X		X		X
Scheduling Constraints		X		X		X
Turf Issues		X		X		X
Low-Motivated Students		X		X		X
Lack of Support - Parents, School, Community		X		X		X
Extra Work		X		X		X
Communication		X		X		X
Facilities		X		X		X
Resources		X		X		X
CHANGE PROMOTER - FACTORS						
Funding		X		X		X
Planning Time/Release Time		X		X		X
Administrative Support		X		X		X
Scheduling		X		X		X
Students		X		X		X
Community Support - Parents, Business & Industry		X		X		X
Facilities		X		X		X
Faculty - Teaching		X		X		X
Communication		X		X		X
Access to Resources - Materials/ Personnel/ Equipment		X		X		X

Participant Sample

Participants in the study consisted of volunteer school district teams from schools in Northern Illinois. These voluntary educational teams included teachers, counselors and administrators from elementary, secondary and unit districts in Northern Illinois.

Subjects

Figure 3 delineates the number of participants in the Multi-Year Expansion Timeline.

Figure 3. "Interconnections" Training Participants 1990-1993.

1990-1991	1991-1992	1992-1993
Participants beginning training:	Participants beginning training:	Participants beginning training:
N=20 district teams	N=22 district teams	N=19 district teams
N=80 teachers	N=98 teachers	N=97 teachers
N=20 counselors	N=18 counselors	N=18 counselors
N=20 administrators	N=17 administrators	N=22 administrators
N=7 corporate partners	N= 8 partners	N= 9 partners
Cummulative Total:		
N=20 districts	N=42 districts	N=61 districts
Total School District Participants:	451	
Total Corporate Participants:	24	

Corporate Partners

The businesses and research institutions that supported the Corridor Partnership's "Interconnections 90," "91," & "92" program are located in the Illinois Research and Development Corridor, extending approximately 25 miles west of Chicago along I-88 from Oak Brook to DeKalb, Illinois. Participating corporations included: AT&T Bell

Laboratory; Amoco Corporation; Geo J. Ball, Inc.; Caterpillar, Inc.; Chemical Waste Management, Inc.; Fermi National Accelerator Laboratory; Furnas Electric Company; Metropolitan Insurance Companies; Motorola Inc.; and Sears Training Center.

Participant Selection

During the three year period from 1990-1992, district teams consisting of 4-5 teachers, a counselor, and an administrator participated in the "Interconnections 90" staff development activities with identified corporate partners. Each year the number of district teams completing the "Interconnections" program increased by 20 teams and the number of corporate participants expanded. Over the three year period of this multi-year program, the total number of district teams participating in the "Interconnections" program was 61. All grade levels K-12 were represented by the elementary, secondary and unit district participants.

An invitation was mailed to all public and private schools in the following counties of Northern Illinois: DeKalb, DuPage, Kane, Will, Lake, Kendall, and parts of Cook through CPEE. Registrations are accepted on a "first received" basis until the workshop was filled with 20 district teams each year.

Instruments

The evaluation of participants knowledge and attitudes regarding the corporate sectors' employment needs and integrated curriculum required measures that would be sensitive to the nature of the topics covered in the "Interconnections 90" program. Consequently, it was necessary to develop instruments that would directly relate to the goals addressed in "Interconnections 90." The content of the "Interconnections" workshop was carefully outlined to specify major issues related to knowledge and attitude development regarding corporate sector's employment needs and integrated

curriculum. Goals 1-6 were synthesized into six areas of focus for the purpose of data collection through a pretest/posttest design. The following six areas were assessed:

1. Current understanding of an integrated curriculum.
2. District readiness for curriculum development.
3. Expectations for the workshop.
4. Workshop structure.
5. Workshop events.
6. Workshop products.

Pretest/Posttest

A likert-type scale was employed using a fifty-five (55) survey items designed to measure workshop particpants' knowledge and attitudes relative to integrated curriculum development, as well as the workshop events and products, and overall rating. Examples of the survey questions include: Question 1:"An integrated curriculum builds student skills in thinking, reading,writing and computation."; Question 10: "Integrated curriculum developed for the "forgotten half" will impact 70% of the U.S. job openings."

Figure 4 delineates the survey items which measured the six areas of focus:

Figure 4. Knowledge and Attitudes Relative to Integrated Curriculum Development

Area of Focus	Questions
Assessment of current understanding	1-10
Assessment of district readiness for curriculum development	11-18
Expectations of the workshop	19-28

The remaining 27 additional questions appeared on the posstest only. (Appendix A):

Area of Focus	Questions
Structure of the workshop	29-43
Workshop events	44-48
Workshop products	49-55

The response format for Questions 1-28 was strongly agree (1), agree (2), unsure (3), disagree (4), and strongly disagree (5). The format differed for the twenty-seven additional items appearing on the posttest only. For Questions 29-43 (Area of Focus 4), the response format was strongly agree (1), agree (2), undecided (3), and disagree (4). Questions 44-48 (Area of Focus 5) had a response format of very valuable (1), valuable (2), marginal value (3), and not valuable (4). Finally, Questions 49-55 (Area of Focus 6) had a response format similar to that of Question 1-28.

The pretest/posttest instrument had background questions concerning participants' gender, position, years in the profession, and academic field of study for the purpose of defining the participant group (see appendix A).

Open-Ended Questionnaires

An open-ended questionnaire was also administered during the pilot year (1990) and in 1991 to ascertain participants' knowledge base and attitudes regarding the concept and feasibility of integrated curriculum development. The questionnaire was formatted to closely follow the areas of focus employed on the pretest/posttest design. The questionnaire contained 7 questions. Survey question 1 asked participants to discuss their concept of integrated curriculum. Survey question 3 asked participants to identify up to three (3) things available in their school that they think will make it possible to develop an integrated curriculum. Survey question 5 asked participants to identify three key science concepts that would be appropriate for integrating science, mathematics, and technology.

This additional instrument allowed participants to express themselves freely as opposed to the forced choice format emphasized on the pretest/posttest measure (see appendix B). This instrument was revised to a forced choice format in 1992 based on responses to the open-ended question about resources. The survey was formatted to closely follow the areas of focus in the pretest/posttest design. Survey question 3 participants were asked to identify the most significant resource available in their school district that they believe will make it possible to develop an integrated curriculum: a) creative, open-minded staff; b) support from administration; c) positive attitudes of faculty, parents and students; d) availability of facilities and equipment; and e) team teaching. Survey question 5 participants were asked what is the most important science concept for integrating science, mathematics and technology: a) problem solving, b) scientific method, c) mechanics, d) observation, and e) space exploration.

Corporate Workplace Tour Evaluation

"Interconnections" Industry and Training Component consisted of a five-day (one week) intensive training workshop held at selected corporate facilities. An important part of the "Interconnections" program was the corporate site visit. During the summer training week "Interconnections" teams participated in visits to three corporate sites: Caterpillar, Inc.; Chemical Waste Management, Inc.; Furnas Electric Co.; In addition, participants selected to attend one of the following sites: AT& T Bell Laboratories; Amoco Corporation; Geo. J. Ball, Inc.; Sears Training Center; Metropolitan Life Insurance Co.; and Motorola, Inc.

For purposes of evaluation, a likert-type scale was designed to measure participants' knowledge and attitude development relative to the pre-employment skills and technological educational needs of selected corporations in the Illinois Research and Development Corridor (I-88). "Corporate Workplace Tour Evaluation" given to each participant sought to determine their reactions and opinions regarding: (A) Information Obtained During the Visit, (B) Elements of the Corporate Visit, and (C) Overall Evaluation of the Corporate Visit in Figure 5.

Figure 5. "Corporate Workplace Tour Evaluation"

Area of Focus	Questions
A. Information Obtained During the Visit	1. Employment opportunities that exist in the company. 2. Trends affecting future job requirements, particularly in areas of mathematics, science, and technology. 3. Compensation/employee benefits. 4. Employment areas particularly in demand, especially as relates to science, mathematics, and technology. 5. Qualifications required for entry level positions. 6. Common problems with poorly prepared applicants in the employment process. 7. Employment skills necessary, especially those related to problem-solving skills, interpersonal skills in working in teams, etc. 8. Retraining effects pursued by the company in the areas of basic skills remediation, as ongoing training/development and education.
B. Elements of the Corporate Visit	9. Overview of the company. 10. Panel presentation. 11. Company tour. 12. Question and answer period. 13. Follow-up discussion. 14. Material on company products and services.
C. Overall Evaluation of the Visit	15-22 General interest. Relevance of visits. Demands. Summany assessment.

The response format for questions 1-8 was a great deal (1), some (2), little (3), none (4). The response format for questions 9-14 was very useful (1), somewhat (2), marginally (3), not at all useful (4), didn't have (5). The response format for questions 15-38 was extremely (1), very (2), somewhat (3), not at all (4) (see appendix C).

IMPACT Survey

The major purpose of the IMPACT Survey was to measure the impact of "Interconnections 90," "91," "92" program on curriculum change at the local school district level. A survey was developed which included questions about the participant and the perceived impact of the "Interconnections" experience at the local level.

The background information section contained four questions including: year of "Interconnections" participation, district, position, grade level. The "IMPACT of Interconnections Experience" included eleven questions related to the implementation of the integrated curriculum module formated in yes/no responses. Participants were asked: "Did you implement the integrated curriculum module you developed during the next school year?"; "Did your "Interconnections" team provide inservice training to other educators within your school building, in your school district, at conferences, workshops or seminars?"

Additionally, participants were asked open ended questions related to achievements and barriers encountered in implementation of integrated curriculum modules (see appendix D). The survey was mailed in August, 1992, to all participants.

A survey was developed for corporate participants about the perceived impact of the "Interconnections" experience. The survey contained open ended questions and a six item likert-type scale rating the "Interconnections" experience. The response format for rating the "Interconnections" experience was excellent (1), good (2), fair (3), poor (4), does not apply (5) (see appendix E). The survey was mailed in August, 1992.

Administration of the Surveys

To determine the effects of "Interconnections 90" on participants' knowledge and attitudes regarding integrated curriculum development, a pretest/posttest design was

employed in 1991 and 1992. The pretest/posttest was designed to measure participant's knowledge and attitudes regarding integrated curriculum. Workshop participants were pretested at the "Interconnections 91, & 92 Kick-Off" held in Year 2 on May 10, 1991, and Year 3 on May 8, 1992, at Motorola Inc. in Schaumburg, IL; and posttested on the final day of the workshop held in Year 1 on June 21, 1991, and Year 3 on June 19, 1992, at the Davea Center in Addison, IL. During Year 1, participants were posttested on June 22, 1990, only. The "Open Ended Questionnaire" was also administered on these dates. The "Open Ended Questionnaire" was designed to measure participant's knowledge of integrated curriculum.

The administrator of the surveys explained the directions to the teachers, counselors, and administrators, and informed them that their answers would be kept confidential. Names were not included on the survey forms.

"Corporate Workplace Tour Evaluation" was designed to measure participants' knowledge of corporate workplace needs. These evaluations were collected each day from participants following their corporate site team visits during the one week summer industry training held in Year 1 during June 18-22, 1990; Year 2 during June 17-21, 1991; and Year 3 during June 15-19, 1992.

The IMPACT survey was designed to measure curriculum change. These surveys were mailed in August, 1992, to all "Interconnections" participants including educator teams and corporate partners in 90, 91, and 92.

Case study information was obtained from telephone interviews with "Interconnections" participants, as well as other district personnel.

Summary

Teachers, counselors and administrators completed anonymous survey instruments administered during the "Interconnections" staff development activities.

These instruments included a pretest/posttest, designed to measure participants' knowledge and attitudes regarding integrated curriculum; an open-ended survey, designed to measure participants' knowledge of integrated curriculum; corporate tour evaluations, designed to measure participants knowledge of corporate workplace needs; an IMPACT survey, designed to measure curriculum change at the local district level; and case study were compiled based on interviews to highlight curriculum change at a selected school district.

Participants developed integrated curriculum modules as the culmination of the "Interconnections" staff development activities to be implemented at the local building level.

Chapter V presents a discussion of the results of the study and analysis of the data pertaining to the research questions.

CHAPTER V

PRESENTATION AND ANALYSIS OF THE DATA

This chapter will present an examination of the research questions: As a result of participation in "Interconnections 90" staff development program....

1) What is the change in teachers', counselors', and administrators' knowledge and attitudes relative to integrated curriculum development?

2) What is the change in teachers', counselors', and administrators' knowledge and attitudes regarding the corporate sector's workforce employment needs?

3) What curriculum changes occur at the local district level?

Analysis of the Data

All data processed was carefully entered and scanned using standard data processing procedures to minimize processing errors. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS-X).

Hypothesis I: Pretest/Posttest Integrated Curriculum Knowledge and Attitudes

Tests to determine significant differences between pretest and posttest measures were employed with an approximation of a correlated t-test applied for questions 1-18. The twenty-seven (27) items on the posttest only (Q29-55) were summarized in a similiar fashion to Q1-28. Mean ratings for Q29-55 were compared to the indeterminent rating of 3.0 (unsure), so that ratings less than 3.0 were viewed as participant agreement, while ratings greater than 3.0 were viewed as participant disagreement. (This is based on the rating scale of 1-5 for responses.)

Posttest Only

The quantitative questionnaire administered in Year 1 on May 10, 1991, and Year 2 on June 21, 1991, provided pretest and posttest comparisons for the first 28 items. The remaining items (Questions 29-55) were administered at the time of posttest only (June 21, 1991) and descriptive analysis regarding Areas of Focus 4-6 were provided. A positive response was noted when the majority of participants (50%) agreed with the statement. A negative response was recorded when the majority of participants (50%) disagreed with the statement. Additionally, a neutral response was noted when the majority of participants (50%) were undecided.

Open-Ended Questionnaires

In addition to statistical analyses, qualitative analyses were used to analyze the data collected from the open-ended questionnaires. Questionnaires were randomly reviewed to determine the frequency and percentages of common responses among participants. Every third survey was analyzed in an item by item format, with rank orders then established for the ten most common responses per item. These responses correspond to the seven (7) open-ended questions administered during the "Interconnections" Industry Training activities.

Hypothesis 2: Knowledge of Corporate Sector Workplace Needs

"Interconnections" participants were scheduled into corporate sites and in turn reponded to the site visit through the completion of the "Corporate Workplace Tour Evaluation." Percentages of participants per site are provided. As a means to show comparative results between "Interconnections 90," "91," and "92" the categories and key words in this section were grouped similarly for the 1991 and 1992 assessment. A cross tabulation was made of the corporate workplace sites visits to provide a general summary of the results.

Hypothesis 3: Curriculum Change: IMPACT Survey

Percentages of responses to the questionnaire items on the IMPACT survey are reported. In addition, common responses to open-ended questions are reported. These open-ended responses were designed to examine opinions from the educator teams and the corporate participants.

DESCRIPTIVE DATA/SAMPLE

Teams

Gender

In 1990 the profile of the "Interconnections" participants represented a slightly higher percentage of female participants (56%). Whereas, the profile of the "Interconnections 91" participants represents a slightly higher percentage of male participants (52.67%) as compared to female participants (45.805). In 1992, no gender information was obtained.

Ethnicity

In 1990 no ethnic data was obtained. The predominant ethnic group in both 1991 and 1992 was white-nonhispanic.

Table 1.--Positions Held in School District

Year	Teacher	Administrator	Counselor	Other
1990	70%	17%	13%	
1991	74.05%	10.69%	10.69%	3.05%
1992	68.5%	15.75%	11.7%	3.9%

The positions held by the "Interconnections" participants ranged from teacher to administrator to counselor. These data reflect the design of the "Interconnections" teams which required that each district team be comprised of 4-5 teachers, a counselor, and an administrator. The "other" participants included library resource personnel or district technology coordinators.

Table 2.--Years in the Profession

Year	0-3	4-7	8-11	12-15	16+
1991	6.11%	11.45%	11.45%	13.74%	54.96%
1992	9.4%	15.6%	4.7%	9.4%	59.4%
1990	No data obtained				

The majority of participants have 16 or more years of experience in the profession.

Field of Study

In 1990 no data was obtained. In 1991 participants represented a variety of academic fields and professional training: 30% represented the area of science, 21.31% vocational education, 19.67% math, 13.11% administration, and .82% guidance and counseling. Missing data represented 14.75%.

In 1992, participants represented a variety of academic fields and professional training: 20.5% represented the area of science, 26.8% vocational education, 17.3% math, 7.9% administration, 10.2% guidance and counseling, 16.4% other.

In summary, the typical "Interconnections" participant was an experienced teacher, white male, with a science background.

School District Team Participation

Twenty-four school district teams participated in "Interconnections" for one year only. Eight school district teams participated in "Interconnections" for two consecutive years. Five school district teams participated in "Interconnections" for three consecutive years.

TESTS OF HYPOTHESIS 1

Teachers', Counselors', and Administrators' Knowledge and Attitudes Relative to Integrated Curriculum Development Would Change in a Positive Direction

Pretest/Posttest Results in 1991 and 1992

Q1: Pretest: An integrated curriculum builds student skills in thinking, reading, writing and computation.

Posttest: An integrated curriculum builds student skills in thinking, reading, writing and computation.

Table 3.--Knowledge About Integrated Curriculum 1991

			Frequency	
	Response		Pre	Post
Strongly Agree	1		88	100
Agree	2		41	27
Unsure	3		1	0
Disagree	4		0	1
Strongly Disagree	5		1	0
		N =	131	128
		$\bar{X}$ =	1.36	1.23
		SD =	.58	.48

1.97 is significant at = .05.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 4.--Knowlege About Integrated Curriculum 1992

	Response		Frequency Pre	Post
Strongly Agree	1		54	50
Agree	2		21	24
Unsure	3		2	3
Disagree	4		0	1
Strongly Disagree	5		0	0
	Missing		1	0
		$\overline{X}$ =	1.325	1.423
N = 77		t-value	-1.65	p-value .103

This indicates that while there was no significant change in attitude, participants were slightly less positive at the time of posttesting.

Q2: Pretest: A module that incorporates an Applied Mathematics or Science or Technology organizing theme with needs of the corporate workplace promotes student workplace literacy such as recycling.

Posttest: A module that incorporates an Applied Mathematics or Science or Technology organizing theme with needs of the corporate workplace promotes student workplace literacy such as recycling.

Table 5.--Knowledge About Integrated Curriculum 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		44	62
Agree	2		53	61
Unsure	3		31	5
Disagree	4		0	0
Strongly Disagree	5		0	0
		N =	128	128
		$\overline{X}$ =	1.90	1.55
		SD =	.76	.57

4.22 is signficant at = .05.

*3 cases missing in pretest.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 6.--Knowledge About Integrated Curriculum 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		36	45
Agree	2		37	27
Unsure	3		4	6
Disagree	4		0	0
Strongly Disagree	5		0	0
	Missing		1	0
		$\overline{X}$ =	1.584	1.500
N = 77		t-value	.97	p-value .334

*3 cases missing in pretest.

This indicates that while participants' attitudes toward this question were not significantly changed, participants were slightly more positive at the time of posttesting.

Q9: Pretest: A course such as "Principles of Technology," which reflects real-world workplace applications, better prepares students for future employment.

Posttest: A course such as "Principles of Technology," which reflects real-world workplace applications, better prepares students for future employment.

Table 7.--Knowledge About Integrated Curriculum 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		44	57
Agree	2		57	59
Unsure	3		20	11
Disagree	4		9	0
Strongly Disagree	5		1	1
		N =	131	128
		$\overline{X}$ =	1.98	1.66
		SD =	.92	.70

3.16 is significant at = .05.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 8.--Knowledge About Integrated Curriculum 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		28	28
Agree	2		35	41
Unsure	3		12	6
Disagree	4		3	2
Strongly Disagree	5		0	1
	Missing		0	0
		$\overline{X}$ =	1.872	1.808
N = 78		t-value	1.872	p-value .496

This indicates that while participants' attitudes toward this question were not significantly changed, participants were slightly more positive at the time of posttesting.

Q10: Pretest: Integrated curriculum developed for the "forgotten half" will impact 70% of the U.S. job openings.

Posttest: Integrated curriculum developed for the "forgotten half" will impact 70% of the U.S. job openings.

Table 9.--Knowledge About Integrated Curriculum 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		32	40
Agree	2		49	60
Unsure	3		47	23
Disagree	4		3	2
Strongly Disagree	5		0	1
		N =	131	126
		$\overline{X}$ =	2.16	1.92
		SD =	.82	.80

2.35 is significant at = .05.

*2 cases missing at posttest

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesing.

Table 10.--Knowledge About Integrated Curriculum 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		24	31
Agree	2		45	38
Unsure	3		9	7
Disagree	4		0	1
Strongly Disagree	5		0	1
	Missing		0	0
		$\overline{X}$ =	1.808	1.756
N = 78		t-value	.51	p-value .609

2.35 is significant at = .05.

*2 cases missing at posttest.

This indicates that while participants' attitudes toward this question were not significantly changed, participants were slightly more positive at the time of posttesing.

Q16: Pretest: Collaboration between education, business and industry is a necessary component of quality curricular development.

Posttest: I will understand that collaboration between education, business and industry is a necessary component of quality curricular development.

Table 11.--Knowledge About Integrated Curriculum 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		52	77
Agree	2		70	45
Unsure	3		6	2
Disagree	4		3	0
Strongly Disagree	5		0	1
		N =	131	125
		$\overline{X}$ =	1.69	1.42
		SD =	.67	.61

3.33 is significant at = .05.

*3 cases missing in posttest.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 12.--Knowledge About Integrated Curriculum 1992

	Response	Frequency Pre	Frequency Post
Strongly Agree	1	41	45
Agree	2	29	26
Unsure	3	5	3
Disagree	4	2	3
Strongly Disagree	5	1	1
	Missing	0	0
		$\overline{X}$ = 1.628	1.577
N = 78		t-value .60	p-value .336
3.33 is significant at = .05.			

This indicates that while participants' attitudes toward this question were not significantly changed, participants were slightly more positive at the time of posttesting.

Q17: Pretest: School teams are an effective way to develop integrated curriculum.

Posttest: I believe that school teams are an effective way to develop integrated curriculum.

Table 13.--Knowledge About Integrated Curriculum 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		42	62
Agree	2		76	60
Unsure	3		11	4
Disagree	4		2	0
Strongly Disagree	5		0	0
		N =	131	126
		$\overline{X}$ =	1.79	1.54
		SD =	.65	.56

3.28 is significant at = .05.

*2 cases missing in posttest.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 14.--Knowledge About Integrated Curriculum 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		42	40
Agree	2		29	29
Unsure	3		7	6
Disagree	4		0	3
Strongly Disagree	5		0	0
	Missing		0	0
		$\overline{X}$ =	1.551	1.474
N = 78		t-value	.97	p-value .336

3.28 is significant at = .05.

This indicates that while participants' attitudes toward this question were not significantly changed, participants were slightly more positive at the time of posttesting.

Q18: Pretest: "Interconnecting" science, math and vocational education is likely to change the structure of school curricula.

Posttest: I believe that "Interconnecting" science, math and vocational education is likely to change the structure of school curricula.

Table 15.--Knowledge About Integrated Curriculum 1991

		Frequency	
	Response	Pre	Post
Strongly Agree	1	48	56
Agree	2	62	52
Unsure	3	15	17
Disagree	4	3	2
Strongly Disagree	5	1	0
	N =	129	127
	$\overline{X}$ =	1.81	1.72
	SD =	.79	.75

0.93 is not significant at = .05.

*2 cases missing at pretest, *1 case missing in posttest.

This indicates that participants' attitudes toward this question were not significantly changed, with participants remaining positive toward this statement at the time of posttesting.

Table 16.--Knowledge About Integrated Curriculum 1992

	Response		Frequency Pre		Post
Strongly Agree	1		29		40
Agree	2		33		29
Unsure	3		15		6
Disagree	4		1		3
Strongly Disagree	5		0		0
	Missing		0		0
		$\overline{X}$ =	1.846		1.641
N = 78		t-value	2.04	p-value	.045

This indicates that participants' attitudes toward this question were significantly more positive toward this item at the time of posttesting.

Q24: Pretest: I expect to gain "hands-on" experience in developing integrated curriculum materials.

Posttest: I gained "hands-on" experience in developing integrated curriculum materials.

Table 17.--Knowledge About Integrated Curriculum 1992

	Response		Frequency Pre	Post
Strongly Agree	1		35	19
Agree	2		83	18
Unsure	3		10	2
Disagree	4		3	0
Strongly Disagree	5		0	0
		N =	131	39
		$\overline{X}$ =	1.85	1.56
		SD =	.65	.60

2.05 is significant at = .05.

*89 cases missing at posttest.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting. However, since 89 cases were missing at the time of posttesting, this interpretation must be viewed with caution.

Table 18.--Knowledge About Integrated Curriculum 1992

	Response		Frequency Pre	Post
Strongly Agree	1		20	7
Agree	2		49	37
Unsure	3		8	8
Disagree	4		1	21
Strongly Disagree	5		0	5
	Missing		0	0
		$\overline{X}$ =	1.872	2.744
N = 78		t-value	-6.10	p-value .000

This indicates that participants' attitudes were significantly less positive toward this item at the time of posttesting.

Table 19.--A Comparison of Integrated Curriculum Knowledge Pretest/Posttest Scores in 1991 and 1992

	Q1	Q2	Q9	Q10	Q16	Q17	Q18	Q24
1991 Mean Pretest Scores	1.36	1.90	1.98	2.16	1.69	1.79	1.81	1.85
1991 Mean Posttest Scores	*1.23	*1.55	*1.66	*1.92	*1.42	*1.54	*1.72	*1.56
1992 Mean Pretest Scores	1.325	1.584	1.872	1.808	1.628	1.551	1.846	1.846
1992 Mean Posttest Scores	-(1.423)	(1.500)	(1.808)	*1.756	*1.577	(1.474)	*1.641	-2.744

*Is significantly more positive at .05 level of significance.

()is slightly more less positive at .05 level of significance.

-()is slightly less positive.

Open-Ended Survey Results 1991

Qualitative results are reported below via a rank order response format. These responses correspond with the seven (7) open-ended questions administered during the workshop activities.

Q1: "Discuss your concepts of an integrated curriculum."

Table 20.--Concepts of an Integrated Curriculum

Concepts	Rank
Integrating subject matter/Decompartmentalize learning	1
Communication between staff, faculty & administration	2
Team Teaching	3
Holistic Education	4
Relating Business/Industry to academics	5
Relating school to real life situations/"hands-on"	6
Working cooperatively with businesses	7
Access to Resources	8
Student interaction	9
Working together towards a common goal	10

The general concensus indicates that participants' concepts of an integrated curriculum appear to focus predominantly on integrating subject matter across departmental lines. Most agree that this integration requires open and positive communication between faculty, staff and administration, and may necessitate a team teaching approach. Although not to dismiss the importance of involving business and industry in the design of an integrated curriculum, participants did not perceive this requirement as a top priority.

The following responses represents a cross-section of participants' responses to Question 1:

> The responsibility of more than one discipline to present material and to demonstrate the crossover or joint relevance of the subject.
>
> The meaningful application of curricular areas within a thematic unit taught by several teachers concurrently or by one teacher as a unit.
>
> Students must be taught how science, social science, English, mathematics and technology are related.
>
> Integrating high tech (CNC-CAD/CAM-CAD) with principles of technology, applied mathematics and manufacturing or industrial attitudes.

Q2: "Identify the required components of a module for interconnecting science, mathematics and technology with the needs of the corporate workplace."

Table 21.--Required Components for Integrating Science, Mathematics and Technology

Components	Rank
Communication and cooperation among faculty and administration	1
Understanding needs of the corporation or workplace	2
Appropriate materials and equipment	3
Hands-on experience	4
Assess and evaluate experiences	5
Time as a resource	6
Funding	7
Space and facilities	8
Attitudes and skills of students	9
Other (flexible schedules, technical writing, feedback from businesses)	10

As was true in Question 1, participants ranked communication and cooperation among faculty and administrators as the priority component. Closely behind this acknowledgement was that the needs of the corporation or workplace must be considered. If one groups the remaining components, it appears that they relate to funding, facilities, and equipment.

The following responses represent a cross-section of participants' responses to Question 2:

> Teachers from all areas must be willing to share ideas and most of all be flexible in their curricular areas in order to provide this revised plan.
>
> Willing staff; necessary materials; necessary time; community support; developing student interest.
>
> Brainstorming by people from similar disciplines/different schools.
>
> Implement interconnection modules with the support of school administrators, individual departments and local corporations.

Q3: "Identify up to three (3) things available within your school district that you believe will make it possible to develop an integrated curriculum."

Table 22.--Resources Available Within School District to Enhance Development of an Integrated Curriculum

Resources	Rank
Creative, open-minded staff	1
Support from administration	2
Positive attitudes of faculty, parents and students	3
Availability of facilities and equipment	4
Team Teaching	5
Funding	6
Unique size of departments and classes	7
Strong academic or vocational programs	8
Cooperation between local business and schools	9
Other (access to industry, self motivation)	10

The overriding resources identified by participants to enhance and ensure the development of an integrated curriculum may be classified under the category of cooperation, support, positive attitudes and creativity of faculty, staff, administration and students. A review of the remaining identified resources is interesting, especially from the perspective that more tangible needs such as space, facilities and equipment were not perceived as important in this implementation.

The following represents a cross-section of participants' responses to Question 3:

> Administrative approval; cooperating teachers; creativity.
>
> Teachers that work well together; commitment from administrators to improve programs; a growing awareness of local businesses that cooperation between them and the school district benefits them.

Commitment of teachers, principal and administration that integration is key to providing a solid, useful education to many of our students.

Creativity of teachers; interested students; eager corporate partners.

Q4: "Identify up to three (3) things that exist within your district that you think will inhibit the development of an integrated curriculum."

Table 23.--Things That Inhibit the Development of an Integrated Curriculum Within School District

Things That Inhibit Development	Rank
Lack of funding	1
Lack of time	2
Resistance to change among faculty	3
Lack of encouragement from central office and administrators	4
Lack of parental support	5
Scheduling constraints	6
Turf issues	7
Extra work involved	8
Low motivated students	9
Other (Apathetic community, overcrowded school, lack of inservice time)	10

In this particular category, the major inhibitors to the development of an integrated curriculum were perceived by participants as a lack of financial and time resources. Closely following this was a perception that colleagues would resist change, coupled with a lack of encouragement and/or support from upper administration. The remaining concerns dealt with turf issues, extra work and diminished parental support.

The following is a cross-section of participants' responses to Question 4: "Old mindedness - leave me alone, I'm comfortable with how things are now."

Unsure of how much time and money district will be willing to invest in all of this.

Lack of encouragement by administration who now feel bogged down with present responsibilities.

Deeply entrenched departmentalized system; 'turf protection'; a tired staff excessively burdened with day to day survival; an administration without vision.

Q5: "List three (3) key science concepts that would be appropriate for interconnecting science, mathematics and technology."

Table 24.--Key Science Concepts Appropriate for Integrating Science, Mathematics and Technology

Science Concepts	Rank
Problem solving	1
Scientific method	2
Mechanics	3
No answer	4
Observation	5
Space Exploration	6
Logic	7
Critical Thinking	8
Measurement	9
Other (Physics, Acid-Base Chemistry, Electricity, Energy)	10

The three (3) key science concepts appropriate for integrating science, mathematics and technology are: 1) problem solving, 2) scientific method, 3) mechanics.

Q6: "List three (3) key mathematics concepts that would be appropriate for interconnecting science, mathematics and technology."

Table 25.--Key Mathematics Concepts Appropriate for Integrating Science, Mathematics and Technology

Mathematics Concepts	Rank
Problem Solving	1
Measurement	2
Mapping and Graphing	3
Estimation and Statistics	4
Basic arithmetic skills	5
Equations and Formulas	6
Algebra	7
No answer	8
Geometry	9
Other (Trigonometry, computations, logic)	10

The three (3) key mathematics concepts appropriate for integrating science, mathematics and technology are: 1) problem solving, 2) measurement, and 3) mapping and graphing.

Q7: "List three (3) key technology concepts that would be appropriate for interconnecting science, mathematics and technology."

Table26.--Key Technology Concepts Appropriate for Integrating Science, Mathematics and Technology

Technology Concepts	Rank
Computers	1
No answer/don't know	2
Problem Solving	3
Hands-on Experience	4
Recycling	5
Machine Use	6
Calculations	7
Manufacturing	8
Laser Technology	9
Other (Genetic engineering, welding, robotics)	10

In comparing Questions 5, 6 and 7, the concept of problem solving was never ranked lower than fourth place. What appeared to be more interesting was the rank order of a "no answer/don't know" response. In regards to key technology concepts, "no answer/don't know" ranked second; for key science concepts it ranked fourth; and for key mathematics concepts it ranked eighth. Also, a review of the randomly sampled questionnaires indicated that even though questions 5, 6 and 7 were responded to, in many cases such responses did not appear to properly answer the questions being addressed. From these results it is assumed that workshop participants were weakest in their knowledge of these final three areas of science, mathematics and technology concepts.

Forced Choice Questions Results

In 1992 the open-ended survey questions were revised to a force choice format. Qualitative results are reported below via a rank order response format. These responses

correspond with the seven (7) forced choice questions administered during the workshop activities.

Q1: "Please choose the answer which you feel if the MOST important aspect of INTEGRATED CURRICULUM."

Table 27.--Aspects Rated Most Important for an Integrated Curriculum

Concepts	Rank	% of respondents
Integrating subject matter/Decompartmentalize learning	1	32.5
Relating Business/Industry to academics	2	27.2
Communication between staff, faculty & administration	3	26.3
Holistic Education	4	11.4
Team Teaching	5	2.6

The general consensus indicates that participants' concepts of an integrated curriculum appear to focus predominantly on integrating subject matter across departmental lines. Most agree that this integration requires open and positive communication between faculty, staff and administration. The importance of involving business and industry in the design of an integrated curriculum, participants was perceived as a top priority.

Q2: "Please indicate the MOST significant component of a module for interconnecting science, mathematics and technology with the needs of the workplace."

Table 28.--Module Components Rated Most Significant for Integrating Science, Mathematics and Technology

Concepts	Rank	% of respondents
Communication and cooperation among faculty and administration	1	43.9
Understanding needs of the corporation or workplace	2	26.3
Hands-on experience	3	17.5
Appropriate materials and equipment	4	11.4
Access and evaluate experiences	5	.9

As was true in Question 1, participants ranked communication and cooperation among faculty and administrators as the priority component. Following this acknowledgement was that the needs of the corporation or workplace must be considered.

Q5: "Which is the most important science concept for integrating mathematics, science, and technology?"

Table 29.--Key Science Concepts Rated Most Important for Integrating Science, Mathematics and Technology

Science Concepts	Rank	% of respondents
Problem solving	1	95.6
Scientific method	2	40.4

Q6: "Which is the most important mathematics concept for integrating science, mathematics, and technology?"technology."

Table 30.--Key Mathematics Concepts Rated Most Important for Integrating Science, Mathematics and Technology

Mathematics Concepts	Rank	% of respondents
Problem solving	1	75.2
Basic arithmetic skills	2	12.4
Estimation and Statistics	3	6.2
Measurement	4	5.3
Mapping and Graphing	5	.9

Problem solving was ranked consistently as the key mathematics and science concepts most important for integrating science, mathematics and technology.

Q7: "Which is the most important technology concept for integrating science, mathematics and technology?"

Table 31.--Key Technology Concepts Rated Most Important for Integrating Science, Mathematics and Technology

Technology Concepts	Rank	% of respondents
Problem solving	1	43.9
Hands-on experience	1	43.9
Computers	2	10.5

In comparing Questions 5, 6 and 7, the concept of problem solving was never ranked lower than first place.

A review of the data support hypothesis 1 that teachers', counselors' and administrators' attitudes and knowledge relative to integrated curriculum changed in a positive direction.

TESTS OF HYPOTHESIS 2

Teachers', Counselors', and Administrators' Knowledge and Attitudes Regarding the Corporate Sector's Workforce Employment Needs Would Change in a Positive Direction

Pretest/Posttest Results 1991 and 1992

Q3: Pretest: The purpose of a high school education is to be able to use printed and written information to function in society, to achieve one's goals, and to develop one's knowledge and potential.

Posttest: The purpose of a high school education is to be able to use printed and written information to function in society, to achieve one's goals, and to develop one's knowledge and potential.

Table 32.--Attitude Toward Workforce Needs 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		56	62
Agree	2		62	62
Unsure	3		6	4
Disagree	4		7	0
Strongly Disagree	5		0	0
		N =	131	128
		$\overline{X}$ =	1.73	1.55
		SD =	.78	.56

2.15 is significant at = .05.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 33.--Attitude Toward Workforce Needs 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		40	39
Agree	2		22	31
Unsure	3		9	6
Disagree	4		6	2
Strongly Disagree	5		0	0
	Missing		1	0
		$\overline{X}$ =	1.753	1.628
N = 77		t-value	1.15	p-value .252

This indicates that while participants' attitudes toward this question were not significantly changed, participants were slightly more positive at the time of posttesting.

Q4: Pretest: Research shows that most young people graduating from high school can read and write to function in their jobs.

Posttest: Research shows that most young people graduating from high school can read and write to function in their jobs.

Table 34.--Knowledge of Workforce Needs 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		1	0
Agree	2		20	27
Unsure	3		34	30
Disagree	4		57	63
Strongly Disagree	5		19	8
		N =	131	128
		$\overline{X}$ =	3.56	3.41
		SD =	.95	.89

1.30 is not significant at = .05.

This indicates that participants' attitudes toward this question were not significantly changed, with most remaining negative toward this statement at posttesting.

Table 35.--Knowledge of Workforce Needs 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		1	1
Agree	2		13	19
Unsure	3		10	18
Disagree	4		44	35
Strongly Disagree	5		8	1
	Missing		2	1
		$\overline{X}$ =	3.592	3.286
N = 75		t-value	2.93	p-value .005

This indicates that participants' attitudes toward this question were significantly more positive toward this item at the time of posttesting.

Q5: Pretest: Employers need students with basic academic skills (i.e., reading, writing and mathematics), communication skills, a good work ethic, adaptability, ability to work in groups, a good self-concept, and leadership skills.

Posttest: Employers need students with basic academic skills (i.e., reading, writing and mathematics), communication skills, a good work ethic, adaptability, ability to work in groups, a good self-concept, and leadership skills.

Table 36.--Knowledge of Workforce Needs 1991

			Frequency	
	Response		Pre	Post
Strongly Agree	1		112	106
Agree	2		17	21
Unsure	3		0	0
Disagree	4		0	1
Strongly Disagree	5		2	0
		N =	131	128
		$\overline{X}$ =	1.19	1.19
		SD =	.58	.45

0 is not significant at = .05.

This indicates that participants' attitudes toward this question were not significantly changed, with participants remaining positive toward this statement at posttesting.

Table 37.--Knowledge of Workforce Needs 1992

	Response	Frequency Pre	Frequency Post
Strongly Agree	1	64	63
Agree	2	13	13
Unsure	3	0	0
Disagree	4	1	1
Strongly Disagree	5	0	0
	Missing	0	1
	$\overline{X}$ =	1.205	1.208
N = 77	t-value	.00	p-value 1.000

This indicates that participants did not change their attitudes toward this item from pretest or posttest.

Q6: Pretest: The trends toward a service-based economy require higher technological skills by entry-level workers.

Posttest: The trends toward a service-based economy require higher technological skills by entry-level workers.

Table 38.--Knowledge of Workforce Needs 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		53	63
Agree	2		51	52
Unsure	3		15	5
Disagree	4		8	6
Strongly Disagree	5		3	1
		N =	130	127
		$\overline{X}$ =	1.90	1.66
		SD =	.99	.83

2.10 is significant at = .05.

*1 case missing in pretest, *1 case missing in posttest.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 39.--Knowledge of Workforce Needs 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		36	31
Agree	2		25	36
Unsure	3		11	7
Disagree	4		5	4
Strongly Disagree	5		0	0
	Missing		1	0
		$\overline{X}$ =	1.805	1.795
N = 77		t-value	.26	p-value .798

2.10 is significant at = .05.

*1 case missing in pretest, *1 case missing in posttest.

This indicates that while participants' attitudes toward this question were not significantly changed, participants were slightly more positive at the time of posttesting.

Q7: Pretest: In a global economy, the competitive edge will go to the corporations that have the best people managing the technology.

Posttest: In a global economy, the competitive edge will go to the corporations that have the best people managing the technology.

Table 40.--Knowledge of Workforce Needs 1991

			Frequency	
	Response		Pre	Post
Strongly Agree	1		65	75
Agree	2		49	40
Unsure	3		12	10
Disagree	4		5	3
Strongly Disagree	5		0	0
		N =	131	128
		$\overline{X}$ =	1.67	1.54
		SD =	.80	.74

1.35 is not significant at = .05.

This indicates that participants' attitudes toward this question were not significantly changed, with participants remaining positive toward this statement at posttesting.

Table 41.--Knowledge of Workforce Needs 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		45	48
Agree	2		27	27
Unsure	3		4	3
Disagree	4		1	0
Strongly Disagree	5		0	0
	Missing		1	0
		$\overline{X}$ =	1.494	1.423
N = 77		t-value	.76	p-value .449

This indicates that while participants' attitudes toward this question were not significantly changed, participants were slightly more positive at the time of posttesting.

Q8: Pretest: High school students need to know "how to learn" due to rapid changes in the workplace which will require job changes in their work lives.

Posttest: High school students need to know "how to learn" due to rapid changes in the workplace which will require job changes in their work lives.

Table 42.--Knowledge of Workforce Needs 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		100	101
Agree	2		25	27
Unsure	3		2	0
Disagree	4		1	0
Strongly Disagree	5		2	0
		N =	130	128
		$\overline{X}$ =	1.31	1.21
		SD =	.69	.41

1.42 is not significant at = .05.

*1 case missing in pretest.

This indicates that participants' attitudes toward this question were not significantly changed, with participants remaining positive toward this statement at the time of posttesting.

Table 43.--Knowledge of Workforce Needs 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		69	69
Agree	2		9	8
Unsure	3		0	0
Disagree	4		0	0
Strongly Disagree	5		0	0
	Missing		0	0
		$\overline{X}$ =	1.115	1.141
N = 78		t-value	- .42	p-value .673

*1 case missing in pretest.

This indicates that while there was no significant change in attitude, participants were slightly less positive at the time of posttesting.

Q9: Pretest: A course such as "Principles of Technology," which reflects real-world workplace applications, better prepares students for future employment.

Posttest: A course such as "Principles of Technology," which reflects real-world workplace applications, better prepares students for future employment.

Table 44.--Attitude Toward Workforce Needs 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		44	57
Agree	2		57	59
Unsure	3		20	11
Disagree	4		9	0
Strongly Disagree	5		1	1
		N =	131	128
		$\overline{X}$ =	1.98	1.66
		SD =	.92	.70

3.16 is significant at = .05.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 45.--Attitude Toward Workforce Needs 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		28	28
Agree	2		35	41
Unsure	3		12	6
Disagree	4		3	2
Strongly Disagree	5		0	1
	Missing		0	0
		$\overline{X}$ =	1.872	1.808
N = 78		t-value	1.872	p-value .496

This indicates that while participants' attitudes toward this question were not significantly changed, participants were slightly more positive at the time of posttesting.

Q19: Pretest: I expect to complete the workshop with a much better understanding of what employers are looking for in new employees.

Posttest: I have completed the workshop with a much better understanding of what employers are looking for in new employees.

Table 46.--Knowledge of Workforce Needs 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		60	70
Agree	2		63	50
Unsure	3		5	3
Disagree	4		3	3
Strongly Disagree	5		0	1
		N =	131	127
		$\overline{X}$ =	1.63	1.54
		SD =	.67	.73

1.02 is not significant at = .05.

*1 case missing in posttest.

This indicates that participants' attitudes toward this question were not significantly changed, with participants remaining positive toward this statement at the time of posttesting.

Table 47.--Knowledge of Workforce Needs 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		35	30
Agree	2		40	42
Unsure	3		1	5
Disagree	4		2	1
Strongly Disagree	5		0	0
	Missing		0	0
		$\overline{X}$ =	1.615	1.705
N = 78		t-value	-1.12	p-value .265

This indicates that while there was no significant change in attitude, participants were slightly less positive at the time of posttesting.

Q23: Pretest: I do not expect to learn much about science or mathematics in this workshop.

Posttest: I learned a significant amount about science or mathematics in this workshop.

Table 48.--Attitude Toward Workforce Needs 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		3	10
Agree	2		18	42
Unsure	3		31	18
Disagree	4		55	52
Strongly Disagree	5		24	4
		N =	131	126
		$\overline{X}$ =	3.60	2.98
		S =	1.01	1.10

4.66 is significant at =.05.

*2 missing cases at posttest.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 49.--Attitude Toward Workforce Needs 1992

	Response	Frequency Pre	Frequency Post
Strongly Agree	1	2	5
Agree	2	25	22
Unsure	3	27	11
Disagree	4	22	13
Strongly Disagree	5	1	13
	Missing	1	0
	$\overline{X}$ =	2.935	3.269
N = 77	t-value	-2.06	p-value .042

This indicates that participants' attitudes were significantly less positive toward this item at the time of posttesting.

Q25: Pretest: I don't expect business/industry representatives to have much to contribute to the practical business of teaching students.

Posttest: Business/industry representatives did have much to contribute to the practical business of teaching students.

Table 50.--Attitude Toward Workforce Needs 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		1	34
Agree	2		3	69
Unsure	3		18	15
Disagree	4		71	7
Strongly Disagree	5		38	2
		N =	131	127
		$\overline{X}$ =	4.08	2.01
		SD =	.76	.87

20.2 is significant at = .05.

*1 case missing in posttest.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 51.--Attitude Toward Workforce Needs 1992

	Response		Frequency Pre		Frequency Post
Strongly Agree	1		22		14
Agree	2		38		40
Unsure	3		15		14
Disagree	4		3		8
Strongly Disagree	5		0		2
	Missing		0		0
		$\overline{X}$ =	1.987		2.282
N = 78		t-value	-2.41	p-value	.019

*1 case missing in posttest.

This indicates that participants' attitudes were significantly less positive toward this item at the time of posttesting.

Q26: Pretest: I expect to gain a better understanding of the employment picture in our region.

Posttest: I gained a better understanding of the employment picture in our region.

Table 52.--Attitude Toward Workforce Needs 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		42	53
Agree	2		74	62
Unsure	3		12	3
Disagree	4		2	4
Strongly Disagree	5		1	4
		N =	131	126
		$\overline{X}$ =	1.82	1.76
		SD =	.72	.90

0.59 is not significant at = .05.

*2 cases missing in posttest.

This indicates that participants' attitudes toward this question were not significantly changed, with participants remaining positive toward this statement at the time of posttesting.

Table 53.--Attitude Toward Workforce Needs 1992

	Response	Frequency	
		Pre	Post
Strongly Agree	1	35	22
Agree	2	36	45
Unsure	3	6	7
Disagree	4	1	3
Strongly Disagree	5	0	1
	Missing	0	0
	$\overline{X}$ =	1.654	1.923
N = 78	t-value	-2.54	p-value .013

This indicates that participants' attitudes were significantly less positive toward this item at the time of posttesting.

Table 54.--A Comparison of Workforce Needs Pretest/Posttest Scores in 1991 and 1992

	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q19	Q23	Q25	Q26
1991 Mean Pretest Scores	1.73	3.56	1.19	1.90	1.67	1.31	1.98	1.63	3.60	4.08	1.82
1991 Mean Posttest Scores	*1.55	3.41	1.19	*1.66	1.54	1.21	*1.66	1.54	*2.98	*2.01	1.76
1992 Mean Pretest Scores	1.753	3.592	1.205	1.805	1.494	1.115	1.872	1.615	2.935	1.987	1.654
1992 Mean Posttest Scores	(1.628)	*3.286	1.208	(1.795)	1.423	-(1.141)	1.808	-(1.705)	-3.269	-2.282	-1.923

*is significantly more positive at .05 level of significance.

-is significantly less positive at .05 level of significance.

()is slightly more positive.

-()is slightly less positive.

Table 55.--Workshop Events Pretest/Posttest 1991 and 1992

Year: 1991

Question	Mean	% Valuable	% Not Valuable	% Unsure
44	1.80	85	0	15
45	2.13	70.6	4	25.4
*46	1.28	97.6	0	2.4
47	1.82	77.6	3.2	19.2
48	1.84	82.7	3.1	14.2

Year: 1992

Question	Mean	% Valuable	% Not Valuable	% Unsure	
44	2.06	13.0	76.6	2.6	6.5
45	2.51	14.5	43.4	21.1	18.4
*46	1.49	61.0	33.8	0	5.2
47	1.92	36.8	40.8	17.1	3.9
48	2.03	28.6	48.1	15.6	7.8

Within this area, workshop participants were significantly in agreement that the use of large group sessions, curriculum writing sessions, training laboratories and interactions with other participants were valuable components of the workshop. In 1991 strongest agreement (97.6%) came in regards to the value of the corporate site visits.

In summary, analysis of the data from 1991 confirm an overall trend that supports hypothesis 2. Teachers', counselors' and administrators' knowledge and attitudes regarding the corporate sectors' workforce employment needs changed in a possitive direction. However, results from 1992 do not support hypothesis 2.

CORPORATE WORKPLACE TOUR RESULTS 1992

"Interconnections 90," "91" and "92" district participants were scheduled into the following corporate sites and in turn responded to the site visit through the completion of the "Corporate Workplace Tour Evaluation."

Table 56.--1990 Number of Participants at Corporate Sites by Day

Corporate Site	6/15	6/16	6/17	6/18	Total N
Caterpillar, Inc.	113	0	0	0	113
Chemical Waste	0	91	0	0	91
AT&T	0	0	20	0	20
Amoco	0	0	12	0	12
Geo. J. Ball	0	0	31	0	31
Motorola Inc.	0	0	16	0	16
Furnas Electric	0	0	0	87	87
Total N Per Day	113	91	79	87	370

Table 57.--1991 Number of Participants at Corporate Sites by Day

Corporate Sites	6/17	6/18	6/19	6/20	Total N
Caterpillar, Inc.	124	4	0	0	128
Chemical Waste	0		960	0	96
Amoco	1	0	27	2	30
Geo J. Ball	0	14	0	14	
Metropolitan Life	1	0	14	0	15
Motorola, Inc.	1	0	19	1	21
Fermi Nat'l. Lab.	0	0	29	1	30
Furnas Electric	0	0	2	93	95
Total N Per Day	127	100	105	96	--

Table 58.--1991 Percentage of Participants at Corporate Sites by Day

Corporate Sites	6/17	6/18	6/19	6/20
Caterpillar, Inc.	97.6	4	0	0
Chemical Waste	0	96	0	0
Amoco	.8	0	25.7	2.1
Geo J. Ball	0	0	13.3	0
Metropolitan Life	.8	0	13.3	0
Motorola, Inc.	.8	0	18.1	1.0
Fermi Nat'l Lab	0	0	27.6	1.0
Furnas Electric	0	0	1.9	95.9

Thus, for June 17, 18, and 20 the majority of site visits occurred at Caterpillar, Chemical Waste Management, and Furnas Electric respectively. June 19 was divided among Amoco, Geo J. Ball, Metrpolitan Life, Motorola, Fermi National Lab and Furnas Electric.

Table 59.--1992 Number of Participants at Corporate Site by Day

Corporate Site	6/15	6/16	6/17	6/18	Total N
Caterpillar, Inc.	120	4	0	0	124
Furnas Electric	3	101	2	1	107
Amoco	0	1	31	2	34
Geo. J. Ball	0	0	29	1	30
Motorola Inc.	1	0	14	7	22
Sears	1	0	23	2	26
Chemical Waste	0	1	0	86	87
Total N Per Day	125	107	105	100	

Table 60.--Percentage (%) of Participants at Corporate Sites by Day

Corporate Sites	6/15	6/16	6/17	6/18
Caterpillar, Inc.	96.0	3.7	0	0
Furnas	2.4	94.4	2.0	1.0
Amoco	0	.9	31.3	2.0
Geo J. Ball	0	0	29.3	7.0
Motorola	.8	0	14.1	2.0
Sears	.8	0	23.2	86.0
Chemical Waste	0	.9	0	0
Metropolitan Life	0	0	0	95.9

Thus, for June the majority of site visits occurred at Caterpillar, Furnas Electric, and Chemical Waste Management respectively. June 17 was divided among Amoco, Geo J. Ball, Morola, and Sears.

"Interconnections 92," "Interconnections 91," and "Interconnections 90" "Corporate Workplace Tour Evaluation" (A Comparison)

As a means to show comparative results between "Interconnections 92," "91" and "90," a review of the August, 1991 and 1990 evaluations report was made to establish any trends. In order to remain consistent with the 1991 and 1990 reports, the categories and key words in this section were grouped similarly for the 1992 assessment.

Table 61.--1992 "Corporate Workplace Tour Evaluation"

Questions 1-8	Day 1 Mean	Day 2 Mean	Day 3 Mean	Day 4 Mean
1. Employment opportunities	(2.03)	1.65	1.79	1.79
2. Trends	1.66	1.64	1.88	(1.73)
3. Compensation	3.08	2.70	2.64	3.06
4. Employment areas	(2.14)	1.83	1.85	1.64
5. Qualifications	(2.29)	(1.78)	1.23	1.98
6. Common problems	2.66	2.31	2.05	2.92
7. Employment skills	(2.15)	1.62	1.97	2.13
8. Retraining efforts	(2.16)	1.92	2.17	2.68

*Over 50% participants reported they gained a great deal of information for some regarding this topic during the corporate visit.

*A great deal of information obtained some information.

()Some information.

Table 62.--1991 "Corporate Workplace Tour Evaluation"

Questions 1-8	Day 1 Mean	Day 2 Mean	Day 3 Mean	Day 4 Mean
1. Employment opportunities	1.78	(1.70)	*1.25	*1.28
2. Trends	*1.55	1.61	*1.61	*1.51
3. Compensation	2.79	2.83	2.14	(2.00)
4. Employment areas	(2.07)	1.71	1.56	(1.70)
5. Qualifications	(2.15)	(2.02)	*1.38	*1.62
6. Common problems	2.37	3.12	2.39	(2.16)
7. Employment skills	(2.02)	(2.27)	*1.68	*1.62
8. Retraining Effort	1.67	2.25	1.88	1.77

*Over 50% of participants reported they gained a great deal of or some information regarding this topic during the corporate visit.

*A great deal of information obtained.

()Some information.

Table 63.--"Overall Evaluation of the Visit" (%)

General Interest (Q 15, 16, 21, 26, 32)	1990	1991	1992
Extremely or Very Interesting	91	87	85
Not at all boring	72	72	71
Not at all dull	70	76	75
Extremely or very stimulating	70	75	68
Extremely or very enjoyable	80	80	76
Relevance of the Visits (Q 17, 18, 29, 38)			
Extremely or very relevant	76	82	75
Extremely or very practical	67	77	71
Not at all useless	85	86	83
Extremely or very informative	91	87	86
Demands of the Visits (Q 19, 27, 30)			
Extremely or very difficult	6	10	8
Extremely or very challenging	43	51	44
Extremely or very demanding	--	22	19
Somewhat demanding	41	37	30
Summary Assessment (Q 20, 23, 24, 28, 33, 35, 36)			
Extremely or very good	91	86	82
Extremely or very worthwhile	87	84	80
Extremely or very valuable	79	79	76
Not at all a waste of time	82	84	80
Extremely or very rewarding	72	67	62
Extremely or very enlightening	85	84	79

As for the "Overall Evaluation of the Visits," Table 63 clearly acknowledges that the majority participants in 1992, 1991 and 1990 found the corporate site visits as extremely or very interesting; extremely or very relevant; and most valuable and worthwhile. Between forty and fifty percent of the participants in 1992, 1991 and 1990 found the corporate site visits to be extremely or very challenging.

Hypothesis 3: Curriculum Change Would be Initiated at the Local District Level

Pretest/Posttest Results 1991 and 1992

Q11: Pretest: Administrators at the building and district level encourage new curricular development.

Posttest: I will be better able to encourage administrators at the building and district level to encourage new curricular development.

Table 64.--Attitude Toward New Curriculum Development 1991

			Frequency	
	Response		Pre	Post
Strongly Agree	1		20	35
Agree	2		67	74
Unsure	3		19	16
Disagree	4		22	2
Strongly Disagree	5		3	1
		N =	131	128
		$\overline{X}$ =	2.40	1.91
		SD =	1.01	.73

4.51 is significant at = .05.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 65.--Attitude Toward New Curriculum Development 1992

		Frequency	
	Response	Pre	Post
Strongly Agree	1	56	57
Agree	2	21	20
Unsure	3	0	0
Disagree	4	1	1
Strongly Disagree	5	0	0
	Missing	0	0
	$\overline{X}$ =	1.308	1.295
N = 78	t-value	.19	p-value .849

This indicates that while participants' attitudes toward this question were not significantly changed, participants were slightly more positive at the time of posttesting.

Q12: Pretest: There is a teacher-team approach in the district both within and between subject disciplines to curriculum development.

Posttest: I will encourage a teacher-team approach in the district both within and between subject disciplines in curriculum development.

Table 66.--Attitude Toward Team-Teaching 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		5	52
Agree	2		41	67
Unsure	3		22	8
Disagree	4		55	0
Strongly Disagree	5		8	0
		N =	131	127
		$\overline{X}$ =	3.15	1.65
		SD =	1.06	.60

14.4 is significant at = .05.

*1 case missing at posttest.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 67.--Attitude Toward Team-Teaching 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		52	51
Agree	2		25	23
Unsure	3		1	2
Disagree	4		0	1
Strongly Disagree	5		0	0
	Missing		0	1
		$\overline{X}$ =	1.346	1.390
N = 77		t-value	- .75	p-value .453

This indicates that while there was no significant change in attitude, participants were slightly less positive at the time of posttesting.

Q13: Pretest: Sufficient planning time is allowed for curriculum development.

Posttest: I will be able to justify planning time for curriculum development.

Table 68.--Attitude Toward Curriculum Planning Time 1991

		Frequency	
	Response	Pre	Post
Strongly Agree	1	2	45
Agree	2	19	66
Unsure	3	11	11
Disagree	4	68	4
Strongly Disagree	5	30	1
	N =	130	127
	$\overline{X}$ =	3.81	1.82
	SD =	1.00	.78

17.8 is significant at = .05.

*1 case missing in pretest, *1 case missing in posttest.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 69.--Attitude Toward Curriculum Planning Time 1992

		Frequency	
	Response	Pre	Post
Strongly Agree	1	72	68
Agree	2	6	9
Unsure	3	0	1
Disagree	4	0	0
Strongly Disagree	5	0	0
	Missing	0	0
	$\overline{X}$ =	1.077	1.141
N = 78	t-value	-1.52	p-value .133

*1 case missing in pretest, *1 case missing in posttest.

This indicates that while there was no significant change in attitude, participants were slightly less positive at the time of posttesting.

Q14: Pretest: There are teaching-learning resources to support curricular innovation.

Posttest: I will encourage teaching-learning resources to support curricular innovation.

Table 70.--Support of Curricular Innovation 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		2	56
Agree	2		43	63
Unsure	3		32	8
Disagree	4		47	0
Strongly Disagree	5		7	0
		N =	131	127
		$\overline{X}$ =	3.11	1.62
		SD =	.98	.60

15.0 is significant at = .05.

*1 case missing in posttest.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 71.--Support of Curricular Innovation 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		54	53
Agree	2		23	25
Unsure	3		1	0
Disagree	4		0	0
Strongly Disagree	5		0	0
	Missing		0	0
		$\overline{X}$ =	1.321	1.321
N = 78		t-value	.00	p-value 1.000

This indicates that participants did not change their attitudes toward this item from pretest or posttest.

Q15: Pretest: Curricular innovations are research-based.

Posttest: I will value curricular innovations that are research-based.

Table 72.--Attitude Toward Curricular Innovation 1991

			Frequency	
	Response		Pre	Post
Strongly Agree	1		6	49
Agree	2		51	62
Unsure	3		38	14
Disagree	4		31	2
Strongly Disagree	5		5	0
		N =	131	127
		$\overline{X}$ =	2.83	1.76
		SD =	.97	.71

10.1 is significant at = .05.

*1 case missing in posttest.

This indicates that participants were significantly more positive in their attitudes toward this question at the time of posttesting.

Table 73.--Attitude Toward Curricular Innovation 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		21	30
Agree	2		41	39
Unsure	3		11	7
Disagree	4		4	2
Strongly Disagree	5		1	0
	Missing		0	0
		$\overline{X}$ =	2.013	1.756
N = 78		t-value	2.79	p-value .007

This indicates that participants' attitudes toward this question were significantly more positive toward this item at the time of posttesting.

Q19: Pretest: I expect to complete the workshop with a much better understanding of what employers are looking for in new employees.

Posttest: I have completed the workshop with a much better understanding of what employers are looking for in new employees.

Table 74.--Attitude Toward Role of Business Needs in Curricular Development 1991

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		60	70
Agree	2		63	50
Unsure	3		5	3
Disagree	4		3	3
Strongly Disagree	5		0	1
		N =	131	127
		$\overline{X}$ =	1.63	1.54
		SD =	.67	.73

1.02 is not significant at = .05.

*1 case missing in posttest.

This indicates that participants' attitudes toward this question were not significantly changed, with participants remaining positive toward this statement at the time of posttesting.

Table 75.--Attitude Toward Role of Business Needs in Curricular Development 1992

	Response		Frequency Pre	Frequency Post
Strongly Agree	1		35	30
Agree	2		40	42
Unsure	3		1	5
Disagree	4		2	1
Strongly Disagree	5		0	0
	Missing		0	0
		$\overline{X}$ =	1.615	1.705
N = 78		t-value	-1.12	p-value .265

This indicates that while there was no significant change in attitude, participants were slightly less positive at the time of posttesting.

Q21: Pretest: I expect to develop curriculum materials I will be able to use in my classes next Fall.

Posttest: I developed curriculum materials I will be able to use in my classes next Fall.

Table 76.--Curricular Module Development Outcomes 1991

			Frequency	
	Response		Pre	Post
Strongly Agree	1		24	29
Agree	2		69	53
Unsure	3		32	36
Disagree	4		4	8
Strongly Disagree	5		0	0
		N =	129	126
		$\overline{X}$ =	2.12	2.18
		SD =	.74	.86

0.59 is not significant at = .05.

*2 cases missing in pretest, *2 cases missing in posttest.

This indicates that participants' attitudes toward this question were not significantly changed at the time of posttesting.

Table 77.--Curricular Module Development Outcomes 1992

	Response	Frequency	
		Pre	Post
Strongly Agree	1	17	11
Agree	2	30	33
Unsure	3	27	12
Disagree	4	2	14
Strongly Disagree	5	1	6
	Missing	1	2
	$\overline{X}$ =	2.21	2.618
N = 76	t-value	-3.24	p-value .002

This indicates that participants' attitudes were significantly less positive toward this item at the time of posttesting.

Table 78.--A Comparison of Pretest/Posttest Scores in 1991 and 1992

	Q11	Q12	Q13	Q14	Q15	Q19	Q21
1991 Mean Pretest Scores	2.40	3.15	3.81	3.11	2.83	1.63	2.12
1991 Mean Posttest Scores	*1.91	*1.65	*1.82	*1.62	*1.76	1.54	2.18
1992 Mean Pretest Scores	1.308	1.346	1.077	1.321	2.013	1.615	2.21
1992 Mean Posttest Scores	1.295	-(1.390)	1.141	1.321	*1.756	-(1.705)	-(2.618)

*is significantly more positive at .05 level of significance.

-is significantly less positive at the .05 level of significance.

()is slightly more positive.

-()is slightly less positive.

Table 79.--Workshop Products Pretest/Posttest Results for 1991 and 1992

Workshop Products	Mean	% Valuable	% Not Valuable	% Unsure
Group Module Initiation	1.75	81.7	3.2	15.1
Clear Purpose	3.25	29	54.9	16.1
Module Quality	3.11	18.3	27.8	54
Module Usefulness	3.55	12.7	59.5	27.8
Module Content	1.99	82.4	4	13.6
Module Completion	3.56	13.5	58.7	27.8
Advocates Module Use	1.96	75	.8	24.2

An analysis of this section indicates that participants were in higher agreement in regards to how well the group began in the development of the curriculum modules, that the modules reflected the substance and philosophy learned during the workshop, and that participants felt good about recommend their modules for use by other teachers in the district. The participants felt less strongly about their sense of how to develop the modules in their own teaching. Fifty-four percent (54%) uncertain about whether the modules they produced were superior to most of the teaching modules they currently use.

Q3: "Please identify the MOST significant recource available in your school district that you believe will make it possible to develop an integrated curiculum."

Table 80.--Resources Available Within School District Rated Most Important to Enhance the Development of an Integrated Curriculum

Resources	Rank	% of respondents
Creative, open-minded staff	1	50.0
Support from administration	2	19.3
Positive attitudes of faculty, parents and students	3	12.3
Availability of facilities and equipment	4	9.6
Team Teaching	5	8.8

The overriding resources identified by participants to enhance and ensure the development of an integrated curriculum may be classified under the category of cooperation, support, positive attitudes and creativity of faculty, staff, administration and students. Specifically a creative, open-minded staff was most important by 50% of the respondents. A review of the remaining identified resources is interesting, especially from the perspective that more tangible needs such as space, facilities and equipment were not perceived as important in this implementation.

Q4: "Please identify the factor that you think will MOST inhibit the development at an integrated curriculum."

Table 81.--Factors Rated Most Inhibiting to the Development of an Integrated Curriculum Within School District

Things That Inhibit Development	Rank	% of respondents
Resistance to change among faculty	1	30.7
Lack of time	2	28.1
Lack of funding	3	24.6
Lack of encouragement from central office and administrators	4	16.7

In this particular category, the major inhibitors to the development of an integrated curriculum were perceived by participants as resistance to change (30.7%). Closely following this was lack of time (28.1%) and lack of funding (24.6%).

Questions 5-7, which relate to key science, mathematics and technology concepts appropriate for integrating curriculum, have been grouped together for purposes of commonality.

IMPACT SURVEY 1992 RESULTS

The IMPACT Survey was mailed to all "Interconnections" participants. A total of 275 surveys were mailed in August, 1992 with 105 surveys returned. 38% of "Interconnections" participants completed the IMPACT survey.

Background Information

The majority of those participants who completed the survey participated in 1991 (65%), followed by 1990 (26%), and 9% in 1992. The majority of participants completing the survey were teachers with 84%, 7% were counselors, and 9% building administrators. Of these teachers the majority were high school teachers 68%, followed by 16% elementary teachers, 9% middle school teachers, and 7% vocational education teachers.

Impact of "Interconnections" Experience Curriculum Change

61% indicated the curriculum modules were implemented during the next school year.

42% indicated the curriculum module was implemented in later years.

40% indicated they developed additional curriculum modules for students beyond the "Interconnections" module. These additional modules were in the math, science, reading, and social studies content areas.

Inservice Training

41% of the "Interconnections" teams conducted inservice training to other educators in the school building; 25% to other educators in the school district; 16% to other schools in their geographic areas; and 15% presented at conferences, seminars, and workshops.

47% continued to network with their "Interconnections" corporate partners.

23% expanded networking contacts beyond their "Interconnections" corporate partners to other businesses.

Administrative Support

0% received funding for special projects.

2% received additional planning time

18% received release time

5% received revised schedules

14% received access to new resource materials

2% received additional personnel

0% reported team teaching

Student Participation

12,072 students were introduced to the integrated curriculum module since participation in "Interconnections."

Comments regarding the student responses to the "Interconnections" curriculum module included: positive, favorable, seemed to enjoy it.

Barriers Encountered:

No money. No administrative support. Planning time. Faculty reluctance. Lack of receptiveness from teachers and administrators.

Achievements/Successes:

Heightened the awareness of the need for integrated curriculum.

Contributed to the initiation of Tech-Prep in our district.

Facilitated breaking the barrier between technology and math to develop applied math.

Attempted more group projects because of the need exposed by industry.

Easier to apply classwork to the world of work.

Students find it easier to learn with the integrated curriculum modules.

Corporate IMPACT Survey

18 was the average number of corporate employees involved in the "Interconnections" experience at each corporate site.

Benefits Gained for the Company

- Strengthen the partnership between Motorola and the education system through dialogue and sharing of resources to help restructure the system.
- Instructors who are aware of the job requirements can give students a reason to learn.
- It helps our corporation develop a better understanding and appreciation of the public education system. It is often eary to criticize the schools but it helps to see the quality, hadworking school people in person.

Potential Benefits Gained for Employees Involved in Interconnections

- It is helpful for us to take a step backward and analyze what we are doing. Nothing helps you in the field as much as having to teach it to someone else.
- Gained insights regarding the difficult task facing schools and increased the respect our employees have for the teaching profession.

100% indicated they would participate in "Interconnections" in future years.

90% indicated "Interconnections" increased knowledge of career paths in their organizations.

100% indicated "Interconnections" increased the understanding of the basic skills required for the workforce.

90% indicated "Interconnections" increased understanding of the workforce requirements for technology, math, science competencies.

95% indicated "Interconnections" increased awareness of the range of job openings and skills required within the company.

Conclusions

Analysis of the data support hypothesis 3.

It was expected that integrated curriculum modules would be incorporated into the curriculum at the local school district level. Sixty-two integrated curriculum modules were produced by "Interconnections" participants (See Appendix F).

West Aurora School District 129 is presented as an example of curriculum change by a participating school district.

"Example of Curriculum Change

West Aurora School District 129"

West Aurora School District participated in "Interconnections" in the pilot year in 1990 with an "Interconnections" team consisting of a middle school administrator, a high school guidance counselor, and two middle school faculty and four high school faculty. The Superintendent and the Assistant Superintendent of Curricluum and Instruction attended the Kick-off Session. The "Interconnections" team identified the theme "curriculum integration through inservice" and identified the following short term district goals and objectives in the curriculum module: 1) inservice staff and report "Interconnections 90" findings; 2) survey what is currently being done in K-12, and 3) develop an integrated curriculum. The following long term goals were identified: 1) to develop and incorporate horizontally and vertically integrated curriculum across all grade levels considering content, process, skills, and attitude; 2) to develop and deliver an inservice model to accomplish this curriculum restructuring.

In 1990 the first middle school curriculum module was developed titled "Home Energy Management" and implemented in the fall of 1990. Results from the IMPACT survey show that annually over 100 students have been introduced to this module since it was developed in 1990. Inservice for faculty was conducted by the "Interconnections" team members. Additionally, a presentation to the Board of Education regarding the "Interconnections" experience and curriculum module was conducted.

In 1991 West Aurora repeated participation in "Interconnections" with a team comprised of a high school administrator, a high school counselor, and 5 high school facutly members. Two of the 5 faculty members had participated in "Interconnections" in 1990. The "Interconnections" team expanded the 1990 curriculum module titled "Technology Inservice Module." The 91 "Interconnections" team identified these three short term goals in the curriculum module: 1) to create an inservice model to move the faculty toward significantly increased integrated educational opportunities in District 129; 2) to identify and synthesize resources to accomplish the inservice that would create an internal/external support system for curriclum integration.

A top priority was to provide greater access to the other West Aurora teachers who had not participated in "Interconnections" to the needs of the business and industry in the region. In order to meet this need a "mini Interconnections" staff development program was developed. All of the faculty at West Aurora high school participated in an inservice program during the school year which followed the "Interconnections" staff development model.

A presentation to the West Aurora Schools' Board of Education was made in June, 1991. The development of a "Tech Prep" Curriculum was proposed in order for all students to have the skills needed for the workforce. In June, 1991, the Board of Education adopted the goals of the "Tech Prep" Curriculum. A Tech Prep design team was formed and provided additional planning time and financial resources. The West Aurora Technology Coordinator reported on the IMPACT survey, ". . . 'Interconnections' has certainly contributed significantly to the initiation of tech prep in our district."

In 1992 West Aurora repeated participation in "Interconnections" with a team comprised of a high school administrator, a high school counselor, and 6 high school faculty members. Again 2 of the team members were participants in the "Interconnections" 1990 and 1991 experience. The "Interconnections" team expanded

the curriculum module for 9th and 10th grade science and technology students titled, "Transportation-Power Vehicle [Power Climber]."

These results confirm that curriculum change did occur in West Aurora as a result of participation in "Interconnections." IMPACT survey results indicate that additional curriculum modules beyond those developed during the "Interconnections" experience were developed in math, science, reading, writing, language arts content areas. These integrated curriclum modules were titled," Light, Color and Plants; Manufacturing Technology, Bridge Building Made Simple, Food Science and Transtech."

CHAPTER VI

RESULTS AND DISCUSSION

The Purpose

This study examined the following research questions:

As a result of participation in "Interconnections 90" staff development program. . .

1. What is the change in teachers', counselors', and administrators' knowledge and attitudes relative to integrated curriculum development?
2. What is the change in teachers', counselors', and administrators' knowledge and attitudes regarding the corporate sector's work force employment needs?
3. What curriculum change occurs at the local district level?

Results are given for the organizational and individual levels of analysis that were identified and explained in Chapter IV.

The Hypotheses

The following hypotheses were tested:

1. It was expected that teachers', counselors', and administrators' knowledge and attitudes relative to integrated curriculum development would change in a positive direction.
2. It was expected that teachers', counselors', and administrators' knowledge and attitudes regarding the corporate sector's work force employment needs would change in a positive direction.

3. It was expected that integrated curriculum modules would be incorporated into the curriculum at the local district level.

This study examined change from two levels of analyses, the individual and the organizational unit of analyses. Statistical analyses were used relating to the three hypotheses stated above. In addition, qualitative analyses were used to examine opinions relative to the concepts and implementation of individual change and organizational change in curriculum at the local level.

The Instrument

The survey instruments (see Appendices) were developed to measure the impact of the "Interconnections" programs over the three year program period 1990-1992. The survey instruments were designed to be sensitive to the nature of the topics covered in the "Interconnections 90" program. A pretest/posttest 55 item likert-type scale was designed to measure "Interconnections" participants' knowledge and attitudes relative to integrated curriculum development, and to measure participants' knowledge and attitudes of corporate workplace employment needs. A seven item open-ended questionnaire was designed to measure participants' knowledge base and attitudes regarding the concept and feasibility of integrated curriculum development. This survey was revised to a forced choice format in 1992. The "Corporate Workplace Tour Evaluation" was designed to measure participants' knowledge of the corporate sector's workplace employment needs.

Data Analysis

Tests to determine significant differences between pretest and posttest measures were employed with an approximation of a correlated t-test. In addition to the statistical analyses related to the pretest and posttest measures, qualitative analyses were used. Qualitative data were reported using frequencies and percentages. The open-ended

questionnaires were randomly reviewed to determine the frequencies and percentages of common responses among participants. Every third survey was analyzed in an item by item format, with rank orders then established for the ten most common responses per item. The "Corporate Workplace Tour Evaluation" provided percentages of participants per site. As a means to show comparative results between "Interconnections 90," "91," and "92," the categories and key words in this section were grouped similarly for the 1991 and 1992 assessment. A cross tabulation was made of the corporate workplace site visits to provide a general summary of the results. The IMPACT survey provides percentages of responses. Additionally, common responses to open-ended questions are reported.

Results

According to Rogers and Shoemaker's (1971) change model presented in Chapter 2, change occurs at the individual level, (micro analytic) where the individual is the adopter or rejecter of the innovation. Change also occurs at the social system level, (macro analytic level). Hypotheses 1 and 2 address change at the individual level, and Hypothesis 3 addresses change at the social system level.

Hypothesis 1

It was expected that teachers', counselors', and administrators' knowledge and attitudes relative to integrated curriculum development would change in a positive direction. Results of the 1991 and 1992 pretest and posttest scores confirm that teachers', counselors', and administrators' attitudes and knowledge relative to an integrated curriculum changed in a positive direction.

Table 19 shows 1991 "Interconnections" workshop participants had significant attitudinal change in their understanding of an integrated curriculum. All questions

focused on integrated curriculum showed that "Interconnections" participants were significantly more positive at the .05 level of significance at the time of posttesting.

Table 19 shows 1992 "Interconnections" participants' knowledge and attitudes toward integrated curriculum development changed in a positive direction. Responses to three out of eight questions showed a level of significance at the .05 level. These positive responses included: integrated curriculum development for the "forgotten half" will impact 70% of the U.S. job openings; collaboration between business and industry is a necessary component of quality curriculum development; and "interconnecting" science, math and vocational education is likely to change the structure of school curricula. Three of the remaining five questions indicated participants were slightly more positive at the time of posttesting. Most notable is the participants' positive response to school team participation as an effective way to develop integrated curriculum. The results of the remaining two questions which were: an integrated curriculum builds student skills in thinking, reading, writing and computation; and I expect to get "hands-on" experience in developing integrated curriculum materials indicate participants were slightly less positive at the time of posttesting. These less positive results can be attributed to the fact that a large number of 1992 participants were repeaters in the "Interconnections" experience from previous years. It would be expected that the impact of the information obtained would diminish due to repetition.

Content analysis of the seven item open-ended 1990 survey revealed a trend toward a positive increase in the understanding of the concepts, processes and implementation of an integrated curriculum. Participants reported that integrating subject matter and decompartmentaling learning are the most important aspects of an integrated curriculum. 27.2% of 122 survey respondents returned rated involving business and industry in the design of integrated curriculum as the second most important. 26% of 122 survey respondents rated understanding the needs of the

corporation or workplace as important. Over 50% of the participants in 1990 agree that integrated curriculum requires open communication between faculty and administration.

"Interconnections" participants in 1991 and 1992 ranked: 1) creative and open-minded staff and 2) support from administration as the top two resources needed to enhance the development of an integrated curriculum. Participants ranked lack of financial and time resources and resistance to change among faculty as the major inhibitors to the development of an integrated curriculum. Problem solving was consistently ranked by both 1991 and 1992 participants as the key science, mathematics, and technology concept for integrating science, mathematics, and technology.

A review of the data support hypotheses 1 that teachers', counselors' and administrators' attitudes and knowledge relative to integrated curriculum changed in a positive direction.

Hypothesis 2

It was expected that teachers', counselors', and administrators' knowledge and attitudes regarding the corporate sector's work force employment needs would change in a positive direction. Visits to selected corporate sites were an extremely valuable component of the "Interconnections" program as rated by the participants. The visits were intended to provide information regarding corporate workplace needs. 91% of the 128 survey respondents in 1991 and 97% of the 113 survey respondents in 1992 rated the corporate visits as most valuable. Data from 1990 through 1992 show an overall trend that participants obtained a great deal of information at the corporate site visits, especially in these areas: trends affecting future job requirements particularly in areas of mathematics, science, technology; employment opportunities that exist in the company; employment skills necessary, especially those related to problem-solving skills interpersonal skills in working in teams; and employment areas particularly in demand

especially as relates to science, mathematics and technology. Two topics according to the participants received less attention at the corporate site visits collectively: compensation/employee benefits and common problems with poorly prepared applicants in the employment process.

Table 63 demonstrates that a significant majority of participants in 1990, 1991, and 1992 found the corporate site visit as extremely or very interesting and very valuable. In 1990, 91% , in 1991, 87%, and in 1992, 85% of the participants rated the corporate site visits as valuable. Participants strongly agreed that the corporate site visits were very valuable. The large group sessions, curriculum writing sessions, training laboratories, and interactions with other participants were rated as valuable components by the participants.

Table 54 shows that five out of eleven questions showed a change in "Interconnections" 1991 participant's attitudes and knowledge of corporate workplace employment needs at the .05 level of significance. Most notable of these include: the trend toward a service-economy require higher technological skills by entry-level workers; a course such as "Principles of Technology," which reflects real-world workplace applications, better prepares students for future employment. Results were significant at the .05 level . 1991 participants did perceive they learned much about science or mathematics in the workshop. Results were significant at the .05 level of significance. The 1991 participants also felt that business and industry representatives have much to contribute to the practical business of teaching students.

Data from 1991 confirm an overall trend that supports hypothesis 2. Teachers', counselors', and administrators' knowledge and attitudes regarding the corporate sector's work force employment needs changed in a positive direction.

However, results in 1992 are more mixed. Table 54 shows participants were slightly less positive at the time of posttesting on five of the eleven questions.

Additionally, participants were significantly less positive at the .05 level of significance on three of these five questions. Of particular importance is the perception that participants were significantly less positive to these statements: 1) learned a significant amount about science and math in this workshop; 2) business and industry representatives have much to contribute to the practical business of teaching students; and 3) gained a better understanding of the employment picture in the region.

The results from 1992 do not support hypothesis 2. Teachers', counselors', and administrators' knowledge and attitudes regarding the corporate sector's work force employment needs did not change in a positive direction. These less positive results may be a result of the large number of participants who repeated their "Interconnections" workshop experience.

Despite the somewhat negative gains for repeaters of "Interconnections," each year "Interconnections" participants reported they obtained a great deal of valuable information at the corporate site visits. Tables 61, 62, and 63 confirm an overall trend each year that the corporate site visits were perceived as a valuable component of the "Interconnections" program.

Hypothesis 3

It was expected that integrated curriculum modules would be incorporated into the curriculum at the local school district level. Sixty two integrated curriculum modules were produced by "Interconnections" participants (see Appendix F). The "Interconnections" products were intended to serve as a catalyst for curriculum change at the local level. The IMPACT survey results indicate that 61% of the 105 survey respondents reported the curriculum modules were implemented during the next school year, and 42% reported the modules were implemented in subsequent years. 40% of the 105 survey respondents reported that additional modules were developed beyond the

"Interconnections" module. These results support the hypotheses that "Interconnections" did impact curriculum change.

Table 79 shows 81.7% of participants were in higher agreement in regards to how well the group began in the development of the curriculum modules. 82.4% of participants were in agreement that the modules reflected the substance and philosophy learned during the workshop. Of the 1991 participants, 75% would recommend their module for use by other teachers in the district. and 54% were uncertain about whether the modules they produced were superior to most of the teaching modules they currently use.

Table 78 shows 1991 "Interconnections" workshop participants had significant attitude change and understanding regarding implementation of integrated curriculum. Five out of seven questions showed participants were significantly more positive at the .05 level of significance at the time of posttesting. For example, participants were significantly more positive at the .05 level of significance to questions such as: administrators at the building and district level encourage new curricular development; and curricular innovations are research based. 1992 results indicate an overall trend toward no significant change. Three out of seven questions showed participants were slightly less positive at the time of posttesting.

According to Rogers' and Shoemakers' (1971) social interaction model, communication of change is a critical component in the change process. Change must be communicated to others in the system via change agents. Based on results of the IMPACT survey, it was clear that there was a ripple effect by "Interconnections" team members. The ripple effect is shown through the inservice activities conducted by the "Interconnections" participants. "Interconnections" team members reported in the IMPACT survey that they provided inservice training to their colleagues. Of the 105 IMPACT survey respondents, 41% reported they conducted inservice to other educators

in the school building, 25% reported they trained other educators in the school district, 16% delivered training to other schools in the area, and 15% of the educators reported that they made presentations at conferences, seminars and workshops.

Required team participation in "Interconnections" was designed to insure the development of a local support network for the implementation of "Interconnections" curriculum improvement activities. Despite this "Interconnections" structure to insure administrative support at the local level, over 50% of the participants reported lack of administrative support as a barrier to implementing the curriculum module. "Interconnections" participants also cited lack of financial resources, planning time, faculty resistance, turf issues, extra work and diminished parental support as barriers to local curriculum improvements.

An important question about the role of "Interconnections" is: Did it serve as a vehicle to more effectively coordinate educators and employers in the region? The data from the IMPACT survey shows "Interconnections" resulted in expanded partnerships between the participating schools and businesses in the region. Of the 105 survey respondents, 47% continued to work with the "Interconnections" partners and 23% of the participating schools expanded partnership contacts beyond the "Interconnections" partners to other businesses in the region.

The benefits of "Interconnections" reached the corporate sector, too. Corporate participants reported they gained a better understanding of the educational system and developed stronger partnerships between their company and schools in their region. A total of 90% of the ten companies reported that "Interconnections" clearly increased educators understanding of the work force requirements, and career paths in their organizations. A total of 100% of the corporate participants indicated they would eagerly participate in the "Interconnections" program in the future.

CHAPTER VII

CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

Based on the data analysis presented in Chapter 5, the following conclusions are offered. First, results of this research supports the change agent's role and impact on the "Interconnections" program facilitation at both the individual level and the organizational level. At the individual level, the "Interconnections" experience promoted significant attitudinal change on the part of workshop participants and a positive increase in participant understanding of the concepts, processes and implementation of an integrated curriculum. At the organizational level, curriculum change occurred at the local level through implementation of integrated modules and inservice training activities.

Based on these positive program results, "Interconnections" is an effective school-business partnership staff development model which can be replicated in other geographic areas where collaborative efforts are desired by local business and industry, higher education and public school systems. Program collaboration such as that which occurred in "Interconnections" between educator and employer clearly leads to a better understanding of corporate work force needs on the part of educators and to corporations understanding the educational system. "Interconnections" created the context or structure for business and education to interact together and served as a catalyst for curriculum change at the local school district level.

A second conclusion drawn from the study is that the model of partnerships as catalysts for systemic educational change is supported by the research. Because

partnerships such as CPEE create the structure for educators and employers to interact, CPEE served as a change agent and communication link between the schools (suppliers) and the business and industries (customers) in the Northern Illinois region. Educators learned about their customer's needs through structured work site visits. Educators in the CPEE region, understanding the needs of business/industry work to improve local curricula that are reflective of work place needs. Greater collaboration between schools (suppliers of product) and their customers (business and industry) did occur at the grassroots level as a result of the "Interconnections" experience.

A final conclusion relates to the role of local educational leaders in implementing educational change at the local level. While partnerships serve as motivation for educational change, it is clear that local leadership within educational organizations determine if changes are implemented. The research shows data that administrative support is an important variable in implementing curriculum improvements at the local level. Educational leaders need to encourage changes and provide access to time, resources and technical assistance necessary for school improvements.

"Interconnections" provided a new regional approach to staff development and curriculum development. CPEE gave educators easy access to corporate environments where educators could observe "real world" applications of mathematics, science, and technology. These corporate site visits, seen by participants as a valuable component of staff development activities, enrich the curriculum with "real world" applications. Schools within this partnership context are open systems interacting freely with their customers.

Implications for Practice

The findings of this study suggest several strengths to be considered for educational practices. "Interconnections" drew a large number of participants, a total of 451 school district participants and 10 corporate participants, were in the study over the

three year program evaluation. Regional staff development such as "Interconnections" promotes a greater diversity in participant mix found within single school districts. The team approach drew school district participants from teaching, counseling and administration who had varied academic backgrounds, years of experience and grade levels.

Corporate participants were also diverse representing manufacturing, wholesale trade, research and development, insurance, and environmental industries located in the Illinois Research and Development Corridor, extending approximately 25 miles west of Chicago along I-88 from Oak Brook to DeKalb, Illinois.

Many more opportunities for school district teams to work in problem solving teams that mirror corporate work place teams were provided through regional collaboration and coordination.

The "Interconnections" school-business partnership staff development program had mutual benefits. For educators, "Interconnections" provided an opportunity to link with area employees and provided access to a variety of corporate cultures. For employees, "Interconnections" provided an opportunity for employees to "connect" to teachers from all grade levels K-12, counselors and school administrators. These mutual program benefits can be achieved by other consortia of schools and businesses.

Data results confirm significant attitudinal change regarding integrated curriculum and the corporate sector's workforce employment needs. As a result of the workshop structure, curriculum change at the local school district level occurred. Sixty-two curriculum modules were developed by "Interconnections" participants that integrate mathematics, science, and technology and work place skills into K-12 curriculum. Samples of these units are available through CPEE as an aid to other educators (see Appendix F).

Future research directions are suggested from this study. Since there was no direct measure of participants' knowledge of corporate workforce needs, it is suggested that future studies measure change in participant's knowledge regarding corporate workforce employment needs and use a control group.

Recruitment of teams to "Interconnections" over the three year period influenced study attitude outcomes. Since 31% of the 42 school districts that produced modules repeated the "Interconnections" experience, the attitudinal impact of the experience became negative. The information presented was already known to participants and lost its impact. Corporate test site visits, seen as "new adventures" by participants, continued to be rated valuable. Therefore, future program recruitment efforts need to concentrate on a broader range of school districts and participants from academic areas other than math and science (e.g., English, social studies, reading, library media).

Future survey administration for regional staff development programs such as "Interconnections" need to be kept as simple as possible. Over the three year period participants reported difficulty in completing the program evaluation surveys. Administration proved cumbersome due to needs for social security numbers on the Scantron form. Due to changes in the survey format, data from the 1990 pilot could not be matched with the 1992 data. For future longitudinal analysis, it is recommended that instruments remain uniform for attitude and knowledge measurement concerning integrated curriculum and workforce needs.

The IMPACT survey measured implementation of modules and staff development initiated at the local school district level. A total of 275 IMPACT surveys were mailed, but only 105 or 38% were returned. "Interconnections" impact is not known for the other 62% of the partcipants. Therefore, for knowledge of full program impact, it would be necessary for future studies to conduct telephone interviews with at least 70% of the participants.

Another factor to consider for program impact is the direct measure of student outcomes. Since the "Interconnections" research model assumed integrated curriculum to enhance student learning by fostering the growth of "students as thinkers," it would be very valuable for future research to study student performance compared with a traditional module versus an integrated module. An experimental study, with control and experimental groups, would be needed for actual outcomes measurement.

Recommendations for Further Research

Further research is indicated in the following areas. First, the research on the effectiveness of school-business partnerships is limited. ERIC searches conducted for this study identified little research on school-business partnerships. The case study of CPEE's evolution presented in Chapter III suggests that as partnerships mature developmentally, the focus of the partnership shifts from providers of enrichment and enhancement programs and services, to agents for systemic change. Do all effective partnerships follow a developmental model? Further research is needed to address the variables that impact effective partnerships. Research is needed to determine how partnerships make the change from program providers to change agents.

Second, the National Association of Partners in Education (NAPE) 1990 survey identified professional development of teachers and administrators as an underdeveloped area of need for partnerships. "Interconnections" was designed to address this underdeveloped school-business partnership program area, but other partnerships need to focus on staff development. The "Interconnections" team building model can be used by others and replicated. Since Glatthorn (1989) reports there is limited research on integrated curriculum for program results additional research needs to address whether integrated curriculum results in improved student achievement. Direct measures of student outcomes is an important future research direction.

Third, this study presented a useful change model for partnerships. The change process used by CPEE in the "Interconnections" program confirm that change occurs at two levels. The example of curriculum change by the West Aurora School District shows that CPEE served as the change agent and communication link between the schools (suppliers) and the business and industries (customers) in the service area. However, further research is needed to define the variables that were successful in implementing integrated curriculum at the local level in many school districts.

Finally, the IMPACT survey results suggest that mutual benefits were gained from collaboration between educators and employers through the "Interconnections" program. Ten corporations participated in "Interconnections" during the three year program as did 61 school district teams. Further research is needed regarding the profiles of the institutions which engage in partnerships. Why do some organizations participate in school-business partnership activities like "Interconnections" while others do not? Is there an organizational profile that characterizes "partnering" organizations?

Summary

This study has investigated the impact of a current program initiative of CPEE, "Interconnections 90: Scientific and Applied Technology and the Corporate Workplace." The results of this study confirm that school-business partnership staff development programs are a catalyst for curriculum change at the local school district level. "Interconnections 90" served as the regional catalyst for stimulating public-private sector collaboration. This close collaboration between business and education is essential to meet the challenge of preparing students with the skills needed for a world class workforce.

The future needs of our information society are realized through innovative projects such as "Interconnections." It is in the here and now that important decisions are

made or not made that impact future generations of students and employers. As Goodlad (1984) has stated:

> Futurists have a tantalizing way of describing the year 2001 as though being there has little to do with getting there. The future simply arrives full-blown. But is is the succession of days and years between now and then that will determine what life will be like. Decisions made and not made will shape the schools of tomorrow (Goodlad, 1984, p. 321).

APPENDIX A

APPENDIX A. PRETEST/POSTTEST

Corridor Partnership for Excellence in Education
"INTERCONNECTIONS 92"

PRELIMINARY INFORMATION

Welcome to "Interconnections 92." Please take a few moments to complete this introductory survey, following the directions outlined below. Thanks very much for your time.

GENERAL DIRECTIONS

1. Please do NOT include your name. Please answer all items on the attached scan sheet. You will need a #2 pencil. Please fill in the number below each heading.

2. In the columns labeled 1, 2, 3, 4, to the left of the space marked "date" on the scan sheet (bottom row), please mark the following:

   Column 1, please mark:

   0: if you are a teacher
   1: if you are an administrator
   2: if your are a counselor
   3: other

   Column 2, please indicate the number of years in the profession:

   0: 0-3
   1: 4-7
   2: 8-11
   3: 9-15
   4: 16+

   Column 3, please indicate your academic field of study:

   0: Science
   1: Mathematics
   2: Vocational Education
   3: Administration
   4: Guidance and Counseling
   5: Other

Column 4, please indicate the primary age level of children you are involved with:

0: elementary school
1: middle school
2: high school

3. Please enter today's date in the area under "date" (to the right of column 4).

4. In the column immediately to the right of the space marked "date" (in the row with no heading), please indicate your gender. Mark 0 if male, 1 if female.

5. Under the space marked "identification number," please enter your social security number. Remember to fill in the numbers below each digit. You do not need to fill in your name.

PART I: ASSESSMENT OF CURRENT UNDERSTANDINGS

For each of the following topics, indicate your current level of understanding using the following scale on the answer sheet:

A: Strongly Agree
B: Agree
C: Unsure
D: Disagree
E: Strongly Disagree

PLEASE BEGIN IN ROW 1 ON THE ANSWER SHEET.

1. An integrated curriculum builds student skills in thinking, reading, writing and computation.

2. A module that incorporates an Applied Mathematics, Science or Technology theme with needs of the corporate workplace promotes student workplace literacy (for example: recycling).

3. The purpose of a high school education is to be able to use printed and written information to function in society, to achieve one's goals, and to develop one's knowledge and potential.

4. Research shows that most young people graduating from high school can read and write to function in their jobs.

5. Employers need students with basic academic skills, communication skills, a good work ethic, adaptability, a good self-concept, and leadership skills.

6. The trends toward a service-based economy require higher technological skills of entry level workers.

7. In a global economy, the competitive edge will go to corporations having individuals with advanced technological skills.

8. Due to rapid changes in the workplace, requiring many possible job changes, it is important for high school students to learn "how to learn."

9. A course such as "Principles of Technology," which reflects real world workplace applications, better prepares students for future employment.

10. Integrated curriculum developed for those students who are not college bound will impact a majority of U.S. job openings.

Assessment of District Readiness for Curriculum Development

11. It is important for administrators at the building and district level to encourage new curricular development.

12. A teacher-team approach is important to curriculum development, both within and between subject disciplines.

13. Sufficient planning time is necessary for curriculum development.

14. Teacher-learning resources are vital for curricular innovation.

15. It is imperative to have research-based curricular innovations.

16. Collaboration between education, business and industry is a necessary component of quality curricular development.

17. School teams are an effective way to develop integrated curriculum.

18. "Interconnecting" science, math and vocational education is likely to change the structure of school curricula.

PART II: EXPECTATIONS FOR THE WORKSHOP

In this section, we'd like to know about your expectations for what you will experience and learn in this workshop. For each of the items below, please indicate your response according to the following scale:

A: Strongly Agree
B: Agree
C: Unsure
D: Disagree
E: Strongly Disagree

19. I expect to complete the workshop with a much better understanding of what employers are looking for in new employees.

20. I expect this workshop to be beneficial.

21. I expect to be able to develop curriculum materials I can use in my classes next fall.

22. I expect to work with teachers whose class content and grade responsibilities are similar to mine.

23. I expect to learn a significant amount about math and science in this workshop.

24. I expect to gain "hands-on" experience in developing curriculum materials.

25. I expect business/industry representatives to have much to contribute to the practical business of teaching students.

26. I expect to gain a better understanding of the employment picture in our region.

27. I expect to be intellectually challenged during this workshop.

28. I expect the workshop to be stressful.

Thank you very much for completing this survey.

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Corridor Partnership for Excellence in Education
"INTERCONNECTIONS 92"

SUMMARY EVALUATION

GENERAL DIRECTIONS

1. Please do NOT include your name. Please answer all items on the attached scan sheet. You will need a #2 pencil. Please fill in the number below each heading.

2. In the columns labeled 1, 2, 3, 4, to the left of the space marked "date" on the scan sheet (bottom row), please mark the following:

   Column 1, please mark:

   0: if you are a teacher
   1: if you are an administrator
   2: if your are a counselor
   3: other

   Column 2, please indicate the number of years in the profession:

   0: 0-3
   1: 4-7
   2: 8-11
   3: 9-15
   4: 16+

   Column 3, please indicate your academic field of study:

   0: Science
   1: Mathematics
   2: Vocational Education
   3: Administration
   4: Guidance and Counseling
   5: Other

   Column 4, please indicate the primary age level of children you are involved with:

   0: elementary school
   1: middle school
   2: high school

3. Please enter today's date in the area under "date" (to the right of column 4).

4. In the column immediately to the right of the space marked "date" (in the row with no heading), please indicate your gender. Mark 0 if male, 1 if female.

5. Under the space marked "identification number," please enter your social security number. Remember to fill in the numbers below each digit. You do not need to fill in your name.

PART I: ASSESSMENT OF CURRENT UNDERSTANDINGS

For each of the following topics, indicate your current level of understanding using the following scale on the scan sheet:

A: Strongly Agree
B: Agree
C: Unsure
D: Disagree
E: Strongly Disagree

PLEASE BEGIN IN ROW 1 ON THE ANSWER SHEET.

1. An integrated curriculum builds student skills in thinking, reading, writing and computation.

2. A module that incorporates an Applied Mathematics, Science or Technology theme with needs of the corporate workplace promotes student workplace literacy (for example: recycling).

3. The purpose of a high school education is to be able to use printed and written information to function in society, to achieve one's goals, and to develop one's knowledge and potential.

4. Research shows that most young people graduating from high school can read and write to function in their jobs.

5. Employers need students with basic academic skills, communication skills, a good work ethic, adaptability, a good self-concept, and leadership skills.

6. The trends toward a service-based economy require higher technological skills of entry level workers.

7. In a global economy, the competitive edge will go to corporations having individuals with advanced technological skills.

8. Due to rapid changes in the workplace, requiring many possible job changes, it is important for high school students to learn "how to learn."

9. A course such as "Principles of Technology," which reflects real world workplace applications, better prepares students for future employment.

10. Integrated curriculum developed for those students who are not college bound will impact a majority of U.S. job openings.

Assessment of District Readiness for Curriculum Development

11. It is important for administrators at the building and district level to encourage new curricular development.

12. A teacher-team approach is important to curriculum development, both within and between subject disciplines.

13. Sufficient planning time is necessary for curriculum development.

14. Teacher-learning resources are vital for curricular innovation.

15. It is imperative to have research-based curricular innovations.

16. Collaboration between education, business and industry is a necessary component of quality curricular development.

17. School teams are an effective way to develop integrated curriculum.

18. "Interconnecting" science, math and vocational education is likely to change the structure of school curricula.

PART II: EXPECTATIONS FOR THE WORKSHOP

In this section, we'd like to know about your expectations for what you will experience and learn in this workshop. For each of the items below, please indicate your response according to the following scale:

A: Strongly Agree
B: Agree
C: Unsure
D: Disagree
E: Strongly Disagree

19. I have completed the workshop with a much better understanding of what employers are looking for in new employees.

20. This workshop was beneficial.

21. I developed curriculum materials I can use in my classes next fall.

22. I worked with teachers whose class content and grade responsibilities are similar to mine.

23. I learned a significant amount about math and science in this workshop.

24. I gained "hands-on" experience in developing curriculum materials.

25. Business/industry representatives had much to contribute to the practical business of teaching students.

26. I gained a better understanding of the employment picture in our region.

27. I was intellectually challenged during this workshop.

28. I found the workshop to be stressful.

PART III: STRUCTURE OF THE WORKSHOP

Following are some statements regarding the general structure of the "Interconnections" workshop. Please indicate your opinion about each statement by using the following scale:

A: Strongly Agree
B: Agree
C: Unsure
D: Disagree
E: Strongly Disagree

29. The objectives for the workshop were made clear to me early in the workshop.

30. The physical facilities were adequate for the workshop.

31. The events of the workshop were sequenced appropriately.

32. The workshop objectives were important in terms of my responsibilities as an educator.

33. The content of the workshop in general was very relevant to my teaching responsibilities.

34. The logistics (transportation, meals, etc.) were handled in a smooth and appropriate manner.

35. The presenters in the workshop were credible to me.

36. The support services provided in the workshop were helpful and appropriate for my needs.

37. The events in the workshop were paced appropriately.

38. The workload we were expected to pursue was appropriate.

39. The intellectual demands of the workshop challenged me.

40. The workshop staff did a good job of managing the workshop.

41. Structurally, there is little I would change in the workshop.

42. I felt the workshop was well organized and implemented.

43. There was a good blend of presentations, visits and writing experiences.

PART IV: WORKSHOP EVENTS

Please rate each of the following workshop events, using the following summary codes:

A: Very Valuable
B: Valuable
C: Unsure
D: Not Very Valuable
E: Of No Value

44. Large group sessions

45. Curriculum writing sessions

46. Corporate site visits

47. Training laboratories

48. Interactions with other workshop participants

PART V: WORKSHOP PRODUCTS

Please indicate your assessment of the curriculum modules you worked on during the workshop, using the following scale:

A: Strongly Agree
B: Agree
C: Unsure
D: Disagree
E: Strongly Disagree

49. Our group made an excellent start on our curriculum module(s).

50. Our group had a clear sense of what we were supposed to do with respect to module development.

51. The module(s) we produced are superior to most of the teaching modules I currently use.

52. The modules we worked on will be very useful in my teaching.

53. The modules we worked on reflect the substance and philosophy we learned during the workshop.

54. I feel we are likely to fully complete the module.

55. I'd be willing to recommend our module for use by other teachers in my district.

PART VI: FINAL EVALUATION

56. If you were to place a letter grade on your overall impression of the workshop events, products, speakers, etc., please indicate the grade using the following scale:

A = "A"
B = "B"
C = "C"
D = "D"
E = "F"

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APPENDIX B

APPENDIX B. OPEN-ENDED/FORCED CHOICE

Corridor Partnership for Excellence in Education

"INTERCONNECTIONS 91"

Please complete the following questions.

1. In the space below please discuss your concept(s) of **INTEGRATED CURRICULUM.**

    1.

    2.

    3.

2. In the space below identify the required components of a module for **interconnecting** science, mathematics, and technology with the needs of the corporate workplace.

    1.

    2.

    3.

    4.

    5.

3. Identify up to three(3) things available in your school district that you believe will make it possible to develop an integrated curriculum.

    1.

    2.

    3.

4. Identify up to three (3) things that exist in your district that you think will inhibit the development of an integrated curriculum.

   1.

   2.

   3.

5. List three (3) key science concepts that would be appropriate for integrating science, mathematics, and technology.

   1.

   2.

   3.

6. List three (3) key mathematics concepts that would be appropriate for integrating science, mathematics, and technology.

   1.

   2.

   3.

7. List three(3) technology concepts that would be appropriate for integrating science, mathematics, and technology.

   1.

   2.

   3.

Check one:
Completed by a: _____ Teacher

_____ Counselor

_____ Administrator

Thank you.

Corridor Partnership for Excellence in Education
"INTERCONNECTIONS 92"

Please complete the following by marking the choice which BEST indicates your answer. Please choose only ONE.

1. Please choose the answer which you feel is the MOST important aspect of INTEGRATED CURRICULUM.

   (a) Integrating subject matter/Decompartmentalize learning
   (b) Communication between staff, faculty and administration
   (c) Team Teaching
   (d) Holistic Education
   (e) Relating Business/Industry to Academics

2. Please indicate the MOST significant component of a module for **interconnecting** science, mathematics and technology with the needs of the workplace.

   (a) Communication and cooperation among faculty and administration
   (b) Understanding needs of the corporation or workplace
   (c) Appropriate materials and equipment
   (d) Hands-on experience
   (e) Assessment and evaluation of experiences

3. Please identify the MOST significant resource available in your school district that you believe will make it possible to develop an integrated curriculum.

   (a) Creative, open-minded staff
   (b) Support from administration
   (c) Positive attitudes of faculty, parents and students
   (d) Availability of facilities and equipment
   (e) Team Teaching

4. Please identify the factor that you think will MOST inhibit the development of an integrated curriculum.

   (a) Lack of funding
   (b) Lack of time
   (c) Resistance to change among faculty
   (d) Lack of encouragement from central office and administrators
   (e) Lack of parental support

5. Which is the most important science concept for integrating mathematics, science and technology?

   (a) Problem solving
   (b) Scientific method
   (c) Mechanics
   (d) Observation
   (e) Space Exploration

6. Which is the most important mathematics concept for integrating science, mathematics and technology?

   (a) Problem Solving
   (b) Measurement
   (c) Mapping and Graphing
   (d) Estimation and Statistics
   (e) Basic Arithmetic Skills

7. Which is the most important technology concept for integrating science, mathematics and technology?

   (a) Computers
   (b) Problem Solving
   (c) Hands-on Experience
   (d) Recycling
   (e) Machine Use

CHECK ONE:
Completed by a ____ Teacher

____ Counselor

____ Administrator

Thank you.

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APPENDIX C. CORPORATE TOUR QUESTIONNAIRE

Corridor Partnership for Excellence in Education
"INTERCONNECTIONS 92"

CORPORATE WORKPLACE TOUR EVALUATION

GENERAL DIRECTIONS

1. Please do NOT include your name. Please answer all items on the attached scan sheet. You will need a #2 pencil. Please fill in the number below each heading.

2. In the columns labeled 1, 2, 3, 4, to the left of the space marked "date" on the scan sheet (bottom row), please mark the following:

   Column 1, please mark:

   0: if you are a teacher
   1: if you are an administrator
   2: if your are a counselor
   3: other

   Column 2, please indicate the number of years in the profession:

   0: 0-3
   1: 4-7
   2: 8-11
   3: 9-15
   4: 16+

   Column 3, please indicate your academic field of study:

   0: Science
   1: Mathematics
   2: Vocational Education
   3: Administration
   4: Guidance and Counseling
   5: Other

Column 4, please mark the corporate tour you are evaluating, as follows:

0: Caterpillar, Inc.
1: Furnas Electric Company
2: Amoco Corporation
3: Geo. J. Ball, Inc.
4: Motorola, Inc.
5: Sears Training Center
6: Chemical Waste Management
7: Metropolitan Life Insurance
8: ServiceMaster

3. Please enter today's date in the area under "date" (to the right of column 4).
4. In the column immediately to the right of the space marked "date" (in the row with no heading), please indicate your gender. Mark 0 if male, 1 if female.

5. Under the space marked "identification number," please enter your social security number. Remember to fill in the numbers below each digit. You do not need to fill in your name.

INFORMATION OBTAINED DURING THE VISIT

How much information about each of the following topics do you feel you obtained from this visit? Please indicate your evaluation of the amount of information you received about each topic by marking:

A: A great deal of information
B: Some information
C: Not very much information
D: No information

PLEASE BEGIN IN ROW 1 ON THE ANSWER SHEET.

1. Employment opportunities that exist in the company.
2. Trends affecting future job requirements, particularly in areas of mathematics, science, and technology.
3. Compensation/employee benefits.
4. Employment areas particularly in demand, especially as relates to science, mathematics, and technology.
5. Qualifications required for entry level positions.
6. Common problems with poorly prepared applicants in the employment process.
7. Employment skills necessary, especially those related to problem-solving skills, interpersonal skills in working in teams, etc.
8. Retraining efforts pursued by the company in the areas of basic skills remediation, as well as ongoing training/development and education.

ELEMENTS OF THE CORPORATE VISIT

Please indicate your evaluation of the elements of your corporate tour listed below. Please mark the extent to which you found each element:

A: Very useful
B: Somewhat useful
C: Marginally useful
D: Not at all useful
E: (Did not have this element in this visit.)

9. Overview of the company
10. Panel presentation
11. Company tour
12. Question and answer period(s)
13. Follow-up discussion
14. Materials on company products and services

OVERALL EVALUATION OF THE VISIT

Following are a number of terms that might be used to indicate your overall evaluation of your corporate visit. For each of these terms, please indicate the extent to which you believe the term applies to your coporate visit, using the following code:

A: Extremely
B: Very
C: Somewhat
D: Not at all

15. Interesting
16. Boring
17. Relevant
18. Informative
19. Difficult
20. Good
21. Stimulating
22. Irrelevant
23. Worthwhile
24. Valuable
25. Necessary
26. Dull
27. Challenging
28. A waste of time
29. Practical

30. Demanding
31. Different
32. Enjoyable
33. Enlightening
34. Exciting
35. Rewarding
36. Provocative
37. General
38. Useless

COMMENTS AND SUGGESTIONS

If you have anything else you would like to say about this corporate visit, please feel free to write your comments below or on the back of this sheet.

THANK YOU FOR YOUR FEEDBACK

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APPENDIX D

APPENDIX D. INTERCONNECTIONS PARTICIPANTS' IMPACT SURVEY

Interconnections IMPACT Survey
August 1992 (School Form)

Background Information:

I participated in Interconnections during these years: (check those that apply)

1990 ( ) 1991 ( ) 1992 ( )

I work for the following school district:_____

I am employed by this school district as:

Teacher ( ) Counselor ( ) Building Administrator ( ) School District Administrator ( )

I work with the following grade levels: (check all those that apply)

Elementary ( ) Middle School/Junior High School ( ) High School ( )

Vocational/Technical ( )

Impact of Interconnections Experience:

Did you implement the integrated curriculum module you developed during the next school year?
YES ( ) NO ( )

Have you used the integrated curriculum module developed in later years? YES ( ) NO ( )

Have you developed additional integrated modules for your students? YES ( ) NO ( )

If YES, how many modules have you developed since participating in Interconnections?

1( ) 2 ( ) 3 ( ) 4 ( ) 5 or more ( )

If YES, in what learning content areas are modules available?
Math ( ) Reading ( ) Fine Arts ( )

Science ( ) Writing ( ) Social Studies ( )

Reading ( ) Language Arts ( ) Foreign Languages ( )

Other:_____

What are the names of the integrated modules you have developed?

_____

_____

Did your Interconnections Team provide inservice training to other educators:

Within your school building ? YES ( ) NO ( )

In your school district? YES ( ) NO ( )

In schools within your geographic region? YES ( ) NO ( )

At conferences , workshops, or seminars? YES ( ) NO ( )

Have you continued to network with your Interconnections Corporate Partner?
YES ( ) NO ( )

Have you expanded your contacts with other business or industrial companies as a result of your introduction to partnerships through Interconnections?
YES ( ) NO ( )

Have you received administrative support in developing integrated curriculum modules in any of the following areas? (Check those that apply.)

Funding for special projects in the areas of:_____( )

Additional planning time ( ) Release time ( ) Revised schedule ( )

Access to new resource materials ( ) Additional personnel ( )

Team-teachers ( )

Other:_____

How many students have been introduced to your integrated curriculum modules since your participation in Interconnections? Total number_____

How have students responded to your integrated curriculum units?

Please provide general comments concerning your implementation of integrated curriculum modules:

Achievements/Success Stories

Barriers Encountered

Other comments:

Return this survey by August 17, 1992 to:
Corridor Partnership for Excellence in Education,
41 W. Benton, Aurora, IL 60506.

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APPENDIX E

APPENDIX E. CORPORATE IMPACT SURVEY

INTERCONNECTIONS IMPACT SURVEY
August 1992 (Corporate Partner Form)

How many employees were involved in the Interconnections experience? _____

What were some potential benefits gained from the Interconnections experience for your company?

What were some potential benefits gained for the employees involved in the Interconnections experience?

Have you had any follow-up contact with districts who participated in Interconnections?
Yes _____ No _____

If YES, what follow-up activities were requested?

Please provide any general comments regarding the Interconnections Program.

Is your company willing to work with Interconnections teams in the future? Yes ____ No ____

Please rate Interconnections experience in terms of its impact:

	Excellent	Good	Fair	Poor	Does Not Apply
Knowledge of career paths in your organization.	1	2	3	4	5
Awareness of your company's need for expanding educational outreach efforts?	1	2	3	4	5

Understanding of the basic skills required for your workforce?	1	2	3	4	5
Potential for future employee recruitment?	1	2	3	4	5
Understanding of your workforce requirements for technology, math, science competencies?	1	2	3	4	5
Awareness of the range of job openings and skills required within your company?	1	2	3	4	5

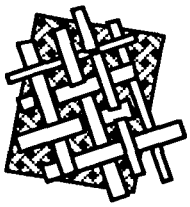
Other comments:

Please return this survey by August 17, 1992 to:

Corridor Partnership for Excellence in Education
41 West Benton Street, Aurora, Illinois 60506

APPENDIX F

APPENDIX F. CURRICULUM MODULES PRODUCED



"Interconnections 90-92"
Scientific and Applied Technology and the Corporate Workplace
PARTICIPATING SCHOOL DISTRICTS

Batavia Unit School District 101
- 1992 -"Bridging the Gap Between the Academic and Vocational Environments"

Cicero School District 99
- 1990 - "Cicero's Interconnections Module"

Community Unit School District 303
- 1992 - "Integrated Technology Course"

Consolidated High School District 230
- 1991 - "Interconnecting the Science of Wave Theory With Technological Applications in Electronics"

Dundee Community Unit School District 300
- 1992 - "Our Changing Workforce"

DuPage Area Occupational Education System (DAOES)
- 1990 - "Read and Interpret Reference Materials"
- 1991 - "Technology and Communication: the Vital Link"
- 1992 - "Employment Related Math Skills"

DuPage High School District 88
- 1991 - "Careers Skills Information"
- 1992 - "Career Interconnections"
- 1992 - "Promoting Technological Aspects of Physics"

Deerfield School District 109
- 1991 - "Is It an 'In Day' or an 'Out Day' ?"

Downers Grove Community High School District 99
- 1991 - "Laboratory Assessment"

Downers Grove Junior High School District 58
- 1990 - "Rehash the Trash"

East Aurora Unit School District 131
- 1990 - "Curriculum Requirement for Students' Success in the Workplace"
- 1991 - "Power of Energy, A Unit of Interdisciplinary Activities for East Aurora Middle Schools"
- 1992 - "Colligative Properties of Solutions"

Elgin School District U-46
- 1991 - "Recycling"

Elmhurst Community Unit School District 205
- 1990 - "It's Your Choice"
- 1992 - "Tabletop Technology"

Fenton Community High School District 100
- 1991 - "Building Yourself the Math, Science, and Technology Connection"

Glenbard Township High School District 87
- 1990 - "Technology Across the Curriculum (T.A.C.)"
- 1992 - "Tech Prep 92-93"

Hiawatha High School District 426
- 1990 - "A 20 Year Environmental Simulation for 80 Acres It's Your Lucky Day!"

Indian Prairie School District 204
- 1990 - "Partnership for 21st Century"

Indian Valley Vocational Center
- 1990 - "Technology Awareness Today/Tomorrow and You"

Joliet School District 86
- 1991 - "In School ... Preparing for Our Future

Kaneland Community Unit School District 302
and
Fox Valley Career Center
- 1991 - "Technology-Environmental-Awareness"
- 1992 - "Technology-Environmental Awareness"

1992 - "Fundamentals of Electricity Generation Using Recycled Automotive Alternators"
1992 - "Fundamentals of Electricity Using Recycled Automotive Starter Motors"

Keeneyville School District 20
1991 - "Communication: A Skill, a Technology"

Kishwaukee Education Consortium
1992 - "Employee 2000"

Leyden High School District 212
1990 - "Atmospheric Transportation - the Glider"

Maine Township High School District 207
1992 - "Technology and Research in the Community"

Morton High School District 201
1991 - "Tech Prep: An Important Interconnection for the 1990's"

Naperville Community Unit School District 203
1991 - "SAG - Students Against Garbage"
1991 - "Avenues of Technology in Your World"

Oak Park Public School District 97
1990 - "A Step Toward the Future"
1990 - "Ecology"

Oswego Community Unit School District 308
1990 - "Tech Times (T2)"
1992 - "Environmental Technologies/Technical Solutions"
1992 - "Attitudes and Ethics"

Peotone Community School District 207-U
1992 - "Gaining Relevant Occupational Wealth (G.R.O.W.)
1992 - "Career Awareness and Information"

Plano Community Unit School District 88
1990 - "Technology and Careers for the 90's"
1991 - "Mathematics and You"

Proviso Township High School District 209
1992 - "Homecoming '93"
1992 - "School to Work"

Rosary High School
1991 - "The More We Get Together ..."

St. Edward Catholic High School
1991 - "Communicating Data Visually"

Adlai E. Stevenson School District 125
1990 - "Teamwork and Technology: A Practical Lab Approach"

Summit Hill School District 161
1990 - "T.E.A. (Technology-Environmental Awareness)"

Sycamore Communtiy Unit School District 427
1990 - "Technology - Your Future"
1992 - "Team Dynamics"

Thornton Township High School District 205
1992 - "Collecting and Interpreting Data"

Troy Community Consolidated School District 30-C
1990 - "Career Awareness"

Valley View Community Unit School District 365-U
1990 - "How to Improve the Skills and Attitudes of Students for Success in the Workplace"

Waukegan Community Unit School District 60
1991 - "The School-Work Connection"

West Aurora Unit School District 129
1990 - "Middle School Curriculum Module #1 'Home Energy Management' "
1991 - "T.I.M. Technology Inservice Module"
1992 - "Transportation - Power Vehicle ('Power Climber')"

Westmont Community Unit School District 201
1990 - "Staff Development Workshop in Use of Technology in the Workplace"

Wheaton-Warrenville Community Unit School District 200
1991 - "Building Bridges Between the Classroom and Career Technology"

Wilmington Community Unit School District 209-U
1991 - "School and Community: United for Excellence in a Technological Era"
1992- "WPNT: The AA Connection (Wildcat Pride News Team: The Academic/Application Connection)"

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VITA

The author, Marsha K. Bollendorf, is the daughter of Frank and Ethel Hollis. She was born December 5, 1948, in Hammond, Indiana. In 1970 she received a B.S. in Elementary Education from Eastern Illinois University. In 1979 she received a M.S. in Counselor Education and in 1982, a Certificate of Advanced Study in Counseling from Northern Illinois University. In August, 1988, Marsha entered Loyola University of Chicago as a doctoral student in Administration in Education Leadership and Policy Studies.

Marsha K. Bollendorf is the Executive Director of the Corridor Partnership for Excellence in Education, a unique partnership between elementary and secondary schools, colleges and universities, research and development laboratories, business and industry, government, and labor. The Partnership serves the Northern Illinois region and the I-88 Research and Development Corridor. In this capacity, Marsha provides leadership in the design and implementation of programs and services which focus primarily on school-business partnerships that facilitate systemic change, and on extending professional learning opportunities for students, teachers, counselors, and school leaders primarily in the areas of mathematics, science and technology.

Under Marsha's leadership, the Corridor Partnership has been recognized as an exemplary school-business partnership by the Illinois State Council on Business/Education Partnerships, listed as one of the "100 Best" partnerships by the *Partners in Education Journal*, and received the 1991 Award of Excellence for "Interconnections 90": Scientific and Applied Technology Literacy and the Corporate

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Ms. Bollendorf also serves as the Business Manager of the West Suburban Regional Academic Consortium, a partnership of eleven higher education institutions located in the Chicago metropolitan area.

Ms. Bollendorf has extensive experience in public education having taught at all levels K-16, and has served as a counselor, and administrator. She also serves as a consultant to school districts and private sector organizations in efforts to establish multiple-constituency partnerships.

Ms. Bollendorf has published a number of articles regarding the development and support of school/business partnerships. In addition, Marsha is a nationally certified counselor and a Clinical Member of the American Association for Marriage and Family Therapy.

APPROVAL SHEET

The dissertation submitted by Marsha K. Bollendorf has been read and approved by the following committee:

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The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

April 15, 1993 — Date

L. Arthur Safer — Director's Signature