

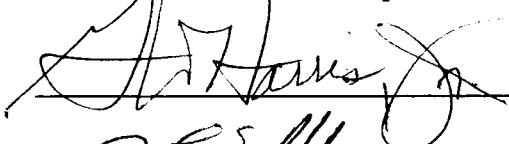
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I am submitting herewith a dissertation written by Albert Earl Piatt entitled "Professional Development Needs of Science Teachers in the Middle Grades in Chattanooga and Hamilton County Tennessee." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Education, with a major in Leadership Studies in Education.

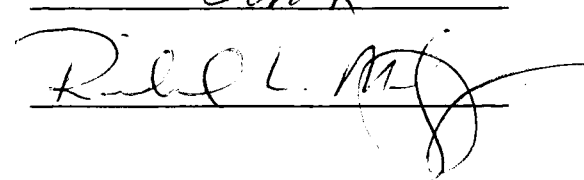


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We have read this dissertation
and recommend its acceptance:







Accepted for the Council:



Associate Vice Chancellor and
Dean of The Graduate School

**PROFESSIONAL DEVELOPMENT NEEDS
OF SCIENCE TEACHERS IN THE MIDDLE GRADES
IN CHATTANOOGA AND HAMILTON COUNTY
TENNESSEE**

A Dissertation
Presented for the
Doctor of Education
Degree
The University of Tennessee, Knoxville

Albert E. Piatt
August 1995

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DEDICATION

This study is dedicated to

John W. Meyer

my seventh and eighth grade science teacher
who instilled in me an appreciation for the sciences

and to the

**Middle Grade Science Teachers
in Chattanooga and Hamilton County, Tennessee**

who provide the hope and encouragement
for future generations of Tennesseans.

ACKNOWLEDGMENTS

I would like to express my sincere appreciation to all of those who contributed to the success of this study. First of all, special thanks to Dr. E. Grady Bogue, chairman of my doctoral committee, for his advice, encouragement, and patience throughout the last two years of study with this program. The assistance of Dr. George Harris, Jr., Dr. Gerald Ubben, and Dr. Rich Metzger, as members of my doctoral committee, is also greatly appreciated.

Secondly, I would like to thank the individuals who volunteered to serve as my panel of experts for the development of my prospectus and survey instrument. I would especially like to thank Dr. Ben Spangler, for supporting and encouraging me to pursue my doctoral studies; Dr. John Carpenter, for permitting me to modify his survey questionnaire to meet the needs of this study; Dr. Ken McEwin, Dr. Jack Rhoton, and Dr. Bob Yager, for taking their time to review my prospectus and draft survey instruments and provide much needed criticism and recommendations; Dr. Lloyd Davis, for his guidance with the data analysis portion of this study; Curtis Drake, Ken Shepard, and Dr. Sylvester Carrington, without whose support this study could not have been undertaken; and Dr. Herb Robinson and Dr. Roger Meyer for their assistance in reviewing the final draft of this study.

Last, but certainly not least, I would like to thank my loving wife and partner of twenty-six years, Linda, without whose patience, support, and continuous encouragement, the completion of this doctoral program and dissertation would not have been possible; and to my daughters, Bonnie—a prospective middle school teacher currently a senior attending Middle Tennessee State University and Dorothy—a sixth grade middle school student attending Ooltewah Middle School in Hamilton County, who understood why, over the past three years, I couldn't always be there for them.

ABSTRACT

The purpose of this study was to provide a basis for the formulation of policies and programs for the professional development of middle grade science teachers. This was accomplished by assessing the professional development perceptions of science teachers in grades six through eight in the Chattanooga Public Schools and the Hamilton County Department of Education. The study also yields suggestions for higher education to strengthen undergraduate and graduate teacher preparation programs for middle grade science teachers.

The major findings of this study are as follows:

1. The current supply of qualified science teachers is shrinking in Hamilton County.
2. The greatest need for content knowledge is in the areas of space sciences and the physical sciences.
3. The greatest topical need for teacher professional development is the integration of technology into the classroom. This was closely followed by the need for updates in availability of science teaching resources, science curriculum, and science teaching methods and strategies.
4. Teachers feel that their preservice teacher preparation only marginally prepared them to teach science in the middle grades.
5. Most teachers feel confident in their ability to teach science in the middle grades, except for their ability to organize and operate science labs.
6. Teachers prefer professional development activities which give them the opportunity to collaborate with their colleagues, both within and outside the school.
7. Teachers express a need for all types of up-to-date teaching resources such as specific content materials, idea books, activity books, computer software, etc..
8. Among the variables examined, the primary significant differences in perceptions investigated in this study was attributed to elementary teachers who are required to teach science outside of their teaching perceived specialty.
9. There were no overall trends readily apparent that would indicate that any one variable analyzed would require separate treatment.
10. The study indicates that it would be beneficial to have a Science Coordinator, as a resource person, available in the central office.
11. Finally, colleges and universities need to work more closely with the public schools in addressing teacher preparation and continuing professional development needs.

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CHAPTER 1

INTRODUCTION

Introduction

Our base of knowledge is growing at an exponential rate, especially in the areas of science and technology. The shift from an industrial oriented to an information-technical oriented society places an increasing demand on everyone to have a knowledge of the sciences in order to utilize emerging technologies. The rapid obsolescence of scientific knowledge demands that the professional development of science teachers be approached differently than it is for other areas of the curriculum (Carnegie Commission, 1991). Even the "...best possible undergraduate science preservice education cannot service classroom teachers adequately in this age of rapidly changing and expanding knowledge and technology" (Hartz and Enochs, 1985, p. 126). A steady decline in national standardized test scores over the past two decades has prompted a renewed nation-wide emphasis on promoting an interest in mathematics, science, and technology, especially among women and minorities (Carnegie Commission, 1991). Recent studies show that student attitudes toward science begin to decline in the middle grades and continue to decline throughout secondary school (American Association of University Women [AAUW], 1992; Jones, Mullis, Raizen, Weiss, and Weston, 1992; Meissner, 1988; Peltz, 1990). Consequently, the majority of projects which respond to this current emphasis are targeted at middle grade students. The goal of these projects is generally stated as "...fostering a long-term interest in mathematics, science, and technology and encouraging students to pursue this interest into their career choices" (Rogers, Benson, and Pregulman, undated).

Middle grade students are, by their nature, one of the most difficult age groups to understand and, therefore, present one of the greatest challenges for teachers. The effectiveness of middle grade teachers is central to the success of all efforts targeting these students. Teacher perceptions of adequacy of content knowledge, perceptions of their preservice teacher preparation, area(s) of teacher certification, years of teaching experience, knowledge of the nature and needs of early adolescents, confidence in science teaching ability, knowledge of methods and teaching strategies for the middle grades, and participation in inservice professional activities combine to affect the quality of the learning environment teachers create for middle grade students.

Statement of the Problem

Most projects which promote an increased interest in mathematics, science, and technology focus on the student. While these projects generally include a teacher inservice training component, relatively few attempts have been made to assess the actual needs of the teachers participating in the projects. An examination of the problem from the perspective of teacher professional development needs could provide a better, longer term solution toward the improvement of science education..

Most preservice teacher preparation programs in the State of Tennessee educate students to meet the teacher certification standards established by the Tennessee Department of Education. Since Tennessee does not require middle school certification, or provide for middle school endorsements (State Board of Education, 1992a), the preservice education of future middle grade teachers often falls short of the standards for middle school teacher education set by the National Middle School Association (NMSA). In Tennessee, middle school teachers are prepared for certification at either the elementary or secondary level. Within the City of Chattanooga and Hamilton County, it is often left up to the principal to decide whether to fill a middle level teacher position vacancy with an elementary or secondary certified teacher.

Rising costs and decreasing appropriations affect the ability of public schools to provide programs of ongoing professional development for their science teachers (Archer, 1993). With the steady decline in resources available to the public schools, it is essential that the shortfalls between preservice preparation, certification requirements, and the actual classroom needs of middle grade science teachers be addressed in as quick and efficient a manner as possible.

Purpose of the Study

The purpose of this study was to provide a basis for the formulation of policies and programs for the professional development of middle grade science teachers. This was accomplished by assessing the professional development perceptions of science teachers in grades six through eight in the Chattanooga Public Schools and the Hamilton County Department of Education. The study also yields suggestions for higher education to strengthen undergraduate and graduate teacher preparation programs for middle grade science teachers.

Research Questions

Specifically, the study attempted to answer the following questions:

- In what areas do middle grade science teachers perceive their professional development needs to be the greatest?
- Do teachers feel that their preservice teacher preparation adequately prepared them to teach science in the middle grades?
- What types of inservice professional development activities do middle grade science teachers prefer?
- What kinds of teaching resources do middle grade science teachers prefer to have made available through professional development activities?
- Do teachers feel confident in their ability to teach science in the middle grades?
- How do response patterns to these five questions vary as a function of gender, ethnicity, total years of teaching experience, experience teaching science in grades six through eight, level of formal education, undergraduate major area of study, and level of certification?

Importance of the Study

Most of the goals for science education projects are long-term; that is, they are aimed at affecting students' post-secondary educational and career decisions. A currently unstated goal of these projects is to affect the long-term behaviors of teachers as well. The results of this study support program evaluation requirements of various science projects in the region, such as the Challenger Center at The University of Tennessee at Chattanooga, the Creative Discovery Museum, the Tennessee Aquarium, the Tennessee Valley Project, and the National Science Foundation's (NSF) Partnership for Minority Student Achievement (PMSA) program being implemented in Chattanooga Public Schools.

On November 7, 1994, the citizens of the City of Chattanooga voted to return the responsibility for the education of their children to Hamilton County beginning with the 1997-1998 academic year. The Chattanooga Public Schools use a centralized system of governance, while the Hamilton County Department of Education currently employs a site-based system of management. A planning committee has been established to ensure a smooth transition to a new, consolidated school system for Hamilton County. This study provides information necessary for the establishment of a professional development program for middle school science teachers in the emerging consolidated school system. It can also serve to provide

information necessary to obtain grant monies under Public Law (P.L.) 103-227, Goals 2000: Educate America Act (Neiman, 1994) and guidelines established by the National Science Foundation (Williams, 1994).

Assumptions

Teacher involvement in needs assessment is a fundamental principle of participatory management for an effective inservice professional development program.

Teachers are aware of their professional development needs and are willing to state them accurately and honestly.

The survey instrument provides an accurate assessment of the middle grade science teachers and their professional development needs.

If teacher professional development policies and activities don't address the perceived needs of the teachers affected, no resulting long-term behavioral change is likely to occur.

Limitations of the Study

The study is limited to middle grade science teachers; it does not necessarily address the needs of teachers in other fields, or at other levels of education, e.g., early elementary or secondary teachers. Although some of the recommendations may have application to the inservice professional development needs of teachers in other academic fields, it was not the main focus of this study.

The subjects for this study were drawn from the public schools in the City of Chattanooga and Hamilton County, Tennessee. The needs identified in this study are specific to this population and may not be generalized to other populations without appropriate caveats.

It was not possible to perform valid ethnic comparisons due to the low number of minority science teachers represented in the population.

The participating school systems required that follow-up interviews be conducted voluntarily, so as not to unnecessarily impose upon teachers and interfere with their normal duties and responsibilities.

Definition of Terms

Early adolescent: The period of human development prior to the onset of puberty through the beginning stages of adolescence (Eichhorn, 1966), generally covering ages ten through thirteen, fourteen, or fifteen, depending on the researcher (Beane, 1993; Hill, 1982; Scales, 1991).

Inservice professional development: This includes all of the activities engaged in by a teacher to improve knowledge and efficacy in the profession of teaching undertaken after entry into the profession.

Middle grades: School organizational structures and grade configurations vary widely from state to state and district to district. The most common use of middle grades among the population of this study is in a grade six through eight configuration. Both of the school systems being surveyed consider the middle grades to reflect that configuration. These grades, however, are currently located in a variety of organizational structures ranging from elementary school to middle school to high school. A "middle grades teacher" would be one who teaches in grades six through eight.

Middle grades science teacher: This is considered to be any classroom teacher in the middle grades with assigned responsibilities for the teaching of science. This teacher may, or may not, have any science endorsement on his, or her, teacher certification.

Middle level: The level of education, between elementary and secondary, which deals primarily with the needs of the early adolescent student.

Middle school: The middle school represents a specific organizational configuration to meet the needs of the students in the middle grades. Nationally, this is either grades five through eight, or six through eight (Alexander, Williams, Compton, Hines, and Prescott, 1968; Irvin, 1992; NMSA, 1986; Scales, 1992). Currently Chattanooga Public Schools consider the middle school to include grades six through eight. The Hamilton County Department of Education is in the process of reorganizing all of its middle schools to a six through eight grade configuration prior to the beginning of 1995-96 school year.

Needs assessment: The collection of information pertaining to the perceived needs of specific populations, analysis of those needs, rank-ordering the perceived priorities of those needs, and providing recommendations for action concerning such needs (White, 1990, p. 13).

Non science-trained teacher: A teacher who has an undergraduate major in education and/or an academic field other than one of the sciences.

Preservice teacher preparation: This includes all undergraduate and/or graduate coursework, field experiences, and student teaching undertaken, which are necessary to obtain teacher certification in the State of Tennessee, prior to beginning the first teaching job.

Science-trained teacher: A teacher who has an undergraduate major in education and/or one of the sciences.

CHAPTER 2

REVIEW OF THE LITERATURE

Introduction

In order to examine the professional development needs of middle grade science teachers, it is important to look at the various factors which affect teaching at the middle level. In doing this, it is necessary to explore a number of areas related to teaching at the middle level. These areas include the nationally perceived shortfalls in science education, the specific needs of the early adolescent student, the middle school concept, the current status of preparation for teaching at the middle level, the influence of teachers on students at the middle level, the impact of inservice professional development activities on teacher competence and skills, and the role that higher education should play in the continued professional development of inservice teachers.

Shortfalls in Science Education

None of the students had experienced hands-on inquiry science taught on a regular basis at any level of schooling. A vast majority saw science teaching as the distribution of factual information. Scientists were seen as an elite core of mostly older cantankerous men by more than 90% of the preservice students. Less than 2% said they had ever met a scientist and none of them had any idea of precisely what a scientist would do during a normal work day, including the handful who personally knew scientists. Likewise, people who taught science were a 'strange breed,' with a few exceptions, and the students in the methods class could not picture themselves 'doing to their students what was done to them in science class. (Jablon, 1994, p. 155)

These statements reflect the perceptions toward science and science education expressed by our future teachers. What these preservice teachers have experienced in their own educational processes influences their attitudes toward science education and science teaching behaviors. Several national studies have indicated that insufficient classroom time is devoted to the teaching of science in the early grades, and that the quality of the instruction received is not sufficient to meet the objectives set forth in P.L. 103-227, *Goals 2000*, i.e., for American students to be first in the world in mathematics and science achievement by the year 2000 (Abell, 1990; Goodlad, 1984; Carnegie Commission, 1991; Neiman, 1994). Anderson (1991) found that

teachers are likely to spend more time teaching science when they have confidence in their ability in science. Science is often taught by teachers who have inadequate preparation, negative feelings, or a lack of confidence to teach it effectively (Williams, 1990). In spite of the lofty national and state goals which have been established for mathematics and science education, the Office of Educational Research and Improvement (OERI) (1993, p. 6) reports that "...higher education continues to graduate elementary teachers with only a few hours of mathematics and science." This report further quotes Professor Gary Sykes of Michigan State University (OERI, 1993, p. 10) who indicates that "...colleges of education continue to educate teachers in the traditional way while policy makers demand that they teach in non-traditional ways. We end up expecting children to learn what we don't educate teachers to teach."

In spite of what has been learned about the importance of activity-based learning in the early and middle levels, teachers continue to place a heavy reliance on textbooks and standardized tests. They incorporate almost none of the available technology into their delivery strategies (Archer, 1993; Carnegie Commission, 1991; Goodlad, 1984; Jones, et al., 1992; Rhoton, 1984; Weiss, 1993; Young, 1993). There is also an absence in teaching the history and philosophy of science and its relationship to society at all levels of education (Dyer, 1983, Goodlad, 1984).

While nationally the supply of science teachers has improved dramatically over the past ten years, there remains a net shortage in all areas of science, except biology (Hudson, 1992; National Council on Excellence in Education, 1983). Minorities and women continue to be under-represented in science in public education today. While women comprise 88% of all lower and middle level teachers (Scales and McEwin, 1994), this percentage drops to 45% by grade 8 (Jones, et al., 1992) for science teachers. The report of the Carnegie Commission on Science, Technology, and Government (1991, p. 24) found that "today's system of education discourages most young women and minorities from the pursuit of math and science, creates expectations of failure, and promotes low self-confidence." Archer (1993) found that minority teachers often are not science specialists, but hold elementary certification and are placed in the poorest schools. "Minorities in the teaching profession are decreasing at a time when the number of minority students is increasing" (Baratz-Snowden, 1988, p. 173; Champagne and Baden, 1988; Holmes Group, 1986; Lipsitz, 1980; Scales, 1991).

Brunkhorst (1987) found that females need specific assistance to enhance their involvement in science. Far too often teachers present science without relating it to other disciplines, or to real-life situations (Williams, 1990). The research of Carol Gilligan (1993) suggests that females are predominantly relationship-oriented in their intellectual development.

The implication is that teachers could make science more relevant to female students by stressing the relationships of scientific principles, facts, and data to society's needs and concerns (Peltz, 1990). Clewell, Anderson, and Thorpe (1992) recommend intervention around the middle level to help both females and minorities to succeed in science.

Needs of Early Adolescents

Students entering the middle grades are making multiple transitions, experiencing profound physical, social, emotional, and intellectual changes simultaneously. They are entering puberty, entering middle school, entering more demanding peer relations, and establishing their independence and self-concepts at the same time they are continuing to work as students. Students who are facing many changes in their lives need teachers and administrators who understand the conditions and characteristics of this age group and who can create intellectuality stimulating and supportive programs of learning. (Epstein, Lockard, and Dauber, 1989, p. 26)

The period of early adolescence is characterized by rapid and sometimes dramatic social, emotional, intellectual, and physical changes, e.g., rapid, but irregular growth rate, impulsive behavior, greater self-reliance, and resentment of authority (Alexander, et al., 1968; Hill, 1982; Klingele, 1979; Lipsitz, 1984; McPartland and Wu, 1988). At the same time, early adolescents are beginning to mature intellectually, are at their height of inquisitiveness, and exhibit a natural curiosity which facilitates a positive condition for learning (Klingele, 1979).

The social, emotional, intellectual, and physiological changes represent, not separate, but interrelated development (Milgram, 1992). Piaget (1970, 1973) notes that this period marks the transition from concrete operations to the emergence of prepositional or formal operations during which the individual may seem to regress intellectually (Alexander, et al., 1968; Hill, 1982; Lipsitz, 1984; Milgram, 1992). It is important for educators to remember that the emergence of formal operations does not mean that the process occurs overnight, nor that it occurs at the same time for all people. While many teachers assume that early adolescents are capable of thinking in the abstract, most early adolescents find instruction requiring the use of formal operations to be very frustrating (Eichhorn, 1984, p. 34; Wheelock and Dorman, 1988, p. 31).

Early adolescents are not all at the same stage of development simply by virtue of their being the same age chronologically (Eichhorn, 1966; Scales, 1991). Diversity is the common characteristic of this critical stage of human maturation which must be considered in the development of the middle level curriculum. Curriculum guides, mandated by state

departments of education, point more toward the orderly acquisition of knowledge and skills than their relationships to psychological development factors, i.e., readiness.

Curricular guides for the middle grades often do not take into account the diversity of individual growth and readiness of early adolescents. Curricular goals should not be based on chronological age during this critical period of transition. Early introduction of concepts and principles requiring the use of abstract thinking too early in an individual's level of development may result in feelings of low self-efficacy and inadequacy, thereby setting the stage for future academic and social problems for the student. This diversity is further complicated by increases in the populations of different ethnic, racial, and cultural groups, increases in the number of non-traditional homes, higher incidence of early pregnancy, sexually transmitted diseases, dropouts rates, teenage violence, substance abuse, and other sociological problems confronting today's late elementary and middle level students (Scales, 1991, 1992; Wheelock and Dorman, 1988).

Beane (1993) identifies the skills which should be addressed in middle level curriculum as: reflective thinking, critical ethics, problem solving, valuing, self-concept/esteem, social action skills, and the search for completeness and meaning. Middle school is the level where student attitudes begin forming and changing (Clewell, et al., 1992). If students have good science experiences in the middle grades, they are likely to maintain a positive attitude toward science throughout their lives (Wylo, 1993).

"The middle school years are often the student's first major encounter with science, therefore can be particularly influential in laying the groundwork for future science study" (Jones, et al., 1992, p.3). Failure to understand the needs of early adolescents, especially those of females and minorities, often leads to the tracking of those students, a practice that may reinforce low self-concept (Archer, 1993). Middle school students show the need for diversity; self-exploration and self-definition; meaningful participation in their school communities; social interaction with both peers and adults; physical activity; a sense of competence and achievement; and structure and clear limits (Clewell, et al., 1992, p. 18; Dorman, Lipsitz, and Verner, 1985; Scales, 1991). Effective schools for early adolescents are ones which recognize that adolescence is a critical stage of human development and which are prepared to reflect and respond to that diversity (Scales, 1992).

Effective middle grade teachers must not only understand the social, emotional, intellectual, and physiological needs of early adolescents, but they must also be able to utilize teaching strategies and learning experiences which facilitate student development (Scales, 1992; Lipsitz, 1984; McPartland and Wu, 1988). Effective teaching strategies at the middle level

include hands-on activities, sufficient time-on-task, contacts with role models in science and technological careers, laboratory work, cooperative learning, manipulative instructional materials, non-threatening competition (where the students compete against themselves rather than each other), independent projects, test preparation, positive academic and personal counseling, and support from parents, teachers, and peers (Clewell, et al., 1992, pp. 22-23).

Intervention strategies for mathematics and science at the middle level are aimed at improving attitudes towards math and science, increasing career awareness, increasing confidence in doing math and science, increasing content knowledge, increasing the use of math and science in daily life, improving test performance, increasing enrollment in higher content courses at the secondary level, and increasing the out-of-school related activities, such as visits to the Challenger Center, Creative Discovery Museum, Tennessee Aquarium, etc. (Clewell, et al., 1992, pp. 24-25).

Middle School Concept

Historically, the junior high school movement arose to respond to the problems of early adolescents during the early 1900s i.e., high dropout rates, lack of skills for emerging occupations, and the unsuitable mores that grow out of adolescence (Henson, 1988; Lipsitz, 1980). Over the next four decades, early adolescence began to emerge at an earlier age, the junior high gradually began to resemble a miniature high school, and critics complained that the junior high had lost sight of its original purpose (Henson, 1988). The time was right for change.

In 1950, a new concept appeared in Bay City, Michigan—the first middle school (Henson, 1988, p. 371). The middle school concept attempted to recapture the original intent of the junior high, i.e., to serve the unique needs and interests of early adolescents (Henson, 1988). Pioneer psychological research by Piaget, Erikson, etc., provided a new view of early adolescents and new approaches to their education. The middle school concept sought to adapt educational practices to individual differences in the social, emotional, intellectual, and physiological maturation of the early adolescents (Lipsitz, 1984). Specifically, the aims of the middle school concept were (Alexander, et al., 1968, p. 19):

1. To serve the educational needs of the "in-between-agers" in a school bridging the elementary school for childhood and the high school for adolescents.
2. To provide optimum individualization of curriculum and instruction for a population characterized by great variability.

3. To plan, implement, evaluate, and modify, in a continuing curriculum development program, a curriculum which includes provision for: (a) a planned sequence of concepts in the general education areas; (b) major emphasis on the interests and skills for continued learning; (c) a balanced program of exploratory experiences and other activities and services for personal development; and (d) appropriate attention to the development of values.
4. To promote continuous progress through and smooth articulation between the several phases and levels of the total educational program.
5. To facilitate the optimum use of personnel and facilities available for continuous improvement of schooling.

The primary curricular focus for the middle school is rooted in the character of early adolescence with emphasis on supporting an interest in learning (Beane, 1993; Grooms, 1967; Klingele, 1979). Today, many schools have adopted the structure of the middle school, i.e., grades five through eight, or six through eight, but have forsaken aims of the middle school concept. In essence, like the junior high schools before them, they too have become miniature high schools.

Preparation for Teaching in the Middle Grades

Schools for ten to fourteen year olds (young adolescents) are changing as more people recognize the uniqueness of this age group. As schools change, so must teachers. Preservice teacher education, however, has not kept pace. Early adolescents are unique, but teachers of early adolescents are prepared as if children of this age were identical with younger or older students. Educators at all levels have proposed that special preservice programs for middle levels are necessary. (Colburn, 1991, Abstract)

There are few preservice teacher preparation programs available which offer comprehensive courses for early adolescent development and middle grades education (Lipsitz, 1980; Kiner, 1987; McEwin, 1992; Scales, 1992). In their recent study of middle grade teacher preparation, Scales and McEwin (1994, p. 75 and p. 79) found that only 22% of the teachers studied received special middle grade undergraduate preparation, and nearly half rated their preparation on essential topics as "poor" or "inadequate". Only about twenty states offer certification, endorsement, license, etc., specifically for middle grades teachers (Epstein, et al., 1989). Most programs prepare teachers for either the elementary or secondary level. Research has shown that there are distinct attitudinal differences between middle school science teachers with elementary and secondary preservice training. Generally, elementary certified teachers tend to be more student-oriented in their attitudes, while the secondary certified teachers are more subject-oriented (Hallman, 1990; Huguenard, 1992; Pontius, 1993). Elementary certified

teachers generally exhibit more anxiety and apprehension toward teaching science (Orlich, 1980; Thompson and Shrigley, 1986; Weiss, 1988). The lack of specific middle grade teacher preparation programs results in the staffing of middle schools with teachers who are not prepared to understand, cope with, and effectively educate early adolescents (McEwin, 1992; Scales, 1992). Special preservice training programs need to be offered for middle grade teachers to meet the needs of early adolescents (Huguenard, 1992; Kiner, 1987; McEwin, 1992; Pontius, 1993).

The National Middle School Association (1986) noted that most preservice programs fall short of the requirements necessary for effective teaching in the middle grades. Specifically, they lacked training in early adolescence, middle level curriculum and instruction, concentration in two broad academic areas, specific methods and reading courses, early and continuous field experience in the middle grades, and availability of inservice professional development opportunities to train in competencies which are lacking (NMSA, 1986). Czerniak (1989) found that the number of science courses taken during preservice preparation, and the number of instructional strategies and methods learned, related strongly to inservice confidence in teaching ability and the lowering of science teaching anxiety. Bailey (1991) found that while teachers take more biology and geology courses than the average college graduate, courses in the physical sciences, e.g., chemistry and physics, were lacking. Abell and Roth (1992) found that science content courses are more effective when taught in combination with a science methods course. Researchers (Archer, 1993; Cain, 1988; Carnegie Commission, 1991) found that middle grade science teachers receive insufficient preparation in physical sciences, mathematics, and scientific methods — with the majority lacking coursework relating to emerging technologies, such as computer science. These identified shortfalls in preservice preparation increase the need for inservice education (Blosser, 1983; Bonnstetter, 1984).

It is important for preservice teachers to develop reflective practices prior to entering the profession (Berliner, 1988). "Coursework only measures exposure to information considered important to teaching performance, not whether it was learned" (Champagne and Baden, 1988, pp. 9-10). Only the teachers themselves can reflect on what they actually learned and what they need to learn to become a better teacher.

There is a severe shortage of research dealing with the transition from preservice to novice science teaching in the lower and middle levels (Abell and Roth, 1992, p. 582). Similarly, Scales (1992) found relatively few studies where middle level teachers expressed their perceptions on their preservice preparation.

Influence of the Teacher on Student Attitudes

The strongest influence on student attitudes toward science learning is the teacher (Reyes and Padilla, 1985; Westerbach, 1982). The middle grades seem to be the pivotal point in attitudes toward science — with females' attitudes dropping, relative to males', and continuing to drop throughout the secondary level (Jones, et al., 1992; Reyes and Padilla, 1985).

Champagne and Baden (1988, p. 2), indicate that the report of the National Governor's Association and the Conference Board recognized the influence of teachers on science learning and career choice. Some researchers have found that the gender of the science teacher has little impact upon female career decisions or level of achievement (Bender, 1990; Humrich, 1988; Peltz, 1990). However, females and minorities are influenced by the teacher's expressed behavior towards them and their attitudes (Clewel, et al. 1992). Leithold (1985) found that student achievement is directly related to the positive science attitudes of adults, i.e., parents and teachers. He found that perceived attitudes toward science of the mothers and science teachers are more influential than the attitudes of the fathers. He also found that gender differences appeared only when the student perceived negative attitudes from adults. Valyo (1985, Abstract) reported that "...an overwhelming majority of working-class women stated that a high school science teacher was most influential in their decision to study Engineering." "Teacher behavior is a significant event in the lives of students and a major determinant of the quality of the educational process" (Johnson, 1984, p. 147).

Inservice Professional Development

The restructuring of schools relies on the development of effective teachers. As they progress in their careers, teachers need to be encouraged to remain aware of new findings in content, pedagogical research, and innovative teaching strategies and techniques. Therefore, teacher inservice becomes a very important structure in the education of the teacher. (Miller, 1993, Abstract)

Teacher professional development does not stop after graduation from a teacher preparation program (Epstein, et al., 1989; Fullan, 1990; Hartz and Enochs, 1985; Linn, 1987; Murnane and Raizen, 1988; Spector, 1986). Teacher education should not be limited to the additional academic courses, or the post-graduate education required to maintain teacher certification or advance up a career ladder. Teachers need access to ongoing professional development activities, more time for planning, reflection, and collaboration with their colleagues, and sufficient opportunities to network, attend workshops and professional

conferences (Archer, 1993; OERI, 1993). Participation in teacher inservice professional development activities is indicative of teacher quality (Champagne and Baden, 1988, p. 17; Evans, 1986). Yager found that teachers who were rated most effective by their science supervisors participated in nearly five times the number of elected inservice activities over a five year period than those who were rated least effective (Yager, Hidayat, and Penick, 1988).

Teacher inservice professional development programs should be focused on the assessed needs, interests, and concerns of the teachers affected by those programs (Evans, 1986, p. 18; Hartz and Enochs, 1985; Patterson, 1993; Poole, 1988; Schafer, 1994; Spector, 1986; Toepfer, 1984). Indeed, the failure of many inservice programs is because of the lack of teacher involvement in the development of those programs (Stronck, 1986; Walton, 1986). Because of the myriad of change factors present in the middle grades, middle school teachers present a unique set of professional development needs (Poole, 1988). Activities should be formulated to help middle level teachers understand the needs of early adolescents and their schools (Epstein, et al., 1989, p. 17). This implies that different professional development activities may have to be formulated for different categories of teachers, such as providing elementary-trained teachers with information on science delivery strategies which are appropriate for teaching early adolescents, or providing secondary-trained teachers with information about the nature of early adolescent development to improve their understanding of and interaction with their students (Epstein, et al., 1989, p. 17). "Inservice programs are absolutely essential if the middle school is to succeed in responding to early adolescent learner needs in the years ahead" (Toepfer, 1984, p. 122; Lipsitz, 1980). Abell and Pizzini (1992) found that extended inservice professional development activities can have a long-term impact on the teaching behaviors of middle level science teachers.

Teachers vary widely in their content knowledge, pedagogical skills, and philosophies of education (Bybee, 1988; Patterson, 1993). As teachers grow through experience, their professional development needs differ (Tammi, 1991). A teacher cannot begin to strive for mastery until after entry into the profession (Blosser, 1983). Berliner (1988) indicates that the following it takes approximately five years for a novice teacher to become reasonably proficient in the profession of teaching. Experiential learning is as important a factor in teacher professional development as it is in law, medicine, or any other practice which society regards as a profession. Inservice programs must consider the developmental stages of teaching if they are to provide meaningful growth experiences for teachers (Sly, 1990).

Finally, the main goal of any teacher professional development program must be to contribute to a long-term change in teachers' attitudes, competence and skills. This implies the

need for a continuous, long-term evaluation effort to monitor the success of the program. Such efforts are lacking in most current inservice programs (Hartz and Enochs, 1985).

Role of Higher Education

Very few institutions have given much encouragement to faculty interest in improving public schools. What we have done instead is simply to relegate all of the work on schools to the faculty of education, then to stuff the faculty of education down at the bottom of the campus hierarchy and ignore it. It should hardly come as a surprise, therefore, that our programs to train school teachers and leaders continue to be unexciting at best and often worse. (Bok, 1992, p. 19)

Derek Bok (1992) argues that higher education, rather than complaining about the poor quality of preparation of today's incoming undergraduates, should become actively involved in improving the quality of public education. Higher education trains the teachers, the curriculum supervisors, the principals, and the superintendents for the public schools and, therefore, must share some of the responsibility for conditions in them (Holmes Group, 1986).

If there is a problem with the quality of public education today, higher education is at least a passive contributor. Institutions of higher education need to take a more active role in the effort to provide better public schools for our local communities. Universities need to establish cooperative programs with local public schools (Archer, 1993; Holmes Group, 1986; Yager, Bybee, Gallagher, and Renner, 1982). "Today's challenge is for the universities to find new and different ways to connect with schools so that the resources of the universities can be put to work in appropriate and beneficial ways" (Arends, 1990, p. 117-118). This can be accomplished through involvement in collaborative research, or the establishment of education resource centers to coordinate experiences for preservice teacher education and provide opportunities for inservice teacher professional development (Arends, 1990; Holmes Group, 1986).

"Higher education is well suited to provide for the continuing education of science teachers—the key to long term improvement in the quality of science teaching and learning" (Crawley, 1987, p. 133). "Continuing education programs in science education offer a means for higher education institutions to make a long term commitment to improve K-12 programs in science education at the local level" (Crawley, 1987, p. 150). Higher education needs to involve *all* of the university's teaching scientists in the professional development of middle grade science teachers, not just the teacher preparation faculty serving in the college of education (Johnson and Aldridge, 1984; Linn, 1987). Higher education needs to come into a closer collaborative

relationship with local schools to better understand the problems currently confronting public education in order to make coursework more meaningful and useful for the inservice teachers taking them (Johnson and Aldridge, 1984; Yager, et al., 1982).

The courses offered by higher education should reflect the needs of the profession, "...not the vested interests of the professors who developed them" (Hartz and Enochs, 1985, p. 129). Postgraduate programs, need to be made available for middle level educational specialists which include courses on early adolescent development, history and philosophy of middle level education, curricular choices and research on middle level education, pedagogy for early adolescents, and advanced studies in the science teaching field (McEwin, 1992).

Summary

A review of the factors confronting science teachers in the middle grades provides many avenues to explore in terms of professional development needs. Societal expectations, as evidenced by lofty stated national and state goals for science, place an increasing pressure on science teachers to improve student interest and achievement in science. This requires middle grade science teachers to maintain currency with developments in science and science teaching strategies.

Middle grade science teachers should be aware of the diversity of needs and abilities of early adolescents to ensure that their teaching methods and strategies are appropriate for their students. The discrepancies between teacher certification requirements, teacher preservice preparation, and the realities of inservice teaching experience require that professional development activities be made available which address the problems associated with these shortcomings. Middle grade science teachers must also come to realize the long-term influence they exert upon their students and adjust their attitudes and classroom behaviors to ensure that their influence remains positive.

Above all, middle grade science teachers must be actively involved, from the very beginning, in the formulation of their teacher professional development programs. Programs and activities which address the assessed needs, interests, and concerns of the teachers affected by them have a greater chance of success in precipitating long-term change in teacher professional behavior. Differences in individual teacher training and experience require flexibility in both the areas of activities offered and in the methods of delivery for these activities — one size doesn't fit all. The main goal of inservice programs should be aimed at

long-term change. This means that effective programs should be viewed as continuous efforts which address constantly evolving needs.

Finally, higher education needs to participate more closely with inservice teacher professional development programs. Higher education is, or should be, the source of the evolving knowledge in science and science teaching strategies. The research mission of higher education provides an excellent means for analyzing the problems of local public schools and formulating workable solutions. While higher education is the primary source for formal professional development training, it should also be the facilitator of other activities designed to increase the competencies and skills of science teachers who have already entered the profession. What institution is better suited for the continuing professional development of science teachers?

CHAPTER 3

METHODOLOGY

Introduction

This study sought to identify the specific professional development needs of middle grade science teachers. The data obtained from this study will be used to determine what treatments are indicated in the formulation of policies and programs for the professional development of middle grade science teachers. The study may also provide information to strengthen the undergraduate and graduate science teacher preparation programs offered by the higher education institutions servicing the region.

Research Design

The study used a combination of quantitative (survey questionnaire) and qualitative (open-response items and follow-up interviews) techniques to obtain a description of perceptions and needs.

Population Definition

The population for this study ($N = 110$) consisted of all middle grade teachers, grades six through eight, in the Chattanooga Public Schools ($N_1 = 45$) and Hamilton County Department of Education ($N_2 = 65$), whose teaching responsibilities include the teaching of science during the 1994-95 school year. Permission was obtained from both school systems (Figures 3 and 4, Appendix A) prior to the conduct of this study.

Methods of Data Collection

The primary quantitative data for this study was collected through the administration of a self-reporting questionnaire (Figure 5, Appendix B). Survey questionnaires were distributed on February 16, 1995 to each teacher through a cover letter from the responsible official in each school system (Figures 6 and 7, Appendix C). A letter from the project director explaining the intent of the study and encouraging participation was included with the survey (Figure 8, Appendix C). The surveys were returned directly to the project director using an enclosed self-

addressed stamped envelope. School principals were asked to assist in the distribution of the questionnaires and return envelopes to each teacher by encouraging them to respond promptly. Two weeks after the initial distribution, A follow-up reminder (Figure 9, Appendix C) was sent to each teacher who had not responded. Two weeks following the reminder, another distribution was made to the remainder of the teachers who had not responded to the initial survey distribution (Figure 10, Appendix C). Survey questionnaires were numbered to facilitate follow-up. Only the project director had access to the distribution list and control numbers. The school system officials and the project director mutually assured that the confidentiality of individual responses would be maintained for this survey.

Qualitative data was collected through open-response questions on the survey questionnaire and follow-up interviews of those teachers who indicated their willingness to participate. While a voluntary sample for the interviews may bias the data collected, it still provided valuable qualitative data in addition to the open-ended response items on the survey questionnaire.

Description of Instruments

After reviewing the literature, an instrument was developed to assess the specific professional development needs of middle grade science teachers. The instrument was constructed after reviewing the previous research and incorporating specific items of interest from science supervisors in the local school systems. Content validity was obtained by submitting copies of the draft instrument to a panel of experts (Figures 11 and 12, Appendix D) representing each school system, selected middle level science teachers, and individuals in higher education recognized for their knowledge in educational research, pedagogy, and science education. These individuals examined the instrument for clarity and content validity and subsequently made recommendations for improvement which were incorporated into the final survey. Reliability of the instrument was determined by calculating Cronbach's coefficient alpha (α) for each part of the survey questionnaire.

The questionnaire focused on the teachers' perception of adequacy of content knowledge to teach science in grades six through eight; perceived adequacy of undergraduate preparation to teach science in grades six through eight; confidence in teaching ability in grades six through eight; ranking of areas professional development need, preferred professional development activities and teaching resources to be made available through professional

development activities; and recommendations to improve inservice professional development activities and preservice teacher preparation programs.

The questionnaire was divided into three parts.

- **Part One**, *Abilities in Science Instruction*, was a modification of Cox and Carpenter's (1989, p. 20) *Personal Abilities in Science Instruction*. Permission was obtained from Dr. Carpenter prior to modification of the instrument. Items were reworded to meet the particular needs of this study and several additional items were included to investigate the perceived adequacy of preservice teacher education programs. It uses a five part Likert-type scale (strongly agree, agree, neutral, disagree, strongly disagree) to measure perceived adequacy of specific content knowledge, adequacy of preservice teacher preparation to teach in the middle grades, and self-confidence in teaching science in the middle grades.
- **Part Two**, *Professional Development Needs*, permitted teachers, using a four-level rating scales, to rate their perceived needs for specific professional development topics (no need, low need, moderate need, high need), their preference for delivery of professional development activities (no interest at all, some interest, moderate interest, would definitely participate), and their needs for teaching resources which could be provided through professional development activities (no use, some use, moderate use, definitely useful). It also provided an open-response recommendation for the improving inservice professional development activities offered by the schools and for improving the preservice preparation of middle grade science teachers.
- **Part Three**, *Background, Education, and Experience*, contained the demographic data to identify the population and divide it into aggregates for comparative analysis. It also provided for additional comments or suggestions. The final item afforded each respondent an opportunity for voluntary participation in a follow-up interview which was conducted after the completion of the initial analysis of the survey data.

A standardized open-ended interview guide (Figure 13, Appendix I) was used to ensure consistency of the questions posed and to reduce bias which can result from having different interviews with different people (Patton, 1987, pp. 112-113). The follow-up interviews attempted to verify the priority of the ranked professional development needs and activities, identify additional teaching resource problems, examine the perceived utility of a centralized science coordinator, measure the perceived responsiveness of higher education to the needs of

the classroom teacher, and solicit recommendations for professional development policies and activities of the emerging consolidated school system.

Data Analysis Procedures

Data was analyzed with the assistance of the Statistical Package for the Social Sciences (SPSS®) for the Macintosh®. Data was analyzed according to gender, total years of teaching experience, total years experience teaching science, level of education, major area of undergraduate study, and level of teacher certification (Murnane and Raizen, 1988; Scales, 1992; Scales and McEwin, 1994). Categories for *total years of teaching experience*, and *total years experience teaching science in grades 6-8* were established after reviewing the distribution of respondents and determining the appropriate groupings. These categories were defined as "Beginning Teachers" with five years or less of experience, "Competent Professional Teachers" with six to fifteen years of experience, and "Career Professional Teachers" with over fifteen years of teaching experience.

Part One through Part Three of the questionnaire, were analyzed using standard descriptive statistics, e.g. frequency (f), percentage, median, mean, mode, etc.. Items left blank by respondents were treated as missing data and were not included in statistical computations. Reliability for the survey questionnaire was calculated by internal consistency methods using Cronbach's coefficient alpha (α). To be considered statistically reliable, a coefficient alpha of .80 or higher needs to be computed for the data collected (Carmine and Zeller, 1979). The demographic data collected was used to describe the population. Results are displayed in Tables E-1 through E-14, Appendix E. While the median is a more appropriate method for summarizing Likert scale data (Gibbons, 1993), for this study, the mean provided a higher degree of specificity for ranking responses. Similarly, the nonparametric statistics which rely on mean rank data were used in the analysis of responses. The mean, in this study, was considered only in terms of its relative rather than actual magnitude. A normal distribution was not assumed for the analysis of data collected except in terms of percentages of positive responses to Parts One and Two.

Abilities in Science Instruction items in Part One were compared for each variable using Mann-Whitney U, or Kruskal-Wallis as appropriate, for the ordinal data collected. The level of significance used for this study was $\alpha = .05$. Responses are displayed in Tables F-1 through F-21, Appendix F. This comparative analysis was used to answer the questions:

- In what areas do middle grade science teachers perceive their professional development needs to be the greatest, with regard to content knowledge?
- Do teachers feel that their preservice teacher preparation adequately prepared them to teach science in the middle grades?
- Do teachers feel confident in their ability to teach science in the middle grades?

Professional Development Needs, identified in Part Two, used rank-ordered means to identify priorities. Responses are displayed in Tables G-1 through G-6, Appendix G. Significance within variables was determined using Mann-Whitney U, or Kruskal-Wallis as appropriate. Rank-ordered priorities were then compared between variables to answer the questions:

- In what areas do middle grade science teachers perceive their professional development needs to be the greatest, with regard to topics of interest?
- What types of inservice professional development activities do middle grade science teachers prefer?
- What kinds of teaching resources do middle grade science teachers prefer to be made available through professional development activities?

Open-ended responses to survey questionnaire items were categorized and are listed in Tables H-1 through H-3, Appendix H. Responses to follow-up interviews were likewise categorized and are listed in Tables I-1 through I-6, Appendix I. The qualitative data collected were used to interpret the quantitative data analyzed and to identify any significant information not included in the quantitative items on the survey questionnaire.

CHAPTER 4

RESULTS

Introduction

Since this was a study of a small population ($N=110$), the response rate to the survey questionnaire was critical to the validity of the study. In the end, ninety-four teachers, or approximately 85% of the population responded to the survey (Table 1). Over 71% of the survey questionnaires returned contained substantive responses to open-response items.

Table 1. Teachers Who Teach Science in the Middle Grades in Chattanooga and Hamilton County, Tennessee

	n	%
Population	110	100
Completed Survey Only	66	60.0
Completed Survey and Follow-up Interviews	28	25.5 % of Population 29.8 % of Survey Respondents
Total Respondents to Survey	94	85.5

Cronbach's coefficient alpha (α) was .92 for the overall survey questionnaire, .91 for Part One, *Abilities in Science Instruction*, and .93 for Part Two, *Professional Development Needs*. The instrument was considered to be statistically reliable for purposes of this study.

A total of twenty-eight respondents participated in the follow-up interviews. Twenty-five interviews were conducted by telephone, with the remaining three being face-to-face interviews. A total of twelve hours and thirty minutes were spent conducting the interviews with an average interview lasting approximately twenty-seven minutes. The length of interviews ranged from fourteen to fifty-six minutes. All respondents interviewed were very cooperative, open, and candid in their remarks.

Relevant Demographic Information

Overall, the demographic information for the population, represented by the respondent data (Figure 1, p. 26, and Table 2, p. 27), is reflective of the national trends identified in the review of the literature. The average respondent to the survey was

white, female, with 14.5 years of teaching experience and 7.6 years teaching science in grades 6-8, holds a masters degree, with an undergraduate major and certification in elementary education.

Rather than being viewed as elementary or middle school teachers, respondents perceive themselves as science teachers, mathematics teachers, language arts teachers, reading teachers, or social studies teachers. Teachers with primary teaching responsibilities other than science were most likely to perceive themselves, for example, as language arts teachers with additional duties teaching science, rather than as science teachers.

Females represented 70.2% of the total respondents. This is consistent with the national average for *all* lower and middle level teachers, but higher than the average for middle level science teachers indicated in the review of the literature.

African American teachers represented only 12.8% of the total respondents. All but two of the African American respondents had over fifteen years of total teaching experience, with the average length of service for the group being 21.5 years. The only other ethnic minority teacher responding to the survey was one Native American with less than 3 years teaching experience. There were no Hispanics or Asian Americans identified in the population.

Although 48.9% of all respondents reported having over 15 years of total teaching experience, only 9.6% reported having taught science in grades 6-8 for over 15 years. While some of these career professional teachers, with undergraduate degrees in secondary education and/or science, have previously taught science at the secondary level, this still would only increase the percentage of experienced science teachers to a maximum of 10.6%. Over 61% of the teachers who majored in secondary education and/or science have over 15 years of teaching experience. That leaves approximately 39% of teachers with undergraduate majors in secondary education and/or science to replace them over the next fifteen years as they retire from the profession. Contrary to the current national trend, the supply of qualified science teachers for the middle grades in Hamilton County appears to be shrinking.

The majority of the respondents interviewed did not differ significantly from the remainder of respondents except that a greater percentage had majored in secondary education and/or science, and were certified at the secondary rather than elementary level (Figure 2, p. 28, and Table 3, p. 29). The survey responses of those interviewed, however, were significantly more positive than those not interviewed in all areas of content knowledge, preparation to teach science in grades 6-8, preparation to teach early adolescents, and all areas of confidence in teaching abilities (Table 10, p. 37).

Figure 1. Demographic Overview of Respondents

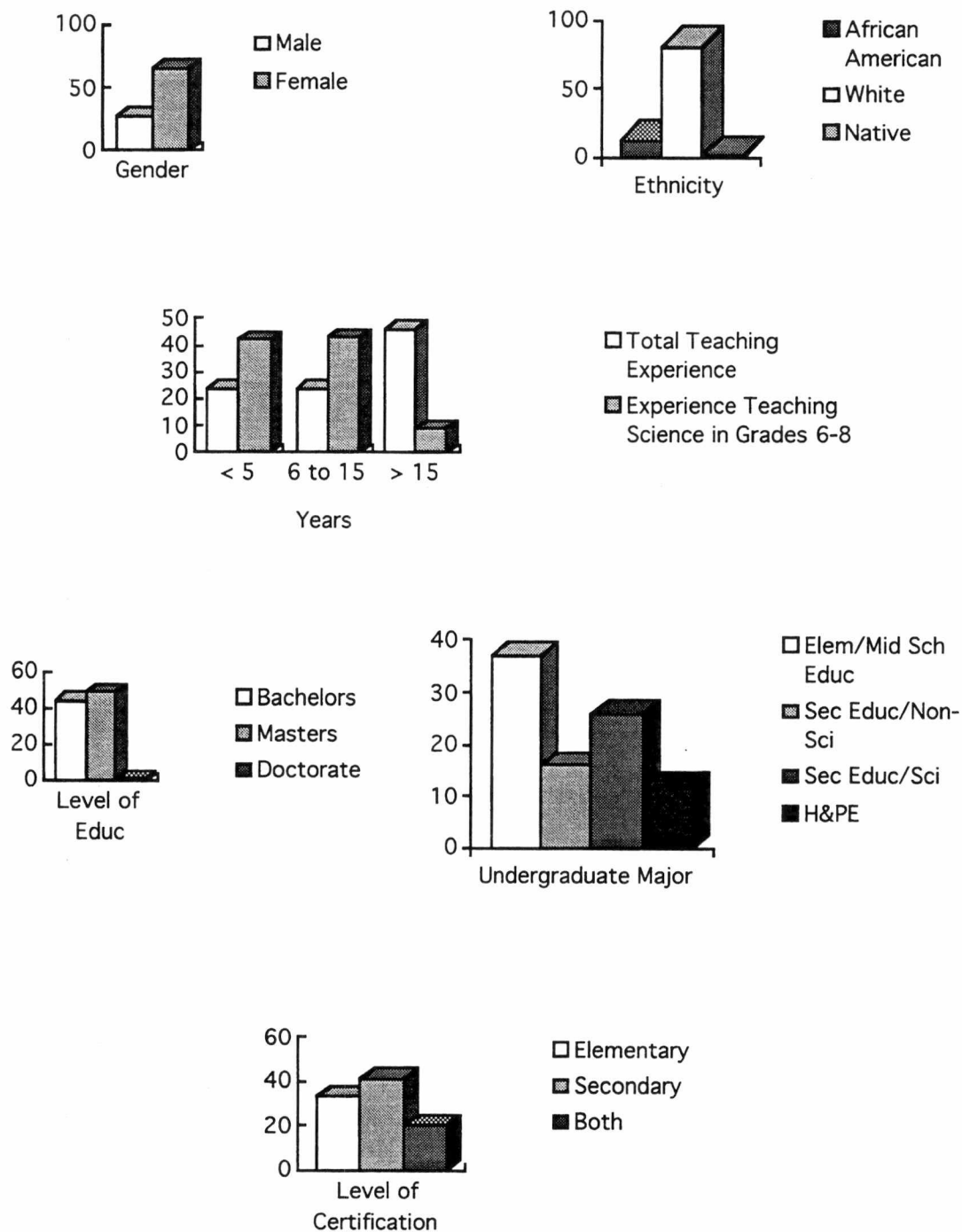
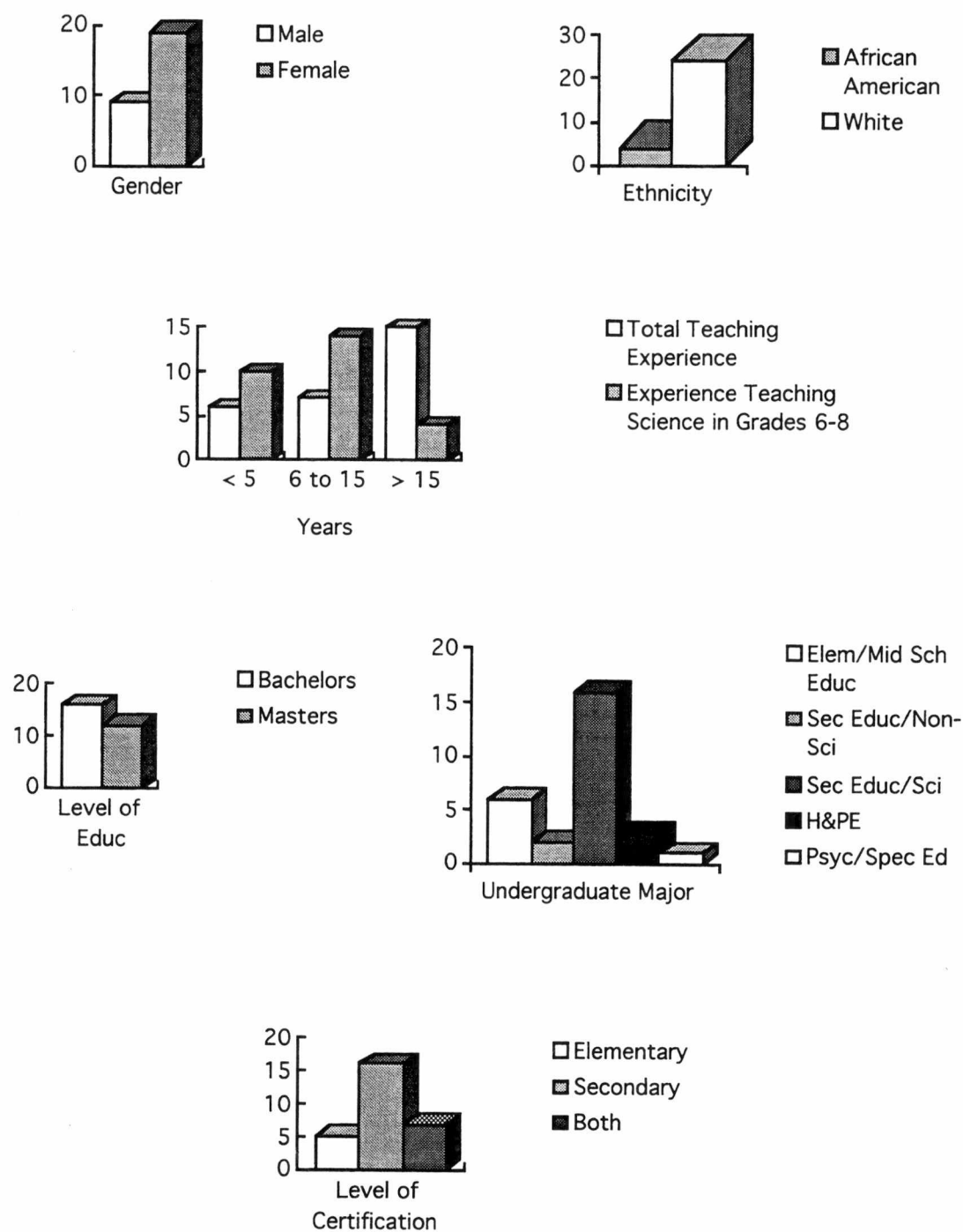


Table 2. Overview of Survey Respondents by Variable Categories Analyzed

Variable	Category	n	Variable														
			Yrs Teaching Experience			Yrs Teaching Science			Level of Education		Undergraduate Major					Level of Certification	
			≤5	6-15	>15	≤5	6-15	>15	B	≥M	Elem	Sec	Sec/Sci	H/PE	Elem	Sec	Both
Gender	M	28	5	9	14	12	15	1	13	15	4	4	9	9	4	15	9
	F	66	19	15	32	30	28	8	31	35	33	12	17	3	29	26	11
Yrs Teaching Experience	≤5 Yrs	24				24	0	0	22	2	12	2	5	4	12	8	54
	6-15 Yrs	24				8	16	0	12	12	10	5	5	3	6	9	9
	> 15 Yrs	46				10	27	9	10	36	15	9	16	5	15	24	7
Yrs Teaching Science	≤5 Yrs	42							28	14	22	6	7	5	21	13	8
	6-15 Yrs	43							13	30	15	8	13	6	11	22	10
	> 15 Yrs	9							3	6	0	2	6	1	1	6	2
Level of Education	Bachelors	44															
	Masters or Higher	50									21	5	12	5	19	16	9
College Major ¹											15	11	14	7	14	25	11
	Elem Educ/Mid Sch	37													30	3	4
	Sec Educ/Non-Sci	16													1	8	7
	Sec Educ/Sci	26													2	23	1
Level of Certification	H & P E	12													0	5	7
	Elementary	33															
	Secondary	41															
	Both Levels	22															

¹ Due to the low number of respondents, two cases of Psychology/Special Education and one missing case were not considered in the analysis.

Figure 2. Demographic Overview of Respondents Interviewed



Results Applied to Research Questions

- In what areas do middle grade science teachers perceive their professional development needs to be the greatest, with regard to content knowledge?

Overall responses to content knowledge statements reflected a high level of agreement (Table 4). Content knowledge appears to be strongest for the life sciences (Mean = 4.128 with 85.1% in agreement) which is consistent with the review of the literature. This was followed by environmental science (Mean = 3.882 with 76.3% in agreement), earth sciences (Mean = 3.851 with 78.7% in agreement), physical sciences (Mean = 3.702 with 71.3% in agreement), and space sciences (Mean = 3.691 with 68.1% in agreement). Likewise, the rankings of teaching resources corresponded directly to the mean responses of content knowledge statements in the order of preferred content-related teaching resources, i.e., life science (Rank = 1), environmental science (Rank = 3), earth sciences (Rank = 5), physical sciences (Rank = 7), and space sciences (Rank = 8). This indicated that the greatest need for content knowledge was in the areas of space sciences and the physical sciences. However, teachers prefer content-related teaching resources in the areas with which they are most familiar.

Table 4. Overall Responses to Content Knowledge

Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	n
1. I believe that my content knowledge of the life sciences is sufficient to allow me to teach science effectively in grades 6-8.	37 39.4%	43 45.7%	4 4.3%	9 9.6%	1 1.1%	94
2. I believe that my content knowledge of the physical sciences is sufficient to allow me to teach science effectively in grades 6-8.	16 17.0%	50 53.2%	13 13.8%	13 13.8%	2 2.1%	94
3. I believe that my content knowledge of the earth sciences is sufficient to allow me to teach science effectively in grades 6-8.	20 21.3%	54 57.4%	9 9.6%	8 8.5%	3 3.2%	94
4. I believe that my content knowledge of environmental science is sufficient to allow me to teach science effectively in grades 6-8.	23 24.7%	48 51.6%	12 12.9%	8 8.6%	2 2.2%	93
5. I believe that my content knowledge of space sciences is sufficient to allow me to teach science effectively in grades 6-8.	12 12.8%	53 56.4%	13 13.8%	13 13.8%	3 3.2%	94

- **Do teachers feel that their preservice teacher preparation adequately prepared them to teach science in the middle grades?**

Overall responses to the adequacy of preservice teacher preparation statements reflected a moderate to low level of agreement (Table 5). This was the only section of the survey where the median and mode were less than 4.0, reflecting low levels of agreement with the items indicated. Preparation to teach early adolescent students elicited the strongest response (Mean = 3.435 with 58.7% in agreement) followed by preparation to teaching adolescent female students (Mean = 3.391 with 54.3% in agreement)—keeping in mind that 70.4% of the respondents were female. These were followed by preparation to teach science in grades 6-8 (Mean = 3.129 with 46.3% in agreement and median = 3.0), preparation to teach students from different cultural and ethnic backgrounds (Mean = 2.859 with 32.6% in agreement, median = 2.5, and mode = 2)—keeping in mind that only 13.9% of respondents were from different cultural and ethnic backgrounds, and the receipt of specific instruction for teaching in the middle school (Mean = 2.859 with 34.8% in agreement, median = 3.0, and mode = 2). Overall, this indicated that teachers feel their preservice teacher preparation was marginally adequate for teaching in the middle grades with a need for stronger preparation in methods and strategies for teaching in the middle grades and in teaching students from diverse backgrounds.

Table 5. Overall Responses to Adequacy of Preservice Teacher Preparation

Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	n
6. Overall, I believe that my preservice teacher education program adequately prepared me to teach science in grades 6-8.	9 9.7%	34 36.6%	16 17.2%	28 30.0%	6 6.5%	93
7. Overall, I believe that my preservice teacher education program adequately prepared me to teach early adolescent students.	12 13.0%	42 45.7%	15 16.3%	20 21.7%	3 3.3%	92
8. Overall, I believe that my preservice teacher education program adequately prepared me to meet the learning needs of early adolescent female students.	12 13.0%	38 41.3%	19 20.7%	20 21.7%	3 3.3%	92
9. Overall, I believe that my preservice teacher education program adequately prepared me to teach early adolescent students from different cultural and ethnic backgrounds.	9 9.8%	21 22.8%	16 17.4%	40 43.5%	6 6.5%	92
10. In my preservice teacher education program, I received specific instruction in the educational philosophy, curriculum, teaching methods and strategies for the middle school.	7 7.6%	25 27.2%	18 19.6%	32 34.8%	10 10.9%	92

• **Do teachers feel confident in their ability to teach science in the middle grades?**

Overall responses to the confidence statements reflected high level of agreement (Table 6), indicating that teachers feel confident, albeit under-prepared to teach science in the middle grades. Ability to evaluate the effectiveness of science lesson plans, units, and materials (Mean = 4.149 with 86.2% in agreement), ability to develop interesting and original lesson plans (Mean = 4.096 with 84% in agreement), and ability to teach science in an interesting and exciting way (Mean = 3.979 with 78.7% in agreement), all showed a high degree of confidence. Ability to organize and operate science labs (Mean = 3.699 with 68.9% in agreement) showed the lowest area of confidence. The need for additional instruction in organizing and operating science labs was also reflected in the data provided in the open-response items (Tables H-2 and H-3) and in the follow-up interviews (Table I-1).

Table 6. Overall Responses to Teacher Confidence

Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	n
11. I believe that I know enough about science teaching methods and strategies to teach science in grades 6-8 in an interesting and exciting way.	32 34.0%	42 44.7%	10 10.6%	6 6.4%	4 4.3%	94
12. I believe that I am able to evaluate the effectiveness of available science lessons, units, and materials.	34 36.2%	47 50.0%	7 7.4%	5 5.3%	1 1.1%	94
13. I believe that I am able to develop interesting and original lessons for science instruction in grades 6-8..	31 33.0%	48 51.0%	9 9.6%	5 5.3%	1 1.1%	94
14. I believe that I have the technical competence to organize and operate an effective science lab for grades 6-8.	22 23.7%	42 45.2%	14 15.1%	9 9.7%	6 6.5%	93

- In what areas do middle grade science teachers perceive their professional development needs to be the greatest, with regard to topics of interest?

Overall, the first four of the top ten ranked professional development needs reflected a strong moderate to high level of perceived need (Table 7). Integration of technology into the classroom was clearly the top priority (with 88.1% of those responding indicating moderate to high need; this was also the only item with a median of 4.0). This was followed by science teaching resources (82.6%), science curriculum updates (84.6%), and science teaching methods and strategies (79.6%). Open-responses (Tables H-2 and H-3) and interviews (Table I-1) indicate that science laboratories and hands-on activities would have been equally as strong; however, they were not listed on this part of the survey questionnaire.

Table 7. Overall Rank Ordering of Teacher Professional Development Needs

Rank	Median	Mean	Item
High Need			
1	4.0	3.462	Integration of technology into the classroom
Moderate Need			
2	3.0	3.283	Science teaching resources
3	3.0	3.154	Science curriculum updates
4	3.0	3.118	Science teaching methods and strategies
5	3.0	2.891	Multiple intelligences in the classroom
6	3.0	2.848	Latest trends in learning theory
7	3.0	2.837	Alternative assessment of student performance
8	3.0	2.802	Psychological problems of disadvantaged youth
9	3.0	2.670	Multicultural and diversity issues in the classroom
10	3.0	2.598	Stress management
11	3.0	2.554	Safety and liability issues in the school
Some Need			
12	2.0	2.444	Teacher counseling skills
13	2.0	2.424	Teaching in the middle grades
14	2.0	2.163	Classroom management
15	2.0	2.132	Early adolescent development
16	2.0	2.111	Supervision and administration

- What types of inservice professional development activities do middle grade science teachers prefer?

Overall, the first nine of the top ten professional development activities reflected a strong moderate to high level of participation interest (Table 8). Items relating to collegiality, i.e., collaboration with other teachers (with 90.3% of those responding indicating moderate to high level of participation interest; this was also the only item with a median of 4.0), meetings with other teachers (83.5%), collaboration with scientists and science educators (76.9%), and visits to other classrooms (72.8%) all ranked in the top ten priorities and were strongly supported by open-responses and interview data. Other highly preferred activities included innovative teaching projects (84.6%), on-site and off-site workshops (81.8% and 73.3%, respectively), science seminars (79.1%), and educational/ public television programs (78.0%). Undergraduate courses were definitely the least preferred professional development activity with only 17.2% of those responding indicating a moderate to high interest.

Table 8. Overall Rank Ordering of Teacher Professional Development Activities

Rank	Median	Mean	Item
Would Definitely Participate			
1	4.0	3.419	Collaboration with other science teachers
Moderate Interest			
2	3.0	3.297	Innovative teaching projects
3	3.0	3.244	Meetings with other teachers
4	3.0	3.216	On-site workshops
5	3.0	3.167	Collaboration with scientists and science educators through Internet, CompuServe, America OnLine, Prodigy, etc.
6	3.0	3.143	Science Seminars
7	3.0	3.150	Off-site workshops
8	3.0	3.033	Educational/ public television programs
9	3.0	3.011	Visits to other classrooms
10	3.0	2.899	Professional conference(s)
11	3.0	2.829	Science Symposiums
12	3.0	2.822	Continuing education courses
13	3.0	2.625	Sabbaticals/ release time
14	3.0	2.589	Graduate courses
Some Interest			
15	2.0	2.472	Collaborative research with higher education
16	2.5	2.455	Postgraduate education programs
17	2.0	2.443	Video tape instruction
18	2.0	1.759	Undergraduate courses

- What kinds of teaching resources do middle grade science teachers prefer to be made available through professional development activities?

All items of teaching resources listed were perceived as moderately to definitely useful, with 90.3% to 72.5% of respondents indicating moderate to high levels of usefulness for items listed. Also, the first twelve of the fifteen ranked items had a median of 4.0 indicating a high level of usefulness for the items; the median for the remaining items was 3.0, indicating a moderate level of usefulness (Table 9). This is reflective of the overall high level of need for up-to-date science materials indicated by the open-responses and interviews. Because of the high level of responses to each item, the rank ordering of teaching resources should be considered arbitrary for the population. The primary importance of this data is that all professional development activities should provide some kind of teaching resources which teachers could take with them for use in the classroom.

Table 9. Overall Rank Ordering of Teaching Resources

Rank	Median	Mean	Item
Definitely Useful			
1	4.0	3.533	Life science teaching materials
2	4.0	3.484	Idea books for science instruction
3	4.0	3.462	Environmental science teaching materials
4	4.0	3.451	Classroom science activity books
5	4.0	3.407	Earth science teaching materials
6	4.0	3.380	Computer software for science topics
7	4.0	3.378	Physical science teaching materials
8	4.0	3.371	Space science teaching materials
9	4.0	3.367	Science instructional video tapes
9	4.0	3.367	Science teacher resource centers
11	4.0	3.341	Multimedia CD software for science instruction
12	4.0	3.272	On-line resources for science instruction made available through Internet, Compu-Serve, America OnLine, Prodigy, etc.
Moderate Use			
13	3.0	3.218	Supplementary curricula
14	3.0	3.189	Science teacher workbooks
15	3.0	3.132	Copy masters for science activities

- How do response patterns to these five questions vary as a function of gender, ethnicity, total years of teaching experience, experience teaching science in grades six through eight, level of formal education, undergraduate major area of study, and level of certification?

Regarding the *Abilities in Science Instruction* items in Part One (Table 10), gender, total years of teaching experience, and level of education yielded no significant differences. Years of experience teaching science in grades 6-8, undergraduate major, and level of certification yielded several significant differences with regard to content knowledge, preservice preparation to teach science in grades 6-8, and confidence in abilities to teach science in grades 6-8.

As one would expect, teachers with five or less years of experience teaching science responded less positively than teachers with more experience teaching science on items concerning content knowledge, preservice preparation to teach science in grades 6-8, and confidence in abilities to teach science in grades 6-8. Significant differences were noted in the content areas of life science, physical sciences and environmental sciences. Information obtained during the interviews indicated that emphasis in elementary preservice training programs on earth sciences and the recent inservice training provided by the Challenger Center in space sciences are possible explanations for not finding significant differences in those content areas. Experienced science teachers indicated receiving significantly better preservice science teacher preparation and were significantly more confident in their abilities to teach science in grades 6-8 than teachers who had taught science for five years or less. This implies that experiential knowledge plays an important role in teacher professional development both in terms of content knowledge and in confidence in ability to teach science.

Elementary education trained teachers responded less positively to items of content knowledge, preservice preparation to teach science in grades 6-8, and confident in their abilities to teach science than teachers who were trained as secondary science teachers, or who received their undergraduate education in one of the sciences. This is consistent with the information found in the review of the literature with regard to the level of science training found in elementary teacher preparation programs and the resulting lack of confidence in science teaching abilities.

Similarly, teachers certified at the elementary level responded less positively to items of content knowledge, except for earth sciences, preservice preparation to teach science in grades 6-8, and confidence in science teaching abilities, except for science teaching methods and strategies, than teachers who were certified at the secondary level. No significant differences were noted for teachers certified at both levels who had majored in either health and physical education or psychology and special education.

Table 10. Overview of Significant Differences Within Variables for Abilities in Science Instruction

Item	Variable					
	Interview	Gender	Yrs Teaching Experience	Yrs Teaching Science	Level of Education	Under-graduate Major
1. I believe that my content knowledge of the life sciences is sufficient to allow me to teach science effectively in grades 6-8.	p> .001	n.s.	n.s.	p> .01	n.s.	p> .001
2. I believe that my content knowledge of the physical sciences is sufficient to allow me to teach science effectively in grades 6-8.	p> .001	n.s.	n.s.	p> .05	n.s.	p> .001
3. I believe that my content knowledge of the earth sciences is sufficient to allow me to teach science effectively in grades 6-8.	p> .001	n.s.	n.s.	n.s.	n.s.	n.s.
4. I believe that my content knowledge of environmental science is sufficient to allow me to teach science effectively in grades 6-8.	p> .001	n.s.	n.s.	p> .05		p> .05
5. I believe that my content knowledge of space sciences is sufficient to allow me to teach science effectively in grades 6-8.	p> .01	n.s.	n.s.	n.s.	n.s.	p> .05
6. Overall, I believe that my preservice teacher education program adequately prepared me to teach science in grades 6-8.	p> .05	n.s.	n.s.	p> .01	n.s.	p> .05
7. Overall, I believe that my preservice teacher education program adequately prepared me to teach early adolescent students.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
8. Overall, I believe that my preservice teacher education program adequately prepared me to meet the learning needs of early adolescent female students.	p> .05	n.s.	n.s.	n.s.	n.s.	n.s.
9. Overall, I believe that my preservice teacher education program adequately prepared me to teach early adolescent students from different cultural and ethnic backgrounds.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
10. In my preservice teacher education program, I received specific instruction in the educational philosophy, curriculum, teaching methods and strategies for the middle school.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
11. I believe that I know enough about science teaching methods and strategies to teach science in grades 6-8 in an interesting and exciting way.	p> .001	n.s.	n.s.	p> .05	n.s.	p> .05
12. I believe that I am able to evaluate the effectiveness of available science lessons, units, and materials.	p> .001	n.s.	n.s.	p> .01	n.s.	p> .05
13. I believe that I am able to develop interesting and original lessons for science instruction in grades 6-8.	p> .001	n.s.	n.s.	p> .05	n.s.	p> .05
14. I believe that I have the technical competence to organize and operate an effective science lab for grades 6-8.	p> .001	n.s.	n.s.	p> .001	n.s.	p> .01

Regarding the *Professional Development Needs*, identified in Part Two, differences between rank orders varied within variables for professional development needs, professional development activities, and teaching resources. Gender was the only variable which yielded significant differences in all subsections of Part Two.

Examining teacher professional development needs (Tables 11 and 12, pp. 39-40), there were only a few significant differences for the top ten priorities with regard to gender, total years of teaching experience, years of experience teaching science in grades 6-8, and undergraduate major. None of the differences significantly affected the order of the rankings except for latest trends in learning theory (overall ranked 6th) and multicultural and diversity issues in the classroom (overall ranked 9th). Those teachers with elementary and secondary non-science majors ranked latest trends in learning theory higher than teachers with secondary and/or science majors and health and physical education (H&PE) majors. Similarly, elementary and H&PE teachers ranked multicultural and diversity issues in the classroom higher than those teacher who were trained in secondary education and science.

Concerning teacher professional development activities (Tables 13 and 14, pp. 41-42), there were a few significant differences for the top ten priorities with regard to gender, undergraduate major, and level of certification. Collaboration with other teachers (overall ranked 1st) was not significantly affected by differences within undergraduate major. Female teachers ranked innovative teaching projects (overall ranked 2nd) and on-site workshops (overall ranked 4th) higher than male teachers. Secondary certified teachers ranked innovative teaching projects higher than elementary certified teachers and those certified at both levels. Teachers trained secondary education and science majors ranked meeting with other teachers (overall ranked 3rd) higher than H&PE teachers. Teachers with secondary and/or science majors and H&PE majors ranked science seminars (overall ranked 6th) higher than teachers with elementary and secondary non-science majors.

With regard to teaching resources (Tables 15-16, pp. 43-44), while there were a few significant differences for gender and level of certification, the mean responses to this subsection were so high that the practical significance of these differences was greatly reduced. This indicates that science teachers are in need of all types of up-to-date teaching resources.

Although there were some significant differences within variables, there were no overall trends readily apparent that would indicate that any one variable would require separate treatment with regard to professional development needs and activities. The overall rankings, therefore, constitute a valid prioritization of needs for the formulation of a middle grade science teacher professional development program for this study.

Table 12. Significant Differences Within Variables in Mean Ranks of Teacher Professional Development Needs

Item	Overall Ranking	Variable						
		Interview	Gender	Yrs Teaching Experience	Yrs Teaching Science	Level of Education	Undergraduate Major	Level of Certification
Integration of technology into the classroom	1	n.s.	p < .01	n.s.	n.s.	n.s.	n.s.	n.s.
Science teaching resources	2	n.s.	p < .01	n.s.	n.s.	n.s.	n.s.	n.s.
Science curriculum updates	3	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Science teaching methods and strategies	4	n.s.	p < .05	p < .05	p < .05	n.s.	n.s.	n.s.
Multiple intelligences in the classroom	5	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Latest trends in learning theory	6	n.s.	n.s.	n.s.	n.s.	n.s.	p < .05	n.s.
Alternative assessment of student performance	7	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Psychological problems of disadvantaged youth	8	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Multicultural and diversity issues in the classroom	9	n.s.	n.s.	n.s.	n.s.	n.s.	p < .01	n.s.
Stress management	10	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Safety and liability issues in the school	11	n.s.	p < .05	n.s.	n.s.	n.s.	n.s.	n.s.
Teacher counseling skills	12	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Teaching in the middle grades	13	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Classroom management	14	n.s.	n.s.	n.s.	n.s.	n.s.	p < .01	n.s.
Early adolescent development	15	n.s.	n.s.	n.s.	n.s.	n.s.	p < .05	n.s.
Supervision and administration	16	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

Table 13. Rank Ordering of Top Ten Teacher Professional Development Activities by Variable Categories Analyzed

Item	Overall Ranking	Variable												
		Gender		Yrs Teaching Experience			Yrs Teaching Science			Level of Education		Undergraduate Major		
		M	F	≤5	6-15	>15	≤5	6-15	>15	B	≥M	Elem	Sec	Both
Collaboration with other science teachers	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Innovative teaching projects	2	6	2	3	3	2	3	3	3	2	2	1	2	4
Meetings with other teachers	3	3	4	6	2	5	4	2	4	4	2	5	2	5
On-site workshops	4	9	3	2	5	6	2	6	2	3	5	1	9	2
Collaboration with scientists and science educators	5	5	5	8	7	4	5	4	5	5	4	4	4	3
Science Seminars	6	2	7	9	-	3	9	4	8	8	6	8	6	8
Off-site workshops	7	-	6	4	5	9	5	8	5	7	7	6	6	6
Educational/public television programs	8	4	9	7	8	8	7	8	7	10	9	10	5	7
Visits to other classrooms	9	8	8	10	4	10	10	7	10	-	8	7	8	10
Professional conference(s)	10	-	10	-	8	-	-	-	-	-	-	-	-	-
Science Symposiums	11	9	-	-	8	7	-	10	-	-	10	-	10	9
Continuing education courses	12	-	-	5	-	-	8	-	9	6	-	8	-	8
Sabbaticals / release time	13	-	-	-	-	-	-	-	-	-	-	-	-	-
Graduate courses	14	-	-	-	-	-	-	-	-	9	-	-	-	-
Collaborative research with higher education	15	-	-	-	-	-	-	-	-	-	-	-	-	-
Postgraduate education programs	16	-	7	-	-	-	-	-	-	-	-	-	-	-
Video tape instruction	17	-	-	-	-	-	-	-	-	-	-	-	-	-
Undergraduate courses	18	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 14. Significant Differences Within Variables in Mean Ranks of Teacher Professional Development Activities

Item	Overall Ranking	Variable					
		Interview	Gender	Yrs Teaching Experience	Yrs Teaching Science	Level of Education	Undergraduate Major
Collaboration with other science teachers	1	p < .05	n.s.	n.s.	n.s.	n.s.	p < .05
Innovative teaching projects	2	n.s.	p < .01	n.s.	n.s.	n.s.	n.s.
Meetings with other teachers	3	p < .01	n.s.	n.s.	n.s.	n.s.	p < .05
On-site workshops	4	p < .05	p < .05	n.s.	n.s.	n.s.	n.s.
Collaboration with scientists and science educators	5	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Science Seminars	6	p < .001	n.s.	n.s.	n.s.	n.s.	p < .01
Off-site workshops	7	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Educational/public television programs	8	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Visits to other classrooms	9	p < .05	n.s.	n.s.	n.s.	n.s.	n.s.
Professional conference(s)	10	p < .01	n.s.	n.s.	n.s.	n.s.	n.s.
Science Symposiums	11	p < .05	n.s.	p < .05	n.s.	n.s.	n.s.
Continuing education courses	12	p < .05	n.s.	n.s.	n.s.	p < .01	n.s.
Sabbaticals / release time	13	p < .05	n.s.	n.s.	n.s.	n.s.	n.s.
Graduate courses	14	p < .001	n.s.	n.s.	n.s.	p < .001	n.s.
Collaborative research with higher education	15	p < .05	n.s.	n.s.	n.s.	n.s.	n.s.
Postgraduate education programs	16	n.s.	n.s.	n.s.	n.s.	p < .001	n.s.
Video tape instruction	17	n.s.	p < .01	n.s.	n.s.	n.s.	n.s.
Undergraduate courses	18	n.s.	n.s.	n.s.	p < .01	p < .05	n.s.

Table 15. Rank Ordering of Top Ten Teaching Resources by Variable Categories Analyzed

Item	Overall Ranking	Variable																
		Gender		Yrs Teaching Experience			Yrs Teaching Science			Level of Education	Undergraduate Major				Level of Certification			
		M	F	≤5	6-15	>15	≤5	6-15	>15	B	≥M	Elem	Sec	Sec/Sci	HPE	Elem	Sec	Both
Life science teaching materials	1	5	1	3	2	2	3	1	3	2	1	1	4	1	5	1	4	2
Idea books for science instruction	2	5	4	1	6	7	1	10	1	1	5	4	1	8	7	6	3	2
Environmental science teaching materials	3	4	5	9	3	1	5	2	5	5	3	4	6	3	-	2	9	2
Classroom science activity books	4	2	9	2	4	9	2	4	2	3	4	2	2	-	1	2	10	5
Earth science teaching materials	5	-	3	4	1	-	4	7	4	4	9	2	4	9	8	5	-	1
Computer software for science topics	6	7	10	4	5	-	8	8	8	6	10	6	7	10	8	2	-	8
Physical science teaching materials	7	7	7	10	7	4	-	3	-	8	6	6	-	3	5	7	7	-
Space science teaching materials	8	-	2	4	-	5	6	9	6	-	2	6	-	6	-	9	1	-
Science instructional video tapes	9	1	-	-	7	2	9	5	9	9	6	-	2	-	2	-	3	7
Science teacher resource centers	10	9	7	8	-	6	6	-	6	6	-	10	10	3	8	8	8	10
Multimedia CD software for science instruction	11	-	6	4	9	9	9	5	9	10	8	9	-	2	-	-	2	8
On-line resources for science instruction	12			-	-	8	9	-	9			-	-	7	-	10	6	-
Supplementary curricula	13											-	7	-	8			
Science teacher workbooks	14	3	-									-	-	-	2	-	-	10
Copy masters for science activities	15	9	-	-	9	-						-	7	-	2	-	-	6

Table 16. Significant Differences Within Variables in Mean Ranks of Teaching Resources

Item	Overall Ranking	Variable					
		Interview	Gender	Yrs Teaching Experience	Yrs Teaching Science	Level of Education	Undergraduate Major
Life science teaching materials	1	n.s.	p < .05	n.s.	n.s.	n.s.	n.s.
Idea books for science instruction	2	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Environmental science teaching materials	3	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Classroom science activity books	4	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Earth science teaching materials	5	n.s.	p < .01	n.s.	n.s.	n.s.	n.s.
Computer software for science topics	6	n.s.	p < .01	n.s.	n.s.	n.s.	n.s.
Physical science teaching materials	7	p < .05	n.s.	n.s.	n.s.	n.s.	n.s.
Space science teaching materials	8	n.s.	n.s.	n.s.	n.s.	n.s.	p < .05
Science instructional video tapes	9	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Science teacher resource centers	10	n.s.	p < .05	n.s.	n.s.	n.s.	n.s.
Multimedia CD software for science instruction	11	n.s.	p < .05	n.s.	n.s.	n.s.	n.s.
On-line resources for science instruction	12	n.s.	p < .05	n.s.	n.s.	n.s.	n.s.
Supplementary curricula	13	n.s.	p < .05	n.s.	n.s.	n.s.	n.s.
Science teacher workbooks	14	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Copy masters for science activities	15	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

Needs or Problems Not Mentioned in the Instrument

Although science teaching resources were listed on the survey questionnaire, resources were defined in the narrower sense when the survey questionnaire was constructed. Open-responses and interviews expanded this definition to include time, funding, equipment, and materials. This view of resources accounted for nearly 33% of all the open responses provided and was commented upon by all of those interviewed. Time for planning, reflection, collaboration, etc., was one of the most frequently mentioned resources. Funding to implement the curriculum, to participate in professional development activities, to reimburse teachers for out-of-pocket classroom expenses, etc., was mentioned frequently. Providing up-to-date materials and new technology, not just to some schools and classrooms, but to all schools and classrooms was viewed as critical to effective curriculum implementation.

Laboratories and hands-on activities were the next most frequently mentioned need by both science-trained and non science-trained teachers. They accounted for over 20% of the recommendations for the improvement of professional development activities and 40% of the recommendations for improving preservice preparation of science teachers.

Additional science content for science-trained teachers and basic science content knowledge for non-science trained teachers were mentioned as necessary to provide up-to-date teaching information. Curriculum related comments accounted for nearly 15% of the recommendations for the improvement of professional development activities and was mentioned by over 37% of those interviewed.

The most frequent recommendations for the improvement of preservice teacher preparation of science teachers were to provide more opportunities for practical classroom experience and more training on science laboratories and hands-on activities. Nearly 29% of the respondents indicated that they felt that preservice teachers should get into the classroom as early as possible and that they be exposed to a variety of classroom settings. Nearly 28% of the respondents indicated that preservice teachers need more experience with science labs and the use of hands-on inquiry methods of instruction. This mirrors the need that teachers felt for their own professional development as well. These responses are listed in Table H-3 for further information.

Respondents interviewed were asked if it would be helpful if a science coordinator were available at the central office of the school system. This question was asked because there currently is a science coordinator for the Chattanooga Public Schools and there had been a science coordinator in the Hamilton County Department of Education until recent personnel

cutbacks due to reduced funding. Overwhelmingly, 96.4% of those interviewed said that a science coordinator was definitely needed, as long as the position was established as a resource person and not an administrative supervisor. Responses to that need are summarized in Table I-4.

To clarify perceptions of adequacy of preservice teacher preparation, respondents interviewed were asked if they felt that higher education was "in-touch" the needs of today's classroom teachers. Nearly 61% indicated that they felt higher education was not responsive to their needs. Their major perception was that university professors of education have been out of the classroom too long, if they had ever taught in the public schools at all. They also felt that the professors relied too much on the recent research of others and books for their information and not enough on personal observation and experience. Over 18%, however felt that, while improvements were being made, some professors remain out-of-touch. The remaining 21%, who were recent college graduates, felt that they had been adequately prepared at their alma maters and indicated that their professors frequently worked with the local schools. Those opinions are summarized in Table I-5.

The final question asked of those who were interviewed was to provide recommendations for the professional development policies and activities of the emerging consolidated school system. Responses focused on four major issues: First, teachers need to be included in the policy making process. Second, the teacher professional development program needs to be available to all teachers. Third, teachers need more opportunities to exchange ideas with their peers and their counterparts in higher education. Finally, better use needs to be made of the time available for inservice training. Rather than restricting themselves to professional development policies and activities, their responses covered a wide range of topics, reflecting their anxieties and concerns for the consolidated school system. Those recommendations and concerns were not included in the analysis for this study but are summarized for information, in Table I-6, for those planning the school consolidation.

CHAPTER 5

SUMMARY, FINDINGS, CONCLUSIONS, DISCUSSION, RECOMMENDATIONS, AND SUGGESTIONS FOR FURTHER RESEARCH

Summary

This study assessed the professional development perceptions of science teachers in grades six through eight in the Chattanooga Public Schools and the Hamilton County Department of Education. Overall, the study was successful in identifying and prioritizing the professional development needs of this group of teachers. It produced information which can assist schools in planning professional development activities and support institutions of higher education in developing programs and activities to support the local public schools.

The consolidation of Chattanooga Public Schools and the Hamilton County Department of Education provides an excellent opportunity for the improvement teacher professional development policies and practices. The results of this study can serve to initiate a program of teacher involvement in policy formulation and activity planning which will ultimately govern their growth and development in the teaching profession.

This needs assessment can support the development a partnership with higher education in its efforts to improve the undergraduate preparation of middle grade science teachers and to assist in their continued development as they progress through the profession. It can assist in focusing on the perceived needs of middle grade science teachers so that local colleges and universities can develop appropriate activities to meet those needs where applicable. Finally, it demonstrates the feasibility of conducting collaborative applied educational research to assess the needs and address the problems confronting local schools.

The Tennessee Board of Education states that professional development is critical to the accomplishment of the ambitious goals that have been set for today's public schools (1992b, p. 1). Teachers are the most important resource in our public schools. Their continued professional development should to be of concern to everyone interested in the improvement of public education. Unless effective programs of teacher professional development are developed and relevant professional development activities are conducted, there is little chance of exceeding, or even meeting the lofty goals that have been established for Tennessee's students. This fact is no

more true than in the area of science education, for it is one of the most dynamic of all of the curricular areas of study. Science education is no less important than it is in the middle grades, because it is during early adolescence that young scholars begin to establish the attitudes and behaviors that will direct them the rest of their lives.

Findings

Analysis of demographic information provided by survey respondents indicates that:

1. Unlike the national trend, the current supply of qualified science teachers appears to be shrinking in Hamilton County. The current cohort of experienced science-trained teachers is rapidly approaching retirement with fewer qualified science teachers entering the profession. This is especially true for the African American science teachers. This declining availability has necessitated the use of non science-trained teachers to teach one or two classes of science as an additional responsibility.

Based on analysis of survey responses, this study found that:

2. Expanded content knowledge is needed for science-trained teachers and knowledge of the basic science concepts is needed for the non science-trained teachers. The greatest need for content knowledge is in the areas of space sciences and the physical sciences. Space science is an emerging field with very few courses offered in preservice teacher preparation programs. The need for more knowledge in the physical sciences is consistent with the national trends identified in the review of the literature.

3. The greatest topical need for teacher professional development is the integration of technology into the classroom. The proliferation of technology in society and the availability of computers in the schools, e.g., through the Twenty-first Century Classrooms, are prompting this interest. The review of the literature reflects that many middle grade teachers lack specific coursework related to emerging technologies, thereby increasing the need for inservice education. This was closely followed by the need for updates in availability of science teaching resources, science curriculum, and science teaching methods and strategies.

Based on a combination of analysis of survey responses and information obtained during follow-up interviews, this study found that:

4. Overall, teachers feel that their preservice teacher preparation only marginally prepared them to teach science in the middle grades. This is consistent with the results of the recent study by Scales and McEwen (1994) concerning the lack of undergraduate preparation for teaching in the middle grades. Specifically, in this study, teachers felt that they had received

inadequate instructional experiences in methods and strategies for teaching science in the middle grades and that they were not prepared to teach students from diverse cultural and ethnic backgrounds.

5. Although not offered as a choice on the survey questionnaire, the need for additional instruction in organizing and operating science labs and conducting hands-on science activities was felt to be equally as important as other highly ranked needs, as indicated by open-responses to the survey and amplified by information obtained during follow-up interviews. Most teachers feel confident in their ability to teach science in the middle grades, except for their ability to organize and operate science labs. This may be a reflection of the current emphasis on hands-on inquiry methods of instruction. All teachers, both science-trained and non science-trained, experienced and novice, expressed a strong interest in this need.

6. Teachers prefer professional development activities which give them the opportunity to collaborate with their colleagues, both within and outside the school. Collaboration and meetings with other science teachers, with scientists and science educators, as well as visits to other classrooms, were mentioned as preferred activities to facilitate professional development. Time to conduct these collaborative activities was also mentioned as being an essential part of professional development. Similarly, innovative teaching projects, on-site and off-site workshops provide a venue for this preferred interaction.

7. Teachers express a need for all types of up-to-date teaching resources such as content materials, idea books, activity books, computer software, etc. Science is a constantly changing field. Science educators are continually trying to develop new materials and new methods and strategies for science education. Professional development activities should provide the latest in teaching resources for teachers to use when they return to their classrooms. Schools should likewise ensure that their media centers are maintained with up-to-date materials.

Based upon the comparative analysis of the demographic variables used for this survey, this study found that:

8. Consistent with the review of the literature, the primary significant differences in perceptions investigated in this study were attributed to elementary trained teachers who are required to teach science outside of their perceived teaching specialty. This includes those teaching in elementary and in middle school settings. The restructuring of the middle schools in Hamilton County will move all of the sixth grades, currently found in elementary school settings, into middle school settings during the next school year. While many of the teachers affected by this restructuring have elected to remain in the elementary school setting, this will not resolve the problem for the middle schools.

9. Analysis of survey responses indicate that there were no trends readily apparent that would indicate that any single variable analyzed would require separate treatment. The overall rankings for professional development needs and activities, therefore, constitute a valid prioritization of needs for the formulation of a middle grade science teacher professional development program in Hamilton County.

The final findings dealt with information obtained solely during the follow-up interviews:

10. Teachers interviewed felt that it would be beneficial to have a Science Coordinator, as a resource person, in the central office. The Science Coordinator could serve as a conduit for up-to-date science information to the classroom teachers, a science resource coordinator, and a science curriculum implementation monitor. Most science teachers felt a need to have someone available at the central office who could lobby for their particular curricular needs.

11. Finally, colleges and universities need to work more closely with the public schools in addressing teacher preparation and continuing professional development needs. This closer contact would reduce teacher perceptions that higher education is out-of-touch with their needs. It would also help higher education to better understand the needs of the classroom teacher, thereby enabling it to better prepare future teachers. By providing more opportunities for preservice teachers to gain valuable experience in the public school classrooms, it would give local schools an opportunity to "recruit" prospective future teachers, thereby increasing the supply of qualified science teachers.

Conclusions

The shrinking supply of qualified science teachers and the shortfalls in preservice preparation for teaching in the middle grades place an increased emphasis on the importance of having an effective inservice program of professional development for middle grade science teachers. The decrease in availability of funding requires that schools make better use of the resources they have available in developing and in implementing such a program. Based on the findings of this study, the formulation of policies and programs for the professional development of middle grade science teachers should include:

- Teacher participation in deciding the format and content of required inservice training activities.

- Training in basic science concepts and science teaching strategies for non science-trained teachers who are required to teach science as an additional duty prior to assumption of that responsibility.
- Periodic inservice science training for both science-trained and non science-trained teachers who are required to teach science. The near-term focus for this training should be on:
 - Integration of technology into the classroom.
 - Organization and operation of science labs and the use of hands-on science activities.
 - Availability of science resources, science curriculum updates, and science teaching methods and strategies.
- Maximum use of available resources, both those in the school, e.g., inservice days/ half-days, master science teachers, Twenty-first Century Classrooms, innovative teaching projects, etc., and those within the local community, e.g., museums, science-related industries, colleges and universities, and science-related programs and projects.
- More efficient use of daily school time to allow teachers to plan, collaborate and reflect on what they have learned and experienced.
- Inservice training should reflect the collegiality preferred by teachers. Activities should allow teachers the maximum opportunity to exchange experiences and ideas.
- Periodic re-assessment of teachers needs to determine if the program is functioning effectively and if the priorities have changed.

Preservice training does not appear to provide adequate preparation for the teaching of science in the middle grades. Colleges and universities need to cooperate more closely with local schools to better understand the needs of classroom teachers and the problems facing the schools for the enhancement of teacher preparation programs. Preservice teacher preparation programs need to include:

- Training directly related to the science teaching methods and strategies for the middle grades.
- Instruction in the use of hands-on, inquiry-based learning through inquiry-based science labs and hands-on science activities.
- Instruction related to the teaching of students from diverse cultural and ethnic groups.

- More opportunities for direct classroom experiences for preservice teachers, beginning early in the program and continuing through graduation.

Discussion

The Tennessee State Board of Education's *Professional Development Policy for Tennessee's Schools* (1992b) incorporates all of the aspects of an effective teacher professional development program reflected in the review of the literature. The model described in the conclusions to this study suggest a more specific approach to policy formulation for meeting these professional development goals. The major problem appears to be with the actual implementation of this policy at the local level.

In a recent interview (O'Neill, 1995, p.20), Peter Senge indicated that while schools are considered to be institutions of learning, most of them are not learning organizations. Schools need to "...find ways to get teachers really working together;...to create an environment where they can continually reflect on what they are doing and learn more and more what it takes to work as teams." This aspect of teacher professional development is reflected in the Tennessee State Board of Education's *Professional Development Policy...* (1992, p. 5) which states that "faculty and staff have time to share and work on new ideas and to reflect upon new learning." This study found that time for planning, collaboration, and reflection is diminishing rather than increasing in most schools. Budget constraints have resulted in personnel reductions and other cost saving measures which have significantly impacted upon the amount of time available to the classroom teacher for professional development activities. The resulting increases in class size, assignment of additional teaching responsibilities, and increases in administrative requirements—e.g., the inclusion of students with handicapping conditions into the regular classroom, requiring the preparation of individual development plans (IDP) which were previously written by the special education teachers— have all affected the teacher's perceived availability of time and control over their professional growth and development. Time for collaboration with other science teachers, both within the schools and across the school district, is extremely limited, if available at all.

The middle school concept is relatively new in Hamilton County. While Chattanooga Public Schools are already operating under this concept, the Hamilton County Department of Education will not complete their plans to implement a consistent sixth through eighth grade middle school organization until the 1995-96 school year. Some of the sixth grade teachers responding to this study are teaching in elementary school settings and could account for some

of the differences in perceptions from those teachers working in middle school settings. The middle school organization presents some unique problems for the schools in this study. The major problem is that of staffing the schools with qualified teachers who are trained and experienced in both the areas of curricular content and in the teaching methods and strategies appropriate to the middle school. While institutions of higher education serving the southeastern region of Tennessee have started to initiate middle level (5-8) teacher preparation programs, it will be some years before they produce enough middle grade science teachers to meet the staffing needs of the County's schools. Since Tennessee does not provide for specific certification or endorsement at the middle school level, school administrators will have to continue to staff their schools with elementary and secondary certified personnel. Professional development activities for "displaced" elementary and secondary teachers become particularly important in the middle schools (Toeffler, 1984), especially for those required to teach science in the middle grades.

The Holmes Group (1986, p. 62) describe competent teaching as a combination of three elements: "subject matter knowledge, systematic knowledge of teaching, and reflective practical experience." The respondents to this study who indicated the most disagreement with their content knowledge, preparation to teach science in grades 6-8, and confidence in ability to teach science in grades 6-8 were primarily trained and certified as elementary teachers, did not perceive themselves as science teachers, and had less than five years of experience teaching science in grades 6-8, regardless of their total years of teaching experience. The reason these teachers were teaching science was attributed to a lack of qualified personnel due to budget cutbacks and the non-availability of qualified science teachers. Administrators, at the school level, required non science-trained personnel to assume some of the teaching load for the school's science classes. While it is true that all elementary certified teachers are technically qualified to teach science, many elementary school teachers feel unqualified and uncomfortable teaching science (Weiss, 1987, p. 97). While the Tennessee State Board of Education's *Rules, Regulations, and Minimum Standards...* (1992a, p. 2) states that "a teacher may teach up to two sections of one course outside the area of endorsement," this policy is intended to apply as an interim measure or for teachers who already have sufficient content knowledge and competence to teach the subject, but may not yet meet the requisite formal education to qualify for subject area endorsement. While the use of this policy does not appear to be widespread, there is a potential for it to increase as experienced science teachers begin to retire and qualified replacements are not found. Many of those teaching science under this policy indicated that they had received little or no training in science prior to the assignment of their additional

teaching responsibilities. If teachers are going to be required to teach outside their area of endorsement and/or perceived competence, i.e., science, then they need to receive appropriate content specific professional development training prior to the assumption of those responsibilities.

Schools should reflect the needs of the greater society which they serve. As society progresses from an industrial toward a technical-information orientation, schools need to reflect this shift. Integration of technology into the classroom takes on an added significance for the study of science in the emerging technical-information society. Students need to be exposed to the same level of technology in the classroom as they find outside the classroom. Outside the classroom, today's students spent their time playing electronic games, watching television, viewing video tapes, using personal computers, etc. This study found integration of technology into the classroom to be the greatest single area of need for the middle grade science teachers in Hamilton County. The activities offered by the Tennessee Valley Project and the Southeast Tennessee Professional Development Consortium for the Integration of Technology provide the greatest immediately available opportunity for meeting this need. The use of technology affords teachers an opportunity to exchange experiences and ideas via the Internet with other science teachers, scientists, and science educators. Unfortunately, neither of the school systems studied are participating in either the Project nor the Consortium.

Similar to the findings of Lane in the metropolitan Nashville and Davidson County schools in 1983, the lack of up-to-date equipment, references, materials, and facilities are still perceived by middle grade science teachers as barriers to teaching. It will not be enough simply to train teachers in the integration of technology into the classroom. Resources must be made available to all teachers so that when they return to their classrooms they can apply what they have learned. Because of the nature of technological change, it is not sufficient merely to provide resources on a one time basis, these resources must be continually kept up-to-date.

Consistent with the review of the literature is the need for training in the space sciences and physical sciences. Training in the space sciences is already available for sixth grade teachers through the partnership established with the Challenger Center at The University of Tennessee at Chattanooga. Both science teachers and teachers in other curricular areas are provided a one day, hands-on inservice experience at the Challenger Center. This opportunity needs to be made available to teachers in all grades in the middle school. The various science departments at The University of Tennessee at Chattanooga have periodically conducted Summer workshops for local teachers. These opportunity need to be tailored to meet the specific

needs of teachers at each level of instruction to ensure that the principles being demonstrated are appropriate for the teacher's grade level and are in line with the teacher's needs.

Current research stresses the importance of laboratories and hands-on inquiry activities, especially for the education of adolescents. Both science-trained and non science-trained teachers in this study indicated a need for further development in the organization and operation of science labs and the conduct of hands-on science activities. This was mentioned frequently, both as a need for improving teacher professional development activities, and as a means of improving the preservice teacher preparation. Teachers also indicated that they would prefer that classroom teachers from similar level schools conduct the activities rather than have an outside "expert" brought in for the purpose. It was also noted that the supplies and materials to conduct these activities also should be available in the classrooms so that the teacher can apply what they have learned. Professional development activities in these areas are important to increase the content knowledge and confidence levels of all middle grade science teachers, specially those who are not trained primarily in the sciences.

With the tendency toward site-based management, there still needs to be a central focus to answer science-related questions, obtain alternative sources of funding and other resources, coordinate curriculum across teaching levels, and advocate for the needs and concerns of the classroom science teachers with administrators at all levels of management. Science and technology are changing rapidly and the demands of the classroom are increasing at too great a rate for teachers to be expected to keep current on the various aspects of science and still perform all the other school-related tasks that devolve upon them. The science coordinator can also ensure that curriculum implementation is consistent throughout the school district to minimize discrepancies as students change schools within the district.

The perception that higher education is "out-of-touch" with the needs of today's classroom teachers may reflect the teachers' lack of recent contact with higher education. This perception can be reduced through a greater involvement of higher education in the public schools. The recommendation for increases in practical preservice field experiences can serve to bring professors of education and prospective teachers closer to the realities of the classroom. Finally, the vast resources of higher education, namely personnel and knowledge, could be better utilized for the advantage of both institutions. Higher education has a need for research opportunities against which its knowledge can be applied. Teachers have professional development needs and public schools have problems which require systematic investigation. By conducting applied educational research to assess the needs and address the problems confronting local schools, both institutions can benefit. Through systematic study of innovative

teaching projects being implemented in local schools, higher education can provide an assessment of the effectiveness of those projects for the schools and contribute to overall body of knowledge in education. By demonstrating a willingness to collaborate, higher education can get back "in-touch" with the public schools in the perceptions of the classroom teacher. This "partnership" can result in the more effective preparation of our future teachers and in improvements in the quality of professional development activities offered to our public school teachers.

Recommendations

The provisions of the *Professional Development Policy for Tennessee Schools* (1992) should be implemented to the fullest extent possible by the every school district. This is especially important with regard to inclusion of teachers in the decision making process and in providing to teachers the time necessary for planning, collaboration, and reflection. The needs and priorities provided by this study form a basis for the formulation of a professional development program for science teachers in the middle grades.

Specifically, the consolidated Hamilton County school district should:

- Use the conclusions of this study as a model for the formulation of policies and programs for the professional development of its middle grade science teachers.
- Ensure that the use of non science-trained teachers to teach science is limit to an interim practice, only until a qualified science teacher can be found. Non science-trained teachers should receive basic science content information, consistent with the curricular objectives for the grade level in which they will be required to teach, and instruction in the organization and operation of science laboratories and hands-on science activities prior to the assumption of their science teaching responsibilities.
- Take maximum advantage of available local resources, such as the Tennessee Valley Project and the Southeast Tennessee Professional Development Consortium for the Integration of Technology, to provide a means for meeting the needs of middle grade science teachers in integration of technology into the classroom.
- Establish a science coordinator position in the central administration to serve as a primary resource for the classroom teacher.
- Develop partnerships with local colleges and universities to assess teacher professional development needs, to assist in conducting teacher professional

development training, and to help find practical solutions to the problems confronting local schools.

Institutions of higher education should increase their contact with local schools by initiating partnerships aimed at the mutual exchange of information and resources. This contact would help higher education gain a better understanding of the realities confronting the classroom teachers and the local schools. It would also go a long way in improving the negative perception of higher education held by the majority of the teachers studied. This closer working relationship could strengthen undergraduate and graduate teacher preparation programs for middle grade science teachers by:

- Providing early and continuing classroom experiences during undergraduate preservice education. This would also serve to provide additional resources to the local schools to reduce the effects of overcrowding and improve opportunities for individualized instruction in the classroom.
- Monitoring the changing needs of middle grade science teachers to ensure that preservice instruction adequately prepares future science teachers for their entry into the profession. The information obtained could be used to update curriculum for preservice education programs and to develop specific professional activities to meet the needs of inservice teachers.
- Providing research opportunities for graduate students to address specific problems faced by the local schools which could not otherwise be evaluated within existing resources. This provides real, practical experience for the graduate student and potential solutions for the local schools.
- Providing job opportunities in the local schools for future science teachers after their graduation. These programs could serve as a source of recruitment qualified science teachers to increase the supply to the middle schools.

Suggestions for Further Research

The school district should conduct efficacy studies to determine if the practice of using of non science-trained teachers to teach science in the middle grades is affecting the academic achievement in science of middle grade students. If it is found that this practice is having a negative affect on student performance, then it must be terminated and qualified teachers identified to replace them. The district cannot be expected to be able to reach the lofty national and state goals for science education by using under-qualified science teachers

The school district should assess the professional development needs of all of its classroom teachers, at all levels of instruction, prior to the formulation of professional development policies and implementation of professional development activities. While this study addressed the professional development needs of middle grade science teachers, the professional development policy for the district must address the needs of all of its teachers.

The State Board of Education should commission a study to determine if specific middle school teacher preparation programs and corresponding certification and endorsement in middle school science education are needed for the State of Tennessee. Research conducted by the Center for Early Adolescence and the National Middle School Association have indicated that specific training and certification is needed for the education of the early adolescent students who populate the middle schools. It is time that Tennessee determined if a change is required in its *Rules, Regulations, and Minimum Standards for the Governance of Public Schools...* to incorporate the requirements for middle school education.

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APPENDICES

APPENDIX A
STUDY APPROVAL LETTERS

Figure 3. Study Approval Letter From Chattanooga Public Schools

CHATTANOOGA PUBLIC SCHOOLS
DIVISION OF TEACHING, LEARNING,
AND STUDENT SERVICES
 1161 West 40th Street
 Chattanooga, Tennessee 37409



Harry J. Reynolds, Ed.D.
 Superintendent

November 4, 1994

Edith M. Szathmary
 The University of Tennessee, Knoxville
 Research Administration
 Coordinator of Compliances
 404 Andy Holt Tower
 Knoxville, TN 37996-0140

Re: Survey of Professional Development Needs of Science Teachers in Grades 6 Through 8

To the UTK Committee on Research Participation:

The Chattanooga Public Schools hereby grants permission for Albert E. Piatt, UTK Doctoral Candidate, to conduct a survey of the professional development needs of the science teachers in the middle grades within our school system in support of his Doctoral Dissertation.

The agreement includes the understanding that the survey will involve contact with the middle level science teachers and building level administrators.

The Chattanooga Public Schools agrees that any data collected in the performance of this survey that is promised to the individual employees of the Chattanooga Public Schools to be confidential, will be held in such confidence by Mr. Piatt and will not be released in any individually identifiable form to the Chattanooga Public Schools, unless required by law. Data collected for these purposes may not be used for any other purposes unless the employees of the Chattanooga Public Schools are informed in detail of such purposes and consent is obtained from each individual. Individual responses will only be analyzed and reported in combination with the responses of others.

Kenneth W. Shepard
 NSF Project Director
 Chattanooga Public Schools

Figure 4. Study Approval Letter From Hamilton County Department Of Education

DR DON LOFTIS
Superintendent

HAMILTON COUNTY
DEPARTMENT OF EDUCATION
201 Broad Street, Chattanooga, Tennessee 37402
615/757-1781 • FAX/615/757 1777

November 7, 1994

Ms. Edith M. Szathmary
The University of Tennessee-Knoxville
Research Administration
Coordinator of Compliances
404 Andy Holt Tower
Knoxville, TN 37996-0140

Re: Survey of Professional Development Needs of Science Teachers in
Grades 6 Through 8

To the UTK Committee on Research Participation:

The Hamilton County Department of Education hereby grants permission for Albert E. Piatt, UTK Doctoral Candidate, to conduct a survey of the professional development needs of the science teachers in the middle grades within our school system in support of his Doctoral dissertation.

The agreement includes the understanding that the survey will involve contact with the middle level science teachers and building level administrators.

The Hamilton County Department of Education agrees that any data collected in the performance of this survey that is promised to the individual employees of the Department to be confidential, will be held in such confidence by Mr. Piatt and will not be released in any individually identifiable form to the Department of Education, unless required by law. Data collected for these purposes may not be used for any other purposes unless the employees of the Hamilton County Department of Education are informed in detail of such purposes and consent is obtained from each individual. Individual responses will only be analyzed and reported in combination with the responses of others.

Sincerely,


Curtis Drake
Director, Middle Schools

CD.es.ggb

APPENDIX B

SURVEY QUESTIONNAIRE

Figure 5. Survey Questionnaire

**Survey of Professional Development Needs
of Science Teachers in Grades 6 Through 8**

Your responses will be kept strictly confidential and will only be analyzed in combination with the responses of others. Participation is voluntary with no penalty for refusal or withdrawal from participation. The returned completed survey constitutes consent to participate.

Abilities in Science Instruction		<i>Circle the most appropriate response:</i>				
1-14. Reflect on your prior training and experience and indicate your agreement with the following statements as they describe your ability to teach science.		strongly agree SA	agree A	neutral N	disagree D	strongly disagree SD
1.	I believe that my content knowledge of the life sciences is sufficient to allow me to teach science effectively in grades 6-8.	SA	A	N	D	SD
2.	I believe that my content knowledge of the physical sciences is sufficient to allow me to teach science effectively in grades 6-8.	SA	A	N	D	SD
3.	I believe that my content knowledge of the earth sciences is sufficient to allow me to teach science effectively in grades 6-8.	SA	A	N	D	SD
4.	I believe that my content knowledge of environmental science is sufficient to allow me to teach science effectively in grades 6-8.	SA	A	N	D	SD
5.	I believe that my content knowledge of space sciences is sufficient to allow me to teach science effectively in grades 6-8.	SA	A	N	D	SD
6.	Overall, I believe that my preservice teacher education program adequately prepared me to teach science in grades 6-8.	SA	A	N	D	SD
7.	Overall, I believe that my preservice teacher education program adequately prepared me to teach early adolescent students.	SA	A	N	D	SD
8.	Overall, I believe that my preservice teacher education program adequately prepared me to meet the learning needs of early adolescent female students.	SA	A	N	D	SD
9.	Overall, I believe that my preservice teacher education program adequately prepared me to teach early adolescent students from different cultural and ethnic backgrounds.	SA	A	N	D	SD
10.	In my preservice teacher education program, I received specific instruction in the educational philosophy, curriculum, teaching methods and strategies for the middle school.	SA	A	N	D	SD
11.	I believe that I know enough about science teaching methods and strategies to teach science in grades 6-8 in an interesting and exciting way.	SA	A	N	D	SD
12.	I believe that I am able to evaluate the effectiveness of available science lessons, units, and materials.	SA	A	N	D	SD
13.	I believe that I am able to develop interesting and original lessons for science instruction in grades 6-8.	SA	A	N	D	SD
14.	I believe that I have the technical competence to organize and operate an effective science lab for grades 6-8.	SA	A	N	D	SD

Figure 5 (continued).

Survey of Professional Development Needs of Science Teachers in Grades 6 Through 8

2

Professional Development Needs

15. Please review the following list of professional development topics. Rate these topics according to how strongly you feel that you need them for your own professional development? Please add any topics that may be of particular interest to you that are not already listed.

Indicate your level of need for each topic by circling the corresponding number to the left of the item:

1 = no need, 2 = low need, 3 = moderate need, 4 = high need

- | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | Alternative assessment of student performance | 1 | 2 | 3 | 4 | Science curriculum updates |
| 1 | 2 | 3 | 4 | Classroom management | 1 | 2 | 3 | 4 | Science teaching methods and strategies |
| 1 | 2 | 3 | 4 | Early adolescent development | 1 | 2 | 3 | 4 | Science teaching resources |
| 1 | 2 | 3 | 4 | Integration of technology into the classroom | 1 | 2 | 3 | 4 | Stress management |
| 1 | 2 | 3 | 4 | Latest trends in learning theory. | 1 | 2 | 3 | 4 | Supervision and administration |
| 1 | 2 | 3 | 4 | Multicultural and diversity issues in the classroom | 1 | 2 | 3 | 4 | Teacher counseling skills |
| 1 | 2 | 3 | 4 | Multiple intelligences in the classroom | 1 | 2 | 3 | 4 | Teaching in the middle grades |
| 1 | 2 | 3 | 4 | Psychological problems of disadvantaged youth | 1 | 2 | 3 | 4 | Other (please specify): |
| 1 | 2 | 3 | 4 | Safety and liability issues in the school | 1 | 2 | 3 | 4 | _____ |
| | | | | | | | | | _____ |
| | | | | | | | | | _____ |

16. Please review the following list of professional development activities. Rate these activities according to how strongly your interest in participation would be as part of your professional development program. Please add any topics that may be of particular interest to you that are not already listed.

Indicate your level of preference for each activity by circling the corresponding number to the left of the item:

1 = no interest at all 2 = some interest 3 = moderate interest 4 = would definitely participate

- | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---------------------------------|
| 1 | 2 | 3 | 4 | Collaborative research with higher education | 1 | 2 | 3 | 4 | Postgraduate education programs |
| 1 | 2 | 3 | 4 | Collaboration with other science teachers | 1 | 2 | 3 | 4 | Professional conference(s) |
| 1 | 2 | 3 | 4 | Collaboration with scientists and science educators through Internet, CompuServe, America OnLine, Prodigy, etc. | 1 | 2 | 3 | 4 | Sabbaticals / release time |
| 1 | 2 | 3 | 4 | Continuing education courses | 1 | 2 | 3 | 4 | Science Seminars |
| 1 | 2 | 3 | 4 | Educational/public television programs | 1 | 2 | 3 | 4 | Science Symposia |
| 1 | 2 | 3 | 4 | Graduate courses | 1 | 2 | 3 | 4 | Undergraduate courses |
| 1 | 2 | 3 | 4 | Innovative teaching projects | 1 | 2 | 3 | 4 | Video tape instruction |
| 1 | 2 | 3 | 4 | Meetings with other teachers | 1 | 2 | 3 | 4 | Visits to other classrooms |
| 1 | 2 | 3 | 4 | Off-site workshops | 1 | 2 | 3 | 4 | Other (please specify): |
| 1 | 2 | 3 | 4 | On-site workshops | 1 | 2 | 3 | 4 | _____ |
| | | | | | | | | | _____ |
| | | | | | | | | | _____ |

Figure 5 (continued).

Survey of Professional Development Needs of Science Teachers in Grades 6 Through 8

3

17. Please review the following list of teaching resources. Rate these resources according to how useful they would be to you if they were made available through the professional development activities in which you would participate. Please add any resources that may be of particular interest to you that are not already listed.

Indicate your level of preference for each resource by circling the corresponding number to the left of the item:

1 = no use				2 = some use				3 = moderate use				4 = definitely useful			
1	2	3	4	Classroom science activity books	1	2	3	4	Physical science teaching materials						
1	2	3	4	Computer software for science topics	1	2	3	4	Science instructional video tapes						
1	2	3	4	Copy masters for science activities	1	2	3	4	Science teacher resource centers						
1	2	3	4	Earth science teaching materials	1	2	3	4	Science teacher workbooks						
1	2	3	4	Environmental science teaching materials	1	2	3	4	Supplementary curricula						
1	2	3	4	Idea books for science instruction	1	2	3	4	Space science teaching materials						
1	2	3	4	Life science teaching materials					Other (please specify):						
1	2	3	4	Multimedia CD software for science instruction	1	2	3	4	_____						
1	2	3	4	On-line resources for science instruction made available through Internet, Compu-Serve, America OnLine, Prodigy, etc.	1	2	3	4	_____						
					1	2	3	4	_____						

18. If you could make one recommendation for improving the inservice professional development activities offered by your school, what would that recommendation be?

(continue on reverse side if needed)

19. If you could make one recommendation for improving the preservice teacher preparation of science teachers in grades 6-8, what would that recommendation be?

(continue on reverse side if needed)

Figure 5 (continued).

Survey of Professional Development Needs of Science Teachers in Grades 6 Through 8

4

Background, Education, and Experience			
20. Gender: ___ Male ___ Female	21. Ethnicity ___ African-American ___ Asian-American ___ Caucasian ___ Hispanic-American ___ Native American ___ Other (please specify) _____	22. Total years of teaching experience: _____ years	23. Total years of experience teaching science in grades 6-8: _____ years
24. Highest level of education completed: ___ Baccalaureate ___ Masters ___ Education Specialist ___ Doctorate College(s) or university(ies) where degree(s) were received: _____ _____ _____	25. College or university major(s): ___ Early childhood educ (K-4) ___ Elementary educ (1-8) ___ Middle school educ (5-8) ___ Secondary educ (7-12) ___ Biology ___ Chemistry ___ Environmental science ___ Geology ___ Physics ___ Other (please specify): _____	26. Area(s) of teacher certification: ___ Grades K-3 ___ Elementary Grades 1-8 ___ Secondary Grades 7-12 Other endorsements (e.g. biology, chemistry, physics, mathematics, special education, etc.): _____ _____ _____	

27. Are there any additional comments or suggestions you would care to make?

(continue on reverse side if needed)

Are you willing to participate in a follow-up interview? ___ Yes ___ No

If Yes, how can I best contact you to arrange for an interview:

Name: _____

Address: _____

Telephone number: _____

Thank you for your time and cooperation.

If you have any questions, regarding this survey, feel free to contact Bert Piatt at (615) 899-6507.

APPENDIX C

SURVEY COVER LETTERS

Figure 6. Cover Letter From Chattanooga Public Schools

CHATTANOOGA PUBLIC SCHOOLS
DIVISION OF TEACHING, LEARNING,
AND STUDENT SERVICES
 1161 West 40th Street
 Chattanooga, Tennessee 37409



Harry J. Reynolds, Ed.D.
 Superintendent

February 13, 1995

Re: Survey of Professional Development Needs of Science Teachers
 in Grades 6 Through 8

Dear Colleague:

The Chattanooga Public Schools has granted permission for Albert E. Piatt, UTK Doctoral Candidate, to conduct a survey of the professional development needs of the science teachers in the middle grades within our school system in support of his Doctoral Dissertation.

The results of the survey will provide data related to the needs of teachers of science in grades six through eight in Chattanooga and Hamilton County. The Chattanooga Public Schools will use this information to support the continued professional development of science teachers in the middle grades. In addition, results of this study will be provided to colleges and universities seeking to improve their teacher preparation programs and post graduate teacher professional studies.

The Chattanooga Public Schools has agreed that any data collected in the performance of this survey that is promised to the individual employees to be confidential, will be held in such confidence by Mr. Piatt and will not be released in any individually identifiable form to the Chattanooga Public Schools, unless required by law. Data collected for these purposes may not be used for any other purposes unless the employees of the Chattanooga Public Schools are informed in detail of such purposes and consent is obtained from each individual. Individual responses will only be analyzed and reported in combination with the responses of others.

Your cooperation in this worthwhile research project is greatly appreciated.

Sincerely,

A handwritten signature in cursive script, appearing to read "Ken Shepard".

Kenneth W. Shepard
 NSF Project Director
 Chattanooga Public Schools

Enclosures

c: Dr. Elizabeth Gaines, Director, Division of Teaching & Learning
 Dr. Sylvester Carrington, Science Supervisor

Figure 7. Cover Letter From Hamilton County Department Of Education



HAMILTON COUNTY DEPARTMENT OF EDUCATION
201 Broad Street, Chattanooga, Tennessee 37402

February 16, 1995

Red Bank Middle School
3715 Dayton Boulevard
Chattanooga, TN 37415

Dear

We are participating in a survey by Mr. Albert E. Piatt, UTK Doctoral Candidate. This study consists of the professional development needs of science teachers in middle schools. It is my opinion that this information will be helpful to our system as we consider enhancing science programs in the middle schools.

Therefore, I would appreciate your assistance and cooperation in filling out his survey. The validity of this study will depend on wide-spread participation. The results will be shared with you. Hopefully, this information will positively impact the middle school students in Hamilton County Schools.

Your positive response to this project will be greatly appreciated.

Sincerely,


Curtis Drake, Director
Middle School Division

BF.msl.ggc

c: Middle School Principals

Figure 8. Cover Letter For Initial Survey Distribution

Albert E. Piatt
1721 Julian Ridge Road
Chattanooga, Tennessee 37421-3321

February 16, 1995

Dear Colleague:

I am conducting a study of the professional development needs of science teachers in the middle grades in Chattanooga and Hamilton County, Tennessee, as part of the requirements for a Doctor of Education degree in Leadership Studies in Education from the College of Education at The University of Tennessee, Knoxville. I have decided to pursue a project which can support attempts to obtain funding for the continuing professional development of science teachers in our public schools.

I am requesting your participation in a survey of the professional development needs of teachers, in grades 6 through 8, who teach science. Attached to this letter is a questionnaire which addresses these needs as you perceive them. By completing this questionnaire, you can input into the formulation of policy and the development of programs and activities which will support your development as a teacher of science.

The questions on the following pages involve the assessment of your needs in accomplishing effective science instruction. They will take only ten or fifteen minutes of your time to complete. Results from this survey will be presented in group form. Individual teachers will not be identified. The instrument is numbered only to allow me to follow-up on questionnaires which are not returned.

Your responses will be kept strictly confidential and will only be analyzed in combination with the responses of others. Participation is voluntary with no penalty for refusal or withdrawal from participation. The returned completed survey constitutes consent to participate.

I would appreciate your response at your earliest possible convenience. Please fill out the questionnaire and mail it back to me as soon as possible. Enclosed is a stamped, return address envelope for your convenience.

Your cooperation is greatly appreciated. I will be happy to provide you with a summary of this study if you desire.

Thank you for your participation in this study. I have not received any grants, or other sources of funding, to conduct this study. I sincerely believe that the findings emerging from this study will provide a valid data base for the improvement of middle level science teacher professional development programs and activities.

Sincerely,

Albert E. Piatt
Doctoral Candidate
The University of Tennessee, Knoxville

Figure 9. Reminder Letter To Initial Survey Distribution

Albert E. Piatt
1721 Julian Ridge Road
Chattanooga, Tennessee 37421-3321
(615) 899-6507

March 2, 1995

«First Name» «Last Name»
«School»
«Address»
«City» «State», «Zip»

Dear Colleague:

Please help! You received a questionnaire on the professional development needs of middle grade science teachers which was distributed on February 16, 1995. My records indicate that you have not yet responded.

Your input is vital to make the study truly reflective of the current needs of teachers in Chattanooga and Hamilton County.

The completed questionnaire is needed by March 10th in order to begin the analysis of the data.

If you did not receive the questionnaire, or if you need another copy with a return envelope, please contact me as soon as possible and I will provide one for you.

Thank you for your time.

Sincerely,

Albert E. Piatt
Doctoral Candidate
The University of Tennessee, Knoxville

Figure 10. Cover Letter For Follow-up Survey Distribution

Albert E. Piatt
1721 Julian Ridge Road
Chattanooga, Tennessee 37421-3321
(615) 899-6507

March 15, 1995

«First Name» «Last Name»
«School»
«Address»
«City» «State», «Zip»

Dear Colleague:

A county-wide study is being conducted to identify the professional development needs of teachers who teach science in grades 6 through 8. The results of this study will be used by the Chattanooga Public Schools and the Hamilton County Department of Education in the formulation of policies and programs for inservice teacher professional development. The results of this study will also be provided to Spaulding and Associates, the consultants for the Hamilton County school merger.

Recently you were sent a professional development needs questionnaire. My records indicate that it has not been returned. For your convenience, I am sending another questionnaire and return self-addressed stamped envelope. Unless a sufficient number of the questionnaires are returned, the results of the study will not truly reflect the needs of all teachers. This is your chance to make your opinions known regarding your continued professional development needs.

Thank you for your cooperation and assistance with this research effort. I sincerely believe that the findings emerging from this study will provide the groundwork for a teacher-directed professional development program within the emerging consolidated county school system.

Sincerely,

Albert E. Piatt
Doctoral Candidate
The University of Tennessee, Knoxville

APPENDIX D

COVER LETTER TO PANEL OF EXPERTS AND

LIST OF PANEL OF EXPERTS

Figure 11. Cover Letter To Panel Of Experts

Albert E. Piatt
1721 Julian Ridge Road
Chattanooga, Tennessee 37421-3321

January 8, 1995

Dr. Robert E. Yager
The University of Iowa
Science Education Center
450 Van Allen Hall
Iowa City, IA 52242-1478

Dear Dr. Yager:

As part of my research project for the Doctor of Education degree in Leadership Studies in Education from the College of Education at The University of Tennessee, Knoxville, I am preparing to conduct a study of the professional development needs of science teachers in the middle grades in Chattanooga and Hamilton County, Tennessee. I have decided to use a panel of experts to assist in reviewing my dissertation proposal and survey instrument. I am requesting that you serve on this panel based on your expertise and experience in the areas of middle school teacher preparation and science education.

Enclosed is a copy of my dissertation proposal, which has been submitted to my faculty committee, and my survey instrument (Appendix C). The survey instrument has been designed to obtain the perceptions, attitudes, and self-perceived behaviors of middle grade (6-8) science teachers in the primary service area for the Challenger Center® at The University of Tennessee at Chattanooga.

The primary objective of this survey is to develop a profile of middle grade science teachers for purposes of identifying self-perceived professional development needs which will assist in the development and improvement of inservice professional development opportunities. Please examine the survey instrument to determine how well it accomplishes this objective. On the instrument, or on a separate sheet of paper, indicate any items which are not clear, should be restated or deleted, and areas which should be included. Your comments on instrument construction would also be helpful.

Thank you for your participation in this study. I have not received any grants, or other sources of funding, to conduct this study. I would appreciate your response at your earliest possible convenience. Enclosed is a stamped, return address envelope for your convenience.

I will be happy to provide you with a copy of the completed study if you desire.

Sincerely yours,

Albert E. Piatt
Enclosure

Figure 12. Panel Of Experts

Dr. Bernard W. Benson
UC Foundation Professor of Education
Executive Director, Challenger Center®
Co-Director Science & Environmental Education Resource Center
The University of Tennessee at Chattanooga
615 McCallie Avenue
Chattanooga, TN 37403

Dr. Thomas E. Bibler
Professor and Head, Teacher Preparation Academy
College of Education and Applied Professional Studies
The University of Tennessee at Chattanooga
615 McCallie Avenue
Chattanooga, TN 37403

Mr. Seldon Bird
Middle School Science Teacher
Flight Director, Hamilton County Department of Education
Challenger Center®
at The University of Tennessee at Chattanooga
615 McCallie Avenue
Chattanooga, TN 37403

Dr. William Butterfield
Professor, Teacher Preparation Academy
College of Education and Applied Professional Studies
The University of Tennessee at Chattanooga
615 McCallie Avenue
Chattanooga, TN 37403

Dr. John R. Carpenter
Center for Science Education
University of South Carolina
Columbia, SC 29208

Dr. Sylvester Carrington
Science Supervisor
Chattanooga Public Schools
1161 West 40th Street
Chattanooga, TN 37409

Dr. Lloyd D. Davis
Guerry Professor of Education, Graduate Studies
College of Education and Applied Professional Studies
The University of Tennessee at Chattanooga
615 McCallie Avenue
Chattanooga, TN 37403

Figure 12. (Continued).

Mr. Curtis Drake
Director, Middle Schools
Hamilton County Department of Education
201 Broad Street
Chattanooga, TN 37402

Dr. Ken McEwin
Department of Curriculum and Instruction
College of Education
Appalachian State University
Boone, NC 28608

Dr. Jack Rhoton
East Tennessee State University
Department of Curriculum and Instruction
Box 70684
Johnson City, TN 37614

Mr. Kenneth W. Shepard
NSF Project Director
Chattanooga Public Schools
1161 West 40th Street
Chattanooga, TN 37409

Dr. Ben Spangler
Retired Professor of Education
University of North Carolina, Ashville
86 Dogwood Drive
Weaverville, NC 28787

Ms. Sheree Wheat
Middle School Science Teacher
Flight Director Chattanooga City Schools
Challenger Center®
at The University of Tennessee at Chattanooga
615 McCallie Avenue
Chattanooga, TN 37403

Dr. Robert E. Yager
The University of Iowa
Science Education Center
450 Van Allen Hall
Iowa City, IA 52242-1478

APPENDIX E

RESPONSES TO

BACKGROUND, EDUCATION, AND EXPERIENCE

Responses to *Background, Education, and Experience*

Table E-1. Gender of Survey Respondents

	<i>f</i>	%
Male	28	29.8
Female	66	70.2

Table E-2. Ethnicity of Survey Respondents

	<i>f</i>	%
African American	12	12.8
Caucasian	81	86.2
Native American	1	1.1

Table E-3. Total Years of Teaching Experience of Survey Respondents

	<i>f</i>	%
≤ 5 Years	24	25.5
6-15 Years	24	25.5
> 15 Years	46	48.9

Table E-4. Total Years of Experience Teaching Science in Grades 6-8 of Survey Respondents

	<i>f</i>	%
≤ 5 Years	42	44.7
6-15 Years	43	45.7
> 15 Years	9	9.6

Table E-5. Level of Education of Survey Respondents

	<i>f</i>	%
Bachelors	44	46.8
Masters	49	52.1
Doctorate	1	1.1

Table E-6. Major Area of Undergraduate Study of Survey Respondents

	<i>f</i>	%
Elementary / Middle Sch	37 ¹	39.4
Secondary / Non Science	16	17.0
Secondary / Science	26	27.6
H. & P.E.	12	12.8
Psyc / Spec Educ	2	2.1
No Response	1	1.1

¹ Four cases reported participation in specific teacher preparation programs for middle schools (5-8)

Table E-7. Level of Certification of Survey Respondents

	<i>f</i>	%
Elementary	33	35.1
Secondary	41	43.6
Elementary and Secondary	20	21.3

Table E-8. Gender of Respondents Interviewed

	<i>f</i>	%
Male	9	32.1
Female	19	67.9

Table E-9. Ethnicity of Respondents Interviewed

	<i>f</i>	%
African American	4	14.3
Caucasian	24	85.7

Table E-10. Total Years of Teaching Experience of Respondents Interviewed

	<i>f</i>	%
≤ 5 Years	6	21.4
6-15 Years	7	25.0
> 15 Years	15	53.6

Table E-11. Total Years of Experience Teaching Science in Grades 6-8 of Respondents Interviewed

	<i>f</i>	%
≤ 5 Years	10	35.7
6-15 Years	14	50.0
> 15 Years	4	14.3

Table E-12. Level of Education of Respondents Interviewed

	<i>f</i>	%
Bachelors	16	57.1
Masters	12	42.9

Table E-13. Major Area of Undergraduate Study of Respondents Interviewed

	<i>f</i>	%
Elementary	6	21.4
Secondary / Non Science	2	7.1
Secondary / Science	16	57.1
H. & P.E.	3	10.7
Psyc/Spec Educ	1	3.6

Table E-14. Level of Certification of Respondents Interviewed

	<i>f</i>	%
Elementary	5	17.9
Secondary	16	57.1
Elementary and Secondary	7	25.0

APPENDIX F

RESPONSES TO

ABILITIES IN SCIENCE INSTRUCTION

Responses to *Abilities in Science Instruction*

Table F-1 Responses to Content Knowledge by Interview

Question	Gender	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
1. Knowledge of the life sciences.	Interviewed	62.07	28	.0002***
	Not Interviewed	41.32	66	
2. Knowledge of the physical sciences.	Interviewed	61.45	28	.0004***
	Not Interviewed	41.58	66	
3. Knowledge of the earth sciences.	Interviewed	60.61	28	.0007***
	Not Interviewed	41.94	66	
4. Knowledge of environmental science.	Interviewed	61.75	28	.0002***
	Not Interviewed	40.65	65	
5. Knowledge of space sciences.	Interviewed	58.02	28	.0069**
	Not Interviewed	43.04	66	

***p*>0.01

****p*>0.001

Table F-2. Responses to Content Knowledge by Gender

Question	Gender	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
1. Knowledge of the life sciences.	Male	45.75	28	.6589
	Female	48.24	66	
2. Knowledge of the physical sciences.	Male	49.66	28	.5851
	Female	46.58	66	
3. Knowledge of the earth sciences.	Male	50.21	28	.4822
	Female	46.35	66	
4. Knowledge of environmental science.	Male	51.68	28	.2326
	Female	44.98	66	
5. Knowledge of space sciences.	Male	49.82	28	.5513
	Female	46.52	66	

No significant differences were found by gender.

Table F-3. Responses to Content Knowledge by Total Years of Teaching Experience

Question	Years	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
1. Knowledge of the life sciences.	≤ 5 Years	41.27	24	.1658
	6-15 Years	44.40	24	
	> 15 Years	52.37	46	
2. Knowledge of the physical sciences.	≤ 5 Years	39.50	24	.1886
	6-15 Years	49.48	24	
	> 15 Years	50.64	46	
3. Knowledge of the earth sciences.	≤ 5 Years	42.38	24	.4266
	6-15 Years	51.40	24	
	> 15 Years	48.14	46	
4. Knowledge of environmental science.	≤ 5 Years	40.46	23	.3437
	6-15 Years	48.75	24	
	> 15 Years	49.36	46	
5. Knowledge of space sciences.	≤ 5 Years	46.60	24	.5037
	6-15 Years	52.50	24	
	> 15 Years	45.36	46	

No significant differences were found by total years of teaching experience.

Table F-4. Responses to Content Knowledge by Total Years of Experience Teaching Science in Grades 6-8

Question	Years	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
1. Knowledge of the life sciences.	≤ 5 Years	39.46	42	.0066**
	6-15 Years	50.76	43	
	> 15 Years	67.11	9	
2. Knowledge of the physical sciences.	≤ 5 Years	39.49	42	.0198*
	6-15 Years	54.30	43	
	> 15 Years	52.39	9	
3. Knowledge of the earth sciences.	≤ 5 Years	44.43	42	.2391
	6-15 Years	47.99	43	
	> 15 Years	59.50	9	
4. Knowledge of environmental science.	≤ 5 Years	40.22	41	.0408*
	6-15 Years	50.84	43	
	> 15 Years	59.56	9	
5. Knowledge of space sciences.	≤ 5 Years	44.48	42	.5621
	6-15 Years	50.06	43	
	> 15 Years	49.39	9	

* $p > 0.05$

** $p > 0.01$

Table F-5. Responses to Content Knowledge by Level of Education

Question	Level	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
1. Knowledge of the life sciences.	Bachelors	43.88	44	.1879
	Masters or Higher	50.69	50	
2. Knowledge of the physical sciences.	Bachelors	44.33	44	.2486
	Masters or Higher	50.29	50	
3. Knowledge of the earth sciences.	Bachelors	46.97	44	.8421
	Masters or Higher	47.97	50	
4. Knowledge of environmental science.	Bachelors	48.62	43	.5601
	Masters or Higher	45.61	50	
5. Knowledge of space sciences.	Bachelors	51.56	44	.1337
	Masters or Higher	43.93	50	

No significant differences were found by level of education.

Table F-6. Responses to Content Knowledge by Major Area of Undergraduate Study

Question	Major	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
1. Knowledge of the life sciences.	Elem/ Mid Sch	35.68	37	.0002***
	Sec/ Non-science	48.81	17	
	Sec/ Science	61.96	26	
	H. & P.E.	39.50	11	
2. Knowledge of the physical sciences.	Elem/ Mid Sch	37.42	37	.0006***
	Sec/ Non-science	44.91	17	
	Sec/ Science	62.12	26	
	H. & P.E.	39.00	11	
3. Knowledge of the earth sciences.	Elem/ Mid Sch	42.04	37	.0255*
	Sec/ Non-science	40.72	17	
	Sec/ Science	57.81	26	
	H. & P.E.	39.61	11	
4. Knowledge of environmental science.	Elem/ Mid Sch	39.21	36	.0090**
	Sec/ Non-science	44.75	17	
	Sec/ Science	58.48	26	
	H. & P.E.	37.25	11	
5. Knowledge of space sciences.	Elem/ Mid Sch	40.47	37	.0193*
	Sec/ Non-science	47.94	17	
	Sec/ Science	57.17	26	
	H. & P.E.	36.25	11	

* $p > 0.05$
 ** $p > 0.01$
 *** $p > 0.001$

Table F-7. Responses to Content Knowledge by Level of Certification

Question	Level	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
1. Knowledge of the life sciences.	Elementary	36.55	33	.0003***
	Secondary	59.09	40	
	Elem & Sec	41.83	21	
2. Knowledge of the physical sciences.	Elementary	36.23	33	.0009**
	Secondary	57.88	40	
	Elem & Sec	44.83	21	
3. Knowledge of the earth sciences.	Elementary	41.52	33	.1658
	Secondary	52.33	40	
	Elem & Sec	47.47	21	
4. Knowledge of environmental science.	Elementary	39.70	32	.0316*
	Secondary	54.46	40	
	Elem & Sec	43.38	21	
5. Knowledge of space sciences.	Elementary	39.74	33	.0301*
	Secondary	54.77	40	
	Elem & Sec	45.40	21	

* $p > 0.05$ *** $p > 0.001$

Table F-8. Responses to Adequacy of Preservice Teacher Preparation by Interview

Question	Gender	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
6. Overall preparation to teach science in grades 6-8.	Interviewed	56.30	28	.0228*
	Not Interviewed	42.99	65	
7. Preparation to teach early adolescent students.	Interviewed	52.11	27	.1681
	Not Interviewed	44.17	65	
8. Preparation to teach early adolescent female students.	Interviewed	54.80	27	.0439*
	Not Interviewed	43.05	65	
9. Preparation to teach students from different cultural and ethnic backgrounds.	Interviewed	50.28	27	.3565
	Not Interviewed	44.93	65	
10. Instruction for middle schools.	Interviewed	46.22	27	.9468
	Not Interviewed	46.62	65	

* $p > 0.05$

Table F-9. Responses to Adequacy of Preservice Teacher Preparation by Gender

Question	Gender	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
6. Overall preparation to teach science in grades 6-8.	Male	48.59	28	.6972
	Female	46.32	65	
7. Preparation to teach early adolescent students.	Male	44.38	28	.5921
	Female	47.43	64	
8. Preparation to teach early adolescent female students.	Male	40.82	28	.1569
	Female	48.98	64	
9. Preparation to teach students from different cultural and ethnic backgrounds.	Male	46.52	28	.9964
	Female	46.49	64	
10. Instruction for middle schools.	Male	47.46	28	.8121
	Female	46.08	64	

No significant differences were found by gender.

Table F-10. Responses to Adequacy of Preservice Teacher Preparation by Total Years of Teaching Experience

Question	Years	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
6. Overall preparation to teach science in grades 6-8.	≤ 5 Years	40.02	24	.2890
	6-15 Years	47.97	24	
	> 15 Years	50.23	45	
7. Preparation to teach early adolescent students.	≤ 5 Years	46.80	23	.9975
	6-15 Years	46.50	24	
	> 15 Years	46.30	45	
8. Preparation to teach early adolescent female students.	≤ 5 Years	44.46	23	.7592
	6-15 Years	44.69	24	
	> 15 Years	48.51	45	
9. Preparation to teach students from different cultural and ethnic backgrounds.	≤ 5 Years	44.07	23	.6258
	6-15 Years	50.69	24	
	> 15 Years	48.51	45	
10. Instruction for middle schools.	≤ 5 Years	52.24	23	.2599
	6-15 Years	40.00	24	
	> 15 Years	47.03	45	

No significant differences were found by total years of teaching experience.

Table F-11. Responses to Adequacy of Preservice Teacher Preparation by Total Years of Experience Teaching Science in Grades 6-8

Question	Years	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
6. Overall preparation to teach science in grades 6-8.	≤ 5 Years	38.07	42	.0036**
	6-15 Years	52.07	43	
	> 15 Years	66.63	8	
7. Preparation to teach early adolescent students.	≤ 5 Years	42.07	41	.3057
	6-15 Years	50.52	42	
	> 15 Years	47.89	9	
8. Preparation to teach early adolescent female students.	≤ 5 Years	40.76	41	.1492
	6-15 Years	50.80	42	
	> 15 Years	52.61	9	
9. Preparation to teach students from different cultural and ethnic backgrounds.	≤ 5 Years	42.32	41	.3362
	6-15 Years	50.52	42	
	> 15 Years	46.78	9	
10. Instruction for middle schools.	≤ 5 Years	49.46	41	.0574
	6-15 Years	40.49	42	
	> 15 Years	61.06	9	

** $p > 0.01$

Table F-12. Responses to Adequacy of Preservice Teacher Preparation by Level of Education

Question	Level	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
6. Overall preparation to teach science in grades 6-8.	Bachelors	47.13	44	.9648
	Masters or Higher	46.89	49	
7. Preparation to teach early adolescent students.	Bachelors	43.60	43	.3012
	Masters or Higher	49.04	49	
8. Preparation to teach early adolescent female students.	Bachelors	42.29	43	.1372
	Masters or Higher	50.19	49	
9. Preparation to teach students from different cultural and ethnic backgrounds.	Bachelors	42.64	43	.1708
	Masters or Higher	49.89	49	
10. Instruction for middle schools.	Bachelors	44.36	43	.4550
	Masters or Higher	48.38	49	

No significant differences were found by level of education.

Table F-13. Responses to Adequacy of Preservice Teacher Preparation by Major Area of Undergraduate Study

Question	Major	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
6. Overall preparation to teach science in grades 6-8.	Elem/ Mid Sch	39.03	37	.0070**
	Sec/ Non-science	38.47	16	
	Sec/ Science	59.73	26	
	H. & P.E.	43.42	11	
7. Preparation to teach early adolescent students.	Elem/ Mid Sch	46.01	36	.5581
	Sec/ Non-science	41.22	17	
	Sec/ Science	49.16	25	
	H. & P.E.	38.33	11	
8. Preparation to teach early adolescent female students.	Elem/ Mid Sch	44.78	36	.8771
	Sec/ Non-science	47.00	17	
	Sec/ Science	46.44	25	
	H. & P.E.	40.00	11	
9. Preparation to teach students from different cultural and ethnic backgrounds.	Elem/ Mid Sch	41.97	36	.1555
	Sec/ Non-science	47.16	17	
	Sec/ Science	52.84	25	
	H. & P.E.	34.88	11	
10. Instruction for middle schools.	Elem/ Mid Sch	43.76	36	.9284
	Sec/ Non-science	44.22	17	
	Sec/ Science	47.84	25	
	H. & P.E.	43.83	11	

** $p > 0.01$

Table F-14. Responses to Adequacy of Preservice Teacher Preparation by Level of Certification

Question	Level	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
6. Overall preparation to teach science in grades 6-8.	Elementary	37.92	33	.0198*
	Secondary	54.82	40	
	Elem & Sec	45.89	20	
7. Preparation to teach early adolescent students.	Elementary	48.13	32	.5756
	Secondary	47.81	39	
	Elem & Sec	41.28	21	
8. Preparation to teach early adolescent female students.	Elementary	46.48	32	.8052
	Secondary	48.04	39	
	Elem & Sec	43.45	21	
9. Preparation to teach students from different cultural and ethnic backgrounds.	Elementary	43.92	32	.7454
	Secondary	48.04	39	
	Elem & Sec	46.58	21	
10. Instruction for middle schools.	Elementary	45.63	32	.9360
	Secondary	47.61	39	
	Elem & Sec	45.67	21	

* $p > 0.05$

Table F-15. Responses to Teacher Confidence by Interview

Question	Gender	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
11. Ability to teach science in an interesting and exciting way.	Interviewed	62.75	28	.0002***
	Not Interviewed	41.03	66	
12. Ability to evaluate the effectiveness of science lessons, units, and materials.	Interviewed	62.34	28	.0002***
	Not Interviewed	41.20	66	
13. Ability to develop interesting and original lessons.	Interviewed	62.21	28	.0002***
	Not Interviewed	41.26	66	
14. Ability to organize and operate science lab.	Interviewed	61.54	28	.0003***
	Not Interviewed	40.74	65	

*** $p > 0.001$

Table F-16. Responses to Teacher Confidence by Gender

Question	Gender	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
11. Ability to teach science in an interesting and exciting way.	Male	44.54	28	.4619
	Female	48.76	66	
12. Ability to evaluate the effectiveness of science lessons, units, and materials.	Male	49.05	28	.6925
	Female	46.84	66	
13. Ability to develop interesting and original lessons.	Male	44.04	28	.3787
	Female	48.97	66	
14. Ability to organize and operate science lab.	Male	44.89	28	.6005
	Female	47.91	65	

No significant differences were found by gender.

Table F-17. Responses to Teacher Confidence by Total Years of Teaching Experience

Question	Years	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
11. Ability to teach science in an interesting and exciting way.	≤ 5 Years	42.50	24	.3349
	6-15 Years	45.13	24	
	> 15 Years	51.35	46	
12. Ability to evaluate the effectiveness of science lessons, units, and materials.	≤ 5 Years	41.56	24	.1908
	6-15 Years	44.56	24	
	> 15 Years	52.13	46	
13. Ability to develop interesting and original lessons.	≤ 5 Years	43.15	24	.4697
	6-15 Years	46.02	24	
	> 15 Years	50.54	46	
14. Ability to organize and operate science lab.	≤ 5 Years	38.67	23	.1756
	6-15 Years	47.79	24	
	> 15 Years	50.75	46	

No significant differences were found by total years of teaching experience.

Table F-18. Responses to Teacher Confidence by Total Years of Experience Teaching Science in Grades 6-8

Question	Years	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
11. Ability to teach science in an interesting and exciting way.	≤ 5 Years	39.02	42	.0122*
	6-15 Years	53.34	43	
	> 15 Years	59.17	9	
12. Ability to evaluate the effectiveness of science lessons, units, and materials.	≤ 5 Years	37.82	42	.0016**
	6-15 Years	53.50	43	
	> 15 Years	64.00	9	
13. Ability to develop interesting and original lessons.	≤ 5 Years	40.54	42	.0276*
	6-15 Years	51.38	43	
	> 15 Years	61.44	9	
14. Ability to organize and operate science lab.	≤ 5 Years	36.49	41	.0009***
	6-15 Years	53.22	43	
	> 15 Years	65.17	9	

* $p > 0.05$

** $p > 0.01$

*** $p > 0.001$

Table F-19. Responses to Teacher Confidence by Level of Education

Question	Level	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
11. Ability to teach science in an interesting and exciting way.	Bachelors	45.50	44	.4747
	Masters or Higher	49.26	50	
12. Ability to evaluate the effectiveness of science lessons, units, and materials.	Bachelors	43.89	44	.1853
	Masters or Higher	50.68	50	
13. Ability to develop interesting and original lessons.	Bachelors	43.90	44	.1874
	Masters or Higher	50.67	50	
14. Ability to organize and operate science lab.	Bachelors	43.93	43	.2810
	Masters or Higher	49.64	50	

No significant differences were found by level of education.

Table F-20. Responses to Teacher Confidence by Major Area of Undergraduate Study

Question	Major	Mean Rank	f	2-Tailed p
11. Ability to teach science in an interesting and exciting way.	Elem/Mid Sch	41.89	37	.0145*
	Sec/Non-science	44.66	17	
	Sec/Science	58.27	26	
	H. & P.E.	33.88	11	
12. Ability to evaluate the effectiveness of science lessons, units, and materials.	Elem/Mid Sch	37.38	37	.0036**
	Sec/Non-science	50.38	17	
	Sec/Science	58.60	26	
	H. & P.E.	39.46	11	
13. Ability to develop interesting and original lessons.	Elem/Mid Sch	40.89	37	.0062**
	Sec/Non-science	45.31	17	
	Sec/Science	59.13	26	
	H. & P.E.	34.21	11	
14. Ability to organize and operate science lab.	Elem/Mid Sch	34.79	37	.0001***
	Sec/Non-science	50.25	17	
	Sec/Science	62.50	26	
	H. & P.E.	34.46	11	

*p>0.05

**p>0.01

***p>0.001

Table F-21. Responses to Teacher Confidence by Level of Certification

Question	Level	Mean Rank	<i>f</i>	2-Tailed <i>p</i>
11. Ability to teach science in an interesting and exciting way.	Elementary	43.08	33	.1168
	Secondary	53.67	40	
	Elem & Sec	42.15	21	
12. Ability to evaluate the effectiveness of science lessons, units, and materials.	Elementary	38.91	33	.0221*
	Secondary	54.89	40	
	Elem & Sec	46.53	21	
13. Ability to develop interesting and original lessons.	Elementary	41.32	33	.0237*
	Secondary	55.48	40	
	Elem & Sec	41.35	21	
14. Ability to organize and operate science lab.	Elementary	36.44	32	.0019**
	Secondary	57.18	40	
	Elem & Sec	43.03	21	

* $p > 0.05$ ** $p > 0.01$

APPENDIX G

RESPONSES TO

PROFESSIONAL DEVELOPMENT NEEDS

Responses to *Professional Development Needs*

Table G-1. Overall Responses to Teacher Professional Development Needs

Item	no need	low need	moderate need	high need	n
Integration of technology into the classroom	1	10	27	55	93
Science teaching resources	3	13	31	45	92
Science curriculum updates	3	11	46	31	91
Science teaching methods and strategies	2	17	42	32	93
Multiple intelligences in the classroom	4	24	42	22	92
Latest trends in learning theory	7	25	35	25	92
Alternative assessment of student performance	6	21	47	18	92
Psychological problems of disadvantaged youth	6	26	39	20	91
Multicultural and diversity issues in the classroom	10	25	41	15	91
Stress management	13	31	28	20	92
Safety and liability issues in the school	14	30	31	17	92
Teacher counseling skills	14	34	30	12	90
Teaching in the middle grades	10	42	31	9	92
Classroom management	22	42	19	9	92
Early adolescent development	20	44	22	5	91
Supervision and administration	24	37	24	5	90

Table G-2. Listing of Teacher Professional Development Needs Not Included in the Questionnaire

Other...	Number of Responses
Practical laboratory activities	3
Hands-on strategies	2
Resources, including time and funding of activities	2
Teaching special needs and handicapped students, i.e., inclusion	2
Basic science knowledge	1
Science projects	1
Field study resources	1
Parental involvement techniques	1
Curriculum mapping	1

Table G-3. Overall Responses to Teacher Professional Development Activities

Item	no interest at all	some interest	moderate interest	would definitely participate	n
Collaboration with other science teachers	2	7	34	50	93
Innovative teaching projects	1	13	35	42	91
Meetings with other teachers	1	13	39	37	90
On-site workshops	4	12	33	39	88
Collaboration with scientists and science educators through Internet, CompuServe, America OnLine, Prodigy, etc.	6	14	29	41	90
Science Seminars	2	17	38	34	91
Off-site workshops	5	18	30	37	90
Educational/ public television programs	2	18	46	25	91
Visits to other classrooms	5	20	36	31	92
Professional conference(s)	5	24	35	25	89
Science Symposiums	6	26	31	24	87
Continuing education courses	10	23	30	27	90
Sabbaticals / release time	18	19	28	23	88
Graduate courses	18	24	25	23	90
Collaborative research with higher education	13	36	25	15	89
Postgraduate education programs	21	23	26	18	88
Video tape instruction	15	33	26	14	88
Undergraduate courses	40	31	13	3	87

Table G-4. Listing of Teacher Professional Development Activities Not Included in the Questionnaire

Other...	Number of Responses
Environmental education conferences	1

Table G-5. Overall Responses to Teaching Resources

Item	no use	some use	moderate use	definitely useful	n
Life science teaching materials	1	5	29	55	90
Idea books for science instruction	0	9	29	53	91
Environmental science teaching materials	3	7	26	55	91
Classroom science activity books	3	8	25	55	91
Earth science teaching materials	3	8	29	51	91
Computer software for science topics	5	12	18	57	92
Physical science teaching materials	5	11	19	55	90
Space science teaching materials	5	7	27	50	89
Science instructional video tapes	3	7	34	46	90
Science teacher resource centers	2	9	33	46	90
Multimedia CD software for science instruction	5	12	21	53	91
On-line resources for science instruction made available through Internet, Compu-Serve, America OnLine , Prodigy, etc.	6	13	23	50	92
Supplementary curricula	2	15	32	38	87
Science teacher workbooks	3	17	30	40	90
Copy masters for science activities	3	22	26	40	91

Table G-6. Listing of Teaching Resources Not Included in the Questionnaire

Other...	Number of Responses
No access to a computer	3
AIM materials	1
Use of current events, i.e., current science, etc.	1
Outdoor laboratories	1

APPENDIX H

OPEN-ENDED RESPONSES TO SURVEY QUESTIONS

Table H-1. General Comments to Overall Survey Response

Category	f	Comments
General Comments	14	My over all preservice education was terrible. My science background during preservice was great. I have "learned to teach" as I have progressed each year. The education classes I took in graduate school were worthless. That may be one of our problems—We train people to "teach," yet they know nothing to teach. Science needs to be fun. I feel that my content knowledge of science is sufficient because I study my science before I teach it. If I did not prepare as much as I do, then I would have to say that my content knowledge is not sufficient enough to allow me to teach it effectively. Currently, the staff members who teach science are teaching outside their area of expertise due to budget cuts. For example, a reading teacher and a language arts teacher are having to "cover" science classes in middle school. They are competent in their areas but haven't had experience teaching science. Highly frustrating! Teachers shouldn't be allowed to teach single subject areas unless they are trained in them. It is very difficult for me to teach science effectively without a sufficient science background. I was not trained as a teacher. I have a science degree with several additional hours in science. Math is my area of certification. I am not certified in science and I only teach 1 class of science. I was not trained to teach science! I am certified in mathematics, however my physics and chemistry background have helped ease my transformation to teaching science. After teaching science this year, I feel I will be much better trained for next year! I am a language arts teacher. I only teach one science course and am not certified to teach science. I am an English teacher. Due to staffing changes, I was asked to teach science. I am qualified in the area of Language Arts but am unqualified to teach science. I have only taught science for 5 or 6 years. Before that I was mainly a social science teacher. I only teach 2 classes of science a year. My background is not science but I have developed a knowledge and respect for science. I'm a Special Education teacher with enough science to receive my BS degree. Now I'm teaching resource science. How do special education teachers fit into the middle school picture? Often the teachers are left out of events. For example, last year, I didn't get the announcements so I didn't know we even had a science fair, so my students didn't participate. Hire a real science teacher!

Table H-2. Recommendations for Improving Professional Development Activities

Category	f	Comments
Resources, e.g., time, funding, equipment, materials, etc.	22	I strongly believe that in order for us to improve our techniques and use of ideas, time and money must also be provided to equip us properly and train us. To give us more time to develop curriculum that incorporates what we will be teaching. Release time for teaching so that interdisciplinary unit planning can happen throughout the year. Paid time during the summer for activities. Working workshops with time to process the information are the most useful. Unfortunately there is seldom time to process or do any followups that are included. I need more time to digest the material already offered. Actually there is not enough time. Time is needed to organize materials and prepare orders to replace materials. Time is also needed to get rooms and materials ready for the first week of school. Time to work and organize in the classroom. That [professional development activities] have practical ideas that I can use now. I hear a lot of wonderful ideas that pertain to other grade levels, or that require equipment that we do not have available (e.g., computers, software, properly running video equipment, etc.) but rarely do I get these. Provide more planning time during the summer. Release time during school day for continuous planning. Some school systems release students for a half day periodically for this purpose. It is hard to do proper laboratory experiments and to provide proper assistance and supervision to 30 students at a time! Smaller class loads would benefit all! Desks and/or tables that would lend themselves to student activities and group investigation. A closet of "goodies" from which to demonstrate, in visual or kinetic ways, the concepts being taught. Make more lab and computer materials available as a matter of course--teachers should not have to apply for grants to receive materials they should get for a regular curriculum! It is hard to teach science when you do not have the technology and materials needed available to you. Teachers need to have workshops to find free science materials to use in the classroom.

Table H-2 (continued).

Category	<i>f</i>	Comments
Resources, e.g., time, funding, equipment, materials, etc. (continued).		Training in the use of the computer in the classroom; also in the use of on-line resources, and time to practice computer skills. Availability of more computers for students in classrooms and science instructional video tapes, especially for topics such as plate tectonics, etc. Computer software made readily available. More computers and materials available for classroom use. Have equipment available for students to use when the teacher goes back into the class armed with all these good ideas.

Table H-2 (continued).

Category	f	Comments
Teacher Interaction/Visitation	14	Meet once every three months to share information on students progress, teaching techniques, and sharing on workshops attended. As science teachers, we would like time to meet in departments. This is not encouraged because it is hoped we would spend all of our time in team meetings planning discipline and creative activities. Curriculum and academic excellence is not stressed in fact it is placed second to the students' feelings. We need to expand our realm - We need to have a network by or through which we can exchange ideas/support each other. - How someone used computers - or taught specific concepts; good field activities - Teams need to work together instead of in isolation. Time to work and develop team ideas and talents. Time to work with other science teachers within the school. Opportunities for sharing ideas, techniques, etc. Once a month grade level meetings would be nice - we need to give and receive ideas - the cooperative learning philosophy is not extended to the teachers. I would like to share ideas with other science teachers. Teachers would improve and develop teaching and curriculum if they could spend time observing and working with peers within their content area. Periodic meetings with other science teachers from other schools, to share ideas and methods used in teaching science More interactive inservice with other teachers/schools. I wish teachers from different schools and school systems had the opportunity to meet and discuss teaching ideas that have worked in the classroom. To visit other schools. Visitation of other classrooms. Experienced and rookie teachers gain useful insight into many areas of strategies, management, curriculum, and especially things not in teacher preparation programs. Visit community resources—nature centers, technical plants, factories, and colleges.

Table H-2 (continued).

Category	<i>f</i>	Comments
Labs and Hands-on Activities	14	Activities that involve designing, setting up, and running labs. To give more workshops relating to labs. My science background is not adequate enough to run laboratory curriculum. I would like ideas for good labs that can be done with large groups (20-30). Help is needed in setting up and maintaining a workable science laboratory, student learning centers, etc. Need science labs. We need science labs with science materials. Simple lab activities coordinated with science units - simple enough for middle school students to participate in and learn from. Hands-on workshops, not lectures. (<i>f</i> = 2) Middle school students should be exposed to more lab and hands-on science projects—less book work. Hands-on activities to use in class. It is not enough to read lessons and look at pictures of experiments. Students must be able to be a part of a lesson—to experience the knowledge and share with each other. Hands-on activities (such as the new space shuttle or the Channel 9 science demonstrations). Hands-on activities for middle school.

Table H-2 (continued).

Category	f	Comments
Curriculum Related	14	First, have a functional curriculum. Give funding to implement it. Then develop inservice based on needs that will enrich and support the objectives of the curriculum. Often inservice is a shotgun approach used to fulfill a requirement. More science workshops. Provide more workshops in physical science. Develop a [science] handbook for students and one for teachers. Curriculum writing which incorporates learning from basic core courses and elective courses. Ideas for science projects, how to coordinate class projects. Continuing science training to up-date ideas. Divide inservices into specific curricula, i.e., one school does science while another does math, teachers go to the school that addresses their topic. They should have at least one inservice a year that focuses on specific subjects, e.g., science, math, history. On the day of inservice, there would be a course for each subject area. Give us more opportunities to learn about the sciences and we will be better teachers. Unfortunately we had no inservice training prior to our science teaching assignment. Focus on content instead of theories. Update new methods in science materials available. That inservice be directly related to subjects taught. Things that can be used.

Table H-2 (continued).

Category	f	Comments
Teacher Involvement in Inservice Planning	10	Let the teachers have more of a say in what instruction is needed in the schools. Stop the repetition. Let us choose. Allow more teacher input, needs, etc. Allow teachers to create through "site-base" their needs for inservice programs - we are all capable! Make them interesting and teacher involved. I would have several teachers to discuss one topic with more demonstrations of the topics. I would have teacher because they are more closely connected with real situations in the classrooms. Teachers need to be included in the planning of inservice time. So much of the time during the first week of school is wasted in system-wide meetings. With other teacher I would recommend...more time allowed for sharing ideas that work (in detail enough to use it). To review all the needs to be addressed and have different topics of inservice development. Issue oriented, where participants have the mandate to change
Administration and Classroom Management	7	I would like to see support and follow-up of ideas presented during inservice activities. Classroom management is a big concern for all teachers. Workshops on such topics as attention deficit disorder (ADD) in order to help us modify a student's work. An inservice that deals with reality—something that I can use in my situation, i.e., large class sizes, very little equipment, inclusion—these are the real needs of the teacher. I would like to see something about issues in our system, not philosophy. Make [professional development activities] shorter and more interesting. Meetings do not have to be long and boring to be effective. More motivation.

Table H-2 (continued).

Category	f	Comments
Miscellaneous		
		Have them in places that are closer to "home."
		Offer staff development at a time which does not require absence from the classroom.
		Provide more opportunities for updating skills and certification opportunities that are relevant.
		I am tired of the "generic" workshops - a whole day listening to some motivational speaker.
		Computer training.
		Introduction and actual hands-on training of available technology that can be utilized in the science classroom.
		Demonstrations of the latest in technology in order to describe and explain it to students.
		Provide inservices led by professional who work in their fields.
		Workshops done by professionals in the science field.
		Offer more classroom-related activities.
		The activities should be relevant to what is going on in each school. System-wide inservices can be useless if that particular activity won't be used in every school.
		More relevant information that we can actually use. Some inservices give us no information that we can take back to the classroom.
		I'd like to see colleges give refresher courses ,or have schools offer release time (like 1 1/2 days) to work with certified science teachers.
		We need grant writing workshops.
		More inservices dealing with cooperative learning.
		With a new program being established in middle school with the coming year, extensive time must be required of each teacher so that each teacher is familiar with the plans.
		Multicultural workshops.

Table H-3. Recommendations for Improving Preservice Teacher Preparation of Science Teachers

Category	f	Comments
Practical/Field Experience	27	Education majors need to get into the classroom as soon as possible in their college career. Many of the student teachers I've dealt with lately don't really have a clear understanding of what is expected or what today's middle schoolers are like. More science content courses taught. Realistic lesson plans. I had one masters level course that still required me to spend anywhere from 5-10 hours developing one lesson plan. The professors are out of touch with how much time is actually available to the classroom teacher for planning. If someone could develop a course on how to write lessons in less time than 15-30 minutes it would be much more practical. [Preservice] teachers should go to different schools for new ideas on how to teach their students. Require volunteer work or practicums in the middle schools which provide direct participation with the students. Less time in theory and ideas. Much more time is needed in practical techniques. More practical and hands-on experiences working with students before student teaching. Let the student teaching be longer, spend less time on theory more time on background information. An internship (once weekly or bi-weekly) with science teachers - gives a chance to get ideas for class activities, etc. — 6-8 grade teachers need to know what they get out of the book. Early and repeated classroom training in different settings. I would recommend a brief session on how to use "start-up" to introduce each lesson. Get them out into the schools to see what really is going on. Observations!! Actual observations of 6-8 grade science classrooms. More field experience. Prepare future educators "realistically" for a "real" science classroom which has no lab equipment nor computers - Science is teacher generated! If at all!! More direct class contact. Less theory, more practice!

Table H-3 (continued).

Category	<i>f</i>	Comments
Practical/Field Experience (continued).		More time in the classroom experience with the "real students" and the "real equipment" that they will be working with.
		More time spent in the classroom or in a variety of classrooms would give the preservice teacher the greatest opportunity for learning.
		More time in classrooms. (<i>f</i> = 3)
		Students spend more time in more classrooms before becoming a teacher.
		Make student teaching longer.
		More time spent observing in classrooms before student teaching.
		Teachers in training need more exposure to the classroom environment. This should include a widerange of teachers, classrooms, and ethnic groups.

Table H-3 (continued).

Category	f	Comments
Laboratories/Hands-on Activities	26	Teach science lab instruction!! Very few teachers actually use the science lab (I'm the only one at my school). More lab work. Provide the instruction in labs that you want us to teach. Be exact and detailed. Stress the use of minds-on/hands-on laboratory activities, displays, science projects, and computers. Teachers need an opportunity to work in their labs. Development of science labs. More experiences in labs. Lab safety and management. Intensive training on teaching science with laboratory activities. A class on doing labs. Science teachers need to be trained in lab techniques and on possible hazardous chemicals. Many teachers do not use the lab because they do not know enough about it. More lab time in the actual manipulation and demonstration of various scientific principles. More preparatory courses involving teaching techniques for hands-on activities such as science labs. Laboratory training.

Table H-3 (continued).

Category	f	Comments
Laboratories/Hands-on Activities (continued).		
		More actual hands-on activities using real problems in our environment. These activities can reflect different areas of science, yet relate to the "real" world.
		Teach them how to do more hands-on.
		Teach demonstration skills for science activities.
		More hands-on activities.
		Emphasis on hands-on projects for students.
		Lots of hands-on experience in various disciplines within the science curriculum.
		More hands-on preparation.
		More real hands-on activities.
		Hands-on activities are essential for effective learning strategies but little training is included in the college prep classes.
		More hands-on science instruction.
		How to do more hands-on activities, experiments, fun activities in science with our students.
		More workshops dealing with demonstrations and higher order thinking skills.

Table H-3 (continued).

Category	<i>f</i>	Comments
Classroom Administration/ Management	14	Classroom management. (<i>f</i> = 2) Much more time is needed in classroom management and behavior. Dealing with today's children is very different from even 10 years ago!! Too much violence, sex, disrespect today!! More preparation in classroom management strategies prior to student teaching. Most of the ones taught don't work. How about crisis intervention training at the preservice level? Provide courses and discipline conflict resolution and parental involvement, also team teaching. Discipline strategies! Be exposed to more teaching and classroom management methods. Deal more with planning, testing, and especially with classroom behavior and discipline. Alternative assessment Become familiar with assessments such as diaries, journal writing, and portfolio. Safety and equipment care and group management need to be taught before placing a teacher in a science classroom.
Content	8	Curricular trends. The methods courses needs to be more in depth. Keep curriculum up-to-date. Science is a continuously changing field—updates on new materials should be made available through the science departments or from the school system. Updated material and methods for teaching science. Require more rigorous program of science content study. Provide courses, seminars, and workshops which provide information, skills, and strategies for the teaching of science and technology.

Table H-3 (continued).

Category	f	Comments
Middle School Orientation	6	Develop a middle school degree separate from elementary and secondary. Distinction of special needs of middle school students. Have a curriculum for science 6-8 and develop the teacher training based on it with regular interval updates. More required science classes in undergraduate level for people who are planning to teach middle school. Have a course just for science methods in the middle school grades—not a combined course for teachers of grades 1-8. In-depth exposure to areas tested in those grades [6-8].
Miscellaneous		Teach teachers to lobby for better materials. Plan and execute interdisciplinary units - focus upon application and integration. Teach them to entertain. More training in special education - how to include special needs children into the regular classroom without taking time away from the other students (this could also be a great inservice topic). Multicultural training.

APPENDIX I

SUMMARY OF RESPONSES TO

FOLLOW-UP INTERVIEWS

Figure 13. Interview Guide

Survey of Professional Development Needs
Followup Interviews

Subject No. _____ Face-to-face _____ Telephone _____ Start _____ Stop _____

1. What do you feel is your single greatest need (topic) for professional development?
(What do you mean by that?)

2. What are your preferences for the delivery of professional development activities?

3. What kinds of science teaching resources do you need the most?

4. (County) Would it be helpful to you if a science coordinator were available at the
Central Office?
(City) How helpful to you is it to have a science coordinator in the Central
Office?

5. Do you feel that colleges and universities are "in-touch" with the needs of today's
classroom teachers?

6. What recommendations would you make to the new consolidated school system
regarding professional development policies and activities?

Table I-1. Summary of Professional Development Needs

Category	<i>f</i>	Summary
Laboratory/ Hands-on Activities	14	Respondents expressed a need for ideas for practical labs and hands-on activities, especially for a large number of students.
Integration of Technology into the Classroom	13	Technology was defined by respondents as computers, computer software, VCRs, laser disks, etc. Some teachers expressed a need for access to the 21st Century Classrooms. Four of the respondents indicated that they were 21st Century Classroom teachers. Respondents expressed a need for training on Internet, image processing, computer software, and classroom management techniques using computers (e.g., large class with minimum number of computers).
Additional Science Content	10	Many respondents expressed a need for additional content in basic science concepts appropriate for the middle school, life science (biology from a cellular perspective), physical sciences (basic chemistry, physics), earth sciences (geology), and space sciences (astronomy) Some respondents indicated that they would like coursework to become certified in additional areas of science content. One respondent was teaching out of certification and did not feel qualified in science
Multiple Intelligences/Inclusion	3	Multiple intelligences was defined by respondents to mean both differences in learning styles and the inclusion of students with special educational needs A need to provide more techniques to deal with special education students was identified. Schools expect classroom teachers to do individual development plans (IDP's), conduct multiple-disciplinary team (M-Teams) meetings, etc. without the necessary training or experience

Table I-1 (continued).

Category	<i>f</i>	Summary
Miscellaneous		
		Graduate level credit for college/university professional development courses.
		AIM workshops/in-service.
		Interdisciplinary development, i.e., include all teachers in the development of science ideas/projects. (<i>f</i> = 2)
		Alternative assessment of student performance.
		Adolescent development.
		Counseling skills.
		Classroom management (large classes, lack of respect). (<i>f</i> = 2)
		Behavioral management techniques with lower ability students.
		Parental involvement techniques in middle schools. Fewer parents are involved today than in previous years.
		Equity.
		Availability of resources, programs, etc., which are tied in to state curriculum objectives.

Table I-2. Summary of Professional Development Activities

Category	f	Summary
Variety of Activities	5	Respondents indicated that they benefited from a variety of professional development activities, depending on who's conducting them and how they are conducted.
Collaboration with Other Teachers	16	The majority of respondents indicated that they were able to collaborate with their colleagues on a regular basis. Regular meetings, small group discussions, visiting and observing other teachers were all means indicated by respondents for professional interactions. Opportunities to meet with and observe the best teachers in the system was mentioned as a possible opportunity for professional development. Most respondents preferred sharing ideas with people who are actually in the field. ($f = 2$) It was suggested that better use of half-days could facilitate interaction. It was pointed out that differences in planning periods preclude on-site collaboration at many schools.
Hands-on Activities/Demonstrations	14	Respondents indicated a preference for practical hands-on activities, demonstrations of principles, and hands-on workshops at the appropriate level (i.e., middle school) with practical direct applications to the classroom. Some respondents preferred activities presented by classroom teachers, instead of "experts" discussing theories.
Conferences	5	Respondents indicated a desire to participate in conferences - to learn the latest techniques and bring them back to share with other teachers.
College/University Activities	4	Most respondents indicated a preference for graduate level courses, possibly a Masters Degree in Science Education. Colleges/universities should offer summer courses for science teachers. Some recommended courses in which they would spend less time in the classroom, more time in the school environment, less structure, and more independent study within the schools. One respondent envisioned a closer partnership between higher education and the public schools.
Workshops	3	Provide workshops or seminars conducted by other teachers from the community rather than national "experts." ($f = 2$) Workshops conducted by specialists in the field of study from outside.

Table I-2 (continued).

Category	<i>f</i>	Summary
Symposiums	3	Respondents indicated that they don't get much from outside "experts" brought in by the school system. (<i>f</i> = 2) Symposiums shouldn't mix levels of teaching. They should be for middle schools teachers only.
On-site Activities	2	Respondents preferred on-site workshops during school hours, after school, or in the summers at the "home" school.
Miscellaneous		Offer Summer institutes, paid by the system, to bring in experts for panel discussions. Provide inservices for science teachers only, not combined with other curricular areas. (<i>f</i> = 2)

Table I-3. Summary of Science Teaching Resource Needs

Category	f	Summary
Release Time and Funding	6	Release time and funding to attend conventions, e.g., NSF, or to hire substitutes to enable teacher to collaborate with other teachers.
Time	7	More time is required for classroom planning, collaboration with other teachers, etc. Too much time is taken for administrative matters or other outside the classroom duties.
Reimbursement for Consumables	17	Most respondents indicated a need for reimbursement for personal money spent for classroom materials, e.g., chemicals, batteries, paper, chalk, pencils, etc. (currently there is a \$50 per teacher limit per year at many schools).
Up-to-date Materials	10	Respondents indicated a need for up-to-date textbooks, supplementary materials to cover state objectives not addressed in the texts, and materials, i.e., current science magazines, books, videos, CD's, etc. The library (resources center) needs to be the center point for resource materials. Activity books are also needed for interdisciplinary training.
New technology	10	Current technology, e.g., TVs, VCRs, overheads, micro projectors, laser disk players, etc., not just computers, needs to be made available to every classroom.
Physical Space, Materials, and Equipment	13	Many respondents indicated a need for a secure supply room /storage areas to maintain equipment, supplies, and long-term experiments, especially considering that more than one class uses the science lab facilities. There is a need for better lab facilities for <u>all</u> schools, not just the new ones. One respondent suggested the use of "portable" labs which could be shared by science teachers in schools without proper lab facilities. There is also a need for basic science materials and equipment, e.g., magnets, cylinders, microscopes, incubators, etc. to do the demonstrations and hands-on activities.
Miscellaneous	12	Science teachers need an assistant to set-up, take-down, monitor labs, etc. Provide hands-on studies in the environment. Funding to implement the curriculum. System-wide handbook for student behavior. Uniformed police officers at every school.

Table I-4. Perception of Need for a Centralized Science Coordinator

Category	f	Summary
Needed	27	Nearly all respondents felt that it would be important to have a science coordinator at the central office—if that position were established as a resource rather than as an administrative supervisor. The science coordinator needs to visit classrooms frequently, to get information out to the teachers, to answer teachers' questions and help find solutions to classroom problems, to obtain funding for innovative projects, to obtain science teaching resources, to oversee curriculum implementation and resources, to coordinate system-sponsored summer institutes, etc. Some respondents felt that there would be a need for two coordinators to keep up with the research and help keep in touch with teachers and provide for follow-up visits to the classroom. It was felt that it would be advantageous, but the position must have some degree of influence with system administrators. The science coordinator must be able to interface with the site-based process.
Not Needed	1	Only one respondent felt that it would not be at all helpful. The science coordinator wouldn't be able to visit enough to see what was really going on.

Table I-5. Perceptions of the Responsiveness of Higher Education to the Needs of Today's Classroom Teachers

Category	f	Summary
Not Responsive	17	Most of the respondents indicated that they felt that colleges and universities are "out-of-touch" with the practical needs of teachers. They felt that professors have no idea of how to deal with typical students from inter-city schools. Professors are too far removed from the classroom. Most of their recent information comes from books and studies rather than through experience or observation. Professors have been out of the classroom too long, if they have ever been in one. Professors do not seem to be aware of how short the money is in school, how inadequate the resources are in the classrooms and how large the classes have grown. They need to spend time in the classroom. Others felt that professors have a lot of good ideas that are not realistic in the real world. Professors teaching teacher preparation programs need to get out into the schools, needs have changed too much in recent years. One respondent reported no having any contact with higher education in over 20 years of teaching, including visits by faculty to the classroom or participation in any workshops. It was observed that most people teaching at college level are in general education, rather than discipline specific. They are not in touch with today's policies and practices. They don't know what is going on in the classroom. Some observed that student teachers don't seem to know what's going on. The college of education should be as hard to get into as the school of law. There needs to be an outreach program between colleges / universities and local schools.
Beginning to Become Responsive	5	Some respondents felt that higher education is beginning to recognize the bad job they've done in the past. Higher education is doing a better job than a few years ago—but it still has a long way to go. At least 75% of the time—it is hard to make (college) textbooks meet reality. Some professors are out-of-touch, while some have their fingers on the pulse. Need more in-class experience. They are and they aren't— need to assist schools by providing top down guidelines so that students are better prepared for higher education by the time they get there..
Responsive to Needs	6	Recent graduates felt that they were prepared. Others observed that students doing observations have been well prepared. Some reported their professors worked frequently with local schools. Recommend having advanced students work with professors / departments in higher education.

Table I-6. Recommendations for Professional Development Policies and Activities of the Consolidated School System

Category	f	Summary
Consolidation Concerns	9	System-wide meetings need to be held on consolidation issues to provide information and interaction between teachers of the two systems before the merger. Faculties need to be kept together as much as possible after consolidation to enable the new system to stabilize. (f=2) Teachers need some sense of job security. The current City/County dichotomy needs to be minimized or eliminated after the consolidation.
Policies and Practices Toward Education	8	The new system needs to be flexible. It should make use of the best of both systems. It should encourage more innovative teaching techniques. It should not discriminate between thematic teaching and traditional approaches, both have a place in the education of the children of Hamilton County. At the same time, it should focus on long-term change and avoid popular trends. Commitment to long-term change will provide the continuity on programs which have already been started, e.g., EFC, and are showing signs of success. As experience has already discovered, different approaches need to be taken with intercity students to counter-balance environmental disadvantages. There needs to be consistency in classroom management policies (discipline/ behavior) and practices. Some teachers feel that they are losing control to "street-wise" adolescents who know just how far the system is willing to back the teacher in the classroom.
Reduce Bureaucracy/ Increase Participatory Management	8	Most teachers feel that there is too much administration and bureaucracy. Decisions are being made which affects the classroom without teacher input. Teachers need to be included in the decision process at all levels. Teachers need to be heard when policy decisions affect them directly. Some teachers indicated that they still need a sense of who is in control. Some site-based management produce decisions have resulted in conflict between site-base and county or state policy. Teachers are asked to do too much (redundant) paperwork. Better use needs to be made of available technology to reduce the amount of paperwork required of teachers. Administrators have been out of the classroom too long. Board members, central administration personnel need to spend time in the classroom where they can see what is really going on. Better accountability over funds should be provided to all personnel in the system. The typical, "No, I don't know what happened to them responses," should be no longer acceptable in a responsible system.

Table I-6 (continued).

Category	f	Summary
Professional Development Policies	6	The new system needs to make a firm commitment to teacher professional development. It should have a program which is available to all teachers. The new program and policies should be more open and flexible in allowing for professional development activities. The new system needs to be more concerned and supportive of its teachers. The new system should encourage and support teachers to adapt to change. A mentoring program should be established, either within the school or district, to provide a career professional science teacher to guide the difficult early years of the new science teachers.
Curriculum Policies and Practices	12	The new system need to have policy and mission statements. The new system needs to offer students more options for their education, e.g., technical education, performing arts, alternative schools, etc. There should be a solid curricular guide available for the county with good, practical activities, i.e., hands-on curriculum. The new system should require curriculum mapping. Currently, in some areas there is no continuity of curriculum. Students have been observed lacking the necessary preparation for math and physical science when they reach high school. Curriculum mapping would ensure that, at each level, skills are developed to support those required at the next level. Consistency across the system would ensure a smooth transition for students as they move between schools in the system. Some teachers would like to see a better variety of science offered. Teachers indicated a preference for competency based education, rather than outcome-based. They felt that it is inappropriate to assess teacher effectiveness based on Tennessee Comprehensive Assessment Program (TCAP) Achievement Test scores alone. They would like to see the new system raise expectations [standards] rather than lower them to accommodate change or give a false sense of success. The current emphasis encourages teachers to teach to the test rather than ensure competency in their students. Finally, if the policy makers are going to mandate curricular changes, the resources to implement those changes should be provided with the mandates.
Professional Development Activities	5	Teachers would like opportunities to meet with other science teachers on a regular basis. They recommended that more classes / workshops be offered to teachers with teacher stipends to attend. And that half-day workshops be held on half-days. They would also like more time to work with higher education personnel in specific fields.

Table I-6 (continued).

Category	f	Summary
Better Use of Inservice Days	3	During inservice days there should be less time spent on the "state of the union" and more time to work with other teachers and in the classroom. Better use needs to be made of pre-school time in training and up-dating activities. Time needs to be provided during the week prior to school opening to clean up classroom and prepare for the upcoming semester.
Miscellaneous		There needs to be middle school training and certification. ($f = 2$) The new system needs to be sensitive to racial issues, e.g., balance between faculty and students. Ensure that everybody has access to local assets, e.g., Challenger Center, Aquarium, Creative Discovery Museum, Channel 9 Science Theater, etc. Provide a list of science contacts/resources for science fairs, classrooms. Provide practical integration of technology for all classrooms, not just the new schools. Teachers need training on multicultural education from both the perspective of a predominantly minority view (inner city teacher) and from a predominantly majority view (suburban teacher). Hire better qualified [science] teachers.

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VITA

Albert Earl Piatt

Albert E. "Bert" Piatt was born February 13, 1948 in Bellaire, Ohio. After graduating from the public schools in Bellaire, he attended Vanderbilt University in Nashville, Tennessee, and The University of Chattanooga, later re-named The University of Tennessee at Chattanooga (UTC), where he completed studies in secondary education, majoring in mathematics and minoring in chemistry, receiving a Bachelor of Science degree on June 8, 1970. In 1973, he received a Master of Education degree from Wayne State University (WSU), Detroit, Michigan, through the WSU overseas program in Berlin, Germany, where he majored in educational psychology and minored in guidance and counseling. In 1976 he received a Master of Arts in Education degree from East Carolina University (ECU), Greenville, North Carolina, through the ECU extension program at Fort Bragg, North Carolina, where he majored in counselor education. He began full-time studies for the Doctor of Education degree at the University of Tennessee, Knoxville, College of Education, in Leadership Studies in Education during the Fall semester of 1992. He received the doctoral degree in August, 1995.

Upon graduation from UTC in 1970, he was commissioned a Second Lieutenant in the United States Army, through the Reserve Officer Training Corps program at the University. On July 31, 1992, he retired from the United States Army at the rank of Lieutenant Colonel in the Regular Army after completing over twenty-two years of active federal service. His career included various assignments with the United States Army Security Agency Europe, United States Army Berlin Brigade, 82d Airborne Division, United States Forces Korea, United States Army Special Operations Command, United States European Command, Joint Tactical Fusion Program Field Office Europe, and the Joint Chiefs of Staff.

He is a member of Phi Kappa Phi, International Scholastic Honor Society, and Pi Lambda Theta, International Honor and Professional Association in Education.

His professional affiliations include: American Counseling Association, American College Counseling Association, American Evaluation Association, Association for Assessment in Counseling, Association for Supervision and Curriculum Development, National Council of Teachers of Mathematics, Reserve Officers' Association, and The Retired Officers Association.

He is presently self-employed as an educational consultant in the Chattanooga, Hamilton County, Tennessee area.