A DESCRIPTIVE STUDY OF RETURNING ADULT LEARNERS' ATTITUDES TOWARD COLLEGE SCIENCE CLASSES

By

DANIEL ALLEN HOUGARDY

Bachelor of Science
University of Tulsa
Tulsa, Oklahoma
1972

Master of Science
Northeastern Oklahoma State University
Tahlequah, Oklahoma
1980

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Graduate College of the
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SCIENCE CLASSES

Thesis Approved:

Kenneth E. Wiggins

Thesis Adviser

Melvin D. Miller

Thomas C. Collins

Dean of the Graduate College

PREFACE

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CHAPTER I

INTRODUCTION

The importance of science in today's school curriculum has received considerable public attention due to our rapidly changing technological society. The 1984 report, A Nation At Risk, The Imperative for Educational Reform from the National Commission of Excellence in Education identified the 1980's and 1990's with a "crisis" in education. According to Mallow (1978), a contributing factor to the crisis has been student reluctance to enroll in college science courses due to a phenomenon described as "science anxiety."

A major goal for science education is the development of a positive attitude toward science. Students' attitudes toward the study of science and of understanding basic science concepts should be more important than their abilities to recite or regurgitate factual scientific information. Ramsey (1969) took the position that students' attitudes determine how they will use their scientific knowledge.

It is generally accepted that there exists an optimal level of anxiety for performance (Daves, 1975). In the case of students studying science, their anxiety level is seldom low; rather, students are so anxious that their performance is severely hindered (Mallow & Greenburg, 1983). Sax (1974), in discussing attitude, stated that the learning of almost any intellectual task carries with it elements of interest and attitude which may either facilitate or hinder additional learning.

A favorable attitude toward science is an important characteristic of any student, therefore, the importance of attitude in returning adult students to science and science instruction is an important factor in attracting adults into scientific and technological careers. Attitude is also a vital factor in influencing returning adult students future performance in personal, school, or work related science. It is crucial that the public not only be scientifically literate and be knowledgeable of technology and science-related social issues, but should also have positive attitudes toward science and science instruction.

Science anxiety, according to Mallow (1981), may be defined as a single form of anxiety specifically related to learning the basic sciences. Science learning has been hindered by anxieties toward science and science education in adult learners brought on through painful memories from past experiences with science courses (Mallow & Greenburg, 1983). Because the world today is being increasingly influenced by science and technology it is imperative that returning adult students receive pragmatic, relevant, and easily understood science instruction that would foster a desire to continue science education.

All colleges serving adult students require basic science courses as part of the general curriculum as well as the basis for many health and nursing programs. Increasing numbers of students entering these fields do so without sufficient confidence or preparation. As a result they enter introductory courses in biology and physical science already fearful of the material and expecting to do poorly (Alvaro, 1979).

In a study conducted with college students at the University of California in 1973 nearly 92 percent of the women and 43 percent of the male students applying for studies in 20 available science fields, could only qualify in five of the fields. This was because they had insufficient background to undertake a science-oriented major (Sells, 1973). According to Alvaro (1979), the consequences of a phenomenon such as science anxiety are numerous, not the least of which is a scientifically illiterate population who are unable to make significant decisions regarding science-based political issues.

Tyler, as early as 1949, recognized a study of the learners themselves would help to identify needed changes in behavior patters of the students the educational institution hopes to produce (Tyler, 1986). We know very little about the anxieties and fears of returning adult learners, how they learn, what they want to learn, what they need to learn, and what environment should be established that would be most conducive to their learning. The focus of this study is: (1) to identify probable reasons for mature students' anxieties toward science classes, (2) investigate relationships between demographics and reasons for anxiety attitudes toward science classes, and (3) recommend possible treatments that would help returning adult students reduce their science anxiety.

Statement of the Problem

The problem under investigation was the nature of anxiety in returning adult learners toward college science classes.

Little attention has been given to the reluctance of adults to enroll in college science courses has been identified with a "crisis" in science education (A Nation at Risk, the Imperative for Educational Reform, 1984). In adult education we must consider the science education needs of those returning to community colleges to fulfill an educational program. Most two year college programs have a six (6) hour science requirement. Generally, first year courses in science tend to be laden with facts and vocabulary and show little concern for concepts, human issues, and philosophical implications. The material is not relevant to any except majors in science (Moore, 1983). It has been observed by this investigator, that a great number of returning adult students will postpone their science requirements until the last semester of their educational program. Some are so anxious about these courses that their performance is greatly hindered or in other instances they drop from their programs altogether before attempting the science course work.

A review of the literature indicated an absence of information about the educational needs of returning adult students in the fields of science and math. Information on adult education programs in science is inadequate. Emphasis of past research on anxiety and fear of science has been directed at students in elementary and secondary grades with identification of characteristics common to these age groups. Little attention has been focused on post-secondary science educational programs, methods for returning adults, specialty class scheduling, and suggestions to educators in offering successful adult science programs. Also, many in the field of science education are adults with little or no knowledge of adult learning characteristics, and their knowledge and abilities are primarily focused on children or youth (Rauch, 1981). Our society requires that science be an important part of adult retraining. There is evidence that (1) societal roles (minorities/women) moves adults away from science careers and course work, (2) a significant number of adults have anxieties toward and avoid science subjects, and (3) prior experience with science is negative.

This study examined the attitudes of returning adult learners toward the study of science. Data gained in comparing variables: methods of instruction, relevance of instruction, fear, past experiences, and motivation to continue may have implications for designing future science curricula where traditional curriculum fails to meet the needs of adults.

Purpose of the Study

The purpose of this study was to descriptively examine the existence and nature of anxiety in adult learners toward college science classes. Data were collected to identify and assess variables that are related to and/or contribute to returning adult students' attitudes toward science classes. The study was an assessment or descriptive analysis of selected variables that pertain to science anxiety in adult learners. Selected demographic characteristics of adult learners and attitudes of adult learners toward science education were examined in the assessment to provide a descriptive picture of the nature of science anxiety in the adult learner. Specific variables that were examined in the study include:

A. Demographic Characteristics of Adult Students

1. sex
2. age
3. previous science background
4. type of science enrolled
5. geographical school type (metro/rural)

B. Attitudes Toward Science Classes

1. SOQOA items
2. relevancy subscale
3. instruction subscale
4. fear of science subscale
5. past science experience subscale
6. motivation subscale
7. overall attitude

It is also the intention of this study to provide information to those who are involved in curriculum design additional knowledge of andragogy and of adult learning characteristics that will reduce science anxiety in returning adult students.

The focus of this study was to descriptively examine characteristics and attitudes of returning adult students relative to their learning of science. The intent of this study was to collect data and descriptively analyze information pertaining to specific questions regarding the nature and variable composition of science anxiety in the adult learner. Five research questions were explored relative to the demographic and attitude variables described in the Purpose section.

Research Questions

The following general research questions determined the data collection and descriptive assessment procedures for the study.

1. Is there a relationship between selected demographic characteristics of adult learners such as sex, age, background, geographic region and the type of science course selected by the student?

2. Do differences exist between males and females in their attitudes toward science as measured by the Science Opinion Questionnaire of Attitudes (SOQOA)?

3. Do differences exist between adult learners with varying science backgrounds in their attitudes toward science as measured by the SOQOA?

4. Do differences exist between adult learners enrolled in different types of science classes in their attitudes toward science as measured by the SOQOA?

5. Do differences exist between adult learners from varying geographic regions in their attitudes toward science as measured by the SOQOA?

Assumptions and Limitations of the Study

For the purposes of this study, the following assumptions are made:

1. Attitudes of returning adult students toward college level science education are measurable.

2. Attitudes toward science education of returning adults can be inferred from responses on the Science Opinion Questionnaire of Attitudes (SOQOA).

3. Based on the results of the SOQOA inferences can be drawn about adult students' attitudes and anxieties toward their science classes.

4. Students electing to take biology will respond similarly to those who elect to pursue physical science.

The following are limitations of the study:

1. Since intact groups were used in the sampling process, specific limitations surrounding nonrandom sampling or lack of sampling and its ramifications in generalizability must be considered in the interpretation of the results (Van Dalen, 1979).

2. The ex post facto design employed by the study must be given consideration regarding the major weaknesses of this type of research, for example, the inability to manipulate independent variables due to a lack of a "treatment"; the lack of power to randomize; and interpretation risks (Kerlinger, 1973, pp. 390-391).

3. Instrumentation development constraints must be given consideration in the interpretation of the results of the study (See Chapter III, Instrument Development).

Definition of Terms

For the purpose of the understanding of this study, the following frequently used terms are defined:

Adult - A person who has reached the maturity level where he or she has assumed responsibility for himself or herself and sometimes others and who typically is earning an income (Hiemstra, 1976, p. 15).

Adult Education - The process by which men and women (alone, in groups or in institutional settings) seek to improve themselves or their society by increasing their skill, their knowledge, or their sensitiveness. Any process by which individuals, groups or institutions try to help men and women improve in these ways (Houle, 1972, p. 229).

Adult Student - Refers to any person who has quit or finished formal school and is engaged in full time adult responsibilities such as a full-time job, and voluntarily undertakes sequential and organized activities with the conscious intention of bringing about changes in knowledge, understanding, skills, appreciation, and attitudes (Knowles, 1980; Klevins, 1982).

Age Categories - Categories 18-23, 24-29; 30-35, 36-41, 42-47, and 48-53 used on the SOQOA in classifying returning adult learners.

Andragogy - Education of the (man) adult, (Knowles, 1980, pp. 42 & 254).

Fear Subscale - The total of questionnaire items 6, 17, 19, 20, and 30 relating to fear or "anxiety" of science on the SOQOA.

Instruction Subscale - The total of questionnaire items 2, 4, 11, 16, 23, 26, and 28 relating to method of instruction on the SOQOA.

Metro College - Referring to a two year college in a city with a population of 350,000.

Motivation Subscale - The total of questionnaire items 10, 15, 21, and 24 relating to motivation to continue science studies on the SOQOA.

Past Experiences - The total of questionnaire items 7, 9, 14, and 27 relating to unpleasant past science experiences on the SOQOA.

Pedagogy - Education of the (boy) child, (Knowles, 1980, p. 42).

Previous Science Background - Categories on the SOQOA used to classify how long ago returning adult students had their last science instruction: less than one year ago, one to five years ago, six to ten years ago, or more than ten years ago.

Relevance Subscale - The total of questionnaire items 1, 3, 5, 8, 12, 13, 18, 22, 25, 29, and 31 relating to relevance of science instruction of the SOQOA.

Rural College - Referring to a two year college in a city with a population of 15,000.

School Type - Geographical categories used for Metro or Rural classification of college returning adult students was currently attending.

Science Anxiety - This term is defined as a diffuse or vague fear which arises in the response to the prospect of learning science (Mallow, 1978).

Science Class - This term is defined as a discipline concerned with the interactions of science and society. It can be viewed as a part of the total spectrum of science; the link between human endeavors called science and the rest of humanity called society. Science education is an inquiry of the factors affecting public understanding and support for scientific enterprise, and an inquiry of the factors set by society upon the pursuit of science (Yager, 1985).

Science Opinion Questionnaire of Attitudes (SOQOA) - A 31-item questionnaire designed for this study to assess reasons for anxiety about science. The SOQOA is composed of relevancy, instruction method, fear of science, past experiences, and motivation to continue subscales. Demographic information includes sex, age, previous science background, type of science enrolled, and geographical school type.

Specialty Science Class - An alternate class offering content "relevant to everyday life" or one of current interest to students that fulfills a science requirement.

Type of Science Enrolled - Categories on the SOQOA used to classify type of science; Biology, Physical Science or Astronomy returning adult students were presently enrolled.

Returning Adult Learners - A heterogeneous group of students used as subjects of this study, with ages ranging from 19 to 53 with the mean age being 27.7 years that were preparing themselves for advanced studies through various majors at two community colleges in or near Tulsa, Oklahoma.

CHAPTER II

REVIEW OF LITERATURE

The review of literature presented in this chapter is divided into five categories:

1. Significance of the Study
2. Related Research
3. Adults and Adult Learning Theory
4. Literature Review and Present Study
5. Summary

The following descriptors were used in an Educational Resources Information Center (ERIC) search during the Spring of 1986, which yielded the following references: (1) Anxiety, (2) Science Education, (3) Adult Anxiety, (4) Science Anxiety, (5) Student Attitude, (6) Questionnaires, (7) Teacher Attitudes, (8) Attitude Tests, (9) Returning Adults, (10) Fear Factor, (11) Academic Achievement, (12) Science Avoidance, (13) Doctoral Dissertations, and (14) Adult Learners. Information was also compiled from professional journals, texts, books, documents, and other publications.

Significance of the Study

The importance of science in today's school curriculum has received considerable public attention due to our rapidly changing technological society. The 1980's and 1990's have been identified with a "crisis" in science and math education. Between 1966 and 1988 the proportion of college freshman planning to major in the sciences and mathematics fell by half, from 11.5 percent to 5.8 percent (Astin, Green, & Korn, 1988). This declining popularity of science seems to reflect students' efforts to prepare themselves for an insecure job market they envision in the future (Green, 1989). A factor in this crisis has been student reluctance to enroll in college science courses due to an avoidance of science instruction or a phenomenon described by Mallow in 1978 as "science anxiety".

Science anxiety has been defined as a diffuse or vague fear which arises in response to the prospect of learning science (Mallow, 1978). Painful memories from past science experiences, an experiment that failed, negative messages about science, or parents' discouraging comments about a student's ability to learn science (Mallow and Greenburg, 1983) have been accepted as the reasons for science anxiety and fear. These arguments are valid and acceptable for the naive or juvenile student's attitudes toward science of the child or immature students who didn't have success learning science in elementary or secondary school. The inference is that a child that did not have success in learning science will have difficulty later because as a child he/she had no control over the learning environment.

It has been observed, that returning college adults still manifest this fear factor and anxiety about their performance toward learning science even though as adults they have many years of experiences, have succeeded in employment, raised families, and as adults have some control over their learning situations.

An additional factor we must consider relates to adult students returning to the community college to fulfill an educational program. Most two-year college programs require six (6) hours of science as a requirement. It has been observed by this researcher, that a great number of these returning adult students will postpone their science requirements until the last courses on their plans of study. Some adult students are so anxious about these courses that their performance is greatly hindered or in other instances dropped form their programs altogether before attempting the course work. According to Maslow's (1962) theory, of the basic needs, individuals who feel insecure about science or science teaching cannot function at a higher need level until these insecurities are met.

Today's college students are scared, averse to risk, insecure, and materialistic (Astin et al., 1988). These students are bitter, bright, unpredictable, and uncertain if the world is worth the trouble due to the fallout of the '80's, for example, HIV/AIDS, recession, drugs, homelessness, divorce, absence of religion, the threat of nuclear war, and an uncertain environmental future (Coupland, 1991).

Research will be required in order to ascertain the reasons for the mature students' fear and anxieties toward science education and assess student's perceptions of anxiety toward science learning. We must also attempt to determine ways science facilitators of adults can remove the anxieties toward science and transform their attitudes of reluctance into attitudes of understanding the importance of science education.

Related Research

The largest and oldest empirical study of higher education in the United States indicates that the nation's science resources, as represented by the students who are planning undergraduate work in the sciences, have suffered serious erosion over the last two decades (Green, 1989). Since 1966 early indicators of undergraduate interest in the sciences have been tracked by the annual survey of entering college freshman conducted by the American Council on Education and UCLA's Cooperative Institutional Research Program (CIRP). The CIRP freshman and follow-up surveys are a rich source of data about the students who pursue higher education in the Unties States. In recent years more than 300,000 students attending some 600 two-year and four-year colleges and universities across the country have participated in the CIRP survey annually (Green, 1989).

The methodology of anxiety research has been widely discussed in psychological studies (McReynolds, 1968; Spielberger, 1976; & Gaudry, 1977) but usually not separate from other psychological constructs in science education research (Westerback, 1982). Psychologists indicate the importance of anxiety research to educators, and terms like "science anxiety" and the establishment of "science anxiety clinics" (Maeroff, 1978 & Mallow, 1981) direct attention to the growing recognition of the role anxiety plays in the avoidance of science study by high school students.

The State-Trait Anxiety Inventory (STAI) has been used as a criterion measure of high anxiety levels that accompany poor academic performance in high school students. The psychometric properties of both the X and Y forms used in studies have been investigated by several authors (Barker, Barker, & Wadsworth, 1977; Gaudry & Poole, 1975; Gaudry, Vagg, & Spielberger, 1975; and Speilberger et al., 1980). State-trait distinctions indicated that anxious prone people were found to be irritable, having a strong desire to do the right thing, discouraged, lonely, cynical, jealous, suspicious, withdrawn, evasive, aggressive, and insecure (Alvaro, 1978). The most recent study by Spielberger et al. (1980) indicated that the X form had some items with poor psychometric properties for high school students and/or confounded anxiety and depression.

Relationships between anxiety and classroom environment were explored in studies (Rentoul & Frasier, 1979; Fraser, 1981) utilizing two instruments--the Individualized Classroom Environment Questionnaire [ICEQ] and the Classroom Environment Scale [CES] (Trickett & Moos, 1973) with middle and high school students. The study furnished evidence that student anxiety was likely to be linked with certain characteristics of their science classroom environment. Lower levels of student anxiety were found in classrooms perceived by students to be characterized by greater participation and rule clarity and by less teacher control. These findings provided valuable guidance about how science teachers might change their classrooms in an attempt to alleviate the interfering and undesirable effects of student anxiety (Fraser et al., 1983).

In a study conducted by Harmon (1977), randomly assigned fifth- and sixth-grade students were assessed to determine the relationships of student anxiety and dependency to the effects of teaching structure on the acquisition of science knowledge and processes within inductive/discovery learning. Instruments used included the Children's Manifest Anxiety Scale (CMAS), the Modified Dependence Proneness Scale (MDPS), and the Ankney-Joyce Reasoning Test. Results support the conclusions that low dependency individuals do better on more complex tasks, and that a high degree of teaching structure is better for difficult tasks. Anxiety has also been measured by the use of Zuckerman's (1960) Affective Adjective Checklist (AAC) on large samples of eighth- and ninth-grade students. In this study it was found that anxiety in the academic area increased as the mathematical content of the subject increased, especially with the female students.

Another variation to measure science anxiety on fourth-, sixth-, eighth-, and ninth-grade students was conducted in the Bowling Green, Ohio, school district in 1984 by Charlene Czerniak. This study related to variables as sex, intellectual capacity, achievement, and attitudes. Among the major findings were the following: (1) feelings of anxiety toward science and science-related topics were significantly sex related; (2) females at grade four already displayed more anxiety toward science than did males; (3) for this study science anxiety did not increase with grade level; (4) it was speculated that teachers' attitudes may affect feelings toward science; and (5) significant differences on science achievement in relation to science anxiety were found, with high levels of science anxiety correlating with low science achievement scores.

An additional study by Sherwood and Westerback (1983) comparing the results of the STAI by Vagg (1980) for male Air Force recruits with the same form on female preservice elementary teachers have also been investigated.

Westerback (1982) stated that most attitude scales in the field of science education measure attitude toward the teaching of science. A similar study in 1990 by Westerback examined anxiety levels about teaching and achievement by elementary teachers before and after an earth science course. Moore's (1975) studies indicated that attitude toward the teaching of science is more closely associated with teaching practices than is attitude toward science. Both the Modified Bratt Aptitude Test (M-BAT) and the STAI were used to measure attitudes toward teaching science in preservice elementary teachers (Moore, 1975; Spielberger et al., 1970).

To help university students work at their scientific potential, Mallow (1981), Loyola University, researched the emotional component of science learning. His research indicated that college students are so anxious about science that their performance is severely hindered.

Results of Related Research

The evidence from the CIRP surveys revealed a number of disturbing trends (Astin et al., 1987). The survey stated that interest in fundamental undergraduate science majors has dropped dramatically over the past 23 years, and more than half the students who enter college planning to pursue science majors change their intended major to nonscience fields (Green, 1989). This finding represents a tremendous loss of talent that institutions should not incur and that the nation can no longer afford.

Science departments themselves are partly to blame for low retention rates. Many science departments take great pride in the number of students who fail to complete key courses in the lower division sequence or who ultimately change majors (Green, 1989).

Results of the 1977 Harmon study of elementary students support conclusions that: (1) the high anxiety individuals gain more knowledge when teaching is highly structured; (2) low teaching structure enhanced low anxiety students' performance relative to that of the high anxiety students.

The additional study by Sherwood and Westerback (1983) comparing the results of the STAI by Vagg (1980) for male Air Force recruits with the same form on female preservice elementary teachers proved to be a reliable indicator of anxiety.

Major findings of Czerniak (1984) included statistical data that showed significant differences on science achievement in relation to science anxiety, with high levels of science anxiety correlating with low science achievement scores. Anxiety feelings toward science and science-related topics were significantly sex related. Males displayed less science anxiety than did female students at grade four, and science anxiety did not increase with grade level. Czerniak also speculated that teachers' attitudes may affect students' feelings toward science. The validity of the various studies was strengthened by replication of earlier works with different samples. Minor modifications in later studies did not appear to have affected the data structure.

Research by Westerback (1982) documented the high level of anxiety about teaching science experienced by preservice elementary school teachers. It was discovered that science-anxious teachers communicate their anxiety to students in various ways, including responding sharply to questions or giving rigid, timed tests that have no flexibility of answer. Westerback's (1990) STAI study indicated that initial anxiety levels were changed to the positive and significant gains were made in achievement of earth science concepts by elementary teachers.

The Fraser (1983) study furnished interesting evidence that student anxiety is likely to be linked with certain characteristics of their classroom environment. Lower levels of student anxiety were found in classrooms perceived by students to be characterized by greater participation and clarification of rules rather than by teacher control. These findings provide valuable guidance about how science teachers might change their classrooms in an attempt to alleviate the interfering and undesirable effects of student anxieties.

In defining "science anxiety", Mallow (1978) asserted the reason for fear and avoidance of science originated as experiences and memories from earlier years that proved negative either through unhappy experiences from school or discouraging comments from parents about the students' abilities to learn science. In order to help self-identified science anxious students overcome both emotional and cognitive barriers to learning, Loyola University of Chicago established the Science Anxiety Clinic in 1977. Here students developed science study skills and acquired psychological techniques for coping with anxiety (Mallow & Greenburg, 1982).

Mallow (1978) found that many students envisioned science as beyond the abilities of the average person. Because of this pattern of avoidance and anxiety, many college graduates, it was discovered were scientifically illiterate. By self-identification the science-anxious students could be helped to develop science skills, reduce overall anxiety and reduce science anxiety.

The crisis in science education has been attributed to student reluctance to enroll in college science courses. This avoidance has left a large portion of the population insecure about science and unqualified to pursue science-related occupations (Barrow, Holden, Bitner, Kane, & Nichols, 1986). These researchers reported that males consistently completed more science courses than females. By not enrolling in science courses, women have disqualified themselves from many careers, effectively keeping them in traditional roles. The solution to this pattern of avoidance and anxiety was to establish a science-anxiety clinic at the University of Maine following the pattern established by J. V. Mallow at Loyola University of Chicago in 1977.

Certain skills were identified as critical for all science students. At the end of the anxiety clinic sessions conducted at the University of Maine (Barrow & Holden, 1986), it was determined the science-shy student would:

1. know how to read science textbooks and lab manuals
2. be able to take notes in science lectures
3. to be able to solve word problems

4. know how to organize data for laboratory reports

5. know how to study for and write science exams

6. be able to utilize the metric system

7. know how to utilize dimensional analysis

Alvaro (1978), in an unpublished doctoral dissertation from Loyola University, found that an experimental science anxiety clinic did accomplish its goals and that many of the skills developed were transferable to other courses.

Adults and Adult Learning Theory

Rapid technological and social change has direct consequences for the future of education. The implications of the "knowledge explosion," particularly in science, technology, and the professions must be considered. It has been estimated by Lindsey, Morrison and Kelley (1974) that for some fields, such as engineering and medicine, the "half-life" of knowledge acquired in professional school is roughly five years. In other words, half of what the doctor or engineer learned in the classroom would be obsolete in only five years. As the amount of knowledge continues to grow exponentially, the structure of knowledge, technology, and work becomes more complex and specialized. Darkenwald and Merriam (1982) pointed out that as a consequence of rapid change, most people must continue to learn throughout their lives merely to keep up with the demands of their jobs.

Economic and social forces in our post industrial society have affected the socio-demographic composition of our nation and has forced us to a new reality of the concept of "lifelong learning." The U. S. Bureau of the Census (1980) stated the number of mature adults is increasing in proportion to the total population as well as in absolute size. In the 1980s and 1990s the baby boom cohort will be entering middle age; by the year 2000, the number of those in the 35 to 44 age group will have increased by 40 percent from about 25 million in 1980 to 41 million (U. S. Bureau of the Census, 1980). Darkenwald and Merriam (1982) viewed it another way, in 1970 the median age was 27.9, and if fertility rates do not increase, it will be 32.8 in 1990 and 35.5 in the year 2000.

Virtually all of these are potential adult learners. Technological change will cause a surge of educational upgrading or refining of past skills and the learning of new ones that are flexible and fit the worker into the mechanized or computerized world of work.

The typical student will be returning to school with years of maturation and experiences. With this maturation the adult learner will bring stresses of middle and older age which include: decisions of parenthood and decisions which determine the quality of family life and the quality of education for children, the stresses of a stagnant economy, and the challenge of environmental and political problems that threaten all future generations.

In response to the many societal changes taking place the adult student will expect the educational organizations to meet their needs and respond to transitions that are characteristic of adult learners.

A review of the literature in the field of adult education reveals some unique principles of adult learning that need to be considered by teachers and facilitators of adults.

These principles are as follows:

1. Adults maintain the ability to learn (Thorndike, 1928; Gerling, 1982).

2. Adults are a highly diversified group of individuals with widely differing preferences, needs, backgrounds, and skills (McClusky, 1964; McBride, 1977; Knox, 1977; Johnston & Rivera, 1965; Gerling, 1982).

3. Adults experience a gradual decline in physical/sensory capabilities (Cross, 1981; Kidd, 1973; Knox, 1977; Gerling, 1982).

4. Experience of the learner is a major resource in the learning situation (Lindeman, 1962; Knowles, 1970, 1981; Gerling, 1982).

5. Self-concept tends to move from dependency to interdependency as an individual grows in responsibilities, experience, and confidence (Knowles, 1978, 1981; McClusky, 1970; Gerling, 1982).

6. Adults tend to be life-centered in their orientation to learning (Knowles, 1978, 1981; Sheehy, 1976; Erikson, 1963; Gerling, 1982).

7. Adults are motivated to learn by a variety of factors (Maslow, 1943; Tough, 1971; Cross, 1981; Kidd, 1973; Houle, 1961; Gerling, 1982).

8. Active learner participation in the instructional/learning process contributes to learning (Lindeman, 1962; Maslow, 1962; Knowles, 1970, 1981; Kidd, 1973; Gerling, 1982).

9. A comfortable supportive environment is a key to successful learning (Knowles, 1979, 1981; Ingalls, 1972; Knox, 1977; Gerling, 1982).

Adults learn differently than children. Adults are almost always voluntary learners (Klevins, 1982, p. 23; Knowles, 1980, p. 25) and will quickly disappear from learning experiences with which they are unsatisfied. Knowles (1980) developed specific characteristics of adult learners that are different from the characteristics of children on which traditional pedagogy is premised. Knowles stated that as individuals mature

> 1. their self-concept moves from one of being a dependent personality toward being a self-directed human being.
> 2. they accumulate a growing reservoir of experience that becomes an increasingly rich resource for learning
> 3. their readiness to learn becomes oriented increasingly to the developmental tasks of their social roles.
> 4. their time perspective changes from one of postponed application of knowledge to immediacy of application, and accordingly, their orientation toward learning shifts from one of subject-centeredness to one of performance-centeredness (pp. 44-45).

From numerous sources in the field of adult education such as Cross, 1981; Kidd, 1973; Knox, 1973; Tough, 1971; Knowles, 1973, 1980, 1981; and Houle, 1961; there has emerged a body of reliable knowledge about adult learning, the process of adult learning, and at adults identified as an essential industry in meeting the needs of our present and future society.

Research by Naisbitt (1984, p. 16) indicated the amount of human knowledge is doubling now every five years or 13 percent per year. But the rate will soon jump to perhaps 40 percent because of new, more powerful information systems. That means that data will double approximately every 20 months. Fifty percent of the products and services that will be available in the year 2000 do not exist today (Stine, 1984). This means virtually the entire adult population needs retraining and new learning to be economically productive. A fifth of the present adult population is functionally illiterate. Most of the rest, including skilled workers, managers, and professionals, have knowledge and skills that technological change is rendering obsolete (Perelman, 1984).

Reforms of elementary and secondary education, however justified, will have little impact on these urgent adult learning needs before the next century. Over three quarters of the U. S. labor force in the year 2000 will be people who are working age adults today (Stine, 1984).

Perelman (1984) argued that as a nation, we are heading for a crisis of obsolescent human workers that will require a new kind of learning enterprise that must be focused on adults rather than children. Children should not be the major target of technology and processes of learning because in seven years those children will still be children and have little or no impact on industry. We cannot afford to wait on the children to learn high-tech skills needed to modernize the economy's work force.

In the 1984 report, A Nation at Risk, the Imperative for Educational Reform from the National Commission of Excellence in Education, it was stressed that we must dedicate ourselves to the reform of our educational system for the benefit of all--old and young alike, affluent and poor, majority and minority. Learning is the indispensable investment required for technological survival in the information age we have entered. The whole idea of what education is will be reconceptualized during the next decade.

Education is said to be the avenue through which future development will travel. To be adequately prepared for employment, or employment change, the adult student must be armed with a general understanding of the workings, values, and institutions of the American economy, the information and wisdom for occupational choice, a motivation to produce, and the ability to do so (Mangum, 1969). It is the responsibility of adult education leadership to see this knowledge is obtained.

More education will not solve America's "human capital" crisis. Traditional training and educational institutions serve only a minority of adult learning needs today and are too limited and inefficient to supply the burgeoning human capital requirements of tomorrow's economy.

The emergence of a knowledge-based economy requires a new synthesis of the functions of training, education, and other forms of communication and learning under the single umbrella of the "learning enterprise" (Perelman, 1984).

Balance is necessary in using the past evidences in vocational and adult education with the obvious future of the labor market as a vehicle for open discussion and action in guiding educators to solving adult training and labor challenges of the new high-tech era. The education reform movement must re-orient itself to the future.

The most formidable challenge of adult education will be to train people to work in the information society. Jobs will become available. Today's graduates who cannot manage simple arithmetic or write basic English will not be the ones filling them. The transition must be toward the older technician. The skills in the areas of nuclear power, transportation, aircraft, utilities, safety engineering, food services, and auto mechanics already need specialized individuals because of advanced designs in high-tech systems.

Naisbitt (1984), in Megatrends, reported that in education we are moving from the short-term considerations of completing our training at the end of high school or college to lifelong education and retraining. The whole idea of what education is will be reconceptualized during the next decade. In the final analysis American education must re-define and adjust its priorities and programs so that they will come into balance with modern adult learner needs and occupational realities.

Literature Review and Present Study

Questions were generated from the literature that identified characteristics that promoted anxieties in students toward science education. An ERIC search yielded descriptors with references that directed attention to the growing recognition of the role anxiety plays in the avoidance of science study by elementary and high school students.

It has been observed by this researcher, that returning adult students still manifest anxieties about their performance toward science learning even though they have some control over their learning situations. Through interviews from returning adult students on science anxieties, variables were generated as the basis for this study. It is the belief of this investigator that we must attempt to discover factors relating to this fear of science and to determine ways science facilitators of adults can remove these anxieties toward science education.

Summary

A review of the literature in the subject area of science anxiety reveals that most educational research in recent years has been done on elementary children, high school students or preservice elementary school teachers. It would appear that attitudes toward science and anxiety about taking science courses are related. Students with positive attitudes toward science tend to have low anxiety about taking science courses.

Psychologists stress the importance of anxiety research to educators because of the role anxiety plays in the avoidance of math and science studies of pre-college students. Relationships have been discovered between teachers' attitudes toward teaching science, classroom environments and student anxiety.

Anxiety feelings toward science and science-related topics tend to be sex related. Female students display greater anxiety toward science than do male students. Females pursue far fewer science-related careers and occupations than do their male counterparts. Science-anxious teachers communicate their anxieties to students and often avoid teaching science altogether, which is detrimental to both teachers and students.

Self-identified science anxious students can overcome both emotional and cognitive barriers to learning science by attending "science anxiety clinics." By attending these clinics students can work to their scientific potential, develop science study skills, and acquire psychological techniques for coping with anxiety.

Omenn (1983) believed that students are awed by the immense challenge of understanding nature, and fear the uses and misuses of certain technologies from pesticides to nuclear weapons. As a result of the patter of avoidance and anxiety, many college graduates have become scientifically illiterate and as adults see themselves hopelessly outside the world of technology.

Psychologists point out the importance of anxiety research to educators indicating a growing recognition of the role anxiety plays in avoidance of science study (Westerback, 1982). Previous research describes generally simple, economical and reliable instruments for measuring anxiety among younger students, however, this researcher was unable to locate any research studies in science education, psychology or the behavioral sciences that assessed anxiety about science in returning adult learners. We know very little on the anxieties and fears of returning adult learners, how they learn, what they want to learn, the methods best for their learning, and what setting should be established that is most conducive to their learning.

Knowles (1980) identified related differences in pedagogical and andragogical learning and four critical assumptions about learners which change in the process of maturation from childhood to becoming an adult. These assumptions are that as individuals mature

1. their self-concept moves from one of being a dependent personality toward being a self-directed human being.
2. they accumulate a growing reservoir of experience that becomes an increasingly rich resource for learning
3. their readiness to learn becomes oriented increasingly to the developmental tasks of their social roles.
4. their time perspective changes from one of postponed application of knowledge to immediacy of application, and accordingly, their orientation toward learning shifts from one of subject-centeredness to one of performance-centeredness (pp. 44-45).

With this maturation, the adult learner will bring stresses and anxieties of middle and old age.

A wide range of objectives has been characteristic in the field of adult education from the beginning of the movement. In Adult Education in Action, published in 1936, prominent educators and philosophers wrote about the need for adult education (Darkenwald, 1982) underscoring the need to prepare adults for new occupations as a major objective, thus bettering the social order, and ensuring worker's stability.

Since human knowledge is doubling in approximately every five years, we are faced with the problem of learning what to do as a society in adult education to meet the needs of the nation for workers. This fact means virtually the entire adult population will need new learning to be economically productive.

We cannot afford to continue to quintain only children as targets of technology and modern processes of learning needed to modernize the economy's work force. The most formidable challenge will be to train people to work in an information society and to develop future oriented self-directed learners.

The charge that today's students are scared, adverse to risk, insecure, and materialistic (Astin et al., 1988) should challenge science departments to develop programs whose environments are less hostile. Unfortunately, most research about talent development focuses exclusively on students and rarely on the key role of faculty behavior and attitudes (Currier and Davis, 1985).

CHAPTER III

METHODOLOGY

Introduction

The quality and quantity of science learning is being reduced by anxieties toward science education in adult learners as indicated by the literature (see Chapter II). The purpose of this study was to descriptively examine the existence and nature of anxiety in adult learners toward college science classes. Data were collected to identify and assess variables that are related to and/or contribute to returning adult students' attitudes toward science classes. The study is an assessment or descriptive analysis of selected variables that pertain to science anxiety in adult learners. Selected demographic characteristics of adult learners and attitudes of adult learners toward science education were examined to provide a descriptive picture of the nature of science anxiety in the adult learner.

This chapter outlines the methodology and procedures used in the five phases of the study which were: (1) population identification, (2) instrument development, (3) collection of data, (4) statistical procedures, and (5) summary.

Sample of the Study

The adult sample used for the study was selected from two different community colleges during the Fall semester of 1985 and Spring of 1986. One college was termed "metro" because it was located in a community of 350,000 people, while the other was called a "rural campus" located in a community of 15,000 people. Both colleges offered evening courses with terminal programs that required six (6) credit hours of science as a prerequisite for graduation in the major programs of study which varied from accounting to pre-veterinary medicine. Both community colleges' curricula were designed to prepare students for advanced studies at four-year colleges or careers in their chosen fields of interest. For some professional students, such as nurses and business people, the colleges' function was an on-going source of continuing education.

The students surveyed were in required evening or Saturday courses, and the students were all returning adults pursuing various majors. Students surveyed were enrolled in either General Biology, General Physical Science, Astronomy, or Introduction to the Physical Sciences courses. The Astronomy course was a substitution course for the second science requirement that generally would have been General Physical Science.

Since intact groups were selected for use in the study, no specific population representation could be determined. Also, generalizability and other sampling limitations must be considered as indicated in Chapter I, Assumptions and Limitations section.

Instrument Development

The second phase of this study was to develop an instrument that would identify the subjects' anxiety levels with respect to demographics and subscale variables.

Several instruments used in related studies were examined but none provided a workable instrument for determining anxieties in adult learners toward science classes. It was necessary for this researcher to design an instrument specific to this study. The Science Opinion Questionnaire of Attitudes (SOQOA) was designed to identify attitudes and assess relationships between adult student characteristics and various anxieties toward science classes. The instrument consisted of 31 statements gathered through interviews by the researcher with returning adults, that related to student anxieties in science toward: (1) relevance of material and science instruction, (2) method of instruction, (3) fear of science, (4) motivation to continue science studies, and (5) unpleasant past experiences. A copy of the SOQOA described in this section is contained in Appendix A.

The SOQOA was administered and monitored by this researcher and the class instructor. Directions were given orally in each session, however, written directions were self-explanatory. No time limit was stressed, but completion of the questionnaire generally took 15 minutes. The terms "science anxiety" or "fear" were never used when referring to the questionnaire.

Respondents to the SOQOA were asked to indicate how they perceived themselves in relation to the past or present science classes they had attempted or were presently involved by circling one of five opinion choices that best matched their own. The instrument used the method of summated rating introduced by Likert, which scales the subjects with respect to an attitude (Van Dalen, 1979). The subjects were instructed to indicate their positions on each statement by selecting one of alternative answers, which were "strongly agree," "agree," "uncertain," "disagree," or "strongly disagree."

Numerical values from 5 to 1 were assigned the responses. The most strong agreement response received a value of 5 and the least strong agreement response received a value of 1. Items six and 12 were assigned reversed values.

Demographic information obtained was sex, age, type of science enrolled, and whether students were attending the metro or rural college. One additional question asked respondents to indicate how long ago their last science course was taken: "less than one year ago," "one to five years ago," "six to ten years ago," or "more than ten years ago."

Attitude statements are grouped into five scales (Table I) with Relevance, Instruction, Fear, Motivation, and Past being key words for coding of data. Of the five scales, 11 items assessed relevance, seven items assessed instruction, five items assessed fear, four items assessed motivation, and four items assessed past experiences. Each scale carried a minimum score of 0 with a maximum score of 55, 35, 25, 20, and 20 respectively.

A pilot test was conducted using teachers in training at Oklahoma State University and adult graduate students in adult education as respondents. Suggestions for improvement were made and these revisions incorporated into the instrument to modify its length and to improve its readability. The sequence of the questionnaire items was random. The final instrument (SOQOA) is presented in Appendix B.

Collection of Data

Data were collected from returning adult students enrolled in community college biological and physical science classes to assess factors relating to their anxieties about science classes. Permission to conduct the assessment was obtained from the Dean of Science Instruction at Tulsa Junior College and from the Head of the Science department at Rogers State College in Claremore, Oklahoma.

After corresponding with the science instructors as to the suitability of students enrolled, students were selected from four classes containing adult learners. Limitations of sample size and sampling technique as discussed in Chapter I (Assumptions and Limitations Section) indicated questionable representativeness of the sample group assessed. The sampling technique as well as the descriptive nature of the investigation also prohibited generalizability considerations. A group of 37 students were used from Tulsa Junior College where a Saturday morning general biology class and an evening general physical science were ascertained to be best suited for answering the questionnaire. It was determined from college officials that Saturday or evening classes generally were preferred by more mature students. An evening class of general physical science and an evening class in astronomy (used as a substitute class for those needing three [3] additional science hours) was selected at Rogers State College. Rogers State College comprised of 39 students for a total of 76 students involved in the assessment.

The researcher visited each class at designated times. Classes were asked to help in this research and were informed that their participation was not mandatory and had no reflection on their grades. An explanation of the questionnaire was given along with an introduction into why the research was being conducted. All students were willing to help and many wanted to know the results of the project when completed. Only one student out of 76 sample respondents failed to follow marking instructions and an additional instrument was given again. A total of 76 instruments were returned which represented a response rate of 100 percent.

Content Validity

Content validity was determined by this investigator and an Oklahoma State Department of Education Science Curriculum Specialist conducting interviews of 17 returning adult students to identify their anxieties. Their anxieties generally fell into categories relating to: (1) relevancy of instruction, (2) methods of instruction, (3) fear of science, (4) poor motivation to continue their study of science, and (5) unhappy past science experiences.

Sax (1974, p. 206) defined validity as the extent to which measurements are useful in making decisions relevant to a given purpose. When appraising the validity of an opinionnaire for a specific study, an investigator may check one or more of the following types of validity: content validity, criterion-related validity, concurrent validity, and construct validity (Van Dalen, 1975, p. 136).

To establish both item and sampling content validity, the opinionnaire constructor analyzed the content of the areas that the opinionnaire was to appraise and structured the SOQOA as the instrument to measure the five aspects of the intended content. Qualified experts (graduate students attending Oklahoma State University pursuing masters or doctoral programs in adult education) were asked to examine all opinionnaire items as to their importance and how well they represented the intended content area. From the sources described in Appendix C it was determined what content items and what proportion of the SOQOA should be devoted to each of the variables of the instrument. Through this process, items were identified that did not have clear meanings and revisions were made accordingly. Table I represents these content items by subscale.

The procedure for establishing concurrent validity was to: (1) administer the pilot opinionnaire to 17 additional individuals identified as returning adult college students presently practicing educators, and had in the past enrolled in science classes at the university level, (2) measure the outcome, and (3) match the opinionnaire items and the actual results the opinionnaire was designed to assess. According to Van Dalen (1979, pp. 136-137), an instrument that makes accurate forecasts concerning the future behavior for which it is designed possesses not only predictive

TABLE I

ITEM IDENTIFICATION AND CLASSIFICATION BY SUBSCALE VARIABLE
ON SCIENCE OPINION QUESTIONNAIRE OF ATTITUDES
CONTENT VALIDITY

SUBSCALE INSTRUMENT VARIABLE	ITEM NUMBER	TOTAL
Relevance	1, 3, 5, 8, 12, 13, 18, 22, 25, 29, 31	11
Fear	6, 17, 19, 20, 30	5
Motivation	10, 15, 21, 24	4
Instruction	2, 4, 11, 16, 23, 26, 28	7
Past Experiences	7, 9, 14, 27	4
Total		31

validity, but also provides some immediate evidence of the usefulness of the opinionnaire or concurrent validity. Descriptive statistics relevant to the subscales in the pilot instrument are available in Tables II and III.

Reliability

A test or scale is reliable if it consistently yields the same results when repeated measurements of a property are taken of the same entities under the same conditions (Van Dalen, 1975, p. 138). Pilot data and resulting information regarding the reliability of the SOQOA are available in tables located in Appendix B.

TABLE II

RANGE, MEANS, AND STANDARD DEVIATIONS FOR ATTITUDE CATEGORIES ON PILOT SCIENCE OPINION QUESTIONNAIRE OF ATTITUDES

Variable	Range	Mean	Standard Deviation
Relevance	11-55	36.35	5.69
Fear	5-25	15.94	4.33
Motivation	4-20	12.06	1.85
Instruction	7-35	22.29	4.25
Past Experiences	4-20	11.24	1.25

N = 17

TABLE III

MEANS AND STANDARD DEVIATIONS OF ITEM RESPONSE ON PILOT SCIENCE OPINION QUESTIONNAIRE OF ATTITUDES

Item*	Mean	Standard Deviation
1	2.94	1.09
2	3.47	1.01
3	4.41	1.00
4	4.47	0.62
5	3.88	1.05
6	3.41	1.33
7	3.11	1.73
8	0.88	1.73
9	2.70	1.45
10	2.17	0.95
11	2.59	1.06
12	3.06	1.39
13	4.00	0.79
14	2.76	1.25
15	2.18	0.88
16	2.88	1.05
17	2.35	0.93
18	2.52	0.87
19	3.11	1.32
20	3.53	1.33
21	4.47	0.62
22	4.23	0.97
23	2.35	0.93
24	3.23	1.03
25	3.70	0.85
26	2.88	1.05
27	2.64	1.16
28	3.65	1.05
29	2.59	1.12
30	3.53	1.37
31	4.18	0.70

*Ranges for each item in the SOQOA are 0-5.

Reliability coefficients were also compiled for the data from the study regarding SOQOA items, Total and Subscales. This information is also available in Appendix B.

Statistical Procedure

Data were coded and entered for all subjects (N = 76) and items (1-31). Descriptive statistical analyses were performed using the Statistical Package for the Social Sciences [SPSS] (Nie, 1975).

Descriptive Statistics

The SPSS Subprogram, Frequencies, with its descriptive statistics options was used to generate frequency tables and descriptive statistical information for the following variables:

1. sex (m, f)
2. age categories, 18-53, at five year intervals
3. previous science background with less than one year, 1-5 years, 6-10 years, and 10 plus years categories
4. type of science enrolled in: Biological, Physical, or Astronomy
5. geographical school type: metro or rural
6. frequency of responses for each: items one through items 31

The above data generated nominal level data.

7. relevance of instruction subscales
8. method of instruction subscale
9. fear of science subscale
10. science background subscale

11. motivation to continue subscale

12. total attitude scores toward science

The above data generated interval level data.

The SPSS Subprogram, CROSSTABS, was used to generate crosstabulation tables for categorical variables involved in the study, for example, sex, age categories, previous science background, type of science enrolled in, and geographical school type. The CROSSTABS procedure was utilized specifically to analyze data relative to the first research question: "Is there a relationship between selected demographic characteristics of adult learners such as sex, age, background, geographic region, and the type of science course selected by the student?"

Research questions two, three, four, and five utilized the FREQUENCIES Subprogram of SPSS with the descriptive statistics option in addition to the CROSSTABS procedure to generate row and column frequencies. The analysis of data for the interval level or continuous variables (relevance, method of instruction, fear of science, science background, motivation to continue, and total attitude subscales) involved examining frequency distributions and descriptive statistics for the low and high scorings with the median used as the cutoff. Each of the research questions (two through five) descriptively examined the above subscales relative to specific demographic variables.

Summary

The discussion in Chapter III focused on population identification and subjects involved in the study, information about instrument development, the method and procedure for collecting data, and the descriptive statistical techniques employed in the analysis of data. The data were collected during the Fall of 1985 and the Spring of 1986.

CHAPTER IV

ANALYSIS OF DATA

This chapter reports the findings of the study relative to the five research questions considered. The study sought to descriptively examine characteristics of adult learners and to assess adult students' attitudes toward science. Descriptive statistical analyses were performed to identify and describe characteristics of the nature of science anxiety in adult learners. The five research questions explored in the study are presented in this chapter with their descriptive statistical procedures, analyses, and findings. The chapter is organized as a descriptive analysis and assessment presentation. A summary of the findings completes the chapter.

Description of Subjects

A frequency distribution of selected demographic characteristics describing the group of subjects that were assessed in the study is presented in Table IV. Table IV reflects frequency and relative frequency specific to the demographic description of the adult study subjects.

Description of Attitudes

Tables V, VI, and VII report the descriptive findings relative to adult learners' attitudes toward science as measured by

TABLE IV

FREQUENCY DISTRIBUTION FOR DEMOGRAPHIC INFORMATION

Variable	f	rf (%)
Sex		
Male	21	27.6
Female	53	69.7
NR	2	2.6
Total	76	100.0
Age		
MA	1	1.3
18-23	26	34.2
24-29	21	27.6
30-35	16	21.1
36-41	6	7.9
42-47	5	6.6
48-53	1	1.3
Total	76	100.0
Previous Science		
Less 1 year	19	25.0
1 - 5 years	27	35.5
6 - 10 years	14	18.4
10+ years	16	21.1
Total	76	100.0
School		
Metropolitan	37	48.7
Rural	39	51.3
Total	76	100.0
Type of Science Enrolled In		
Biological Science	37	48.7
Astronomy	22	28.9
Physical Science	17	22.4
Total	76	100.0

TABLE IV (Continued)

Variable	f	rf (%)
Age (individual)		
0 - No Response	1	1.3
18	1	1.3
19	5	6.6
20	1	1.3
21	9	11.8
22	7	9.2
23	3	3.9
24	3	3.9
25	1	1.3
26	5	6.6
27	3	3.9
28*	5	6.6
29	4	5.3
30	7	9.2
31	2	2.6
32	3	3.9
33	1	1.3
34	1	1.3
35	2	2.6
36	4	5.3
38	1	1.3
40	1	1.3
42	1	1.3
43	3	3.9
45	1	1.3
50	1	1.3
Total	76	100.0

*The (mean) $\bar{X}$ age for all returning adult students was 27.7.

TABLE V

FREQUENCY DISTRIBUTION FOR ALL ITEMS ON SCIENCE OPINION QUESTIONNAIRE OF ATTITUDES

ITEMS	SCALE SD 1 f	%	D 2 f	%	UNC 3 f	%	AG 4 f	%	SA 5 f	%	NA f	%	TOTAL f	%
1. I would like my science classes to relate to something I already know.	5	6.6	18	23.7	9	11.8	22	28.9	22	28.9	0	0	76	100.0
2. I would like my science class to be self-paced.	3	3.9	22	28.9	16	21.1	24	31.6	11	14.5	0	0	76	100.0
3. I would like to feel my science classes are necessary.	4	5.3	1	1.3	5	6.6	30	39.5	36	47.4	0	0	76	100.0
4. I would like my science classes to be taught more than one way.	0	0.0	1	1.3	12	15.8	25	32.9	38	50.0	0	0	76	100.0
5. I would like my science education to be relevant to daily living.	1	1.3	4	5.3	11	14.5	28	36.8	32	42.1	0	0	76	100.0
6. Science courses have always been hard and demanding on me.	9	11.8	29	38.2	8	10.5	18	23.7	11	14.5	1	1.3	76	100.0
7. I no longer remember many of the concepts that were taught in previous science classes.	9	11.8	26	34.2	12	15.8	19	25.0	10	13.2	0	0	76	100.0
8. Science related social problems should be a major political issue.	2	2.6	14	18.4	29	38.2	21	27.6	10	13.2	0	0	76	100.0
9. I liked my previous science classes.	7	9.2	15	19.7	4	5.3	37	48.7	12	15.8	1	1.3	76	100.0
10. My science classes motivated me to pursue additional science studies.	13	17.1	27	35.5	11	14.5	15	19.7	10	13.2	0	0	76	100.0

TABLE V (Continued)

	ITEMS	SCALE SD 1 f	%	D 2 f	%	UNC 3 f	%	AG 4 f	%	SA 5 f	%	NA f	%	TOTAL f	%
11.	The materials presented were accurate, clearly written and with use of appropriate vocabulary.	7	9.2	15	19.7	15	19.7	33	43.4	6	7.9	0	0	76	100.0
12.	I often feel my science classes are unnecessary.	14	18.4	34	44.7	6	7.9	17	22.4	5	6.6	0	0	76	100.0
13.	I would like my science learning to be applied beyond situations of the classroom.	1	1.3	3	3.9	5	6.6	38	50.0	29	38.2	0	0	76	100.0
14.	Science classes I have taken were relevant and beneficial.	7	9.2	13	17.1	8	10.5	34	44.7	13	17.1	1	1.3	76	100.0
15.	I would consider pursuing a science career.	22	28.9	20	26.3	13	17.1	13	17.1	8	10.5	0	0	76	100.0
16.	I feel the teaching of science related social issues is prevalent in currently taught science classes.	5	6.6	19	25.0	27	35.5	21	27.6	4	5.3	0	0	76	100.0
17.	Past science programs included an appropriate level of information where I feel the probability of success in future science educational experiences.	5	6.6	11	14.5	30	39.5	25	32.9	3	3.9	2	2.6	76	100.0
18.	In past science courses results of modern research were related clearly as to how they applied to the learner.	3	3.9	23	30.3	20	26.3	27	35.5	3	3.9	0	0	76	100.0

TABLE V (Continued)

ITEMS	SCALE SD 1 f	%	D 2 f	%	UNC 3 f	%	AG 4 f	%	SA 5 f	%	NA f	%	TOTAL f	%
19. I'm concerned the science class may hurt my grade point average.	15	19.7	26	34.2	10	13.2	18	23.7	7	9.2	0	0	76	100.0
20. I feel the science instructors enhanced my fear and inadequacy of the science taught.	17	22.4	18	23.7	12	15.8	23	30.3	6	7.9	0	0	76	100.0
21. My science classes should be understandable as well as fun.	0	0.0	3	3.9	1	1.3	25	32.9	47	61.8	0	0	76	100.0
22. I would like to feel my science instruction is beneficial.	0	0.0	0	0.0	1	1.3	34	44.7	41	53.9	0	0	76	100.0
23. The way science is taught in classes I have taken has been relevant to everyday life.	6	7.9	23	30.3	18	23.7	24	31.6	5	6.6	0	0	76	100.0
24. I feel indifferent about science news because of "scientific illiteracy."	6	7.9	26	34.2	17	22.4	23	30.3	4	5.3	0	0	76	100.0
25. It is my opinion science related social issues should be directly addressed in the classroom.	1	1.3	10	13.2	17	22.4	32	42.1	16	21.1	0	0	76	100.0
26. My science classes were logically organized.	1	1.3	13	17.1	16	21.1	41	53.9	5	6.6	0	0	76	100.0
27. In previous science classes discussion was allowed on innovative approaches to old problems.	6	7.9	25	32.9	22	28.9	19	25.0	4	5.3	0	0	76	100.0

TABLE V (Continued)

ITEMS	SD 1 f	SD 1 %	D 2 f	D 2 %	UNC 3 f	UNC 3 %	AG 4 f	AG 4 %	SA 5 f	SA 5 %	NA f	NA %	TOTAL f	TOTAL %
28. The science instructors often use unnecessary jargon in the presentations.	3	3.9	26	34.2	15	19.7	19	25.0	12	15.8	1	1.3	76	100.0
29. Science information presented had current interest and value.	4	5.3	19	25.0	16	21.1	31	40.8	5	6.6	1	1.3	76	100.0
30. I feel an inadequacy in past science preparation.	11	14.5	25	32.9	7	9.2	20	26.3	13	17.1	0	0	76	100.0
31. I would like to be able to practice what I learn in science through outside discussion, projects, or case studies.	1	1.3	8	10.5	10	13.2	34	44.7	23	30.3	0	0	76	100.0

* SD = Strongly Disagree
D = Disagree
UNC = Unclassified
AG = Agree
SA = Strongly Agree
NA = Not Applicable

TABLE VI

MEANS AND STANDARD DEVIATIONS FOR ALL ITEMS ON SCIENCE OPINION QUESTIONNAIRE OF ATTITUDES RELATIVE TO SUBSCALES

Item	$\bar{X}$	Standard Deviation
Subscale Relevancy		
1. I would like my science classes to relate to something I already know.	3.50	1.31
3. I would like to feel my science classes are necessary.	4.22	1.02
5. I would like my science education to be relevant to daily living.	4.13	0.94
8. Science related social problems should be a major political issue.	3.30	1.01
12. I often feel my science classes are unnecessary.	2.54	1.22
13. I would like my science learning to be applied beyond situations of the classroom.	4.20	0.83
18. Results of modern research were related clearly as to in past science courses how they applied to the learner.	3.05	0.99
22. I would like to feel my science instruction is beneficial.	4.53	0.53
25. It is my opinion science related social issues should be directly addressed in the classroom.	3.68	1.00
29. Science information presented had current interest and value.	3.15	1.12
31. I would like to be able to practice what I learn in science through outside discussion, projects, or case studies.	3.92	0.99

TABLE VI (Continued)

Item	$\bar{X}$	Standard Deviation
Subscale Fear		
6. Science courses have always been hard and demanding on me.	2.87	1.34
17. The science program included an appropriate level of information where I feel the probability of success in future science educational experiences.	3.05	1.07
19. I'm concerned the science class may hurt my grade point level.	2.68	1.29
20. I feel the science instructors enhanced my fear and inadequacy or the science taught.	2.78	1.31
30. I feel an inadequacy in past science preparation.	2.99	1.37
Subscale Motivation		
10. My science classes motivated me to pursue additional science studies.	2.76	1.32
15. I would consider pursuing a science career.	2.54	1.35
21. My science classes should be understandable as well as fun.	4.53	0.72
24. I feel indifferent about science news because of "scientific illiteracy".	2.91	1.09
Subscale Instruction		
2. I would like my science class to be self-paced.	3.24	1.14
4. I would like my science classes to be taught more than one way.	4.32	0.79

TABLE VI (Continued)

Item		$\bar{X}$	Standard Deviation
11.	The materials presented were accurate, clearly written and with use of appropriate vocabulary.	3.21	1.14
16.	I feel the teaching of science related social issues is prevalent in currently taught science.	3.00	1.01
23.	The way science is taught in classes I have taken has been relevant to everyday life.	2.99	1.10
26.	My science classes were logically organized.	3.47	0.90
28.	The science instructors often used unnecessary jargon in the presentations.	3.11	1.23
Subcale Past Experiences			
7.	I no longer remember many of the concepts that were taught in previous science classes.	2.93	1.27
9.	I liked my previous science classes.	3.38	1.30
14.	Science classes I have taken I feel were relevant and beneficial.	3.40	1.29
27.	In previous science classes discussion was allowed on innovative approaches to old problems.	2.87	1.05

TABLE VII

NUMBER OF ITEMS PER SUBSCALE, RANGES, MEANS, AND STANDARD DEVIATIONS OF THE SCIENCE EDUCATION SUBSCALES, AND TOTAL SCORES

Variables	No. of Items	Actual Range	Possible Range	$\bar{X}$	s.d.
Relevancy	11	28-49	0-55	40.22	4.62
Instruction	7	14-29	0-35	23.22	2.81
Fear	5	8-22	0-25	14.37	3.84
Motivation to Continue	4	8-19	0-20	12.74	2.44
Past Experiences	4	7-18	0-20	12.58	2.35
Total	31	81-126		103.23	8.23

the SOQOA. Table V presents the frequencies of respondents for each item on the SOQOA. Means and standard deviations for each item on the SOQOA are reported in Table VI. Table VII provides appropriate descriptive information relative to each subscale on the SOQOA.

Findings from Tables V, VI, and VII provide an overall description of the attitudes of the study respondents toward science. These initial assessment results reflect respondents' perceptions relative to the subscales of relevancy, instruction, fear, motivation, and past experiences, as well as their total attitude toward science courses.

Descriptive Results Relative to the Five Research Questions

This section reports the descriptive findings of the data analyses procedures used to examine each of the five research questions explored by the study. Each research question is presented relative to the statistical procedures and descriptive analyses utilized. Findings are reported and discussed relative to each question.

Question One

Is there a relationship between selected demographic characteristics of adult learners such as sex, age, background, and geographic region, and the type of science courses selected by the student?

Descriptive findings pertaining to question one are presented in Table VIII. Descriptive analyses performed relative to question one utilized the Cross Tabulation procedures with the selected demographic variables of sex, age, previous science, and school crosstabulated with the type of science courses selected by students.

Table VIII lists the results of the cross tabulations of several categorical variables. Categorical variables examined include: sex, age, previous science background, and type of school (metro/rural). Resulting frequencies presented in the crosstab cells indicate a heavy weighting or strong preference by all demographic groupings for biological science with astronomy as the second choice of science course for all groupings and physical science as the third choice. Specific descriptive results regarding Table VIII indicate that mature returning adult students (age 42-53 age groupings) were more likely to select alternative science offerings (Astronomy) over the curriculum offerings of biology or physical science in which they had earlier experiences. Further inspection of the crosstabs table revealed that 65 percent of the subjects were over what might be considered normal college attending age (18-23) and fit into the age profile of a returning adult student. Only 22 percent of the subjects (n = 76) surveyed elected to take physical science, 76.5 percent of those being in the age category of 18 to 23. The age groupings of 24-31 students preferred biological science. The more mature student (42-53 age groupings) elected to take astronomy.

Other results from Table VIII indicate that the longer period of time for the previous science background, the more reluctant the

TABLE VIII

CROSSTABULATIONS OF CATEGORICAL DATA OF SEX, AGE, BACKGROUND, AND GEOGRAPHIC REGION WITH TYPE OF SCIENCE COURSES SELECTED

	Row Frequencies							
	Type of Science Course							
	1		2		3			
	Biological Science		Astronomy		Physical Science		Raw Score	
Category	N	%	N	%	N	%	N	%
Sex								
NR	2	100.0	0	0	0	0	2	3.0
Male	12	57.0	7	33.0	2	10.0	21	27.0
Female	25	47.0	13	25.0	15	28.0	53	70.0
Total							76	100.0
Age								
NR	1	100.0	0	0	0	0	1	1.0
18-23	10	38.0	3	12.0	13	50.0	26	34.0
24-29	11	53.0	7	33.0	3	14.0	21	28.0
30-35	11	69.0	5	31.0	0	0	16	21.0
36-41	3	50.0	2	33.0	1	17.0	6	8.0
42-47	1	20.0	4	80.0	0	0	5	7.0
48-53	0	0	1	100.0	0	0	1	1.0
Total							76	100.0
Previous Science								
<1 year	8	42.0	9	47.0	2	11.0	19	25.0
1-05 years	11	41.0	3	11.0	13	48.0	27	36.0
6-10 years	7	50.0	6	43.0	1	7.0	14	18.0
10+ years	11	69.0	4	25.0	1	6.0	16	21.0
Total							76	100.0
School								
Metropolitan	37	100.0	0	0	0	0	37	49.0
Rural	0	0	22	56.0	17	44.0	39	51.0
Total							76	100.0

returning adult student was to attempt physical science. Most students (49 percent) preferred biological science, astronomy (29 percent) was preferred among the most recent science takers (40.9 percent) with less than one year, and physical science was the least popular choice (22 percent) of all students who had previous science experiences. In addition, 36 percent of returning adults had their last science course between one and five years before. Almost 40 percent of the subjects surveyed had received no science training in six of more six years, and 61 percent of the returning adult students had no recent science education which was categorized as within the previous five years.

Further crosstabulation information and descriptive results from school type or geographic region indicated that 72 percent of those returning adult students from the rural campus had not received any science training within the past year. Only 28 percent of all students had received any science instruction within the last year. It was interesting to note students who enrolled at the Metro Campus had moderate distributions in all four previous science background categories.

Crosstabulation information regarding sex of students and type of science course selected revealed that of the 26 percent of adult students enrolled in astronomy, 59 percent were female with 45 percent over the age of 30. The younger female student (24-30) indicated a preference for biology, whereas the 18 to 23 age category female enrolled in physical science. Returning male students' percentage distributions were moderate in both biology and physical science. It was noted that male students over the age of 35 avoided astronomy completely.

Descriptive findings relative to question one indicate that demographic characteristics of age and sex were found to relate to subjects' selection or choice of science course enrollment. Although these findings are specific to the group of respondents utilized in this study, the results provide a framework for demographic focus areas in future assessments.

Question Two

Do differences exist between males and females in their attitudes toward science as measured by the SOQOA?

Question two regarding sex differences was explored using the Frequencies with descriptive statistics procedure. Table IX contains the results derived from the descriptive analysis relative to sex for each of the subscales on the SOQOA (past, instruction, relevancy, motivation, fear, and total attitude). Table IX reports frequencies for high and low scores (median scores were used to generate low and high frequency categories) on each subscale as well as means and standard deviations for each.

Row frequencies depicted in Table IX indicate the following descriptive results. A larger percent of males (62 percent) than females (49 percent) reported high scores (more positive attitudes) toward past experiences in science courses. This finding is corroborated by the higher mean score for males than females on the past subscale. A similar finding is reported in Table IX regarding the subscale of instruction. A larger percent of males (62 percent)

TABLE IX

FREQUENCY DISTRIBUTIONS AND DESCRIPTIVE STATISTICS FOR THE SCIENCE OPINION QUESTIONNAIRE OF ATTITUDES SUBSCALES BY SEX

	LOW		HIGH			
	Row Frequencies					
Subscales	F	%	F	%	$\bar{X}$	S
Past						
Males	8	38.0	13	62.0	13.3	1.8
Females	27	51.0	26	49.0	12.2	2.5
Instruction						
Males	8	38.0	13	62.0	24.2	2.0
Females	29	55.0	24	45.0	22.9	2.9
Relevancy						
Males	7	35.0	14	65.0	40.8	3.8
Females	23	43.0	30	57.0	39.9	4.8
Motivation						
Males	15	71.0	6	29.0	13.0	2.5
Females	35	66.0	18	34.0	12.6	2.5
Fear						
Males	17	81.0	4	9.0	13.3	3.7
Females	27	51.0	26	49.0	14.9	3.8
Total						
Males	8	38.0	13	62.0	104.6	7.1
Females	30	57.0	23	43.0	102.5	8.5

Males N = 21
Females N = 53

than females (45 percent) indicated high scores (high quality of instruction) on the instruction subscale. This finding is supported by a higher resulting mean score for males than females on the instruction subscale. More males indicated the need for relevancy in science courses (65 percent) than females (57 percent) with a supporting higher mean for males than females on the relevancy subscale. However, overwhelmingly more females expressed high fear of science courses (49 percent) than males (nine percent) which is corroborated by a higher mean score for females than males on the fear subscale. The overall or total attitude findings for males and females on the SOQOA indicate that males have a more positive (62 percent report high total scores) attitude than females (43 percent report high total scores) which is substantiated by a higher mean score on the total subscale for males than females.

The findings indicated that that some differences exist between males and females in their attitudes toward science, science courses, and instruction in science. Although more males than females reported positive past experiences in science courses but less motivation to continue taking science classes, males indicated a more positive overall attitude toward science, more relevancy in their perceptions of science courses, and higher contentment with their perceptions of the quality of instruction than females. Thus, the overriding subscale that seems to be contributing to the overall lower (more negative) attitude of females than males toward science is the fear subscale.

Question Three

Do differences exist between adult learners with varying science backgrounds in their attitudes toward science as measured by the SOQOA?

Data collected relative to question three were analyzed using the frequencies/descriptive statistics and crosstabs procedures. Table X contains the results derived analysis with row frequencies, means, and standard deviations reported for each of the four categories of previous science experiences or background (less than one year, one to five years, six to ten years, and 10 or more years) relative to the five subscales of the SOQOA. Median scores for each subscale were used to generate the low and high frequency categories.

Descriptive findings in Table X indicate that respondents who had taken recent science courses (less than one year ago and within the past five years) perceived science courses as more positive (63 percent and 41 percent respectively scoring high on the past subscale) than students who had taken science courses more than five years prior to this assessment (less than 30 percent).

Respondents with more recent experience in science courses (less than one year ago) rated instruction as much higher quality (as indicated by high scores on the instruction subscale) than respondents who had taken science courses more than a year prior to this assessment. High mean scores on the instruction subscale by respondents who had had recent science coursework (less than one year ago) corroborate the frequency findings.

TABLE X

FREQUENCY DISTRIBUTIONS AND DESCRIPTIVE STATISTICS FOR THE SCIENCE OPINION QUESTIONNAIRE OF ATTITUDES SUBSCALES BY PREVIOUS SCIENCE BACKGROUND

	LOW (Row Frequencies)		HIGH (Row Frequencies)			
Subscales	F	%	F	%	$\bar{X}$	S
Past						
<1 year	7	37.0	12	63.0	13.2	2.3
1-05 years	16	59.0	11	41.0	12.2	2.0
6-10 years	10	71.0	4	29.0	11.4	2.1
10+ years	12	75.0	4	25.0	13.4	2.7
Instruction						
<1 year	8	42.0	11	58.0	23.4	2.9
1-05 years	20	74.0	7	26.0	22.8	2.3
6-10 years	8	57.0	6	43.0	23.0	3.6
10+ years	11	69.0	5	31.0	24.4	2.6
Relevancy						
<1 year	7	37.0	12	63.0	40.5	4.6
1-05 years	13	48.0	14	52.0	39.0	4.8
6-10 years	4	29.0	10	71.0	40.4	3.9
10+ years	9	56.0	7	44.0	41.8	4.9
Motivation						
<1 year	10	53.0	9	47.0	14.1	2.9
1-05 years	20	74.0	7	26.0	12.8	2.0
6-10 years	12	86.0	2	14.0	12.3	2.0
10+ years	13	81.0	3	19.0	11.4	2.2
Fear						
<1 year	15	79.0	4	21.0	13.3	4.0
1-05 years	19	70.0	8	30.0	14.3	4.3
6-10 years	8	57.0	6	43.0	16.1	2.8
10+ years	11	69.0	5	31.0	14.3	3.3
Total						
<1 year	8	42.0	11	58.0	104.5	9.2
1-05 years	15	56.0	12	44.0	101.1	7.8
6-10 years	5	36.0	9	64.0	103.2	6.6
10+ years	10	63.0	6	37.0	105.4	8.8

<1 year N = 19
1-05 years N = 27
6-10 years N = 14
10+ years N = 16

A majority of respondents (63 percent, 52 percent, and 71 percent) who had taken science courses within the last ten years rated science as relevant (high score on relevant subscale) to their lives. However, a majority (56 percent) of respondents who had not taken a science course within the past ten years rated science as not relevant (low score on relevant subscale) to their lives.

All four categories of previous science backgrounds indicated low motivation for continuing to take science courses. Low means for each background grouping as reported in Table X corroborate the notion of low motivation among respondents regardless of the recency of experience of the respondent.

Background recency of experience in science is not necessarily a factor influencing respondents' anxiety or fear towards science as indicated by the results in Table X for the fear subscale. Respondents from all four background categories (less than one year to more than ten years previous experience in science) indicated only a small amount of fear toward science (low science anxiety score) with means ranging from 13.3 to 16.1 on the fear subscale. Also, a majority of respondents (79 percent, 70 percent, 57 percent, and 69 percent) indicated low scores (low anxiety) on the fear subscale from all four previous science background categories.

Overall attitudes toward science (the total score) reported by respondents from varying previous science backgrounds indicated a fluctuation pattern of positive and negative attitudes relative to the number of years or recency of the science background. Respondents who had taken science courses within the previous year and respondents who had taken science courses six to ten years prior to this assessment reported positive attitudes (high scores) overall toward science (58 percent and 64 percent respectively). Respondents whose previous science background was one to five years prior to his assessment or whose background in science exceeded ten years reported overall negative attitudes toward science (56 percent and 63 percent respectively). These findings are supported by the descriptive statistics reported in Table X.

A summary of findings reported in Table X regarding the SOQOA subscales indicate that respondents who have had recent experience/exposure to science (less than one year) report low anxiety (fear) toward science, positive attitudes toward science instruction, high or strong feelings toward the relevancy of science in their lives, overall positive attitudes (total) toward science, and greater motivation to continue taking science courses than respondents from the other three background categories. A similar pattern is reflected by findings specific to the ten or more years since previous science experience/exposure group, but in the opposite direction. Adult students who had not taken any science coursework in ten or more years reported higher anxiety (fear) levels, low motivation to continue taking science courses, low relevancy perceptions and low to negative overall attitudes toward science.

Specific findings indicate that students with previous science backgrounds of less than one year ago have more positive attitudes toward science than students with previous science backgrounds of more than ten years ago with positive attitudes appearing more frequently within the motivation to continue subscale. Returning adult students who have had no science within the last six to ten years would like their science education to have relevance to to daily living; that returning adult students who have had no science within the last six to ten year period can no longer remember many of the science concepts previously taught; that returning adult students who had no science within the last year have little motivation to pursue additional science studies; that returning adult students who attempted science classes more than six years previous remember them as relevant and beneficial; and, that only those returning adult students who had any science within the last year felt that in previous science classes discussion was allowed on innovative approaches to old problems.

Results indicated that fewer adult students in the less than one year category reported high fear toward science than the number of students in the other groupings.

Question Four

Do differences exist between adult learners enrolled in different types of science classes in their attitudes toward science (as measured by the SOQOA)?

Question four findings are presented in Table XI. Table XI contains frequency distributions, crosstabulations (row frequencies) and descriptive statistics for each of the types of science classes (Biology, Astronomy, and Physical Science) relative to each of the subscales (past, instruction, relevancy, motivation, fear, and total). High and low categories were generated using the median as the point of separation. Other descriptive statistics presented in Table XI include means and standard deviations for each subscale subdivided by type of science categories of Biology, Astronomy, and Physical Science.

Results reported in Table XI relative to the past subscale indicate that returning students enrolled in biology or physical science classes have predominantly negative past experiences in science (57 percent and 82 percent recording low past scores respectively for biology and physical science) while a majority of students (59 percent) enrolled in astronomy reported high or positive attitudes toward their previous science experiences. Students enrolled in physical science classes reported more negative perceptions concerning their previous science backgrounds ($\bar{X}$ = 11.4, s = 2.2) than students enrolled in biology or astronomy. Results of this analysis revealed the attitude response of those students returning to school did not like their previous science classes and the science requirement.

An examination of the findings in Table XI regarding the instruction subscale revealed that a majority of students enrolled in biology and astronomy rated the instruction subscale high (54 percent and 64 percent respectively) with physical science students overwhelmingly reporting low ratings for instruction (76 percent). Students enrolled in astronomy reported higher mean attitudes ($\bar{X}$ = 24.4, S = 2.5) toward the quality of instruction than students enrolled in biology or physical science. Although astronomy is classified as a physical science, it is not in the traditional general nature of a physical science course. Astronomy is a specific

TABLE XI

FREQUENCY DISTRIBUTIONS AND DESCRIPTIVE STATISTICS FOR THE SCIENCE OPINION QUESTIONNAIRE OF ATTITUDES SUBSCALES BY TYPE OF SCIENCE

	LOW		HIGH			
	Row Frequencies					
Subscales	F	%	F	%	$\bar{X}$	S
Past						
Biology	21	57.0	16	43.0	12.9	2.2
Astronomy	9	41.0	13	59.0	12.9	2.4
Physical Science	14	82.0	3	18.0	11.4	2.2
Instruction						
Biology	17	46.0	20	54.0	23.2	3.1
Astronomy	8	36.0	14	64.0	24.4	2.5
Physical Science	13	76.0	4	24.0	22.3	1.9
Relevancy						
Biology	22	59.0	15	41.0	39.4	5.8
Astronomy	5	23.0	17	77.0	42.7	4.2
Physical Science	11	65.0	6	35.0	38.9	3.0
Motivation						
Biology	20	54.0	17	43.0	12/6	2.6
Astronomy	9	41.0	13	27.0	13.5	2.7
Physical Science	11	65.0	6	47.0	12.1	1.5
Fear						
Biology	21	57.0	16	43.0	14.6	3.5
Astronomy	16	73.0	6	64.0	13.4	3.8
Physical Science	9	53.0	8	12.0	15.2	4.5
Total						
Biology	21	57.0	16	43.0	102.6	9.6
Astronomy	8	36.0	14	64.0	106.9	6.4
Physical Science	15	88.0	2	12.0	103.0	5.1

Biology N = 37
Astronomy N = 53
Physical Science N = 17

topic subject and one that has relevancy in a newsworthy sense in today's society.

Astronomy students also reported higher relevancy subscale scores than returning students enrolled in biology or physical science. More than three-fourths (77 percent) of the returning students enrolled in astronomy gave high ratings to the relevancy of their science course, whereas less than half of the biology (41 percent) and physical science (35 percent) of the students rated their courses as highly relevant. Higher mean scores for astronomy students on relevancy ($\bar{X}$ = 42.7, S = 4.2) also support the relevancy findings.

A majority of returning students enrolled in astronomy classes (59 percent) reported high motivation to continue taking science courses, while less than half of the biology and physical science students (46 percent and 35 percent respectively) indicated a strong or high motivation to continue taking science courses. These findings are corroborated by the descriptive statistics accompanying the motivation subscale.

A greater number of astronomy students (73 percent) than biology (57 percent) or physical science students (53 percent) expressed low fear or low anxiety toward science courses. Returning students enrolled in physical science expressed more fear (anxiety) toward science ($\bar{X}$ = 15.2, S = 4.5) than biology or astronomy students.

Also, more astronomy students reported high or positive overall attitudes toward science (64 percent) than biology or physical science students (43 and 12 percent respectively) with an overwhelming number of physical science students (88 percent) expressing overall low attitudes toward science.

A summary of the findings in Table XI indicated that returning students who selected traditional general science courses (biology and physical science) are not as positive in their attitudes toward their past or previous experiences in science; their perceptions of the quality of instruction they have received in their science coursework; the degree of relevancy of their science classes to their lives; their level of motivation to continue taking science coursework; their level of science anxiety or fear; and their overall attitude toward science than returning students who selected nontraditional or specialty courses of astronomy with more physical science students expressing negative attitudes toward science than biology students.

Question Five

Do differences exist between adult learners from varying geographic regions in their attitudes toward science (as measured by the SOQOA)?

Descriptive findings pertaining to question five are reported in Table XII. Row frequencies for high and low ratings by respondents for each of the SOQOA subscales and descriptive statistics relative to the adult learners' geographic region (metropolitan versus rural) are presented in Table XII. Median scores were used to generate low and high frequency categories.

More rural students (49 percent) than metropolitan students (43 percent) indicated low or negative past or previous experiences/backgrounds in science. However, a majority of students form both geographic regions (metro, 57 percent and rural, 51 percent) indicated positive or high ratings for their past or previous science backgrounds.

More metropolitan returning adult students rated instruction high or positive (57 percent) than rural students (46 percent) with a majority of rural students (54 percent) indicating low or negative attitudes toward instruction.

Over two-thirds of the rural returning adult students (67 percent) perceived their science courses as highly relevant to their lives while just over half (51 percent) of the metropolitan students reported high relevancy ratings. These findings are supported by the descriptive statistics also presented in Table XII.

Motivation to continue taking science coursework was reported to be low by both geographic groups with almost two-thirds (62 percent) of the metropolitan students reporting low motivation ratings and almost three-fourths (72 percent) of the rural students reporting low motivation ratings. Low means for both groups on the motivation subscale ($X = 12.6$, $S = 2.6$ for metro group and $X = 12.9$, $S = 2.4$ for rural group) corroborate these findings.

High anxiety or fear toward science was expressed by almost two-thirds (64 percent) of the rural returning adult students and over half (57 percent) of the metropolitan returning adult students. High science anxiety levels were indicated by both groups' descriptive statistics ($\overline{X} = 14.6$, $S = 3.5$ for metro group and $\overline{X} = 14.2$, $S = 4.1$ for rural group).

TABLE XII

FREQUENCY DISTRIBUTIONS AND DESCRIPTIVE STATISTICS FOR THE SCIENCE OPINION QUESTIONNAIRE OF ATTITUDES SUBSCALES BY GEOGRAPHIC REGION (METRO/URBAN SCHOOL)

	LOW (Row Frequencies)		HIGH (Row Frequencies)			
Subscales	F	%	F	%	$\bar{X}$	S
Past						
Metropolitan	16	43.0	21	57.0	12.9	2.2
Rural	19	49.0	20	51.0	12.3	2.4
Instruction						
Metropolitan	16	43.0	21	57.0	23.2	3.1
Rural	21	54.0	18	46.0	23.5	2.5
Relevancy						
Metropolitan	18	49.0	19	51.0	39.4	5.0
Rural	13	33.0	26	67.0	41.1	4.1
Motivation						
Metropolitan	23	62.0	14	38.0	12.6	2.6
Rural	28	72.0	11	28.0	12.9	2.4
Fear						
Metropolitan	21	57.0	16	43.0	14.6	3.5
Rural	25	64.0	14	36.0	14.2	4.1
Total						
Metropolitan	18	49.0	19	51.0	102.6	9.6
Rural	21	54.0	18	46.0	103.8	6.8

Metropolitan N = 37
Rural N = 39

Overall positive (high) attitudes toward science were reported by more metropolitan students (51 percent) than rural students (46 percent). However, approximately only one-half of either geographic group (metro or rural) perceived science with positive overall attitudes.

A summary of the findings reported in Table XII revealed that metropolitan students seem to report overall high positive attitudes toward their previous science backgrounds, their science instruction and instructors, their motivation to continue taking science courses, and their overall attitudes toward science courses. Rural students perceived science with high relevancy ratings, but more rural students than metropolitan students expressed high fear or anxiety toward science.

Summary

Chapter IV has presented the analysis and descriptive findings of the assessment study. Descriptive data analyses reported in the chapter include a description of the subjects used in the study, and descriptive analyses and findings relative to each of the five research questions. Summary statistics and relevant findings were presented and discussed according to their application to each of the questions explored in the study.

CHAPTER V

SUMMARY, DISCUSSION, IMPLICATIONS, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

Earlier chapters presented a rationale for the study, a review of the literature, and the collection of data and analysis of the findings. This chapter includes a summary of the study, discussion of the findings and implications as well as conclusions and recommendations.

Summary

The purpose of this study was to descriptively examine the existence and nature of science anxiety in adult learners. Data were collected to identify and assess variables that are related to and/or contribute to returning adult students' attitudes toward science classes. The study was an assessment or descriptive analysis of selected variables that pertain to science anxiety in adult learners. Selected demographic characteristics of adult learners and attitudes of adult learners toward science education were examined in the assessment to provide a descriptive picture of the nature of science anxiety in the adult learner. Specific variables that were examined in the study include:

A. Demographic Characteristics of Adult Students

1. sex
2. age
3. previous science background
4. type of science enrolled
5. geographical school type (metro/rural)

B. Attitudes Toward Science Classes

1. Science Opinion Questionnaire of Attitudes (SOQOA) items
2. relevancy subscale
3. instruction subscale
4. fear of science subscale
5. past science experience subscale
6. motivation subscale
7. overall attitude

The intent of this study was also to provide information to those who were involved in curriculum design additional knowledge of andragogy and of adult learning characteristics that may be found to contribute to and/or explain science anxiety in returning adult students.

A Likert Scale questionnaire under the title "Science Opinion Questionnaire of Attitudes" (Appendix A) was the specially designed instrument used in this study, and administered to the subjects during the Fall semester of 1985 and the Spring semester of 1986.

The statistical procedures employed in the study were analyzed using the Statistical Package for the Social Sciences [SPSS] (Nie, et al., 1975). The SPSS Subprogram, CROSSTABS, was used to generate crosstabulation tables for categorical variables involved in the study. Row frequencies with descriptive statistics were reported relative to high and low ratings of respondents for each of the subscales on the SOQOA relative to each of the five research questions generated by the study.

The statistical procedures employed in the study provided an analytical vehicle for descriptively exploring demographic and attitude characteristics of a selected group of adult learners.

Discussion and Implications

The interpretation of data resulted in the findings summarized below:

1. Descriptive findings relative to .research question one indicate that demographic characteristics of age and sex were found to relate to adult stdents; selection or choice of science course enrollment in college.

2. Findings specific to the second research question indicated that more males than females report overall positive attitudes toward science, science instruction, relevancy, and past experiences in science with females reporting high anxiety or fear towards science.

3. Results of the study relative to the third research question indicated that recency of experience or exposure to science is related to attitude toward science with adult students who have had recent (less than five years ago) science courses reporting high positive attitudes toward science and low anxiety levels while returning adult students who had not taken science courses for more

than ten years perceived science as negative and reported high science anxiety levels.

4. Research question four findings indicate that returning adult students who have selected specialty science classes (rather than traditional science classes) report high positive attitudes toward science and low science anxiety levels.

5. Results from the descriptive findings relative to research question five indicate that adult students from metropolitan geographic regions report high positive overall attitudes toward science, whereas rural students report low or negative attitudes toward science with rural students reporting high levels of science anxiety.

Descriptive statistics enabled the researcher to meaningfully describe findings relative to the sample of returning adult learners. These findings may have implications that college instructors of science and curriculum planners should do more careful course preparation in terms of relevancy of material presented, and a method of instruction more suited to the characteristics of adult learners taking into consideration past experiences, fears of science, how long since their last classroom science, and motivation factors during the early stages of class organization.

Specific findings suggested the more mature female student possessed an anxious attitude toward physical science and preferred specialty class offerings, especially if they had no recent science classes. This factor may have value for curriculum planners in developing courses, taking sex and age into consideration, that attract students on an interest basis.

Instructional methods seemed to have a great influence on the attitudes of the returning adult student. The findings suggested both male and female students preferred their science classes to be clearly presented, current and up to date, relevant to daily living, and presented with unnecessary jargon.

The findings suggested the need for motivational or fun activities and a need for topics addressing science related social issues. This factor may have value for science instructors when planning instructional methods and presentations. This implies the science instructor who can motivate adults may reduce science anxiety. This study may provide a data base regarding the returning adult learners' attitude toward science classes.

Conclusions

1. It is concluded that early knowledge of the returning adult student and the breakdown of the learner by age categories, sex, previous science backgrounds, type of school attending, and type of science enrolled in determining placement in traditional or specialty science classes will aid in the early identification of science anxiety in returning adult students.

2. It is concluded that past science classroom experiences, opinions on course relevancy, and methods of instruction must be given consideration in the early identification of science anxiety in returning adult students.

3. It is concluded that knowledge of the adult students' previous science backgrounds by college science instructors is an

important factor in the early identification of science anxiety on the part of returning adult students.

4. It is concluded that curriculum planners and science instructors offer specialty science course options, which would match the current needs of the learners, and reduce their anxiety toward science courses.

5. It is concluded that knowledge of attitude differences of returning adult students attending metro and rural college campuses is a contributing factor in explaining or describing science anxiety in returning adult students.

Recommendations

The following recommendations are made for those who are involved in the instruction, curriculum design, program planning, and facilitation of learning for the returning adult student.

1. An orientation class session should be set by the science instructor to discuss past science experiences of the returning adult student.

2. Colleges should offer a variety of specialty science courses to meet the needs of returning adult students who are nonscience majors.

3. A reassessment of present general education science courses by college science instructors should be undertaken to accommodate the special characteristics of the returning adult learner.

4. College science instructors should be aware of the individual needs and anxieties of the adult learner and adjust their lectures and laboratory activities to meet these needs.

5. Organize and conduct class activities to meet the anxiety needs of the various groups of returning adult students.

6. In-service courses, workshops, and seminars should be made available for college teachers who are not familiar with the characteristics of the returning adult learner.

7. Future research should consider the occupations of returning adult students, which might identify sources of additional differences in their attitudes toward science.

8. Future research should determine if there are additional differences in the variables between individuals who graduated from public or private secondary schools.

9. Future research should assess college science teachers' attitudes toward their own methods using a variation of the SOQOA.

10. Future research should pursue appropriate assessment of the SOQOA as a standardized measure of science anxiety.

Final Statement

We are moving from an industrial to an information society, where we will use our brain-power to create instead of our physical power, and the technology of the day will extend and enhance our mental capabilities. As we take advantage of the opportunities for investment in the future, we must not lose sight of the human element in the face of all the new advanced technology.

Education should focus learning skills on the relevance and importance on competency in what the learner does and focus on the individual's part as an important resource for the future. The attitude of educators is influential in shaping a learner's values.

As Miller (1984) pointed out, promoting a positive attitude toward the need for lifelong learning is important.

Planning educational strategies for the science anxious learner can best be done by considering the nature and reason for the anxiety. An adult learner who developed science anxiety at an early age represents a definite challenge to the instructor or facilitator of learning. All face the problems of being an adult, and a knowledgeable adult educator can bring skill and understanding to the science teaching profession.

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APPENDIXES

APPENDIX A

SCIENCE OPINION QUESTIONNAIRE OF ATTITUDES

PAST AND PRESENT

SCIENCE OPINION QUESTIONNAIRE OF ATTITUDES

PAST AND PRESENT

Sex ___M___F___ Age______
Circle one

Instructions: After each of the following statements circle the number of the opinion that best matches your own.

1. Strongly Agree 2. Agree 3. Uncertain 4. Disagree 5. Strongly Disagree

1.	I would like my science classes to relate to something I already know.	1	2	3	4	5
2.	I would like my science class to be self-paced.	1	2	3	4	5
3.	I would like to feel my science classes are necessary.	1	2	3	4	5
4.	I would like my science classes to be taught more than one way.	1	2	3	4	5
5.	I would like my science education to be relevant to daily living.	1	2	3	4	5
6.	Science courses have always been hard and demanding on me.	1	2	3	4	5
7.	I no longer remember many of the concepts that were taught in previous science classes.	1	2	3	4	5
8.	Science related social problems should be a major political issue.	1	2	3	4	5
9.	I liked my previous science classes.	1	2	3	4	5
10.	My science classes motivated me to pursue additional science studies.	1	2	3	4	5
11.	The materials presented were accurate, clearly written and with use of appropriate vocabulary.	1	2	3	4	5
12.	I often feel my science classes are unnecessary.	1	2	3	4	5
13.	I would like my science learning to be applied beyond situations of the classroom.	1	2	3	4	5
14.	Science classes I have taken were relevant and beneficial.	1	2	3	4	5
15.	I would consider pursuing a science career.	1	2	3	4	5

16.	I feel the teaching of science related social-issues is prevalent in currently taught science classes.	1	2	3	4	5
17.	Past science programs included an appropriate level of information where I feel the probability of success in future science educational experi-ences.	1	2	3	4	5
18.	In past science courses results of modern research were related clearly as to how they applied to the learner.	1	2	3	4	5
19.	I'm concerned the science class may hurt my grade point average.	1	2	3	4	5
20.	I feel the science instructors enhanced my fear and inadequacy of the science taught.	1	2	3	4	5
21.	My science classes should be understandable as well as fun.	1	2	3	4	5
22.	I would like to feel my science instruction is beneficial.	1	2	3	4	5
23.	The way science is taught in classes I have taken has been relevant to everyday life.	1	2	3	4	5
24.	I feel indifferent about science news because of "scientific illiteracy".	1	2	3	4	5
25.	It is my opinion science related social issues should be directly addressed in the classroom.	1	2	3	4	5
26.	My science classes were logically organized.	1	2	3	4	5
27.	In previous science classes discussion was allowed on innovative approaches to old problems.	1	2	3	4	5
28.	The science instructors often use unnecessary jargon in the presentations.	1	2	3	4	5
29.	Science information presented had current in-terest and value.	1	2	3	4	5
30.	I feel an inadequacy in past science preparation.	1	2	3	4	5
31.	I would like to be able to practice what I learn in science through outside discussion, projects, or case studies.	1	2	3	4	5

SELECT ONE:

My last science course was:

- [ ] Less than 1 year ago
- [ ] 2 - 5 years ago
- [ ] 6 - 10 years ago
- [ ] 10+ years ago

APPENDIX B

KUDER RICHARDSON 20 COEFFICIENTS OF INTERNAL CONSISTENCY FOR THE SOQOA ITEMS, TOTAL, AND SUBSCALES

KUDER RICHARDSON 20 RELIABILITY COEFFICIENTS FOR ITEMS ON PILOT SCIENCE OPINION QUESTIONNAIRE OF ATTITUDES

Item	r	P
1. I would like my science classes to relate to something I already know.	.50	.050*
2. I would like my science class to be self-paced.	.44	ns
3. I would like to feel my science classes are necessary.	.74	.010*
4. I would like my science classes to be taught more than one way.	.69	.010*
5. I would like my science education to be relevant to daily living.	.47	ns
6. Science courses have always been hard and demanding on me.	.48	ns
7. I no longer remember many of the concepts that were taught in previous science classes.	.22	ns
8. Science related social problems should be a major political issue.	-.12	ns
9. I liked my previous science classes.	-.49	.050*
10. My science classes motivated me to pursue additional science studies.	.47	ns
11. The materials presented were accurate, clearly written and with use of appropriate vocabulary.	.53	.050*
12. I often feel my science classes are unnecessary.	.58	.050*
13. I would like my science learning to be applied beyond situations of the classroom.	.26	ns
14. Science classes I have taken were relevant and beneficial.	-.07	ns
15. I would consider pursuing a science career.	-.05	ns

Item	r	P
16. I feel the teaching of science related social-issues is prevalent in currently taught science classes.	.71	.010*
17. Past science programs included an appropriate level of information where I feel the probability of success in future science educational experiences.	.37	ns
18. In past science courses results of modern research were related clearly as to how they applied to the learner.	.71	.010*
19. I'm concerned the science class may hurt my grade point average.	.69	.010*
20. I feel the science instructors enhanced my fear and inadequacy of the science taught.	.76	.001*
21. My science classes should be understandable as well as fun.	.56	.050*
22. I would like to feel my science instruction is beneficial.	.11	ns
23. The way science is taught in classes I have taken has been relevant to everyday life.	.66	.010*
24. I feel indifferent about science news because of "scientific illiteracy".	.68	.010*
25. It is my opinion science related social issues should be directly addressed in the classroom.	.64	.050*
26. My science classes were logically organized.	.60	.050*
27. In previous science classes discussion was allowed on innovative approaches to old problems.	.71	.010*
28. The science instructors often use unnecessary jargon in the presentations.	.62	.010*

Item	r	P
29. Science information presented had current interest and value.	.70	.010*
30. I feel an inadequacy in past science preparation.	.56	.050*
31. I would like to be able to practice what I learn in science through outside discussion, projects, or case studies.	.78	.001*

*Significance Level

N = 17

KUDER RICHARDSON 20 COEFFICIENTS OF RELIABILITY FOR ANXIETY VARIABLES ON PILOT SCIENCE OPINION QUESTIONNAIRE OF ATTITUDES

Variable	r	p
Relevancy	.91	.001*
Instruction	.96	.001*
Fear	.85	.001*
Motivation	.78	.001*
Past Experiences	.34	ns

*Significance level

N = 17

APPENDIX C

CONTENT VALIDITY

To establish both item and content validity, with the permission of Dr. James Key, doctoral candidates from Oklahoma State University attending AGED 5980 Research Design class evaluated all instrument items as to their importance and how well they represented the intended content area. These 22 doctoral candidates were utilized to offer content validity expertise. All 22 students were education specialists pursuing doctoral degrees within various areas of education.

VITA

Daniel Allen Hougardy

Candidate for the Degree of

Doctor of Education

Thesis: A DESCRIPTIVE STUDY OF RETURNING ADULT LEARNERS' ATTITUDES TOWARD COLLEGE SCIENCE CLASSES

Major Field: Occupational and Adult Education

Biographical:

Personal Data: Born in Henryetta, Oklahoma, November 17, 1937, the son of Oscar Daniel Webster and Evelyn Mildred Hougardy.

Education: Graduated from Central High School, Tulsa, Oklahoma, in June, 1956; received Bachelor of Science degree in Education from University of Tulsa in June, 1972; received Master of Education in June, 1974 and Master of Education with emphasis in Higher Education (Community College Teaching) in June, 1980 from Northeastern State University, Tahlequah, Oklahoma; completed requirements for the Doctor of Education degree at Oklahoma State University in July, 1992.

Professional Experience: Director, Technical Recruiting, Enterprise Personnel Consulting, Tulsa, Oklahoma, 1964-1970; Oologah-Talala Public Schools, Classroom Teacher, Oologah, Oklahoma, 1972-1991; Instructor of Biological Science, Human Ecology, Special Pre-service/Inservice courses for educators, Tulsa Junior College, Tulsa, Oklahoma, 1988-1991;

Professional Organizations: American Association of Adult and Continuing Education (AAACE); National Science Teachers Association; National Biology Teachers Association; National Speleological Society; Oklahoma Education Association (AEA); Oklahoma Science Teachers Association; Phi Delta Kappa; Oklahoma Wildlife Federation; National Education Association (NEA); National Wildlife Federation; Oologah Classroom Teachers Association; Oklahoma Academy of Science; Oceanic Society; Professional Association of Diving Instructors; Cousteau Society; Learning Resources Network.