EFFECTIVENESS OF THE INQUIRY METHOD OF INSTRUCTION IN TEACHING A SECONDARY HOME ECONOMICS TEXTILES UNIT

by

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APPROVAL PAGE

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The purpose of this study was to examine the effect of the inquiry method of instruction on achievement of clothing and textiles secondary students. In addition, relationships among posttest scores, first semester clothing and textile grades, number of class sessions attended, grade classification, and teacher/student attitudes were examined.

The nonrandomized control group, pretest-posttest design was used. The experimental group was composed of seven teachers and 74 students; six teachers and 63 students formed the control group. Eight lessons using the inquiry approach developed by the researcher were used for assessment devices. The 66-item achievement test used as pretest and posttest had a reliability of .88, obtained by using the Kuder-Richardson formula 20. Two questionnaires assessed teachers' attitudes and their perception of their students' attitudes toward the inquiry method. Responses to the teacher questions indicated that teachers in the experimental group reacted favorably to the inquiry method and would use it when appropriate. Most of the teachers reported that students developed inquiry skills and mastered important concepts related to textiles. The fourth instrument

assessed students' attitudes toward the instructional method and materials.

Analysis of covariance was used to test for differences in the mean gain scores between the two groups with pretest as the covariate. Scores of the experimental group were statistically higher than those of the control group (p < .035).

Multiple regression analysis was performed to determine if there were significant relationships among posttest scores of students and the independent variables. The significant regression equation (p < .0001) accounted for 55% of the variance. Pretest scores, student semester clothing and textiles grades, class attendance, teachers' attitudes, and students in the 12th grade were significant predictors of posttest achievement scores. Results indicated no significant relationships among the dependent variable and students' attitudes and grade classification of students in grades 9, 10, and 11.

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My son, Alrik Kumar Lunsford whose love is my guiding light.

My father and mother, Thurman and Rosetter Watson whose training instilled in me a will to succeed and the drive to achieve all my goals.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

CHAPTER I

INTRODUCTION

One of the main thrusts in American education today is teaching students to think (Beyer, 1984; Costa, 1985; Marzano et al., 1988). Educators would argue that this has always been the goal of education (Enhrenberg, 1985). Teaching students to think is not a new idea (Dewey, 1916), but one that the profession has always practiced. Yet, the activities and interaction patterns in many classrooms do not contribute to growth in thinking (Marzano et al., 1988); many students are not using higher order thinking skills.

Countless examples in the literature cite students' inabilities to answer higher level questions on tests or to do well on complex academic tasks. Scores on the Scholastic Aptitude Test are at an all-time low and The College Board (1983) has asked that more attention be given to the student's ability to reason. The National Science Board Commission (1983) proposed that a fundamental goal of schools be one of developing the student's capacity for problem-solving. A Nation at Risk (1983) reported that students are deficient in higher level thinking and called for immediate efforts to correct the situation. Business leaders are appalled by the low problem-solving skills levels of graduates (New York Committee on Economic Development, 1985), and college instructors decry the inability of undergraduate students to engage in analytical thinking (Maeroff, 1983; Starr, 1983). Beyer (1988) suggested that the problem lies in the traditional curriculum: "The lack of student's proficiency in thinking lies in 'what' schools attempt to teach about thinking and 'how' they go about doing it" (p. 28).

Beyer (1988) points to four problems: (a) the instructional methods used by most teachers do not help students learn how to think, (b) teaching procedures fail to reinforce or provide appropriate support for teaching and learning the operations that constitutes thinking, (c) the school curriculum suffers from severe skill overload, and (d) educators have not reached a consensus on exactly which thinking operations should be taught.

Over a decade ago, educators recognized students' inabilities to think and approached the problem in various ways. A "back to basics" program was one approach to reduce students' deficiencies. This program, however, continued to nurture an educational system pragmatized by the how-to's and the instant-gratification mentality of our society. The major change was to spend more time on the same kind of instructions. This kind of instruction-- recall, rote memorization, and drill and practice skills needed for assembling, manufacturing, and agriculture--is no longer in demand. Even though standardized test scores did improve, there is little evidence that students are better educated in the sense of being prepared to contribute to society and to live satisfying lives (Beyer, 1988).

Another way to overcome student deficiencies was through competency-based education. Many states continue to stress competency education/competency testing (North Carolina State Department of Public Instruction, 1988) as a way to achieve educational goals related to the development of thinking skills. "Competency-based education is a system for planning and implementing classroom activities to help each student develop certain specified competencies" (North Carolina State Department of Public Instruction, 1988, p. xi). This approach is concerned with subject matter: concepts, causes and effects, procedures, values, rules, and facts (Shear, 1986). There is little emphasis on the processes or the "how" of acquiring information, making choices, or thinking and valuing (Parker & Rubin, 1986).

North Carolina is among the states that developed and uses a competency-based model to teaching and learning. The consumer home economics program under the vocational education division in North Carolina follows this model. Recognizing the model's limitations in developing thinking skills, the consumer home economics curriculum guide suggests that whenever possible the teacher should plan and conduct classroom activities which require students to use and develop higher order thinking skills (American Home Economics Association, 1967; North Carolina State Department of Public Instruction, 1988).

Many home economics curricula mandate competency-based programs even while home economics teachers are being challenged to teach higher order thinking skills that will allow students to go beyond simple recall of facts and ideas (Horn, 1981; Kowtaluk & Kopan, 1990; North Carolina Department of Public Instruction, 1988). The challenge includes teaching students how to reason, make realistic and careful judgements, and develop creative solutions to problems. According to Horn (1981) the educational context has evolved: "...if the purposes of Home Economics have not changed over the years, the cultural setting has; our technology has changed, our methods have changed; our audiences have changed, and our values have changed" (p. 21).
These changes should be reflected in subject-matter selection and emphasis, and in instruction that is personalized, self-directed, process-centered, and relevant to secondary students. Staying relevant will require constant reevaluation, redoing, rethinking, and retooling by teachers.

Today's educational emphasis is shifting to processes. Brown (1978) endorsed processes and emphasizes thinking as the active process for knowing about something and acquiring meanings:

> ... modes of thinking are learned and are as much the substance of learning as subject matter. They become, therefore, a deliberate part of the content of curriculum in two ways: (a) in selecting instructional modes

> which will encourage development of the ways of thinking which are desirable and (b) in deliberate examination of processes and standards of thinking. (Shear, 1986, p. 60)

One method which is process-centered and enables students to deal with problem identification and problem-solving is the "inquiry" method which encourages students to ask questions that will lead them to answers they seek (Costa, Hanson, Silver, & Strong, 1985). There is an increased chance that the materials will enter long-term memory and become lasting, durable, and applicable to new situations (Costa et al., 1985).

The inquiry method helps students learn how to learn (Goldmark, 1968). In this method, the inquirer controls the process. Students learn to seek out information and to use what they have investigated (Blair, 1988). Cognitive gains match the student's own goals, thereby building learner autonomy. The inquiry method is recommended for investigating and explaining unusual phenomena (Suchman, 1966).

Inquiry cannot be programmed and teachers cannot be concerned with getting the right answer. Many explanations may be possible and students are encouraged not to be satisfied with the first explanation that appears to fit the facts (Joyce, 1986).

> Some of the outcomes which may be expected after repeated experiences with the inquiry method are: students will become better able to autonomously and voluntarily build and test theories and explanations to

> problems, and discuss the strengths and weaknesses of various problem-solving strategies in a wide range of topic areas. (Costa, Hanson, Silver & Strong, 1985, p. 166)

Students become aware of their own problem-solving strategies, organizational abilities, and inventiveness in designing experimental approaches.

Inquiry has proven to be beneficial in helping students to think (Black, 1952; Dewey, 1916; Suchman, 1966) while learning subject matter. Although inquiry training was originally developed for the natural sciences, it is useful in all subject areas (Joyce, 1986). Therefore, the issue is one of whether cognitive processes can be taught effectively for transfer (indirect) or whether they must be taught in relation to particular kinds of problems (subject matter). The Wisconsin, Ohio, Minnesota, and Pennsylvania curricula are based on Brown's (1978) philosophy. Each of these curricula appears to use a two-fold approach:

> We have to have it both ways--both problem-centered and discipline-centered ...if we are to produce students who, at the same time that they think, are fully aware of the intellectual processes that they themselves are using. (Foshay, 1962, p. 71)

There are two issues that support the need for research on combining thinking processes with subject-matter content. The first is the inability of students to make sound decisions and the lack of this ability may be embedded in what is being taught and how it is being taught in the classroom.

In addition, educators, administrators, parents, and national and community leaders have recognized the need to change the way students are educated. What this change will be is not evident. The change that many seem to agree upon is the need to teach students how to think. Learning how to think is as important as is subject-matter; neither can be neglected. One teaching model which successfully combines the two is called the "inquiry" method. The researcher, being a home economist, was interested in knowing whether home economics content could be infused into an inquiry model.

Statement of the Problem

The major purpose of this experimental study was to examine the effects of the use of the inquiry method of instruction in the teaching of clothing and textiles in secondary home economics. To investigate the characteristics of the inquiry method, materials were developed for use in the teaching of textiles. This study, combining the inquiry model with a competency-based educational framework, would introduce students to the use of inquiry to seek solutions to problems.

Objectives

This study had three objectives:

1. Develop teaching materials and assessment measures

using the inquiry model for a unit in North Carolina's Home Economics 7035 Clothing and Textiles course.

2. Test materials with selected classes to determine effect on student achievement in Home Economics 7035 Clothing and Textiles classes.
3. Determine the teachers' and students' attitudes toward the instructional method and teaching materials developed for the Home Economics 7035 Clothing and Textiles classes.

Hypotheses

Four null hypotheses were tested for this study:

H_1 There is no significant difference in the gain from pre-to-posttest for the achievement scores of students who have and have not been exposed to the inquiry method of instruction.

H_2 There are no significant relationships among the posttest achievement scores of students and their:

a. pretest score.
b. first semester clothing and textiles grades.
c. grade classification.
d. the number of class sessions attended during the experimental unit.

H_3 There is no significant relationship between posttest achievement scores of students and teacher attitudes toward using the inquiry method of instruction.

H_4 There is no significant relationship between posttest achievement scores of students and student attitudes toward using the inquiry method of instruction.

Limitations

The teachers involved in this study volunteered to participate. Therefore, they may have been more interested, motivated, and concerned about student learning than nonvolunteers might have been. The assignment to group was not made randomly which was another limitation. It was the intent of the researcher to randomly assign teachers to experimental and control groups. However, the majority of the volunteers came from a school system where inservice training had to be open to all teachers and conducted at the same time. Thus, the teachers in this system made up the experimental group. A third limitation was the duration of the unit. The unit lasted 15 days, covering 15 50-minute class sessions. This was a short time to create change, especially in thinking and attitudes.

Summary

A national concern demands new ways to teach students to think. A combination of the traditional content-centered curriculum with the inquiry method can provide exciting, effective ways to promote student thinking in the classroom. This study was designed to test one way to do this with home economics students who are studying clothing and textiles. The next chapter presents the theoretical basis for this study.

CHAPTER II

REVIEW OF LITERATURE

This study examines the effects of the use of the inquiry method of instruction on achievement of home economics clothing and textiles secondary students. The review of the literature outlines factors that influence: the need to teach thinking, thinking skills students need to have, and thinking skills students learn from inquiry. Because no information was found on the inquiry method of instruction for teaching clothing and textiles, the use of the inquiry approach in science is reported.

The Need to Teach Thinking

Although teaching students to think is a complex task, many educators contend that traditional methods are teaching students to think, and indeed, education and thinking are inseparable. Yet, research studies suggest that students are doing poorly on standardized tests because students are deficient in abstract thinking and in their ability to reason. Regardless of our desire to teach students to think, the gap is widening between this desire and what is actually happening (Ehrenberg, 1985).

Scores from national tests confirm the inability of students to think. The results from the National Assessment of Educational Progress (1981) suggest that 38% to 85% of American students cannot engage in critical thinking. Silver (1986) analyzed the results of The National Assessment of Educational Progress and concluded that students approach academic tasks in a mechanical fashion without much apparent thought about what they are doing. The following example illustrates Silver's conclusion:

Estimate the Answer 3.04 X 5.3

(a) 1.6 (b) 16 (c) 160 (d) 1,600 (e) don't know

Twenty percent of the 13-year-olds and 40% of the 17-year-olds answered correctly. When the same group of students were asked to compute the answer for a similar problem, 60% of the 13-year-olds and 80% of the 17-year-olds answered correctly (Marzano et al., 1988, p. 2).

Other evidence reveals that most high school and college students do not do well on tasks that require critical thinking (Beyer, 1988; Costa, 1985; Norris, 1985), and many high school and college graduates cannot engage in higher order thinking. Disturbing results were reported when the Cornell Critical Thinking test was administered. This test examines decision-making coupled with principles of thinking (Ennis & Millman, 1985). The test items were designed to see if the subjects had a knowledge of certain principles of thinking and application. The "Level X" test is a timed 71 item test for grades 4 to 14 that includes sections on induction, deduction, observation, credibility, defining, and assumption identification. Of the schools administering "Level X" test, the highest reported median score was 48 out of a possible score of 71; this score was obtained by 10th grade history students. Above average IQ 8th graders obtained the lowest median score of 29. Median scores were 30 out of a possible 52 for college undergraduates taking the "Level Z" test. The test has 52 items that include sections on induction, deduction, observation, credibility, defining, and assumption (Norris, 1985).

The Watson-Glaser tests are designed to measure examinees' ability to recognize assumptions, evaluate arguments, and appraise inferences. The test was administered in 1982 to high school students in Cleveland, Ohio. The median scores for high school students were between 41 and 47 with a maximum score being 80. Increases occurred with grade level. Median scores for college students ranged from 52 to 60 (Norris, 1985).

These tests are the most widely recognized measures to assess thinking skills. If one agrees that the kind of problems posed on these tests are the kind of problems students should be able to solve, these results do demand attention from educators. The median scores are low, suggesting that at least half of the student population cannot consistently think critically to solve problems on the tests (Norris, 1985).

Additional research suggests that students do not demonstrate ability to use higher order thinking skills. Students are intellectually docile (Sizer, 1984), concerned with giving the right answers (Marzano et al., 1988), and treat abstract knowledge as information (Perkins, 1985). These characteristics result from the way students learn what is taught and how it is taught (Beyer, 1988; Jones, 1987).

Teaching students how to think has been viewed as an educational option, but McPeck (1981), Norris (1985), and Siegel (1980; 1984) view critical thinking as an indispensable part of education. Being able to think critically is a necessary condition for being educated and teachers have a moral obligation to teach students to think.

> Teaching with the spirit of critical thinking is the only way to satisfy the moral injunction of respect for individuals, which must apply to students as well as anyone else. (Norris, 1985, p. 40)

Following this line of reasoning, students have a "moral right" to teaching that embodies the spirit of critical thinking and a "moral right" to be taught how to think critically. Thus, abiding by the moral principle of respect for persons, teachers must recognize "...the student's right to question, to challenge, and to demand reasons and justifications for what is being taught" (Siegel, 1980, p. 4).

Student deficiencies in thinking are a growing concern for several reasons. One reason is that it is important to teach thinking because of the rapid growth of information that is available to us. In 1970 the amount of information that was available to us was doubled every ten years. In 1985 it was doubling every five and one-half years and it is estimated that by 1991 information available to us will be doubling every twenty months. Second, it is imperative that schools teach cognitive skills that will last a life time (Beyer, 1988). As Sternberg (1987) points out:

> Bodies of knowledge are important, of course, but they often become outdated. Thinking skills never become outdated. To the contrary, they enable us to acquire knowledge and to reason with it, regardless of the time or place or the kinds of knowledge to which they're applied. So in my opinion, teaching thinking skills is not only a tall order but the first order of business for a school. (p. 42)

Third, without higher order thinking skills, students will be unlikely to function successfully in subsequent grades or in the world outside the classroom. Most of the jobs, responsibilities, and activities encountered outside school require responses at higher levels of behavioral complexity. They often involve analysis, synthesis, and decision-making behaviors in the cognitive domain, organization and characterization behaviors in the affective domain, and articulation and naturalization behaviors in the psychomotor domain (Borich, 1988).

If students are to develop into adults who are comfortable with and skilled in thinking critically, they must receive special preparation. Students must be taught, to value the authority of their own reasoning capacities, to comprehend principles of rational thought, and to consider it natural that people differ in their beliefs and points of view ... that they can learn how to learn from others, even from their objections, contrary perceptions, and differing ways of thinking (Paul, 1984). Students must be taught how to read, write, speak, listen, and reason so as to entertain comparisons and contrasts. Most students in their everyday lives talk and listen to people who are looking at events and situations in a variety of ways. Information technology and the political, social, and economic milieu of today's society will require higher order thinking skills needed for problem-solving and decisionmaking (National Commission on Excellence in Education, 1983).

Too often teachers and students assume that students have learned because they ..."were told; took a course; attended class, read the text, and listened; scored well on exams; and/or have diplomas and degrees" (Kraft, 1985, p. 154). These assumptions must be abandoned if students are to be taught how to think.

In summary, four factors have influenced the decision to teach students how to think (Beyer, 1988; Ennis, 1985; Lipman, 1984; Paul, 1984). First, it is quite evident that a large portion of our students do not apply critical thinking skills (National Commission on Excellence in Education, 1983; Research & Policy Committee, 1985; The College Board, 1983). Second, the response to complaints of student deficiencies in thinking has become a growing public concern (Kraft, 1985; McTighe & Schollenberger, 1985). Third, conditions of the present and the future demand a citizenry skilled in making thoughtful decisions. Fourth, research findings from the cognitive science have alerted us to the inappropriateness of the methods presently used to teach thinking, and have provided new insights into what is required to correct this deficiency (Beyer, 1988; Bruner, 1985; Norris, 1985; Paul, 1985).

Thinking Skills Students Need to Have

Many educators agree that thinking should be taught and that there are a number of reasons for the lack of success in doing so. Some of the reasons are confusion about which skills should be taught as thinking skills, failure to identify the components of those skills chosen to be taught, use of inappropriate teaching techniques, use of curricula that attempt to cover too many skills in too little time, and the lack of congruence between what is taught and what is tested as thinking skills (Beyer, 1985).

From the many approaches used to categorize thinking skills, three were selected for this review: Bloom's taxonomy of cognitive objectives (1956), Marzano's et al. (1988) core thinking and process skills, and Joyce's (1985) teaching models which incorporate higher order thinking skills. In addition to the identification of thinking skills, another consideration is whether they should be taught separately or should be integrated in the teaching of content.

Most of the research in cognitive psychology and problem-solving rests on the premise of hierarchies in skill building. Teachers often sequenced instruction from simple to complex which encourages proceduralization. One proponent of sequencing thinking skills instruction is Beyer (1984). He believes that this is the only way to teach thinking skills and advises teachers to provide:

> ...step by step instructions on how to use specific thinking skills "to spell out" ... exactly how to execute a skill ... the crucial part of teaching a skill is discussing its operational procedures (p. 558).

Beyer (1984) suggests that Benjamin Bloom's taxonomy serves as a useful guide for identifying thinking skills. Bloom's taxonomy (1956) suggests a hierarchy of cognitive skills. The taxonomy defines the operations listed in terms of the various levels of applications. This classification of objectives relates one level of cognitive operations to another with each level including at least some of those beneath it. The cognitive skills in Bloom's taxonomy include knowledge, comprehension, application, analysis, synthesis, and evaluation. For example, to evaluate data one must also recall, understand, apply, analyze, and synthesize these data; thus to teach and learn the skill of evaluation, one needs to be taught the preliminary operations.

Bloom's taxonomy does not mention many of the cognitive operations such as comparing, contrasting, classifying; specific applications of analysis, forms of reasoning; and problem-solving. Beyer is aware of the limitations of this taxonomy, yet he views the list as the best tool to identify a common core of basic thinking operations.

Beyer (1985) readily endorses Bloom's taxonomy because it is widely used in American schools. This taxonomy is the vehicle teachers use and with which educators are comfortable. Bloom's taxonomy would not significantly alter the educational philosophy nor the thinking of the teacher. Many educators accept Bloom's general categories and are convinced that the higher order skills identified are essential to education at all levels. Thus, thinking critically using this taxonomy is learning how to ask and answer questions requiring application, analysis, synthesis, and evaluation; learning to teach critical thinking, therefore, is straightforward. Based on these assumptions, the taxonomy and the ability to "generate a variety of question types" are all an educator needs to teach critical thinking skills. The view that educators using different question types will increase their students' ability to think is significantly misleading according to Norris (1985). Another major dimension of thinking is processing cognitive operations which are essential tools for achieving most goals in the real world (Jones et al., 1987). Process is non-existent in Bloom's taxonomy.

Processes are mental activities, i.e., acquiring information, making choices, thinking, and valuing which are interrelated rather than discrete functions (Parker & Rubin, 1986). Since processes are actions taken with or upon subject matter, one without the other is inconceivable (Shear, 1986). The practice of thinking requires content; the ability to make inferences and generate new information depends on content-specific information (Shear, 1986; Bransford, Sherwood, & Hasselbring, 1985). Thus, thinking involves teaching students subject matter as well as teaching them the processes of thinking. Addressing this issue, Rosenshine and Stevens (1986) stated:

> Explicit teaching procedures are most applicable in those areas where the objective is to master a body of knowledge or learn a skill which can be taught in a step-by-step manner. Thus, these procedures apply to the teaching of facts that students are expected to master so that they can be used with new information in the future. Examples include arithmetic facts, decoding procedures, vocabulary, music notation, English grammar, the factual parts of science and history, the vocabulary and grammar of foreign languages, and the factual and explicit parts of electronics, cooking, and accounting (p. 377).

Students are expected to apply processes or thinking skills to a body of facts. This includes mathematical computations, blending sounds in decoding, map reading, the mechanics of writing personal and business letters, English grammar, applying scientific laws, solving algebraic equations, or tuning an automobile engine. Students are taught a general rule which is then applied to new situations.

Marzano et al. (1988) cite eight thinking processes that can help students build a foundation for learning any content, apply knowledge, or produce new knowledge. The thinking processes are: concept formation, principle formation, and comprehension -- knowledge acquisition; problem-solving; decision-making, research and composition -- apply new knowledge; and oral discourse. The thinking skills embedded in these processes that could be used in the integration of teaching thinking skills with subject-matter were also identified by Marzano et al. (1988).

Blair (1988), Shear (1986), and Joyce (1985) agreed with Marzano et al. (1988) that process (thinking skills) should be linked with content and that the way learners use skills depends on the process and the content area. Each skill has a given process and the criteria and measures for each skill will differ.

The core thinking skills selected by Marzano et al. (1988) were the ones cognitive psychologists report as being important to learning and thinking; each appears to be teachable as established through research studies, field studies, or widespread use in the classroom, and each is valued by educators as important for students to learn. Eight core thinking skills identified by Marzano et al. (1988) as often occurring in the thinking process are:

* Focusing - defining problems and setting goals
* Information gathering - observing and formulating questions
* Remembering - encoding and recalling
* Organizing - comparing, classifying, ordering, and representing
* Analyzing - identifying: attributes and components, relationships and patterns, main ideas, and errors
* Generating - referring, predicting, and elaborating
* Integrating - summarizing and restructuring
* Evaluating - establishing criteria, verifying.

The authors emphasized that these skills could be used at any point in a thinking process and the same thinking skills could be repeated. The listing of the skills should not be interpreted to support teaching of these skills in isolation.

Recognizing the importance of identifying and defining core skills as well as the "fuzziness" in the distinction between a process and a skill, Marzano et al. (1988) differentiate between process and skills in terms of being "goals" or a "means to achieve a goal." Marzano et al. (1988) conclude that processes involve using a sequence of skills intended to achieve a particular outcome. Students are expected to be involved in various skills to conceptualize, comprehend, compose, and solve problems. For example, students do not summarize for the sake of summarizing, nor do they set goals as the means to an end.

Marzano et al. (1988) illustrate the relationship between processes and thinking skills by comparing a tennis coach to a classroom teacher. In a tennis game, the player uses component skills that were learned and could be improved upon from isolated practice. The beginning tennis player may be successful in serving the ball, but proficiency develops in game situations through awareness and independent practice of component skills. A good tennis coach would provide isolated practice as well as tennis games. When the student is playing, the coach offers feedback on how the player is applying the skill.

Similarly, a classroom teacher can enable students to improve their ability to compose, solve problems, or make decisions by giving students the opportunity to use thinking skills such as observing, comparing, or inferring. During a lesson using a thinking process, the teacher may observe that students are not careful observers nor are they logically supporting inferences. Just as a tennis coach may instruct a player to "keep your eye on the ball," or "get your racket back," the classroom teacher may coach students to "look again to see what else you can observe" or "explain how the instance you cited supports your position" (p. 65).

Based on the teachers' observation of the students' thinking processes, the teacher may need to provide some isolated skill practice. The classroom teachers' coaching during a thinking process is like the tennis coach's reminders during a game: it helps students recall and apply what they learned during practice.

Thinking processes often begin with an unresolved problem. Students define the problem and set goals. Next, information is gathered by observing and formulating questions or activating prior knowledge. At certain points in this process, information is organized by comparing, classifying, or ordering. Data are organized and checked for accuracy, identification of main ideas, attributes and components, relationships and patterns. Additional ideas may also be generated by inferring, predicting, and elaborating. Occasionally, information is combined, summarized, and reconstructed. Eventually students arrive at a solution, construct new meaning or create a product. Established criteria are used to evaluate and verify aspects of the proposed solution or product. "Because this general pattern of skills is characteristic of descriptions of most thinking processes it can be helpful in designing units of instructions" (Marzano et al., 1988, p. 67).

"Models of teaching that directly teach both content and intellectual process" have been identified by Joyce and Weil (1986, p. 5). Models identified to help teachers merge thinking processes and content are:

* Attack problems inductively (Taba, 1966). Thinking skills identified in this concept formation model are enumerating and listing, grouping, labeling, categorizing, identifying and exploring relationships, making inferences, predicting consequences, explaining unfamiliar phenomena, hypothesizing, and verifying the prediction.
* Acquire concepts (Bruner, Goodnow & Austin, 1967). Students acquire concepts by labeling; comparing and contrasting; generating and testing hypotheses; creating dialogue; identifying alternatives; being sensitive to logical reasoning in communication; predicting consequences; and explaining and verifying predictions.
* Process information skills models: inquiry training (Suchman, 1962), scientific inquiry (Schwab, 1965), and group investigation (Dewey, 1917; Thelen, 1960). The models of inquiry and group investigation teach students to engage in casual reasoning, observing, collecting, and organizing data;
identifying and collecting variables; formulating and testing hypotheses, explaining; and inferring.
* Analyze personal behavior, set personal goals, and conduct independent inquiry; nondirective teaching (Rogers, 1983), and awareness training (Brown, 1964;

Perls, 1968; Schultz, 1958, 1966). These models include the thinking skills of defining the situation, discussing problems, planning, decision-making,and integrating.

There are relationships between Joyce's models of teaching (1985) and Marzano's et al. (1988) thinking process and skills. They both identify either a teaching model or a process of thinking skills included in each. Twelve of the same thinking skills identified by both authors are: defining problems and setting goals; observing; organizing and comparing; analyzing and identifying attributes and components; analyzing relationships; generating and predicting; integrating and verifying. Teachers are encouraged to use strategies that will increase their students' awareness of the components of thinking.

All of these models contribute to growth in thinking ability, cognitive development, and conceptualization (Hunt, 1977; Sigel, 1984) and thinking skills are greatly improved when strategies are combined to teach subject matter (Joyce, 1985). Both types of learning--content and thinking--are basic skills and both should receive adequate attention in our schools. Each type of learning contributes to the other. According to Blair (1988), ..."a literate person possesses both facts and understanding and can use information to analyze and think divergently" (p. 56).

Thinking Skills Students Learn from Inquiry

The thinking skills of inquiry are: defining problems, observing and formulating questions, recalling, comparing, classifying, identifying attributes and components, identifying relationships and patterns, inferring, predicting, summarizing, restructuring, and verifying. Many of the skills cited here were identified by Marzano et al. (1988), and included in Joyce's (1988) models of teaching.

The inquiry method fosters independent learners, develops intellectual discipline and skills necessary to raise questions, encourages students to search out answers stemming from curiosity, (Joyce, 1985), and enhances the development of creativity (Henson, 1988). Students learn to question why events happen and to acquire and process data logically, thus discovering why things are the way they are. Once students experience this process in the classroom, whatever happens in the classroom can happen wherever or whenever circumstances are similar (Borich, 1988).

The inquiry method is built around intellectual confrontations. Students are presented a problem by the teacher (Henson, 1988) and asked to draw conclusions and generalizations or to find a pattern of relationships. Responses can take many different forms during the inquiry process. Students can rearrange or add to the material presented to make it more meaningful. Many explanations may be possible and students are encouraged not to be satisfied with the first explanation that appears to fit the facts. While inquiry learning is concerned with solving problems, it does not require solutions but a rather flexible, systematic approach toward solutions. There is rarely a single, best answer and students are guided to an answer that goes beyond the problem or the material presented (Henson, 1988).

According to Lazarowitz and Lee (1976), an intriguing thing happens to the total perspective and behavior pattern of teachers and students who are involved in inquiry learning. The teachers become student-oriented rather than subject-oriented. Students become more cooperative and less competitive (Johnson & Johnson, 1976) and teacher student relationships are positive. A high degree of involvement from all its participants from the beginning and throughout the process is required for inquiry learning (Tathart & Binghan, 1973). Therefore, the inquiry learner is internally motivated and works for the joy of learning. Involvement in inquiry learning improves students' attitudes toward the subject in particular and toward school in general.

"Knowledge won through inquiry is not knowledge merely of facts but of the facts interpreted" (Schwab, 1962, p. 14). The conceptual principle of inquiry renders knowledge fragile, dubitable, and subject to change, and "it is important to convey this principle to students - that all knowledge is tentative" (Joyce, 1986).

The Inquiry Method of Instruction

The inquiry strategy, often called inquiry training, was developed by Richard Suchman (1966). It is based on the scientific method of instruction and designed to teach students a process to investigate and explain unusual phenomena. Like Bruner and Taba, Suchman believed that students could become increasingly conscious of their process of inquiry, and be taught scientific procedures directly (Joyce, 1986).

Suchman (1966) and Beyer (1971) have done extensive work using the inquiry strategy. The syntax of Suchman's model has five phases: (1) confronting the puzzling situation, (2) data gathering (verification), (3) data gathering (experimentation), (4) organizing information gathered and explaining discrepancy, and (5) analyzing the problem-solving strategy used during the inquiry. Student classroom activities are based on these phases.

During phase one, students are presented with surprising, puzzling events or ideas. The teacher presents the problem situation and explains inquiry procedures to the students. The teacher provides as little guidance as possible and expectations are minimal; students are free to explore and learn on their own. The expected consequences of exploration are that students will: (a) discover the inadequacy of their background knowledge to deal with new phenomena, (b) be stimulated and motivated by curiosity, and (c) be provided with a common experience to further develop concepts. Students are now mentally prepared for the second phase: data gathering-verification or invention or concept introduction (Costa, 1985; Joyce & Weil, 1986).

In phase two, the teacher provides experiences for concept development. This concept development helps students understand the relevant relationships within the concept and between concepts that give meaning and understanding to the idea or event.

The third phase, data gathering-experimentation (discovery or concept application), allows students to use concepts in a variety of situations. Students observe how the essential features of the concept stay the same even though the context changes (Germann, 1989). Students are responsible for building and testing their theories and explanations by determining what data are needed and how data may be obtained. The teacher acts as a facilitator to help students acquire information and data that are needed. The teacher asks questions and helps students recognize the difference between questions that attempt to verify "what is" and questions or activities that "experiment" with the relationship among variables (Joyce & Weils, 1986). The questions are intended to help students search for and discover the answer with a minimum of assistance from the teacher (Borich, 1988). These questions guide students into discovering new ways of solving a problem or viewing a dilemma.

The way the questions are asked is important in using this strategy. Good questions do not ask students to state a rule or quote a definition; instead, good questions ask students to apply rules to something (Henson, 1988).

Students are asked to organize data and formulate explanations during phase four. Several theories or explanations are possible. Students are encouraged not to be satisfied with the first explanation that appears to fit the facts. The teacher's role becomes one of restraining students whenever they assume that a variable has been disproven when it has not (Joyce, 1986).

In phase five, students are asked to analyze patterns of inquiry: the lines of questioning that were productive, the questions that were most effective, and the type of information that was needed. Evaluation follows this phase. The teacher cannot be concerned with subject matter or getting the right answer. The whole idea behind the inquiry strategy is to bring about a community, searching together for a more accurate and powerful explanation of everyday phenomena (Black, 1952).

Developing a framework to solve everyday problems was the premise of Beyer's inquiry model (1971). His model, sometimes referred as a problem-solving strategy (1979), consists of seven steps: defining the problem, developing a tentative answer, testing that answer, evaluating the hypotheses, formulating a tentative conclusion, checking, and concluding.

In the inquiry process developed by Beyer (1979) the problem is presented as a question. The problem might be in the form of a real-life or a hypothetical situation, a case study, a picture or cartoon, an object -- anything that is puzzling. This establishes the goal for inquiry which is to recognize what the problem is and state it in the form of a question.

Once the problem has been identified, the process of searching for answers begins. Three steps characterize this process: hypothesizing (developing one or more tentative answers), testing the hypotheses, and drawing conclusions. Before the conclusion is accepted, checking whether procedural or substantive errors were made, or whether other procedures might produce the same or different results must be done (Beyer, 1988). If the hypothesis has met the stated criteria, it is then considered to be the desired solution. These three steps may be repeated over and over until a satisfactory answer has been determined (Changing Times Education Service, 1975). Once a conclusion is reached, students apply what they have learned to real-life situations.

The two models are similar. Both include identifying a problem and clearly stating it as an early phase in the process. In phase two of Suchman's model, the students are concerned with concept formation, i.e., labeling, categorizing, and interpreting data. Students using Beyer's model in phase two are concerned with hypothesizing. Students scan the available data and recall previously learned data to seek a connection or relationship among the data. Beyer suggests that brain storming and working backward from the ideal or the goal to the existing condition has proven to be a useful technique at this point.

The kind of operations that are done in phases three, four, and five -- gathering, organizing, and evaluating data -- are the same for both models. In addition, Beyer's model is concerned with critical analysis leading to a tentative conclusion. If the hypothesis is rejected for insufficient supporting data or failure to meet stated criteria, attention then shifts to the invention and testing of new hypotheses, or to redefining the problem (Beyer, 1988).

Although Suchman's (1966) and Beyer's (1979) models were designed for the natural sciences, their procedures have proven useful in a variety of subject areas because inquiry uses a general problem-solving framework. Whenever a topic can be formulated as a puzzling event, it becomes suitable for inquiry training. The construction of the puzzling event is the crucial and critical task to developing inquiry. "It transforms curriculum content into problems to be explored" (Joyce & Weils, 1986). The problem statement describes the discrepant event and provides the information that is initially shared with all of the students. The inquiry model is selected according to the various disciplines and the purposes of inquiry. Thus, models of inquiry point out the variety of actions that can be involved in the process.

The researcher's model of inquiry combines the strengths of both Suchman's (1966) and Beyer's (1971) models. The researcher wanted to introduce home economics secondary students to textiles by using a scientific approach and do it in such a way that teachers would feel comfortable using it. The researcher had to come up with a model that combined the familiar with the unfamiliar. The home economics teachers were familiar with competency-based education, textiles information, and the six-point lesson plan which was the format used for teaching and learning. By combining Suchman's and Beyer's models, the researcher developed an inquiry model that used the six-point lesson plan, objectives, competencies, and suggested activities from a state curriculum guide using the competency-based education framework.

The researcher's model had six phases of operations: introduce the inquiry experience, define the puzzling event, gather data, develop a conclusion, apply the conclusion, and summarize the experience.

During phase one, the teacher lists or states the objectives for the lesson and introduces the students to the inquiry experience. The topic for discussion is related to a previously learned experience or encounter. Phase one is teacher centered and the stage is set for the inquiry process.

In phase two, the puzzling event is presented. The puzzling event is either a problem dealing with a real-life situation or an experiment using textile content defined by the curriculum guide. Students are then asked to hypothesize about the solution to the problem.

The third phase, data-gathering, allows students to test the hypotheses. Data needed and the procedure for testing the hypotheses are identified and made available to the students. In this phase the teacher becomes the facilitator and the students are responsible for testing the theories.

In phase four, students discuss conclusions from the organized data and formulate explanations and evaluate the reasonableness and quality of ideas. The teacher discusses the conclusions and asks questions about student findings.

Students analyze patterns of inquiry in phase five by applying the conclusion. The teacher takes the students back to the puzzling event and asks them for solutions. The teacher also places the students into a similar situation allowing them to practice what they have just learned. Teacher guidance throughout the process eventually leads to accurate conclusions.

What the student learned becomes apparent in phase six. In this phase, students are asked to summarize the lesson. Up to this point students have been testing and applying conclusions to their theories so that they may solve the original problem.

In summary, process and content are both important and the inquiry method has successfully combined them. Although the process of inquiry takes precedence over content (Spitze, 1968-69), content is learned and remembered longer when taught in conjunction with thinking skills.

Using Inquiry to Teach Science

Since the science curriculum incorporated the inquiry strategy over twenty years ago, the researcher turned to studies in science education examining the effect of the inquiry method of instruction on achievement. The search of the literature provided no documentation of inquiry studies in textiles or home economics.

Despite the importance of teaching science through an inquiry approach, a discrepancy exists between general statements about the importance of inquiry and the attention given to it in practice (Welch, Klopfer, Aikenhead & Robinson, 1981). Studies of science education in American schools point to this discrepancy which suggests that inquiry is not being taught effectively (Barufaldi & Swift, 1980; Costenson & Lawson, 1986; Hurd, 1970; Hurd, Bybee, Kahle, Yager, 1980; Nagalski, 1980; Welch et al., 1981).

Teachers made positive statements about the value of inquiry and yet felt more responsible for teaching facts that show up on tests (Welch et al., 1981). A majority of the teachers surveyed by Welch et al. (1981) had four complaints about the inquiry approach: difficult to manage, caused confusion, failed for most students, and was too difficult for the low-and average-ability students.

In a similar study, Costenson and Lawson (1986) reported that many biology teachers do not like an inquiry approach because students cannot read inquiry materials, outcomes of inquiry are too uncertain, most students are not capable of inquiry, regular biology classes have few formal reasoners, and students and teachers feel uncomfortable about inquiry.

Hurd et al. (1980) also found that teachers not only feel uncomfortable with inquiry, but feel ill-prepared in their eyes (and in the eyes of others) to guide students in inquiry learning. Welch et al. (1981) also reported that one-third of the teachers surveyed were not adequately prepared to teach inquiry and felt they received inadequate support for such teaching.

This discrepancy between educators' expectations for inquiry behavior and the actual results was the premise of Sweitzer and Anderson's (1983) research on a quantitative assessment of the existing research on training outcomes associated with teaching inquiry behaviors and the techniques and procedures used to obtain them. For their study, a broad definition of inquiry strategy was used:

> ...those teacher behaviors that facilitate student acquisition of concepts, processes, and skills through active involvement with general inquiry strategies. It incorporates aspects of the investigative and discovery phases of science and affords opportunities for the students to test and refine concept meanings. Through this type of learning, and the acquisition and synthesis of scientific knowledge and processes, the ability to perform scientific inquiry becomes possible. A teacher equipped to engage in inquiry teaching would possess questioning skills that are divergent, have a knowledge of science processes and have the capacity to conduct student-centered inductive learning activities. (Sweitzer & Anderson, 1983, p. 455)

Studies were selected from 1965-1980. Sixty-eight studies were coded resulting in 177 effect size calculations. One hundred and fifty-four effects sizes were outcomes measured on teachers while 19 were outcomes measured on students and four were student measures about teachers. While researchers advocate measuring teacher behavior by evaluating students' performance, this was done in only a limited number of cases and no analysis of the effect sizes related to outcomes measured on teachers by students was performed.

Three variables were significant at the 0.05 level: multiple choice methods included in the treatment variables on training, grade level with effect size, and the measurement method for the means effect size.

Outcome criteria were classified as knowledge and intellectual processes, teachers' classroom behaviors, and affective outcome. Knowledge of science processes was measured in 33 cases and produced a mean effect size of 1.08. The measurement of the outcome variable inquiry strategy in the classroom behavior category had a mean effect size of 0.89.

Sweitzer and Anderson (1983) concluded that a variety of teacher education programs result in changes in science teachers' knowledge, classroom behaviors, and attitudes. There was a variety of potentially successful approaches available to put inquiry into practice although all approaches were not of equal potential.

One study (Bennett, 1983) investigated the relationship of the teachers' curricular plans and actions to the general pattern of verbal interaction in the classroom and to pupil feelings regarding their instructional experiences. Bennett used Suchman's (1966) and Ausubel's (1963) models to provide frameworks for developing the inquiry strategy and the advanced organizer strategy. Evidence from the analyses confirmed that when strategy was held constant, sequence, teacher, and school effects influenced classroom interaction patterns. All of the descriptive data pertaining to the interaction patterns refer to the advance organizer and inquiry lessons. Teacher and student roles were distinctly defined according to the curricula organizing strategy used in the classroom. The teacher student ratio of speech was approximately two-to-one in the advance organizer lessons and one-to-two in the inquiry lessons. The most remarkable characteristic of the teacher-student talk data was the inverted pattern of conversation for the two strategies.

Teacher talk in the advance organizer was twice the total amount of teacher talk in the inquiry lessons. Widely differentiated patterns of silence and/or confusion in the inquiry lessons were twice as large as in the advanced organizer lessons. Consequently, it may be inferred that there were more thoughtful pauses and a generally slower tempo of interaction in the inquiry lessons than in the advance organizer lessons. More than twice as much time was devoted to content in the advanced organizer lessons than in the inquiry lessons. The main purpose of the advance organizer lessons was learning subject matter, whereas in the inquiry lessons, subject matter was not the main concern. The teachers asked substantially fewer questions and gave much less information to the students in the inquiry lessons than in the advance organizer lessons.

Scott's (1973) study investigated the longitudinal effects of the inquiry strategy method on the styles of categorization of pupils. The independent variable in the study was the inquiry strategy method developed by Suchman and modified by Scott. The dependent variable was the student's style of categorization, which was assessed by the Siegel Cognitive Style Test. Ninety-two students were involved in the study. Forty-two of the students were experimentals and received two to three years of inquiry strategy exposure in their science classes during their later elementary or early junior high school years. The remaining students were used as comparisons, having received conventional science teaching only. Students were questioned to ensure exposure/nonexposure to the inquiry strategy.

The longitudinal groups were tested twice -- at the end of the seventh grade and again prior to graduation from high school. The two questions answered from this testing: (1) Were the styles of categorization of inquiry exposed students different from students who had received conventional science teaching? (2) If there were any differences in styles of categorization between the two groups of students, would these results be stable over a period of five years?

The cross-sectional groups were tested one time (just before high school graduation). The question to be answered by this testing program was: Were the styles of categorization of the students exposed to the inquiry process any different from a cross section of their classmates prior high school graduation? Results indicated changes in cognitive styles after entry into the inquiry program which were statistically significant in two categories ($x^2 = 6.78$, $p < .01$), ($x^2 = 6.78$; $p < .01$).

The students in the longitudinal group engaged in inquiry procedures were more analytical than comparison students who had not experienced the inquiry method. The inquiry process apparently had a persistent effect on the students' analytical behavior so that the students maintained a significant advantage over comparison students for six years

(x^2 = 6.13, $p < .02$). Since the results were consistent across both the longitudinal and cross groups, the inquiry strategy method improved the students' ability to classify objects through analytical preference.

Implications for the Study

Learning and thinking are inseparable, because one cannot learn without thinking about something. A teaching model that successfully combines the two processes is the inquiry method. The inquiry model teaches students how to think (process), while learning content (subject-matter). Although the inquiry method was developed for the natural sciences and has been given significant attention, few studies support the premise of increased student achievement. The review of the literature supported the positive effect of the inquiry process, implications for use, and the lack of teacher training in its use. Teachers must study theories, see them demonstrated, practice them, and use them in the classroom many times before they can become comfortable with them. Hence, instructional materials developed for textiles using the inquiry process was the focus for this study.

CHAPTER III

METHODS AND PROCEDURES

The major purpose of this study was to examine the effect of the inquiry method of instruction on achievement of secondary home economics students in clothing and textiles classes. This chapter describes the experimental design of the study, site and sample selection, the development of instructional materials, instrumentation, data collection, and data analysis.

Design of the Study

A quasi-experimental design was used for this study (Cook & Campbell, 1979). The nonrandomized control group, pretest-posttest design was used as a result of the groups available for participation in the study. Each teacher administered the pretest, taught the unit, and administered the posttest. Demographic and background information: grade level, grade-point average, and number of classes missed were collected as potential covariates in the analyses. The independent variables were grades students received at the end of the first semester in their clothing and textile class, the number of class sessions students attended during the experimental unit, and the grade students were in during the experimental unit. The dependent variable was the posttest achievement score.

In addition, in the experimental group, the effect of two independent variables on the dependent variable was examined. These independent variables were student and teacher attitudes toward the use of the inquiry method of instruction.

Selection of Sample

The subjects were 9th, 10th, 11th, and 12th grade secondary students enrolled in a second semester home economics course in clothing and textiles in District III in North Carolina. In search of a sample for this study, the researcher contacted a North Carolina home economics state consultant. The consultant suggested that the researcher contact vocational directors in District III because of its diverse student population (city and rural school districts). The consultant provided the researcher with a list of eighteen District III vocational directors, their telephone numbers, and their individual school systems. The researcher telephoned all of the local directors and asked for their assistance in identifying the sample to be used in the research. The directors were asked to respond to three questions pertaining to research requirements. The researcher wanted to know whether Clothing and Textile 7035 was taught in their system, and if so, was it taught as a year-long course? Clothing and Textile 7035 is a two-semester course usually (but not necessarily) with clothing being taught the first semester and textiles the second semester. The researcher's study focused on textiles; therefore, the research would have to be done during the semester textiles was taught. The third question dealt with the number of classes in the textiles unit. Of the 18 school systems contacted, four did not offer a course in clothing and textiles and one local director did not respond. One director sent out a memo to all home economics teachers in that school system. All the other local directors told the researcher to personally contact the teachers. A total of 30 schools was identified.

Once the schools, teachers, and number of sessions were identified, teachers who met the criteria for participation in the study were sent a letter explaining the purposes of the study, research requirements, and a form soliciting participation (Appendix A). The researcher's letter was mailed to 20 secondary home economics clothing and textiles teachers. Thirteen (65%) of the teachers responded. Of the number responding, 6 or 46% of the teachers volunteered to participate. The local director's memo about the study was sent to 20 home economics teachers. Thirteen (65%) responded; 12 or 92% volunteered to participate representing eleven schools in Wake County. The 12 from Wake County were selected as the experimental group because the researcher was not allowed to randomly assign volunteers to the experimental and control groups. All Wake County teachers had to be inserviced at the same time due to the system's policy. Of the 12 teachers who initially volunteered from Wake County, only 7 agreed to remain in the study after the inservice workshop. Therefore, 7 Wake County teachers from 5 different schools and 74 students formed the experimental group. Six teachers from 5 different counties and 63 students formed the control group. Teachers in both groups were instructed not to teach topics prior to the experiment that related to textiles.

Development of Instructional Materials

Materials were developed using the inquiry approach to help students learn technical information about textiles and use various scientific facts to make clothing decisions. Objectives and subject-matter content were competency-based and selected from the North Carolina 7035 Clothing and Textile Curriculum Guide. The competency statements from this curriculum guide provided the foundation upon which the objectives, content, teacher/learning activities, resources and test items were based. North Carolina state-adopted clothing and textiles textbooks, teacher guides, and several other textile texts were examined. Based upon the information obtained from the textbooks and the curriculum, information about thinking skills, and suggestions of a state consultant, five topics were selected. The topics were:

(1) fiber identification, (2) types of yarns, (3) man-made fibers, (4) fiber properties, and (5) care of fabrics. The six objectives selected from the curriculum guide were:

1. Name the different types of fibers.
2. Explain the characteristics of natural and manufactured fibers.
3. Describe ways yarns are made.
4. Identify appropriate use of fabrics for clothing and home interior products.
5. Demonstrate stain and soil removal techniques.
6. Identify different products which are helpful in caring for textile products.

Based upon these objectives, the researcher developed lesson plans that used the inquiry strategy with textiles content. Lesson plans were developed in the "Six Point Lesson Plan" format that is used in the school systems in North Carolina. The Six-Point plan contained six parts: focus and review, statement of objectives, teacher input, guided practice, independent practice, and closure.

Components of the researcher's lesson plans were: objectives, introduction, instruction and data-gathering, developing a conclusion, applying the conclusion, and summarizing. Although the parts of the plans are headed differently, the format of both are similar: (a) objectives are stated to guide the lesson, (b) the teacher guides students to focus on the lesson by introducing the topic and relating it to a previous encounter, (c) students acquire new information which is presented under the headings of instruction and data gathering and teacher input, (d) developing a conclusion, and (e) students apply the conclusion of the researcher's model, corresponding with guided and independent practice. The greatest difference in the two plans is found in the last component. Lesson endings are left to the discretion of the teacher in the sixpoint plan, whereas students summarize the lessons in the inquiry plan.

Lesson Plans

The researcher believed that the selection of textiles content to fit into an inquiry model was crucial. Criteria used in the selection of the content were that it was possible to pose it as a problem, be relevant to life experiences, and fit into the inquiry model. Six phases of operation within the lesson plans are described as follows.

Phase 1. During phase one, in the materials developed, the teacher introduced the inquiry experience. The topic for discussion was introduced by relating it to a previously learned experience or encounter. Phase one was student and teacher centered, setting the stage for the inquiry process.

Phase 2. In phase two, the puzzling event was presented. The puzzling event was either a problem dealing with a real-life situation or an experiment. The problem was in the form of a question which helped the students to recognize the problem. Students were then asked to hypothesize about possible solutions to the problem. Puzzling events help students to become aware of potential learning and to develop their own questions.

Phase 3. The third phase, data-gathering, allowed students to test the hypotheses. Data needed to test the hypotheses were identified and made available to the students. Hence, students were introduced to explicit textile concepts in the context of a meaningful problem. In this phase the teacher becomes the facilitator and the students are responsible for testing the theories.

Phase 4. In phase four, students developed conclusions from the organized data and formulated explanations. Student worksheets were included with each lesson to help them understand the explanations and emphasize key concepts. The teacher discussed the conclusions and asked questions about student findings.

Phase 5. Students were asked to analyze patterns of inquiry in phase five by applying the conclusion. The teacher took the students back to the puzzling event and asked them to re-examine their original hypotheses.

Phase 6. What the student learned became apparent in phase six. In this phase, students were asked to summarize the lesson and apply information learned to new situations. Up to this point students had been testing and applying conclusions to their tentative hypotheses in order to solve the original problem. A copy of a lesson plan is in (Appendix B).

Instructions were given throughout the lesson plans. These instructions served to communicate possible responses from students and bridge the gap between teacher and researcher. Teachers were given instructions on posing questions that solicit student responses. The comments that students made formulated the hypotheses. The researcher included possible hypotheses that related to the lesson. The next set of instructions helped students gather data. Teacher instructions guided students through activities and experiments. Instructions were also given on how to introduce new concepts. For example, in the lesson on abrasion, students were given garments and asked to identify where abrasion had occurred and why it had occurred. Students were sent to various stations that contained activities and information that would help the students answer these questions. The researcher gave explicit instructions on how to set up each station. In addition to communicating to the teachers possible student responses, the researcher included sample questions designed to guide students in relating the data obtained for solving the original "puzzling event" to new problems. Usually, the lesson plan format and content using the inquiry method is structured by both teacher and students as the lesson unfolds. However, since the participants in this experimental study were not familiar with the inquiry method of instruction, the researcher provided more structure than would be needed by experienced teachers to provide guidance in use of the method.

Thus, in each of the lesson plans, ideas for introduction of the lesson and the puzzling event were given. The students were then asked to hypothesize about the "puzzling event." From this point on, the teacher's role was one of facilitator. It was the teacher's responsibility to keep the student discussion focused and to ask questions that would lead to developing a conclusion. After experimentation the teacher led the discussion, helped students internalize the process by providing an application experience, and helped students summarize what was learned. Student sheets guided the students in recording and organizing the outcome of the inquiry experience (Appendix C).

Pilot Test

Prior to use in the study, the lesson plans and assessments measures were pilot tested with subjects similar to the sample population in the study. The pilot test determined the appropriateness and practicality of the materials to be used. The most useful resources for the topics to be taught were also considered. The sample consisted of 15 interior design students studying textiles in a Burlington City school. Just before the unit started, students completed the pretest to be used in the study. In the pilot study, fiber identification was taught first, followed by types of yarns, fiber properties, manufactured fibers, and care of fabrics. The results of the pilot study revealed that separate lessons for natural and manufactured yarns were not appropriate for the inquiry experience, so these lessons were combined. Following the pilot study, the teacher and student suggestions were incorporated into the final plans. The order of the topics was rearranged and more time was allotted for some of the lessons. Student worksheets were also modified. Guidelines were written for the teachers to facilitate communication between the researcher and the teacher. The eight lessons developed for the experiment were:

1. Identification of Fiber Categories - Burn Test
2. Distinguishing Natural Fibers - Microscopy
3. Structure and Performance of Manufactured Fibers - Nylon
4. Fabric Structure and Performance - Absorbency
5. Comparative Analysis of Fabric Characteristics - Resiliency
6. Fabric Structure and Performance - Wicking
7. Fabric Structure and Performance - Abrasion
8. Laundry Practices.

Workshop for Teachers

The researcher conducted a workshop on the inquiry process and its use in teaching textiles for teachers in the experimental group. The workshop had four objectives: (1) understand the inquiry process, (2) differentiate between the roles of teacher and students in the inquiry method, (3) compare and contrast the inquiry method of teaching to more traditional methods of teaching, and (4) relate the inquiry process to the teaching of textiles.

A filmstrip contrasting the expository and inquiry methods of two consumer-education teachers was used to introduce the inquiry process. The participants were asked to describe, from a student's point of view, the learning that occurred in each of the classrooms. Participants cited advantages and disadvantages of both methods and stated they preferred being a student in the classroom where inquiry was taught.

The participants were introduced to the steps of the inquiry process and its application for teaching textiles by using activities developed by the researcher. Participants experienced defining problems to establish the goal for inquiry, developing hypotheses, and gathering data. After teachers became familiar with the framework, they applied the inquiry process to the teaching of textiles. The workshop participants then experienced inquiry by using one of the lesson plans and series of worksheets developed by the researcher.

At the completion of the inquiry experience, participants were given a tentative schedule for participating in the experiment. The researcher emphasized the importance of adhering to the proposed schedule and using the lesson plans developed for experimentation. Participants were reminded that the purpose of the research was to compare the inquiry method of instruction with the more traditional methods; anonymity of data was guaranteed and participants signed human subject forms. There was approximately six weeks between the workshop and the teaching of the topics. The teachers were asked to use this time to acquaint their students with the inquiry process.

Teachers in the control group were invited to participate in the inquiry workshop in May after the completion of the experiment. The researcher conducted the workshop and used the same inquiry model, activities, and lesson plans that were used with the experimental group. The teachers were given a copy of the eight lesson plans for future use.

Instrumentation

No instruments were found to assess knowledge on textiles. Therefore, four instruments were developed by the researcher to collect data for this experimental study: "Textiles Test," "Student Attitude Toward Inquiry," "Teacher Data Survey," and "Teacher Interview."

The "Textiles Test," consisting of 66 items, was used for both the pretest and posttest assessment of student achievement. It included 15 multiple choice, 12 double multiple choice, 34 matching, and five scenario alternative-response items developed from the objectives for each lesson (Appendix D).

A table of specifications was constructed to ensure the content validity of both the subject matter and the cognitive level of the objectives to be measured. The test was examined by a high school teacher and two college instructors experienced in test construction and evaluation. Suggested revisions were made before the pilot test. The test was then used with the same students who pilot tested the lesson plans. An item analysis was run on data obtained from the pilot test and revisions were made for clarity only. No revision was made as a result of item difficulty and discrimination indices based on the results of the analysis. The reliability of the "Textiles Test," using scores of students in the experimental group, was measured by the Kuder-Richardson Formula 20. This formula assessed the homogeneity of the posttest items. Each question on the test was assigned a value of 1 for a total of 66 points. The variance of scores on the total test was calculated. The product of the proportion of correct and incorrect responses was calculated and a coefficient of .88 was obtained.

Data were obtained from the teachers in the experimental group only by using forced-choice and open-ended questions in a personal interview. The interview technique was chosen so that the respondents could express themselves and help the researcher give meaning to the data. A Likert-type "Teacher Data Survey" form of 14 items focused on the teachers' attitude toward the inquiry method, level of confidence, and satisfaction with the inquiry process as well as the instructional materials used to teach the topics. A five point scale ranging from 1 (strongly disagree) to 5 (strongly agree) was used to score each of these statements. Of the 14 items, seven were stated in a negative manner and the other seven were stated in a positive manner. Teachers also provided personal data and information relating to pupil reactions (Appendix E).

The "Student Attitude Toward Inquiry" form sought two types of data. The first part (seven questions), gathered demographic and background information about the students. Two questions were demographic, two dealt with previous encounters with textiles, and the others dealt with clothing practices. The second part of the "Student Survey" assessed the students' attitudes toward the inquiry process and the instructional materials used. Using a Likert-type scale a series of 12 items allowed for a response of (1) strongly disagree, (2) disagree, (3) uncertain, (4) agree, and (5) strongly agree. Negative items were scored in reverse. Scores were then calculated by adding each student's score on all questions and dividing by the number answered. Thus a high score indicated a positive attitude toward the inquiry method and the instructional materials used (Appendix F).

Data Collection

Toward the end of January 1990, teachers received specific directions to follow while conducting the research project. The experimental group was notified of the place and date of the inquiry workshop and was instructed not to teach topics previously indicated before the experiment began. The control group was asked to wait until after the pretest had been given to teach the specified content.

One week before starting the study, teachers in the experimental group received the pretest, the inquiry lesson plans, and supplies needed to teach the topics on textiles. All materials needed were listed at the beginning of each lesson in a section entitled "Preparation for the Class Session." Most lessons required the use of textile products. Several textile companies donated their products to this project (Appendix G). Other products were furnished by the researcher. In addition to fibers, yarns, and fabrics, chemicals and scientific equipment had to be provided. The researcher furnished the chemicals and most of the scientific equipment. The home economics teachers borrowed remaining scientific equipment from the science teachers in their schools. The researcher measured and mixed the chemicals, cut fabric swatches, yarn samples, and organized supplies for each lesson.

All students were pretested at the beginning of the unit and the topics were taught. Students were posttested and completed the student survey at the end of the unit. Throughout the study the researcher was available to answer questions, assist in instruction, set up equipment for labs, and solve problems should they arise. In addition, teachers completed the Teacher Data Survey and were interviewed by the researcher.

The control group followed the same schedule. In addition to being instructed not to teach the topics until notified, they were given a proposed outline of topics to follow. The students in the control group were pretested in April 1990, the topics were taught, and the students were posttested at the end of the unit. The researcher collected the posttest at the workshop that was held for the control group in May 1990.

Data Analysis

All data collected for this study were analyzed through the services of the University of North Carolina at Greensboro Computer Center. SAS, which is a system of computer programs designed for the analysis of social science data, was used.

Descriptive statistics summarized the teachers' level of confidence and satisfaction with strategies used to teach textiles. The frequencies subprogram summarized the responses of the group of students to the survey measures and other demographic data, mean scores, and standard deviations of the variables.

Inferential statistics were used to analyze the change score between posttest and pretest. The $\underline{t}$-test determined the extent to which predicator variables explained a significant amount of the variation selected in the posttest scores. Analysis of covariance was used, with the pretest as the covariate, to determine if the mean scores of the two groups were significantly different. A .05 level of significance was used in the analyses. Kuder-Richardson Formula 20 determined the reliability of the cognitive section of the instrument.

Multiple regression was employed to determine the independent variables which accounted for significant amounts of variation in the dependent variable. This procedure, used with the cognitive and attitudinal scores, determined relationships among the scores and the independent variables.

CHAPTER IV

FINDINGS AND INTERPRETATION OF DATA

The purpose of this study was to examine the effect of the inquiry method of instruction on achievement in a secondary school setting. Achievement scores of two groups of students were compared; one of which had been exposed to the inquiry method of instruction and one which had not. The relationship among posttest achievement scores of students and their pretest scores, grades students received at the end of their first semester clothing and textiles classes, the number of classes attended during the experimental unit, and student classification were examined. Posttest achievement scores of the experimental group were examined in relation to student and teacher attitudes toward the use of the inquiry method. This chapter presents and discusses the demographic characteristics of participants, tests of hypotheses, and analysis of test results.

Demographic Characteristics of the Participants

The sample for this study consisted of 144 students. Of the 144 participants selected, 7 were eliminated because they did not take either the pretest or posttest, resulting in 74 participants in the experimental group and 63 participants in the control group. All of the participants were secondary high school home economics students enrolled in a 7035 Clothing and Textiles class in District III in North Carolina during the 1990 spring semester.

Demographic information was collected from the experimental group. Seventy-six percent of the subjects were female and 24% were males. Of the 74 participants 35% were freshmen, 30% were sophomores, 18% were juniors, and 18% were seniors. The inquiry unit lasted 15 days. Thirty-one percent of the students attended all classes while an additional 41% attended 13 or 14 classes. The mean number of days missed was 2.16. Therefore the average number of days students attended was 13 (Table 1).

Table 1

Demographic and Background Information on Subjects in Experimental Group (N=74)

	No.	%
	Grade Classification	
Grade		
09	26	35.1
10	22	29.7
11	13	17.6
12	13	17.6

(Table 1 Continued)

Demographic and Background Information on Subjects in Experimental Group (N=74)

	No.	%
Number of Class Sessions Attended		
2	1	1.4
4	1	1.4
7	2	2.7
8	1	1.4
9	1	1.4
10	5	6.8
11	2	2.7
12	8	10.8
13	12	16.2
14	18	24.3
15	23	31.1
Influence on Clothing Purchases		
Student	59	79.7
Mother	9	12.2
Father	-	-
Peers	-	-
Friends	2	2.7
Others	4	5.4
Responsibility for Care of Clothing		
Student	49	66.2
My Mother	25	33.8
My Father	-	-
My Sister	-	-
My Brother	-	-
Other	-	-

In part one of the "Student Attitude Toward Inquiry" instrument, students were asked to respond to clothing practices and previous encounters with textiles. Two questions dealt with buying clothes. Students made the decision as to what to buy 80% of the time and their mothers made the decision for clothing purchases 12% of the time. Sixty-six percent of the participants were responsible for the care of their clothing, whereas for the remaining 34% their mothers cared for the clothing. Forty-six percent of the participants had never studied textiles. Of the 54% who had studied textiles 91% had done so in home economics (Table 2).

Table 2

Previous Exposure to Study of Textiles (N = 74)

	No.	%
Home Economics Class	31	91
Boy Scouts	1	3.22
Girl Scouts	0	-
4-H Club	0	-
Other	2	6.45

Test of Hypotheses

Four hypotheses were tested in this study. The data and statistical analyses used to determine their acceptance or rejection are presented in this section.

Hypothesis 1:

There is no significant difference in gain from pre-to-posttest for the achievement scores of students who have and have not been exposed to the inquiry method of instruction.

An analysis of covariance was used to test gains in the achievement scores for the experimental (exposed to the inquiry method of instruction) and control (not exposed to the inquiry method of instruction) groups with pretest as the covariate to correct for initial differences, if any between groups. The 0.05 level of significance was used in testing for substantive differences between the mean gains. The mean scores, standard deviations, and gain scores for the Textiles Test for the experimental and control groups are presented in Table 3; the analysis of covariance is presented in Table 4.

Table 3

Means, Standard Deviations, and Gain Scores on the Textiles Test

		Pretest		Posttest		Gain	
	N	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Experimental	74	24.2	7.2	34.2	11.2	10.0	4.0
Control	63	23.9	6.6	30.6	7.2	6.7	0.5

Table 4

Analysis of Covariance for Posttest Mean Scores with Pretest Mean Scores as the Covariate

Source of Variance	df	SS	MS	F	*p*
Textile Pretest	1			3.43	
Group	1	401.86	200.93		.04
Error	134	7838.39	58.49		
Corrected Total	136	8240.25			

F-test was statistically significant at the 0.05 level.

The analysis of covariance resulted in an F ratio of 3.43 ($p < .035$), which indicated a significant difference between groups (Table 4). Students exposed to the inquiry method of instruction had significantly larger gains in achievement scores than students not exposed to the inquiry method of instruction. The experimental group experienced a gain of 10.0 from pre-to-posttest whereas, the mean gain score for the control group was 6.7. The hypothesis, therefore, was rejected.

Examination of Test Scores

An item analysis of data provided percentages of students having the item correct in the pretest and the posttest. The average percentage of correct answers for the questions relating to each lesson was computed to determine whether the instructional materials had enabled students to achieve the objectives (Table 5).

Table 5

Results of Responses to Pretest and Posttest Items for Experimental Group

Lessons	% Average Correct Pretest	Item No. Posttest	% Correct Pretest	% Correct Posttest	% Gain	Average % Correct Posttest	Average % Gain
Burn		57	20	28	8		
		58	55	43	-12		
		59	69	82	13		
		60	32	43	11		
	47.1	41	46	49	3	50.4	3.3
		42	28	35	7		
		43	50	39	-11		
		22	77	84	7		
Microscopy		48	33	62	29		
		49	39	54	15		
		51	43	64	21		
		52	49	62	13		
		54	39	58	19		
		27	15	24	9		
	34.5	28	45	51	6	47.8	13.3
		29	35	35	0		
		30	22	45	23		
		17b	57	61	4		
		18a	30	53	23		
		21b	23	42	19		
		3	19	11	- 8		
Nylon		53	41	39	- 2		
		55	26	36	10		
		56	23	38	15		
		31	42	49	7		
	34.3	35	53	72	19	46.4	12.1
		36	14	24	10		
		20a	41	62	21		
		20b	31	43	12		
		10	38	55	17		

(Table 5 Continued)

Results of Responses to Pretest and Posttest Items for Experimental Group

Lessons	% Average Correct Pretest	Item No. Posttest	% Correct Pretest	% Correct Posttest	% Gain	Average % Correct Posttest	Average % Gain
Absorbency		45	74	74	0		
		33	41	42	1		
		34	50	58	8		
	46.4	16a	46	74	28	60.0	13.6
		16b	35	32	- 3		
		17a	41	59	18		
		1	38	81	43		
Resiliency		46	20	59	39		
		18b	41	53	12		
		21a	45	68	23		
	38.7	11	43	70	27	57.4	18.7
		12	23	47	24		
		13	31	31	0		
		25	68	74	6		
Wicking		7	22	46	24		
		9	38	69	31		
	30.6	14	34	38	4	52.2	21.6
		44	35	50	15		
		50	24	58	34		
Abrasion		47	58	64	6		
		32	30	45	15		
		37	38	50	12		
		38	39	42	3		
	42.3	39	38	35	- 3	43.9	1.6
		40	43	30	-13		
		2	18	19	1		
		4	36	35	- 1		
		23	53	64	11		
		24	70	55	-15		
Laundry		19a	54	65	11		
		19b	45	51	6		
		5	28	55	27		
	43.5	6	35	58	23	63.7	20.1
		8	35	85	50		
		15	38	51	13		
		26	70	81	11		

Eight questions were based on objectives from lesson one, burn test; 13 questions from lesson two, microscopy; 9 questions related to lesson three, nylon; 7 questions pertained to objectives from lessons four (absorbency), 5 (resiliency), and eight (laundry); 5 questions were based on knowledge of wicking (lesson six), and 10 questions on abrasion (lesson 7). The total number of items on the test was 66.

Before the inquiry method of instruction was presented, answers to only four of the questions were already known by at least 70% of the students. There was no one area where these items were located. One question each was from lessons on the burn test, absorbency, abrasion, and laundry. It was apparent from the responses on the pretest that students did not know the textiles information and the objectives of the lessons on textiles were appropriate. The posttest shows that more than 70% of the students knew answers to 10 out of the 66 questions asked. Of these 10 questions, 80% to 89% knew answers to five of those and 74% knew answers to three.

An examination of pre-to-posttest scores revealed that 19 of the questions had a gain of less than 10%. Approximately 40% of the students knew answers on the pretest to seven of the questions that showed this small increase and for four out of those seven questions more than 70% knew the right answers. The small increase for the latter items did not necessarily reflect poor performance because many of the students already knew the answers in the pretest. The remaining questions in this less-than-10%-category did reflect poor performance and problems in learning the material.

Some of the latter items were from the lesson on the identification of fibers: burn test. Students were asked to respond to the questions: "What determines how a fabric performs?" and "What distinguishes one fiber from another?" Four questions measured the students' ability to categorize and classify the observed burning characteristics of fibers. Students were asked to find those distinguishable characteristics that differentiate between natural fibers and name the natural fibers based upon that distinction. Posttest score results indicated that students were not able to make this distinction and draw a parallel between fiber appearance, fabric characteristics, and performances.

Three of the questions on absorbency fell into the less-than-10%-increase category. Comparing the absorbency of natural and manufactured fabrics and explaining how the structure of these fibers affects absorbency, comfort, and ease of care required students to draw upon several inquiry thinking skills. Students had to categorize fibers (natural: cotton, linen, wool, and silk; manufactured: nylon, polyester, monacrylics, and acrylics), observe fiber structure, and relate fiber structure to absorbency, comfort, and ease of care. Their poor performance on these items indicates that they evidently needed more experience with these thinking skills in the class sessions.

Identifying attributes and components were the inquiry skills addressed in the lesson on abrasion. These skills required students to identify areas in garments that were susceptible to abrasion, identify components of abrasion, and explain the attributes and components of the fiber that would cause abrasion. More than half of the students knew answers to only three of the ten questions on abrasion before the lesson and four of the questions after the lesson. Four of the questions in this same lesson resulted in a loss. For example, students were asked where abrading occurs first in jeans. Areas where abrasion could occur in jeans were the distracters in the test items and were not the right answer. Students had to identify attributes and components of abrasion on jeans to know which area would abrade first.

Other questions in this less-than-10%-increase category--one each from the lessons on nylon, wicking, and laundry, and two from resiliency--required similar thought processes. Students were not familiar with the inquiry method of instruction. Many of the concepts were new and students probably expected the learning to consist of facts, rules, and definitions; and students had few or no unanswered questions about the lessons. It is doubtful that students noticed and observed the phenomena associated with the lessons. For example, many of the students probably had never wondered about the appearance of fibers under the microscope or associated that appearance with fabric characteristics and performance.

The lessons on microscopy, abrasion, and nylon had the lowest average percentage correct on the posttest. The average percentage correct on the three lessons was less than 50%. The lesson on abrasion related to applying abrasion properties of yarns to the garment (the relationship between fiber properties and performance). The questions on nylon pertained to differentiating between terms relating to manufactured filaments and applying the terminology to end products made from nylon. Questions on microscopy dealt with fiber characteristics and explaining how those characteristics affected clothing performance. Students may have had difficulty with the vocabulary, or with discriminating, forming relationships, and applying conclusions.

Seven of the nine questions on nylon pertained to terminology. To answer these questions correctly, students had to differentiate between two or more concepts by focusing on similar or dissimilar properties. Questions that ask students to compare and/or contrast force them to sharpen their understanding. According to Joyce (1985) and Marzano et al. (1988) students need to be made aware of their thought processes.

The content with the greatest gain was represented by the nine questions in which there was a gain from pre-to-posttest of more than 25%. The greatest learning occurred in items from lessons on microscopy, absorbency, wicking, resiliency, and laundry. There was a 29% gain in scores on the microscopy questions. Students were able to make a distinction between the observed structure of cotton and other natural and manufactured fibers.

Both of the test questions designed to measure absorbency asked students to relate the characteristics of cotton to absorbency and comfort. Students' gain scores were 28% and 43%. Scores indicated that students could apply the thinking skills of observing, classifying, categorizing, comparing, and identifying relationships with content (cotton).

Relating the properties of resiliency to performance of natural and manufactured fabrics was the objective of the lesson on resiliency. One question dealt with terminology whereas the other asked students to apply that terminology. For example, students had to associate the properties of wrinkling, creasing, crushing, and appearance to resiliency to answer the questions relating to boys' dress pants and the pants being durable enough to withstand bending and stretching at the knees. These two questions had a percentage gain average score of 33.

Students examined wicking properties of natural and manufactured fabrics in the lesson on wicking. Students had to integrate knowledge of fabric type and structure and make inferences about wicking. For example, question seven asked students "Why are disposable diapers comfortable enough for a baby to wear?" Before students could select an answer, they had to focus on the problem (Why are disposable diapers comfortable enough for a baby to wear?), gather and organize information (What are non-absorbent fibers?), analyze (What is the relationship between nonabsorbent fibers and comfort?), generate (Nonabsorbent fibers will not absorb moisture; yet the baby is comfortable), and integrate knowledge (Nonabsorbent fibers will not let air in or absorb moisture; therefore, something special must be done to the fabric to make it comfortable). Only 22% of the students knew the answer to this question on the pretest, and at the end 46% knew it. Student gain score to this question was 24%.

For one of the questions on laundry, 35% knew the right answer on the pretest; at the end of the lesson the percentage had increased to 85, a 50% gain. The item dealt with selections of laundry aids. Students had to compare and contrast various laundry products to answer the question correctly.

Several questions with the highest gain dealt with fiber properties, comfort, and performance of apparel. Question 1 had a 43% gain and measured student knowledge on absorbency. The fabrics used to test absorbency were cotton and nylon. Students had used these fabrics in three other lessons and had probably become familiar with their properties. Another explanation, might be that students may have been more interested in knowing the answer to these questions since they deal with situations students are likely to encounter (if they have not already).

At the completion of the lessons on inquiry there were only 16 questions for which less than 40% of the students knew the answers. Four of the questions measured knowledge on nylon and abrasion, three measured knowledge on microscopy, two measured knowledge on burning characteristics, and one question each measured knowledge of absorbency, resiliency, and wicking. Two of the questions on abrasion asked students to indicate the degree of abrasion that would occur on certain apparel items. Students had to integrate the attributes and components of fabric characteristics (texture, hand, yarn, and fabric structure). Students are not accustomed to using this thought process. In addition, most of the questions about the burn lesson required students to remember information to relate to other concepts. The lesson on the burning characteristic of fibers was taught at the beginning of the experiment. Students probably did not remember the flammable characteristics of the fibers.

Nine questions generated average percentage losses. A possible reason may be attributed to the clarity of the questions. Fifty-five percent of the students on the pre-test associated rough feeling fabrics with textures, and only 43% were able to make the association three weeks later. When students were asked to describe the burning characteristics of polyester, 50% of the students were able to do so on the pretest; this number decreased to 39% on the posttest. The rest of the items in this category reflect similar responses indicating a need to examine these test questions.

Five of the nine questions with average gains were analyzed for possible explanations. Question 3 was fairly difficult to answer (difficulty index = 30%) and had almost no discriminating power (D = .10). Forty-five percent of the students in the upper group chose the wrong answer, distracter 1. The correct alternative was chosen by 35% of the students in the upper group. An inspection of the question revealed ambiguity. The stem did not present a clearly formulated problem. The alternative and the distracters were fabric properties with distracters being incorrect responses for various reasons. The analysis revealed that the distracters were functioning effectively; more students in the upper group answered correctly and all distracters were selected as a possible alternative. Confusion in the upper group probably occurred because the concepts of blending fibers and properties of fabrics were not linked to the process of association, or the distracters were too much alike.

Questions 43 and 58, in the negative category, discriminated in a positive direction. More students in the upper group answered the questions correctly. The index of discriminating power was acceptable (D = .30 and .35 respectively). This may be partly due to some of the students in the upper group choosing more than one alternative and the distracters could not be used in the analysis. All alternatives were selected by some of the students in the lower group; the distracters appeared to be operating effectively.

In question 24, students were given a scenario and asked to select the answer based on a yes/no response. More students in the lower group than the upper group answered it correctly; thus, the question discriminated in a negative direction. Although more students in the upper group (7) than the lower group (3) answered question 40 correctly, more of the students in the upper group (10) also selected the wrong distracter. This question was on abrasion and asked students to indicate the degree of abrasion of lacy cotton/ nylon gloves. This question may have been confusing to the students. Students may not have known that "lacy" refers to fabric structure and cotton/nylon are fiber blends.

Of the 66 questions, at least 50% of the students knew answers to 38 of the posttest items as opposed to 14 of the pretest items; 65% knew answers to 13 questions in the posttest as opposed to 6 in the pretest. Students were not accustomed to this method of instruction. Test questions forced students to discriminate, compare, identify relationships, and patterns. As Beyer (1988) and Joyce (1985) suggested, students need practice in developing thinking skills. Students may not have been given enough time to test and retest their theories before reaching a conclusion. In addition, the reading level of the test and/or activities may have been too difficult for the students.

Hypothesis 2:

There are no significant relationships among the posttest achievement scores of students and:

a. their pretest scores.

b. their first semester clothing and textiles grade.

c. their grade classification.

d. and the number of class sessions attended during the experimental unit.

The data used to test this hypothesis were pretest scores, first semester clothing and textiles grades, the number of class sessions students attended (from teacher grade books), the grade classification of students (from the Student Attitude Toward Inquiry Survey), and the posttest achievement scores. The results of the multiple regression analyses utilizing the dependent variable posttest achievement scores and four selected independent variables indicate a significant regression equation p <.001 (Table 6). The eight predictor variables in the multiple regression equation explained 55.4% of the variation in posttest achievement scores. The F value of 11.72 suggested that the model achieved statistical significance.

Table 6

Results of Multiple Regression Analysis for Achievement Scores

Variable	Unstandardized Regression Coefficients	t-Value
Intercept	-30.18	2.14*
Pretest	0.77	5.32*
Semester Grade	0.34	3.46*
Class Attendance	6.42	2.14*
Teacher Attitude	0.58	2.66*
Student Attitude	0.26	-1.60
Grade 10	-1.53	0.65
Grade 11	-0.14	0.05
Grade 12	5.95	2.18*

*Statistically significant at the 0.05 level
F value = 11.72
R^2 = .55
Standard error of the estimate = 7.89

Concerning the pretest scores, the unstandardized regression coefficient of .77 was statistically significant; thus, pretest score is a good predictor of posttest score. To be specific, as a student pretest score is increased by 10, his or her posttest score increases by 7.70. A unit increase in grade point average would increase the posttest score by .34. Each additional class session the student attended increased their posttest score by 6.4.

For this analysis, grade classification was coded as dummy variables with 9th graders being the reference category. On the average the 10th graders scored 1.53 less than 9th graders on the posttest achievement scores. However, since this coefficient did not achieve statistical significance, this difference may be attributed to chance fluctuations. Further, 9th graders also scored higher on the posttest than 11th graders. Again, this difference (.14) is not statistically significant and may be attributed to random error. Finally, with respect to grade classification, 12th graders scored significantly higher on the posttest than 9th graders. Specifically, on the average, students in the 12th grade scored almost 6 points higher on the posttest than 9th graders. Two of the variables in the null hypothesis were not rejected (students in grades 10 and 11). Four of the variables: pretest score, semester grade, 12th graders, and class sessions attended were rejected.

Hypothesis 3:

<u>There is no significant relationship between posttest achievement scores of students and teachers' attitudes toward use of the inquiry method of instruction</u>.

Regarding the hypothesized relationship between teacher attitude and achievement scores the understandardized regression coefficient of .58 was statistically significant. That is, a one unit increase in teacher attitude increased the student achievement score by .58. Thus, the null hypothesis of no difference was rejected and the relationship was confirmed.

Hypothesis 4:

<u>There is no significant relationship between posttest achievement scores of students and student attitudes toward use of the inquiry method of instruction</u>.

Mean student attitude was 39. The hypothesis pertaining to the effect of student attitude on student achievement scores was negligible (.26). The regression coefficient did not achieve statistical significance; the null hypotheses of no difference was not rejected.

Descriptive Analysis of Teacher Attitudes

Teachers in the experimental group responded to 14 items on the Teacher Data Survey Form using a Likert-type scale with response categories ranging from "strongly agree" to "strongly disagree" (Table 7). All of the teachers either strongly agreed or agreed that they could develop inquiry lesson plans and would use this process when applicable. Six of the seven teachers reported that lab experiences strengthened their understanding of textile principles, that the time required to prepare the inquiry lessons was worth it, that students developed inquiry skills and mastered important facts and concepts related to textiles, that students were actively involved throughout the experimental unit, and that the inquiry method was stimulating.

The greatest variability in answers occurred regarding whether students were internally motivated. The length of class time the inquiry method of instruction took received the highest percentage of undecided responses. Three of the teachers did not enjoy using the inquiry method of instruction and found the process to be difficult. One of the teachers agreed that the inquiry method took too much class time and the materials used were impractical. The mean score for teacher attitude was 55, out of a possible score of 70, which indicated positive attitudes toward the inquiry method of instruction (Table 7).

Table 7

Teacher Responses to Attitude Survey (N=7)

	Abbreviated Statements	Strongly Agree	Agree	Unde- cided	Dis- agree	Strongly Disagree
1.	High degree of student involvement.	2	4		1	
2.	Inquiry process difficult to use.	2	1		3	1
3.	The time needed well worth it.	2	4	1		
4.	Takes too much class time.		1	2	3	1
5.	The materials were impractical.		1	1	1	4
6.	Approach was stimulating.	4	2	1		
7.	Did not enjoy this method.	1	2		1	3
8.	Experiments too complex.	1			2	4
9.	Likely to use in teaching.	4	3			
10.	Lab experiences did not help my understanding of textile principles.	1			1	5
11.	Students developed inquiry skills mastered facts and concepts.		6		1	

Note: Complete wording of statements is in Appendix E.

(Table 7 Continued)

Teacher Responses to Attitude Survey (N=7)

	Abbreviated Statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
12.	Students internally motivated.	1	3	1	1	1
13.	Discussions did not help students draw conclusions.				2	5
14.	Can develop own inquiry lesson plans.	4	3			

Note: Complete wording of statements is in Appendix E.

Descriptive Analysis of Teacher Interviews

The researcher conducted interviews with each of the teachers in the experimental group. The researcher was interested in the teachers' perceptions of their students' reactions toward the inquiry method of instruction and instructional materials used to teach the experimental unit. A combination of open-ended and closed questions was used in the single interview. The teachers were asked the same questions in the same order.

Closed questions were used to solicit the teacher's responses to the extent their students were engaged in the inquiry process. Teachers responded to a nine-item rating scale indicating the extent their students engaged in the inquiry process (Table 8).

Six of the seven teachers indicated that their students most of the time or frequently were able to apply the content to new situations, collect relevant information, carry out the learning activities, and be involved with the discussions. Five teachers reported that students were able to recognize the relationships among ideas.

The greatest variability in teacher responses occurred regarding whether students were able to follow directions without teacher assistance. According to the teachers, less than 50% of the students were not able to formulate hypotheses; yet, approximately 52% were able to recognize the problem and solve it.

Three items on the opened-ended survey asked the teachers to elaborate on the instructional activities and changes that occurred in their students. Teachers reported that the burn test was the most appealing and stimulating activity for the students, followed by microscopy, and laundry. Reactions to the learning materials on nylon varied the most. The students' least favorable activities were in the yarns, abrasion, and wicking classes.

Table 8

Extent of Student Engagement in the Inquiry Process (N = 7)

	Most of the Time	Fre-quently	Occa-sionally	Not at all
1. Able to recognize relationships among ideas?	5	2	-	-
2. Given the opportunity to apply content to new situations?	4	2	1	-
3. Able to collect relevant information?	4	2	1	-
4. Able to formulate hypotheses?	1	2	4	-
5. Able to recognize and solve the problem?	3	1	3	-
6. Involved in the discussions?	3	3	-	1
7. Involved in carrying out the learning activities?	4	2	1	-
8. Able to follow the directions and carry out the activities without teacher assistance?	3	1	2	1
9. Able to grasp the basic understanding of fiber structure and performance?	3	-	3	1

Teachers were also asked to describe their students' reactions toward the instructional activities and lab experiences. Five of the teachers reported that students were interested in studying textiles. It was a motivational experience, a welcome change, fun, and they enjoyed it. Two of the teachers felt that their students did not like the activities; that making nylon was gross, the labs were a waste of time, and these activities were too much like science.

Teachers, with two exceptions, did notice some observable changes in their students' behavior. Teachers said students learned to share; they shared more because they engaged in conversation to solve problems, talked very freely, and were interested in continuing the inquiry experience. For example, in the burn test most of the residue is black; students wanted to know why? Other comments indicated that students were more receptive and participated longer in the classroom activities. These teachers also felt that the verbal participation and sharing of ideas increased self-confidence in their students.

When teachers were asked how appropriate the activities were for the age level of students and the teaching of textile concepts, varying responses occurred. One teacher felt that the material was inappropriate, not because of age level, but because the students lacked experience and that the concepts were possibly too advanced. Another teacher felt that "everything was appropriate" even though students needed help with concepts. On the other hand, two teachers felt that the concepts were excellent and materials were appropriate for the age level of students except for the lesson on microscopy. Only one teacher felt that students did not need many of the concepts to function in the real world; e.g., lessons on yarn formation, wicking, and abrasion.

Teachers reported that the presence of equipment aroused student curiousity from the beginning. They were not accustomed to seeing microscopes, beakers, and scales (scientific equipment) in the home economics laboratory. Teachers in the experimental group used this curiosity to introduce the lessons. Teachers were equally surprised at the number of activities home economics students could do involving textiles. Although all of the teachers had taken at least one textiles course in college and were involved in experimentation, they thought the activities were too difficult for high school students.

Science teachers in the same schools were also curious. They wanted to know what was going on in home economics. The home economics teachers were eager to share and exchange information with their colleagues.

Two of the teachers expressed dissatisfaction with the experiment. On several occasions they told the researcher that the lessons were too long, their students wanted to sew, and this method should be reserved for students going to college or interested in research. They also felt that the research should have been conducted at the beginning of the semester.

Descriptive Analysis of Student Attitudes

Students in the experimental group responded to 12 items on the "Student Attitude Toward Inquiry" survey using a Likert-type scale with response categories ranging from strongly agree to strongly disagree (Table 9). Sixty-one percent of the students indicated that the atmosphere in the classroom was relaxed and they could express themselves freely. Over 50% of the participants reported that they liked to work in groups, that the discussions after the laboratory experiments helped them to see what they had learned, and that the activities helped them to make sound decisions about the selection and care of clothing. Approximately 50% of the students either strongly agreed or agreed that the unit was not dull and boring, the lab experiments were not a waste of time, that they enjoyed doing them, and the class activities were interesting. Responses indicated that approximately 33% of the students either strongly agreed or agreed that the unit made them think for themselves and the work sheets were not too difficult.

The highest variability in answers occurred regarding whether the class activities were interesting. Forty-seven percent of the students either strongly disagreed or disagreed with the statement that they felt pressured to come up with the right answer. When asked if they liked the way the unit was taught, 46% responded positively, 23% were uncertain while 31% disagreed with the statement.

Table 9

Student Responses to Attitude Survey (N=74)

	Abbreviated Statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1.	Unit made me think for myself.	2.7	33.8	24.3	27.0	12.2
2.	Unit was dull and boring.	25.6	20.3	12.2	29.7	12.2
3.	Class activities were interesting.	12.2	33.7	28.4	17.6	8.1
4.	Work sheets were too hard.	10.8	24.3	18.9	29.7	16.2
5.	Lab experiments were enjoyable.	14.9	29.7	20.3	17.6	17.6
6.	Discussions after the lab experiments helped in seeing how to use what was learned.	17.6	37.8	22.9	12.2	9.5
7.	Did not like activities that required group work.	5.4	14.9	22.9	39.2	17.6

Note: Numbers represent percentages.
Complete wording of statements is in Appendix F.

(Table 9 Continued)

Student Responses to Attitude Survey (N=74)

	Abbreviated Statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
8.	Doing the lab experiments were a waste of time.	18.9	13.5	21.6	31.1	14.9
9.	Classroom atmosphere was relaxed.	18.9	41.8	17.6	12.2	9.5
10.	Activities helped in making sound decisions about the selection and care of clothing.	12.2	43.2	17.6	20.3	6.7
11.	Felt pressured to come up with the right answers.	6.8	24.3	21.6	29.7	17.6
12.	Did not like the way unit was taught.	9.5	21.6	22.9	28.4	17.6

Note: Numbers represent percentages.
Complete wording of statements is in Appendix F.

Discussion of Findings

This study examined the effects of using the inquiry method of instruction in teaching textiles in secondary home economics and assessed teacher and student attitudes toward the instructional method and teaching materials developed for the study. The results of this study indicated that the inquiry model used had a statistically significant effect on textile knowledge. Students exposed to the inquiry method of instruction had higher gain scores than the control group with the number of classes attended being a significant variable affecting posttest achievement scores. These findings were consistent with other research findings which supported inquiry as an effective teaching method (Beyer, 1971; 1988; Costa, 1985; Joyce,1986; Suchman, 1966).

The inquiry model developed using the framework of Suchman (1966) and Beyer (1979) defined the essential elements of inquiry. This framework--consisting of an introduction to the experience, defining the puzzling event, gathering data, discussion, and drawing conclusions--was used to study textiles content. Since there was no difference between experimental and control groups on pretest scores, the differences between the groups on posttest scores may be attributed to the mode of instruction. Students who received the inquiry method of instructions performed significantly better than those who did not, suggesting that it should be a useful alternative to traditional methods.

Success in the teaching of process and content is partially explained by the degree of student involvement throughout the inquiry experiment (Borich, 1988; Henson, 1988; Joyce, 1985). Instead of teachers lecturing to their students, information was shared between the teacher and the students. Teachers presented situations whereby students could recall previous experiences and relate them to real-life situations.

The items on the achievement instrument were based on the objectives of each lesson taught. The objectives represented an array of cognitive skills: gathering, organizing, analyzing, predicting, generating, integrating and summarizing information. The items on the textiles test required students to use thinking skills that were identified by Joyce (1985) and Marzano et al. (1988) as core, i.e., what all students need to know. Students were required to apply knowledge to different situations. For example, question 16a asked students which fabric would be most comfortable on a hot humid day. Question 16b asked students to select the reason for their choice to 16a. Before students could select an answer, they had to focus on the problem (It is hot and humid.), gather and organize information (What happens when it is hot and humid?), analyze (What is the relationship between fabric and a hot humid day?), generate (When it is hot, the body perspires.), and integrate knowledge (The fabric needs to absorb the body perspiration so that, as the fabric absorbs moisture, the body feels cool and comfortable). Seventy-four percent of the students knew the answer to 16a, but only 32% were able to engage in the process and answer 16b correctly.

One reason students may not have known the answer is because students are not accustomed to linking process with content (Blair, 1988; Joyce, 1985; Shear, 1986). Thinking is organizing knowledge and strategies (Jones, 1987) and there is correlation between the degree of metacognitive awareness and the level of performance on complex problem-solving tasks. Another factor that may have attributed to the lack of connection is the ambiguity of the test questions. When these items were analyzed, 16a discriminated in a positive direction whereas 16b had no discriminating power because an equal number of students in both upper and lower scoring groups got the right answer.

Results from teacher observations suggested, in general, that most students had a favorable attitude toward the inquiry method. For example, teachers reported that students were highly involved throughout the lessons; they developed inquiry skills, and mastered facts and concepts. In addition, teachers felt that the students recognized relationships among ideas, recognized and solved the problems and followed directions, and carried out activities without teacher assistance. These findings are similar to those of Joyce's (1985), who suggested that the inquiry method fosters independent learning and develops the intellectual discipline and skills necessary for asking questions.

The second hypothesis dealt with the effects on mean posttest scores of four variables: pretest score, semester clothing and textiles grade, grade classification, and the number of class sessions attended. Pretest score, semester clothing and textiles grade, 12th grade level, and the number of class sessions attended were statistically significant in explaining the posttest scores. Significant relationships between posttest achievement scores and second semester clothing and textiles grades and the number of class sessions attended suggests that semester grades and class attendance may have been significant due to natural correlation between learning and being in a learning situation.

Studies analyzed by Sweitzer and Anderson (1983) found that grade level was a significant variable in measuring knowledge and intellectual processes. Results of this study relating knowledge to grade level appear mixed. Twelfth graders scored better on the pretest, suggesting that they knew more than the students in lower grades. On the other hand, 9th graders knew more than 10th and 11th graders. A possible explanation for this could be that a larger percentage of 10th and 11th grade students than 9th graders had not studied textiles or been responsible for selecting and caring for their own clothing. Being able to relate previous encounters to the inquiry process is crucial if learning is to take place (Joyce, 1986).

Another variable dealt with the influence teacher attitudes had on student success. With regard to the teacher attitude survey there was a positive relationship between student posttest scores and teacher attitudes. Few studies in science education using the inquiry method of instruction analyzed the effect of teacher behavior on student performance (Sweitzer & Anderson, 1983).

The results of the study indicated that the independent variable (student attitude) had no effect on student posttest achievement scores. Results of the analysis of the items on the student attitude survey indicated various responses. In response to a general statement about whether or not they liked the way the unit was taught, 46% replied in the afffimative. The experimental unit lasted 15 days. This is a short period for changes to occur in attitudes and opinions.

The inquiry method of instruction was successful in teaching textiles. There are several advantages in using this method. It is a cooperative process that: (a) requires a high degree of involvement throughout the learning experience for both teacher and student, (b) is flexible in that students ask questions and seek the truth, and (c) uses personal experiences that add meaning to learning.

However, the success of this method depends on commitment from the teacher. Inquiry is a slow process and is time-consuming. The time it takes to prepare for the lesson is as time-consuming as the process. Teachers need equipment that often must be borrowed. Supplies must be gathered, measured and/or mixed for activities and stations set up prior to class. Prior to class, teachers must also devise ways to help students organize data, e.g. develop charts, tables, worksheets, or modify existing materials. This method is quite different from traditional methods of instruction and must be practiced before teachers and students are comfortable with using it. It is imperative that teachers become comfortable with the process, if not, they may become frustrated and abandon the method for a more familiar one.

This study supported other research which indicated that the inquiry method had the potential for increasing student learning when inquiry takes precedence over content. It is the opinion of the researcher that, as teachers become more familiar with this teaching method, and if it is effectively used, there will be important applications for its use in home economics as well as other disciplines. In using this method, the teacher guides students to become inquirers who actively seek solutions to problems that are reality-based.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

The major purpose of this study was to examine the effect of the inquiry method of instruction on achievement of home economics secondary students in clothing and textiles classes. Three objectives were selected for this study: (1) develop teaching materials and assessment measures using the inquiry model for a unit in North Carolina's Home Economics 7035 Clothing and Textiles course; (2) test materials with selected classes to determine effects on student achievement in Home Economics 7035 Clothing and Textiles classes; and (3) determine teacher and student attitudes toward the instructional method and teaching materials developed for the Home Economics 7035 Clothing and Textiles classes.

A quasi-experimental nonrandomized control group, pretest-posttest design was used in the study. The independent variables were: pretest score, first semester clothing and textile grade, class sessions attended, grade classification, teacher attitudes, and student attitudes. The dependent variable was posttest achievement score.

Eight lessons were developed for the textiles unit: (1) identification of fiber categories - burn test; (2) distinguishing natural fibers - microscopy; (3) structure and performance of manufactured fibers - nylon; (4) fabric structure and performance - absorbency; (5) comparative analysis of fabric characteristics - resiliency; (6) fabric structure and performance - wicking; (7) fabric structure and performance - abrasion; and (8) laundry practices.

These lessons, combining textiles information with an inquiry approach, were designed for 15 50-minute classes. Textiles content was infused into the researcher's six-step inquiry model: (1) introduce the inquiry experience, (2) define the puzzling event, (3) gather data, (4) develop a conclusion, (5) apply the conclusion, and (6) summarize the experience.

The subjects were secondary high-school home economics students enrolled in a 7035 Clothing and Textiles class in District III in North Carolina during the 1990 spring semester. Eleven teachers volunteered to participate in the study. The experimental group was composed of seven Wake County teachers from five different schools and 74 students. Six teachers representing five different counties and 63 students formed the control group.

Four instruments developed by the researcher were used in this study. A 66-item textiles test was used for both the pretest and posttest. The content validity of the items were checked by a high school teacher and two college professors in home economics education with expertise in evaluation. The reliability of the test was measured by Kuder-

Richardson Formula 20 and was found to be .88.

Two of the instruments were questionnaires completed by teachers in the experimental group. The researcher personally interviewed each teacher. Forced-choice and open-ended questions were asked to assess teacher observations of student behavior while using the inquiry method and materials. In addition, teachers completed a Likert-type survey to determine their level of confidence and satisfaction toward the inquiry process and materials used to teach the topics.

Responses by teachers in the experimental group indicated positive attitudes toward the inquiry method of instruction. Four of the seven teachers found the strategy to be stimulating, enjoyed using it with their students, and indicated that they would use the inquiry method of instruction in teaching when appropriate.

The fourth instrument sought two types of data from students in the experimental group. Seven questions gathered demographic and background information. Twelve Likert-type items assessed the student attitudes toward the instructional method and materials used.

Before the unit was presented in the spring of 1990, teachers in both groups received specific directions for conducting the research project. The researcher conducted a workshop on the inquiry process and its use in teaching textiles for teachers in the experimental group. Teachers engaged in the process by using one of the lesson plans developed by the researcher. There was approximately six weeks between the workshop and the teaching of the topics. Teachers were asked to use this time to acquaint their students with the inquiry process.

The study started in April, 1990. One week before the study, teachers in the experimental group received the pretest, the inquiry lesson plans, and supplies needed to teach the topics on textiles. All students were pretested at the beginning of the unit. The topics were taught and students were posttested at the end of the unit. The control group was pretested, teachers taught topics using traditional methods, and students were posttested at the end of the unit. The researcher collected the posttest at the workshop that was held for the control group in May.

Descriptive statistics (frequency distribution, means, standard deviation, and percentages) were used to summarize demographic characteristics of the sample, the teacher's level of confidence, and satisfaction toward the inquiry method and instructional materials. Inferential statistics tested four null hypotheses. Each hypothesis was tested at .05 level of significance using analysis of covariance and multiple regression.

An analysis of covariance was used to test Hypothesis 1: There is no significant difference in the gain from pre-to-posttest for the achievement scores of students who have and have not been exposed to the inquiry method of instruction. Students in the experimental group had a mean gain of 10.03 in their achievement scores whereas the control group mean gain was 6.71. The gains of the experimental group were statistically significant $F = 3.43$ ($p < .04$). Therefore, Hypothesis 1 was rejected and one may conclude that the inquiry method of instruction was effective in teaching textile content to secondary home economics students.

Hypotheses 2, 3, and 4: there are no significant relationships among the posttest achievement scores of students and their pretest scores, their first semester clothing and textiles grades, their grade classifications, class sessions attended, teacher attitudes, and student attitudes were tested by multiple regression. The significant regression equation ($p < .0001$) accounted for 55% of the variance. Pretest scores, student semester clothing and textiles grades, class attendance, teacher attitudes, and students in the 12th grade were significant predictors of posttest achievement scores. Results indicated no significant relationships among posttest achievement scores, student attitudes, and grade classifications of students in grades 9, 10, and 11.

Recommendations

Emphasis on content and not process is being questioned by educators, politicians, parents, and students and there is a growing need to focus on how to think. This study explored the possibility of combining subject-matter with process and results show promise for infusing the two.

Based upon the results of this study, some recommendations for future research in the inquiry method of instruction are as follows:

1. Incorporate the inquiry process into other subject-matter areas in secondary home economics.
2. Identify additional variables, e.g. students' IQ, reading levels, and thinking skills that could influence the amount of information students learned from using the inquiry method of instruction.
3. Conduct a longitudinal study with randomly selected subjects to see what effect the inquiry method would have over a period of time.
4. Design a measure to assess skills taught in inquiry.

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APPENDIX A

CORRESPONDENCE

6604 Craig Road
Durham, North Carolina 27712
November 28, 1989

Dear

The purpose of this letter is to request your help in a research project to be conducted during the spring semester, 1990. This project involves developing and testing lesson plans for five topics in the 7035 Clothing and Textiles course.

Your local director is aware of this study and suggested that I contact you directly. If you are willing to participate, you will be required to attend a workshop at which time the instructional method and instructional materials will be shared. The workshop may be three one-hour sessions or a one three-hour session depending on whatever is convenient for you. Depending on the number who indicate willingness to participate, it may become necessary to randomly select a limited number of participants for the study.

Regardless of whether or not you are willing to participate, please complete and return the enclosed form (below) before December 15, 1989. Thank you for your cooperation.

Sincerely,

Magnoria W. Lunsford
Doctoral Student, UNC-G
Home Economics Education

Dr. Barbara Clawson
Professor, UNC-G
Home Economics Education

_____ Yes, I wish to participate in the study and am willing to attend the workshop.

_____ No, I do not wish to participate.

Name ____

Name and Address of School ______________________________

____

Telephone Number (919)______________ Best Time to Call __________

How many 7035 Clothing and Textiles classes will you be teaching during the spring semester, 1990?

How many students are in each class?

APPENDIX B

LESSON PLAN

DIRECTIONS TO TEACHER

PREPARATION FOR CLASS SESSION

MICROSCOPY

Supplies Needed: Microscopy

1. Fabric swatches: cotton, linen, wool, silk from the lesson the "Burn Test."
2. Needle pick
3. Microscope
4. Glass slides and cover slips
5. Glass rod
6. 50-50 Glycerine and water mixture or distilled water
7. Number one pencils (optional)
8. Pink pearl erasers (optional)
9. Textbook: Clothing Fashion Fabric Construction
10. Transparency on types of yarns

Procedure for Preparing Slides

Prepare a slide for each of the fabric swatches.

1. Pull a yarn from each fabric swatch.
2. Untwist and tease the yarn apart into fibers.
3. Place the fibers on a slide.
4. Mount the fibers on a side with a drop of the glycerine-water mixture.

5. Carefully lower a clean, dry coverslip at an angle onto the slide/fiber surface and tap gently to remove air bubbles.
6. Place a prepared slide under the microscope.
7. Examine the fiber at low magnification (50 to 60x).
8. Examine the same fiber under high magnification (250 to 500x).
9. Adjust the microscope for viewing.
10. Make sure that the number on the fabric swatch matches the number on the microscope.

Supplies Needed: Natural Fibers and Yarns

1. Silk thread representing filament
2. 2 ply yarns
3. 3 ply yarns
4. Fibers of cotton, flax, wool, silk in labeled envelopes
5. Photomicrograph
6. Scotch tape

Length of Lesson: 3-4 days

Subject Textiles

Topic Distinguishing Natural Fibers - MICROSCOPY

Objectives

1 To name the natural fibers.
2. To describe the fiber structure of the natural fibers.
3. To describe: fibers, fabrics, monofilament yarns, ply yarns, cable yarns and blends.
4. To explain how yarns from natural fibers affect clothing performance.
5. To explain how yarns affect the characteristics of fabric.

Introduce the Lesson

The burning test gave clues to fiber types. We discovered that fibers in certain classifications behave a particular way. We discovered that all natural fibers tend to have the same burning characteristics and manufactured another. However, we know that fabrics made from natural fibers are not all the same. Just as a good detective analyzes the clues collected so must a fabric detective. Your mission today is to find those distinguishable characteristics that make a distinction between natural fibers and to name the natural fibers.

Puzzling Event

My mother has always given me advice about my clothing: Wrap that wet bathing suit in a cotton towel. It's cold and rainy today, you will be warmer, drier and more comfortable in your wool jacket. Unpack your suitcase as soon as you arrive. Your clothes need to relax just like you do. Besides, most of the wrinkles will fall out of the clothes you hang up. So far, mom has been right even when I didn't follow her advice. What is it about these fabrics that make them behave the way they do? In other words, what are the different characteristics of fabrics and how do these characteristics affect fabric performance?

Instructions

Give each student a set of natural fabrics. Examine the fabrics carefully. Do they look alike? Do they feel alike? Since they are all natural fabrics, why don't they look and feel alike? Why do they perform differently?

Hypothesize (These may be possible comments)

Record ideas students come up with on the board. Encourage responses but do not suggest hypotheses.

1. Each fiber has individual characteristics.
2. Fibers come from different sources. These sources will determine their differences.

<u>Data Gathering</u>

So far you have been exposed to fiber fabrics, and yarns. Today you will define these terms. Hold up a piece of fabric and ask:

1. "Which one does this illustrate, fabric or yarn?" (fabric).
2. Now, "How would you define fabric?". (Fabric is cloth of any kind). Remove a yarn from the piece of fabric.
3. "What is fabric made from?" (yarns). Untwist and tease the yarn into fibers.
4. "Do you remember from the burn test what these particles are called?" (fibers). How would you define these yarns? Thus we see that yarns are made from fibers that have been twisted together or laid side by side to form a strand.
5. "What do fibers look like?" (hair, they are very thin).
6. "How would you define fibers?" (Hair like material that fabric is made from). Fibers are classified according to their length.
7. "What can you say about the length of this fiber?" (It is short). Show students a silk filament.
8. "What can you say about the length of this yarn?" (It is long). This is silk filament. You will learn about filament yarns in the next lesson. All natural fibers except silk are short. Yarns made from short fibers

are called staple fibers. Staple fibers may be single like this one or be made of two parts like this one or three parts like this one. (Show transparency and point to the different types of yarns). In this lesson you will be doing some exploring to help answer questions about yarn structure, what yarns look like, how yarns are made, and how yarns affect fabric characteristics and performances. Students will be doing two activities. Have some students go to the microscope while others do seat work.

1. Give students using the microscopes the lab sheet named, "Natural Fiber Identification." Tell them to follow the directions carefully and not to readjust the microscopes. If they need help, instruct them to see the teacher.
2. Give the other students the lab sheets named, "Natural Fibers" and "Natural Yarns." Instruct them to follow the directions carefully, and fill in the chart. Complete lab exercises on both lab sheets.
3. Read chapter 15, pages 174-178 and chapter 16, pages 185-187 in the text: <u>Clothing Fashion Fabric Construction</u>.
4. Monitor student progress. Keep them focused.

<u>Developing a Conclusion</u>

Discuss developing the conclusions and applying the conclusion with the entire class. As the teacher, you must ask questions to get students to give the answers in parentheses.

1. What name did you give fabric sample A? (cotton). B? (wool). C? (linen). D? (silk).
2. You observed the characteristic appearance of natural fibers under the microscope. These characteristics make up fiber structure which determines the performance of that fabric.

a. What did cotton look like?

(Cotton looks like a twisted ribbon. Under the microscope, it appears as a flat, twisted ribbon. Describe those characteristics that makes cotton different from other natural fibers? (The centers in each twist assist in holding water. The twist helps to keep the fibers together.) How does the the structure of cotton affect comfort? durability? care? Comfort refers to absorbency, wicking, breathability and stretchability. Cotton is absorbent, thus making it comfortable to wear. Durability refers to strength, shape retention, resiliency, abrasion resistance, and colorfastness. Cotton is strong and dyes easily. Care includes washability, fabric resistance to stains and spots and wrinkle recovery. Cotton wrinkles easily. Special finishes must be applied to prevent wrinkling and shrinkage.)

b. What did linen look like?

(Linen is a fabric made from flax.) Describe those characteristics that makes linen different from other natural fibers. (The nodes and bamboo shoots are responsible for the texture of linen). How does the structure of linen affect comfort? durability? care? (Linen is very absorbent. It is stronger than cotton but has lower resiliency. It is washable, wrinkles like cotton but dries quicker than cotton).

c. What did wool look like?

(Wool fibers are covered with scales). Describe those characteristics that makes wool different from other natural fibers? (Wool fibers trap air, which prevents the loss of body heat. This makes you feel warm in cold weather. The overlapping scales help to shed raindrops). How does the structure of wool affect comfort? durability? care? (Wool absorbs moisture from the air or body thus helping you to stay dry. Wool has all of the desirable charactertics of durability. Wool felt when excessive moisture and heat are applied, thus it requires dry cleaning. Some wool fabrics can be washed because a special finish has been applied. Wool fabric worn next to the skin may cause some discomfort).

d. What did silk look like?

(Silk is clear and looks like a glass rod under the microscope). Describe those characteristics that makes silk different from other natural fibers? (You might see some faint little marks. It has a high gloss or sheen). How does the structure of silk affect comfort? durability? care? Silk is comfortable to wear because it is soft and smooth. The fiber is strong but is weakened by dry-cleaning, perspiration and abrasion.

3. How are some yarns are formed? (The types of yarns are: a) monofilament - one strand such as silk. b) single - twisting two strands of fibers together. c) ply-twisting of two or more single yarns together. d) cable - two or more ply yarns twisted together). How does yarn formation affect fabric characteristics? (Much of the beauty, texture, performance and variety of fabrics are due to the difference in the yarns. Smooth yarns yield smooth fabrics. Staple fibers are short and rough. These fibers produce rough, dull, fuzzy yarns. The fabrics are duller and rougher than fabrics made of smooth, shiny filament yarns. Strong fibers create strong yarns, which produce strong fabrics).

4. How does twisting affect the behavior of yarns? (Twist holds fibers together to produce a yarn. Twist affects yarn diameter and appearance. Yarn diameter is the thickness of the yarn. Ply gives a yarn strength. Low twist yarns are softer and weaker. High twist yarns are firm, strong and usually fine in size. High twist yarns may cause some fabrics to shrink).
5. How does twisting affect the appearance of yarns? (High twist yarns are dull in texture. Low twist yarns are more lustrous. Loose twist yarns are more fuzzy, may pill and usually pick up soil more readily).
6. What are blended yarns? (Yarns are blended when different fibers are combined in one yarn). How does the blending of yarns affect fabric performance? (Blending was designed to make use of the best qualities of each fiber. For example, cotton is often combined with polyester. The cotton offers comfort, softness, and absorbency. Polyester adds strength, wrinkle and shrink resistance and quick drying). What affect does blending of yarns have on fabric appearance? (Silk may be combined with wool to increase its luster).

<u>Applying the Conclusion</u>

Recall the puzzling event.

1. "Why is it a good idea to wrap your wet bathing suit in a cotton towel?" (Cotton is absorbent. It will soak

up the water from the bathing suit thus keeping the water contained).

2. Why will wool be warmer, drier, and more comfortable on a cold rainy day? (Wool has scales. The scales overlap thus trapping body heat and causing water to shed).
3. "Does it matter whether you unpack your suitcase upon arrival if the clothes in the suitcase are made out of natural fabrics?" (Silk and wool are very wrinkle resistant. The physical fabric structure of wool and silk gives them wrinkle resistant properties).

Summary

Let's go back to our original question. Why don't all natural fabrics look and feel alike and why are their performances different? (Differences are due to fiber structure and yarn structure).

Resource

School of Human Environmental Science (1988). Clothing and Textiles Laboratory Manual: Department of Clothing and Textiles. North Carolina, University of North Carolina at Greensboro.

APPENDIX C

STUDENT WORK SHEETS

NATURAL FIBER IDENTIFICATION

Name: ______________________________

Directions: View the fibers through the microscope.

1. Using the space provided, sketch a few fibers in your view.

2. Compare your sketch with the photomicrograph provided.

3. Identify the fiber and describe what the fiber looks like.

4. Structure refers to the way the fiber is made and the way the fiber looks. Read pages 176-177 in Clothing Fashion Fabric Constructions. Answer the questions pertaining to fabric structure and comfort, fabric structure and durability and fabric structure and care.

Swatch: ____________________________

Name of Fiber: ______________________

Describe what the fiber looks like:

How does its structure affect comfort?

How does its structure affect durability?

How does its structure affect care?

Swatch: ______________________________

Name of Fiber: ______________________

Describe what the fiber looks like:

How does its structure affect comfort?

How does its structure affect durability?

How does its structure affect care?

Swatch: ______________________________

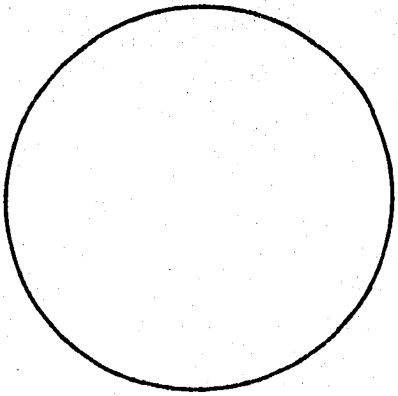
Name of Fiber: ______________________

Describe what the fiber looks like:

How does its structure affect comfort?

How does its structure affect durability?

How does its structure affect care?



Swatch: ______________________________

Name of Fiber: _______________________

Describe what the fiber looks like:

How does its structure affect comfort?

How does its structure affect durability?

How does its structure affect care?

NATURAL FIBERS

Name: ______________________________

Directions:

1. Read pages 186-187 in Clothing Fashion Fabric Construction.
2. Place a small amount of each of the fiber samples from the envelope in your hand. Use the questions below to fill in the chart about length, texture, and appearance:
   a. Length of fiber - How long is it? Are the fibers pulled? Are the fibers thick or thin?
   b. Texture - Is the surface smooth, fuzzy, rough, soft, stiff?
   c. Appearance - Is it wavy, shiny, dull? What color is it?
3. Twist the fiber sample to make a yarn. Attach to the chart below.
4. Take a small amount of the same fiber and make a yarn by pulling the fiber straight. Attach to the chart below.
5. Next use a small amount of the same sample and make a yarn by knotting. Attach to the chart.
6. Answer the questions below the chart from the information recorded.

Fiber	Length of Fiber	Texture of Fiber	Appearance of Fiber	Sample of Twisted Fiber	Sample of Pulled Fiber	Sample of Knotted Fiber
Cotton						
Wool						
Flax						
Silk						

1. How are yarns formed?

2. What affect do staple fibers have on yarn?

3. What does twisting, knotting and pulling have to do with the way natural yarns look?

4. Take a small amount of wool and a small amount of silk and blend together. What affect does the blending of these fibers have on yarn appearance?

NATURAL YARNS

Procedure:

1. Remove a yarn from your envolope.
2. Examine the yarn. Does the yarn have a low, loose or high amount of twist? Place an "X" in the box that describes the amount of twist.
3. Untwist the yarn.
4. Describe the length of the yarn. Is it short or long? Are the fibers exactly parallel or somewhat randomly positioned. Write your answer in the space provided under "Description."
5. Describe the appearance of the yarn. Is it wavy, shiny, dull? Write your answer in the space provided under "Description."
6. Is the yarn single, ply, or cable? Place an "X" in the space under "Type of Yarn" that answers this question.
7. Mount the yarn in the space labeled "Attach Yarn."

Amount of Twist			Description		Type of Yarn			
Low	Loose	Tight	Length	Appearance	Single	Ply	Cable	Attach Yarn

Using the information from the chart, answer the questions below:

1. How does the amount of twist affects the yarn's appearance?
2. How does the amount of twist affects the behavior of the yarn?
3. Define these terms: (a) monofilament or single yarns, (b) ply yarns, (c) cable yarns.

APPENDIX D

TEXTILES TEST AND ANSWER KEY

Name_______________________________

TEXTILES TEST

DIRECTIONS: MULTIPLE CHOICE. Select the <u>best</u> answer and write the number on the line to the left.

____ 1. If you were purchasing towels, which fabric would be most absorbent?
1. cotton.
2. polyester/cotton.
3. polyester.
4. rayon.

____ 2. Which fabric should be chosen to reduce or eliminate pilling?
1. acrylics.
2. acetate.
3. polyester.
4. cotton.

____ 3. When compared to 100 % rayon fabric, a fabric made out of 50% rayon and 50% polyester would have
1. half the properties of each fiber.
2. increased loss of strength when wet.
3. increased wrinkle resistance.
4. higher heat retention.

____ 4. The first sign that a pair of jeans is abrading shows up
1. at the knees.
2. in fading.
3. at the pockets.
4. at the waistband.

____ 5. Which of the fabrics listed below would be weakened by chlorine bleach?
1. polyester.
2. wool.
3. cotton.
4. linen.

____ 6. Why should soiled white garments be washed separately?
1. The detergent is not strong enough to remove the stain and clean the rest of the wash load.
2. All white or light colored fabrics absorb soil from the wash water.
3. Other garments become soiled from the same stain.

____ 7. Disposable diapers are made of nonabsorbent fibers, but are comfortable enough for a baby to wear because the fibers are
1. absorbent.
2. abrasion resistant.
3. resilient.
4. able to wick.

____ 8. Laundry aides should be selected according to
1. commercials seen on television that resemble your laundry problems.
2. whether the clothes will be laundered at home or at a laundromat.
3. basic fiber properties of garments to be cleaned.
4. what friends recommend and know that works.

____ 9. What affect does the wicking ability of manufactured fabrics have on comfort?
1. It increases comfort.
2. It decreases comfort.
3. It has no effect on comfort.

____10. Which category of fibers have little or no absorption?
1. natural.
2. protein.
3. cellulosic manufactured.
4. noncellulosic manufactured.

____11. In order for a boy's dress pants to be durable enough to withstand bending and stretching at the knees, the fabric must have a high
1. rate of absorption.
2. degree of resiliency.
3. degree of wicking.
4. yarn count.

____12. Durability is important in upholstery fabrics. For this reason fabrics selected to cover furniture should have the following characteristic:
1. washable.
2. absorbency.
3. elasticity.
4. resiliency.

____13. In order for fabrics to maintain a fresh appearance all day, the fabric must
1. be absorbent.
2. resist abrasion.
3. have the ability to wick.
4. be resilient.

____14. If you were a sportswear buyer and needed to purchase rain wear for your department, which fabric property would be most important?
1. The fabric must be absorbent.
2. The fabric must have the ability to wick.
3. The fabric must be resilient.
4. The fabric must be abrasion resistant.

____15. The reason for <u>not</u> soaking wool in an enzyme detergent is because the enzyme detergent will
1. attack the proteins of wool.
2. causes wool to discolor.
3. make it almost impossible to remove stains later.

DIRECTIONS: Items 16a-21b consist of two parts. Choose the best answer to both parts. Write the response on the line to the left of each number.

____16a. A garment made from which fabric would be most comfortable on a hot humid day?
1. cotton.
2. rayon.
3. acetate.
4. polyester.

____16b. The reason for my choice in 16a. is that a garment made from this fabric will
1. absorb moisture.
2. wick moisture away from the body.
3. trap moisture between the fibers of this fabric.

____17a. The most comfortable sweater to wear while sitting around a camp fire on a cool evening would be made of
1. cotton.
2. wool.
3. nylon.
4. silk/polyester.

____17b. The reason for selecting the fabric in 36a. is because of its ability to
1. retain its shape.
2. resist pilling.
3. draw moisture away from the body.
4. trap air.

____18a. Which fabric would be best suited for hotel bed linens if the hotel manager is primarily interested in ease of care?
1. cotton.
2. rayon/polyester.
3. cotton/polyester.
4. linen.

____18b. The fabric in 37a. is suitable because it is
1. resilient.
2. wrinkle resistant.
3. abrasion resistant.
4. absorbent.

____19a. Coffee is a (an)
1. water based stain.
2. oil based stain.
3. oil and water based stain.
4. protein based stain.

____19b. Therefore, which procedure would be used to clean an item with the type of stain that's referred to in 38a.?
1. machine wash.
2. dry clean.
3. wash in an enzyme detergent.

____20a. What is the apparatus used to form manufactured fibers?
1. drawing instrument.
2. spinning tool.
3. spinneret.
4. melting instrument.

____20b. The apparatus in 20a. also determines the shape and size of manufactured fibers which explains
1. the spinning method used.
2. how the substance is extruded.
3. the versatility of the fabric.
4. the color of the fabric.

____21a. When you hold a fabric in your hand and crush it and the fabric returns to its original shape, the fabric has high
1. absorbency.
2. abrasion resistant properties.
3. resiliency.
4. wicking ability.

____21b. Which one of the fabrics below has the characteristic described in 21a?
1. cotton.
2. rayon.
3. linen.
4. wool.

DIRECTIONS: Read the scenario below and the statements following it. If the statement gives a clue that the garment is cotton, Circle YES. If the statement does not give a clue that the garment is cotton, Circle NO.

Sarah has cut all labels from her clothes because they irritate her neck. She has an assignment to bring an item of clothing made of 100% cotton to her next FHA\HERO meeting. Which of the following characteristics would be clues to Sarah that the garment is cotton?

YES NO 22. The garment has a peculiar odor.

YES NO 23. The yarn is fuzzy and the length of the fiber is short.

YES NO 24. The garment pills.

YES NO 25. The garment wrinkles easily.

YES NO 26. The garment needs pressing after each wash.

DIRECTIONS: On the line to the left of each definition in Column A, write the number of the type of yarn in Column B. Each yarn may be used once, more than once, or not at all.

COLUMN A Definition	COLUMN B Types of Yarns
____27. made from two or more single yarns that are not alike	1. blends
____28. yarns made of one strand	2. textured yarns
____29. different fibers combined into one yarn	3. monofilament
____30. two or more single yarns twisted together	4. mended yarns
____31. a yarn permanently set into ripples, waves, zigzags or various twists	5. ply yarns
____32. created from fibers twisted together or laid side by side	6. complex yarns
	7. yarns

DIRECTIONS: On the line to the left of each occasion in Column A, write the number of the fiber content that's most appropriate in Column B. Each fiber content in Column B may be used once, more than once, or not at all.

COLUMN A Occasion	COLUMN B Fiber Content
____33. female guest at a summer wedding	1. 75% wool/25% polyester
____34. best man in a winter wedding	2. 65% acetate/35% silk
____35. dancer in a modern dance performance	3.75% linen/25% cotton
____36. suit to be worn by a concert pianist	4. 40% nylon/30% cotton and 30% spandex
	5. 50% polyester/50% nylon

DIRECTIONS: On the line to the left of each item in Column A, write the number that corresponds to the clothing item's degree of abrasion resistance in Column B. Each degree of abrasion in Column B may be used once, more than once, or not at all.

COLUMN A Item	COLUMN B Degree of Abrasion Resistance
____37. cotton blouse	1. low
____38. knit rayon dress	2. medium
____39. firmly woven silk scarf	3. high
____40. lacy cotton/nylon gloves	

DIRECTIONS: On the line to the left of each yarn in Column A, write the number of its flammable characteristic in Column B. Each flammable characteristic in Column B may be used once, more than once, or not at all.

COLUMN A Yarns	COLUMN B Flammable Characteristics
____41. cotton	1. yarns self-extinguish
____42. wool	2. yarns continue to burn after removed from flame
____43. polyester	3. yarns don't melt and burn
	4. yarns burn slowly with melting when in the flame

DIRECTIONS: On the line to the left of each definition in Column A,write the number of the fabric performance in Column B. Each fabric performance in Column B may be used once, more than once, or not at all.

COLUMN A Definition	COLUMN B Fabric Performance
____44. movement of moisture along the fiber's length or around its width	1. abrasion
	2. durability
____45. how well a fabric takes in moisture	3. resiliency
	4. wicking
____46. ability to spring or bounce back into shape	5. absorbency
____47. rubbing or friction applied to the surface of a fabric or fiber	

DIRECTIONS: On the line to the left of each fiber's appearance in Column A, write the number of the fiber in Column B. Each fiber in Column B may be used once, more than once, or not at all.

COLUMN A Fiber Appearance		COLUMN B Fiber
____48.	looks like a twisted ribbon	1. cotton
____49.	looks like a bamboo pole	2. flax
____50.	covered with scales	3. silk
____51.	clear, looks like a glass rod	4. polyester
		5. wool

DIRECTIONS: On the line to the left of each definition in Column A, write the number of the types of fibers in Column B. Each fiber in Column B may be used once, more than once, or not at all.

COLUMN A Definition		COLUMN B Types of Fibers
____52.	basic hairlike unit from which fabric is made	1. cellulosic fibers
		2. fibers
____53.	fibers developed through experimentation from substances found in nature	3. manufactured fibers
____54.	fibers that come from plant sources	4. natural fibers
		5. noncellulosic fiber
____55.	produced primarily from wood pulp with minimum chemical steps	6. textured fibers
____56.	made from molecules that come from petroleum, air, natural gas and water	

DIRECTIONS: On the line to the left of each description in Column A,write the number of the fabric characteristic in Column B. Each characteristic in Column B may be used once, more than once, or not at all.

COLUMN A Description of Property	COLUMN B Fabric Characteristic
____57. drapeable	1. appearance
____58. feels rough	2. hand
____59. looks silky	3. texture
____60. shiny fabric	4. loft

TEXTILES TEST
ANSWER KEY

1	1.
4	2.
4	3.
2	4.
2	5.
2	6.
4	7.
3	8.
1	9.
4	10.
2	11.
4	12.
4	13.
2	14.
1	15.
1	16a.
1	16b.
2	17a.
4	17b.
3	18a.
2	18b.
1	19a.
1	19b.
3	20a.
3	20b.
3	21a.
4	21b.
YES **NO**	22.
YES NO	23.
YES **NO**	24.
YES NO	25.
YES NO	26.
6	27.
3	28.
1	29.
5	30.
2	31.
7	32.
3	33.
1	34.
4	35.
2	36.
2	37.
1	38.
3	39.
2	40.
2	41.
1	42.
4	43.
4	44.
5	45.
3	46.
1	47.
1	48.
2	49.
5	50.
3	51.
2	52.
3	53.
4	54.
1	55.
5	56.
2	57.
3	58.
1	59.
1	60.

APPENDIX E

TEACHER DATA SURVEY

TEACHER DATA SURVEY

Directions: Indicate the extent to which you agree or disagree with each statement by circling the appropriate number. In making your rating, use the following symbols:

5 = SA - Strongly Agree

4 = A - Agree

3 = U - Uncertain; have no opinion either way

2 = D - Disagree

1 = SD - Strongly Disagree

	Statement	SD	D	U	A	SA
1.	There was a high degree of student involvement throughout the lesson.	1	2	3	4	5
2.	I found the inquiry process to be difficult to use.	1	2	3	4	5
3.	The time it takes to prepare for the inquiry lesson is well worth it.	1	2	3	4	5
4.	On the whole, the inquiry process takes too much class time.	1	2	3	4	5
5.	The materials provided for the lessons were impractical.	1	2	3	4	5
6.	Using this approach was stimulating to me.	1	2	3	4	5

	Statement	SD	D	U	A	SA
7.	I did not enjoy using this method with my students.	1	2	3	4	5
8.	The lab experiments were too complex for the students.	1	2	3	4	5
9.	I am likely to use the inquiry process in teaching when appropriate.	1	2	3	4	5
10.	The lab experiences did not strengthen my understanding of textile principles.	1	2	3	4	5
11.	My students developed inquiry skills and mastered important facts and concepts.	1	2	3	4	5
12.	My students were internally motivated.	1	2	3	4	5
13.	The discussions did not help the students to draw relevant conclusions about the lessons.	1	2	3	4	5
14.	I believe I can develop my own inquiry lesson plans.	1	2	3	4	5

TEACHER INTERVIEW

Directions: Which rating indicates the extent to which your students exhibited the following behavior.

Most of the Time

Frequently

Occasionally

Not at All

To what extent were the majority of your students:

1 able to recognize relationships among ideas?

2 able to apply content to new situations?

3 willing to collect relevant information?

4 able to formulate hypotheses?

5 able to recognize and solve the problem?

6 involved in the discussions?

7 involved in carrying out the learning activities?

8. able to follow the directions and carry out the activities without teacher assistance.

9. able to grasp the basic understanding of fiber structure and performance.

Directions: Elaborate on the following questions.

1. Which activities were appealing to and stimulated the interest of the students? Which ones were not?

2. What is your reaction to the amount of time the inquiry process required?

3. How practical were the activities from the standpoint of equipment and supplies? Please explain.

4. Were any of the activities inappropriate for the age level of the students? for teaching textile concepts? Which one(s)?

5. Describe your student's reactions toward the activities and lab experiences.

6. Describe your reactions toward the activities, the unit content and the lab experiences.

7. From using this method, what changes did you notice in your students: (a) level of participation, (b) sharing of ideas, (c) grades, (d) respect for other students, and (e) level of confidence.

The interviewer will ask for:

attendance

first semester grades

educational attainment of teacher

teaching experience

racial makeup of class.

APPENDIX F

STUDENT ATTITUDE TOWARD INQUIRY

STUDENT ATTITUDE TOWARD INQUIRY

The researcher is interested in your opinion about the inquiry method of instruction. This survey is strictly confidential. There are no right or wrong answers and your honest response is needed.

Directions: Indicate the extent to which you agree or disagree with each statement about the textiles unit you just completed by circling the appropriate number. In making your rating, use the following symbols:

5 = SA - Strongly Agree

4 = A - Agree

3 = U - Uncertain; have no opinion either way

2 = D - Disagree

1 = SD - Strongly Disagree

	Statement	SD	D	U	A	SA
1.	This unit made me think for myself.	1	2	3	4	5
2.	The unit on textiles was dull and boring.	1	2	3	4	5
3.	The class activities used with the textiles unit were interesting.	1	2	3	4	5
4.	The work sheets were too hard.	1	2	3	4	5

	Statement	SD	D	U	A	SA
5.	I enjoyed doing the lab experiments.	1	2	3	4	5
6.	The discussions after the lab experiments helped me to see how I could use what we had learned.	1	2	3	4	5
7.	I did not like the activities that required group work.	1	2	3	4	5
8.	Doing the lab experiments were a waste of time.	1	2	3	4	5
9.	The atmosphere in the classroom was relaxed and I could freely express myself.	1	2	3	4	5
10.	The activities in this unit have helped me to make sound decisions about the selection and care of clothing.	1	2	3	4	5
11.	I felt pressured to come up with the right answers.	1	2	3	4	5
12.	I do not like the way this unit was taught.	1	2	3	4	5

STUDENT SURVEY FORM

Directions: Please respond to the following by placing an (X) in the appropriate space.

1. SEX:

______ 1) Female

______ 2) Male

2. GRADE:

______ 1) 9

______ 2) 10

______ 3) 11

______ 4) 12

3. Have you previously been involved with the study of textiles?

______ 1) YES (GO DIRECTLY TO THE NEXT QUESTION)

______ 2) NO (SKIP TO QUESTION 5)

4. Where did you obtain the information on textiles?

______ 1) Home Economics Class

______ 2) Boy Scouts

______ 3) Girl Scouts

______ 4) 4-H Club

______ 5) Other, (Specify) ______________________________

5. Who is the one person with the most influence in deciding your clothing purchases?

   _____ 1) I am

   _____ 2) My Mother

   _____ 3) My Father

   _____ 4) My Classmates\Peers

   _____ 5) My Friend(s)

   _____ 6) Other, (Specify)______________________________

6. How often do you purchase an outer garment of clothing?

   _____ 1) Once a Week

   _____ 2) Twice a Month

   _____ 3) Once a Month

   _____ 4) Every 2 - 6 Months

   _____ 5) Every 7 - 11 Months

   _____ 6) Once a Year

7. Who is responsible for the care of your clothing?

   _____ 1) I am

   _____ 2) My Mother

   _____ 3) My Father

   _____ 4) My Sister

   _____ 5) My Brother

   _____ 6) Other, (Specify)______________________________

APPENDIX G

NAMES AND ADDRESSES OF TEXTILE COMPANIES

NAMES AND ADDRESSES OF TEXTILE COMPANIES

Cotton Incorporated
4505 Creedmoor Road
Raleigh, NC 27612
Raouf Taraboulsi, Manager, Fiber Processing Center

DeSales Yarn Outlet
829 Knox Road
McLeansville, NC 27301
Mary Stowe, Manager

Dominion Yarns
840 Plantation Road
P.O. Box 2856
Burlington, NC 27216
C. Allen O'Shields, Plant Manager

Edgecombe Manufacturing Company
Saint James Street Extension
Tarboro, NC 27886
Albert Maran, Manager

Glen Raven Mills
Glen Raven, NC
Steven Hooper, Manager

Halifax Cotton Mills
P.O. Box 1098
South Boston, VA 24912
David Nicoll, Manager

Horikoshi New York, Inc.
55 West 39th Street
New York, NY 10018

JPS Converter & Industrial Corporation
P.O. Box 250
Stanley, NC 28164
Bill Wall, Manager

Monsanto Company
Decatur, Alabama
Attention: Bruce Terry

Polylok Corp. Knit Fabric
3006 Andconda Road
Tarboro, NC 27886
Douglas House, Plant Manager

Tom Togs Manufacturing
Conetoe, NC 27819
Jim Garrett, Manager