Effects of 4-H Hand-on School Enrichment Lessons on Science Test Scores

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Effects of 4-H Hands-On School Enrichment Lessons on Science Test Scores

This research paper is presented to the Graduate Faculty of the Department of Occupational and Technical Studies at Old Dominion University

In Partial Fulfillment of the Requirements for the degree of Master of Science in Occupational and Technical Studies Career and Technical Education Concentration

By
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August 2008
This research paper was prepared by Wendy R. Herdman under the direction of Dr. John M. Ritz in OTED 636, Problems in Occupational and Technical Studies. It was submitted to the Graduate Program Director as partial fulfillment of the requirements for the degree of Master of Science in Occupational and Technical Studies with a concentration in Career and Technical Education.

APPROVAL BY: ____________________________  ____________________________

Dr. John M. Ritz  Date
Advisor and Graduate Program Director
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Thank you to the administrators and teachers of Cople Elementary School for allowing me to enter their classrooms to provide this new hands-on learning experience in the third and fifth grades. Special thanks go to Mr. Michael Hurdle, assistant principal, who helped coordinate a schedule that worked for all of the teachers. Special thanks also go out to the third, fourth and fifth grade teachers who willingly disrupted their regular schedule to allow me to complement their science content with 4-H hands-on lessons. Not only did Cople Elementary School invite me into their classrooms but they also provided me with the test scores to conduct this research.

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~Wendy R. Herdman
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CHAPTER I

INTRODUCTION

4-H is the development program of Virginia Cooperative Extension and is committed to helping youth to learn the leadership, citizenship and life skills that will enable them to become productive and contributing members of their communities. The central theme of 4-H education is “learning-by-doing” (Virginia 4-H, n.d.).

4-H has many different delivery modes. One of them is school enrichment. This is not the delivery mode that most people think of when they think of 4-H. The traditional delivery mode recognized by most people is the 4-H club. School enrichment is a delivery mode that is used to reach a large number of children who are diverse in age, ethnicity and socioeconomic status. The Standards of Learning (SOL’s) have become the defining factor of instructional time in Virginia public schools. School administrators are reluctant to use 4-H school enrichment curriculum because they are hesitant to relinquish instructional time even though all new 4-H curricula in Virginia are correlated to the SOL’s.

4-H clubs as a delivery mode have a proven record for helping young people to develop life skills. For the 4-H school enrichment delivery mode to make the same claim and become more widely accepted as a valuable resource for schools, evaluation of school enrichment programs will need to document this outcome (Diem, 2001).
4-H uses experiential education as a model for developing curriculum. The experiential learning method includes a cycle of steps that include: experiencing a hands-on activity; sharing results, reactions and observations publicly; processing the experience by discussing and reflecting; generalizing to connect the experience to real world examples and then applying what was learned to a similar or different situation in the future (Jamison, n.d.).

Statement of Problem

The problem of this study was to determine whether participation in 4-H hands-on in-school SOL enrichment lessons improved science SOL test scores for third and fifth graders.

Hypothesis

To guide this study, the following hypothesis was projected:

H₁: Third graders who experienced 4-H hands-on in-school SOL enrichment activities had higher science test scores than in years when 4-H hands-on curricula were not used.

H₂: Fifth graders who experienced 4-H hands-on in-school SOL enrichment activities had higher science test scores than in years when 4-H hands-on curricula were not used.

Background and Significance

School enrichment as a 4-H delivery mode was often used because it was a mode that reached a large diverse population and it was a way to promote other 4-H programs. But in a time when SOL’s were paramount to school accreditation and No Child Left Behind legislation, school administrators were
reluctant to bring "outside acts" into the classroom for fear of taking away from precious instructional time.

John Dewey’s educational philosophies included theories about experience as a teaching tool. It is well known that Dewey was a proponent of experiential education. Dewey stressed that not all experiences are equal in terms of education. The quality of the experience was critical to learning (Dewey, 1916). 4-H educational specialists have taken great time to create quality curricula that would provide a quality learning experience. 4-H educational programming was designed to facilitate a hands-on learner-centered environment by using the experiential learning model as an instructional strategy.

Hands-on activities have been a variable of many research projects. A study was conducted in Turkey to investigate the effects of hands-on activities on eighth grade students’ science process skills and attitudes toward science. Hands-on activities produced better science processing skills and positive attitudes toward science than to teacher-demonstration teaching methods (Bilgin, 2007). A study conducted in Maine showed that experience based learning activities improved both knowledge and behaviors related to dairy foods for elementary school students (Savoie, 2006). Another experimental study revealed that hands-on activities are effective supplements to regular technology education classroom presentations. Participants in this study who experienced hands-on activities had better scores on post-tests. The author suggested that psychomotor participation can increase learning and he generalized that hands-activities could enhance any concept (Korwin, 1990).
4-H was a public education resource that is offered at no cost to participants. Hands-on learning was the central theme of 4-H educational programming. New 4-H curriculum was SOL correlated and used the experiential learning model. 4-H curriculum could be taught by local county extension agents, teachers or 4-H volunteers.

4-H programming has the potential to enhance classroom education by providing the thorough, experience-based learning for which it is known. For 4-H school enrichment programming to become a widely-accepted and valued resource, there needed to be evidence of the positive impact that it can have on learning (Diem, 2001).

Limitations

This study was confined to science instruction of third and fifth graders at Cople Elementary School in Hague, Virginia, in Westmoreland County. 4-H science, engineering and technology curricula were used to provide hand-on lessons and activities. SOL scores for grades three and five were compared for the school years ending in 2007 and 2008.

Assumptions

The assumptions made in this research were:

1. Children experienced the same science content from their teachers in the two different school years of the study.

2. Virginia 4-H curriculum materials were correlated to the Virginia SOL’s and have been systematically designed and developed by education experts.
3. Virginia’s science SOL tests have been tested to have both construct and content validity and were reliable measures of science knowledge.

4. SOL test scores provided by the school were representative of each entire grade level.

Procedures

This study will center on the SOL test scores for science for third and fifth grade students. SOL test scores from a year without 4-H hands-on in-school enrichment will be compared to a year when 4-H hands-on school enrichment curriculum was used. Test of significance will be conducted and used as a qualitative measure to help interpret the data and measure the impact of the 4-H hands-on in-school lessons.

Definition of Terms

Youth development conjured many ideas. The 4-H youth development program was different from many youth programs in that it was a program of Cooperative Extension and used research-based teaching methods and curricula. To forego confusion, the following terms were defined as they specifically relate to the research paper.

4-H: A youth development program of the Virginia Cooperative Extension. 4-H was committed to helping young people to learn leadership, citizenship and life skills that will enable them to become productive and contributing members of their communities. The central theme of 4-H education was “learning-by-doing”. 4-H programs were open to all youth ages 5-19. It was an informal education program conducted by our state land-grant universities, the U.S. Department of...
Agriculture and local governments and it was carried out by extension agents, staff and 4-H volunteers.

Virginia Cooperative Extension (VCE): A local connection to Virginia’s land-grant universities, Virginia Tech and Virginia State University. Its purpose was to help people improve their lives by providing research-based educational resources through a network of on-campus and local extension offices and educators.

Experiential learning or education: Process in which the learner “does” something, reflected upon what s/he has done and then discovered a new way to apply that knowledge in another situation. The process was intentional and required a facilitator to create an environment that is learner-centered (Jamison, n.d.).

Learning-by-doing: Another term for experiential learning or hands-on learning.

Standards of Learning (SOL): The Standards of Learning for Virginia public schools described the Commonwealth’s expectations for student learning and achievement in grades K-12 in English, mathematics, science, history/social science, technology, the fine arts, foreign language, health and physical education and driver education. These standards represented the knowledge that a large group of educational stakeholders feel youth should acquire in public schools.

Delivery mode: Different ways in which 4-H programming can be delivered to a youth audience.

School enrichment or hands-on in-school lessons: A 4-H delivery mode in which participants were involved in non-club learning experiences. SOL enrichment
programs were coordinated with school personnel and deliver content that is
correlated with the SOL's.

Overview of Chapters

The challenge in this study was to measure the impact of 4-H hands-on
school enrichment lessons on science SOL test scores. Chapter I introduced the
research problem of determining the impact of participation in 4-H hands-on in-
school enrichment programs and proposed a hypothesis that the school
enrichment would improve science SOL test scores. The background and
significance detailed the importance of acceptable SOL scores and the value of
experiential education and how 4-H could enhance learning in the classroom.
The boundaries of the study were set in the limitations. Assumptions were
detailed so that certain variables could be held true to replicate the experiment.
The procedure gave a brief overview of how the study will progress. Terms that
have special meaning to the study were defined in the definition of terms section.

Chapter II of this study will include a review of literature to reveal other
relevant studies and indicate the need for further study. Chapter III will define the
methods and procedures used to collect data for the study. Chapter IV will detail
the specific findings of this study. Chapter V will summarize the study, draw
conclusions based on the data and make recommendations about the use of 4-H
school enrichment curriculum.
CHAPTER II
REVIEW OF LITERATURE

To understand the relationship between science achievement, science instructional methods and 4-H curricula, a review of literature was conducted to determine the current context regarding science instructional methods, hands-on or experiential education and 4-H philosophy and in-school curriculum.

Science Instruction in the United States

The United States of America has been a superpower in the world in many rights including science and technology, but evidence exists now that the U.S. has lost that edge and influential people have noticed. Educational funding, needs assessments and instructional strategies have begun to change.

Lawmakers noticed the change in U.S.'s science and technology status and in 2005 requested that the National Academies (an association that includes the National Academy of Sciences and the National Academy of Engineering) formally assess the U.S.’s position in the global picture of science and technology (Lemonick, 2006). The resulting report was entitled “Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future” and it outlined the status of research, development and science in general in the U.S. and called for increased government funding. The report indicated that the U.S. is facing a significant challenge: its young people are not prepared with the necessary science, engineering and technology workforce skills to be competitive (Rising Above the Gathering Storm, 2005).
In 2006 President Bush announced the American Competitiveness Initiative (Bush, 2006). One aim of the initiative has to strengthen education in the U.S. by improving mathematics and science education, foreign language studies and high schools. President Bush referred to that initiative again in his State of the Union Speech in January 2008. He discussed this initiative and requested that Congress “double the federal support for critical basic research in the physical sciences and ensure America remains the most dynamic nation on Earth” (State of Union, 2008). In addition to increasing government dollars for research in various forms the plan included training 70,000 additional high school science and mathematics teachers (Lemonick, 2006).

In 2006, Linda Froschauer, the president of the National Science Teachers Association, issued a formal statement to and about science teachers in the U.S. The launching of Sputnik in the late 1950’s instigated improving science education in America. Today there is no Sputnik to make science popular. In that light, Froschauer stated that educators are the people who need to encourage students to pursue education and careers in science, technology and teaching. Today, science teachers and others aware of the decline of science education need to be the driving force in science education by showing passion and enthusiasm for science to students, school boards, parent teacher organizations and parents (Froschauer, 2006).

An article entitled, “Science Instruction: An Endangered Species” laid out plainly that teaching elementary science well was imperative in turning scientific decline around. The authors stressed that science, by its nature, was a process-
oriented, discovery- or inquiry-based approach to solving problems and answering questions. Science was not a body of facts to be memorized, and because of that science needs to be taught in a way to promote discovery and inquiry (Conderman, 2008).

The American Association for the Advancement of Science (AAAS) was an international non-profit organization dedicated to advancing science around the world by serving as an educator, leader, spokesperson and professional association (AAAS, 2008). In an effort to reform science education, the AAAS created a tool called “benchmarks of learning for science literacy”. These benchmarks were what the AAAS recommends all students should know and be able to do in science, mathematics, and technology by the end of grades two, five, eight and twelve. The benchmarks were developed for educators to use to design K-12 curricula to teach science more effectively (AAAS, 2006).

The AAAS recommended instructional strategies for teaching the science content of their benchmarks (AAAS, 2006). To teach about the world view of science for grades three through five, the benchmarks recommended an emphasis on scientific engagement through the use of hands-on activities and investigations through inquiry. To teach about science inquiry for grades three to five, the benchmarks recommended that students conduct simple investigations of their own and work in small groups. Students should be encouraged to observe carefully, measure with increasing accuracy, record data clearly and communicate their results in writing, in graphs and oral presentations. Investigations should often be followed up with presentations to the entire class.
and then followed with class discussions. Scientific enterprise should be taught to grades three through five in a way that stresses clear communication and positive and successful science careers (AAAS, 2006).

Hands-on Instruction / Experiential Education

Experiential education was an instructional strategy where students experience an activity or “do” something and then reflect on that experience and discover new ways to apply the new knowledge or skills in a future situation (Jamison, n.d.). Experiential education could be the key to help learners make that connection to their futures. Young people must see the connection between what they are being taught and its application later in their life. Learning needed to be linked to the world beyond the classroom (Styles, 2003). The constructivist learning theory viewed the learning process as the construction of meaning from experience. The teacher’s role in the experiential education process was that of a facilitator helping learners connect the experience to reality and to construct personal meaning (Merriam, 1999). The constructivist learning theory was founded in the work of Jean Piaget and John Dewey and experience is the critical element in this theory and knowledge constructed from the experience is applied to future situations. Students could learn more when the learning opportunity is interactive and not passive (Sigel & Cocking, 1977). Both the American Association for the Advancement of Science (1993) and the National Research Council (1996) accepted the constructivist learning approach as the best instructional practice for teaching science (as cited in Townsend, Rule, Meyer & Dockstader, 2007).
There was a conflict in our present education system between meeting systemic standards like reaching acceptable test scores while actually preparing a young person with problem-solving skills and critical thinking skills that are critical for their future success. There needed to be an instructional setting and strategy that promotes lifelong learning (Styles, 2003).

Hands-on Instruction in Science

A study in Germany compared two methods of instruction for teaching visual perception content in ninth grade biology classes and their effects on cognitive learning and the emotional states of students (Schaal & Bogner, 2005). One group of students worked at workstations and their work was inquiry-based and included an introduction, learner-centered activities, group activities and hands-on activities. Another group of students received conventional teacher-centered instruction with identical content but no hands-on activities.

Data were collected through pre-test and post-test to measure pre-existing knowledge and the change in knowledge. A questionnaire was applied after completing half of the unit to measure short-term emotional states. Both groups experienced a significant increase in conceptual knowledge but had different emotional effects. The workstation group reported higher “well-being” but more boredom than the conventional instruction group. Those students who had a more learner-centered experience at workstations could relate the content area better to their futures (Schaal & Bogner, 2005).

One study examined the effects of hands-on technology based activities on cognitive knowledge and retention (Korwin, 1990). The purpose of the study
was to determine if hands-on technology-based activities could enhance learning among eighth grade students by reinforcing cognitive knowledge and improving retention. Eighth grade students from industrial arts and math classes were selected to participate.

Geodesic domes were selected as the content and two methods of instruction were used. One group of students received information through reading and a hands-on group assignment and another group received information through reading and an illustrated lecture. A post-test was administered to determine cognitive gains from each group and the same post-test was given again after two weeks to measure retention levels.

The group which used hands-on activities had a greater score on both post-tests. There was a significant difference between learning with and without the hands-on activities. Retention levels in both groups did decrease but not significantly. The hands-on group lost slightly more information but still had more knowledge than the illustrated lecture group. The results of this study suggested that hands-on activities enhanced cognitive learning and also suggested that relating technological concepts can be more effectively taught using hands-on concepts (Korwin, 1990).

Another study described the process of developing research-based teaching material for the nitrogen cycle (Townsend et al., 2007). Additional experimental research that was spurred by developing the new material examined the effects of different instructional methods. One group of students learned about the nitrogen cycle using hands-on nitrogen cycle cards and objects
to create a nitrogen cycle and writing poetry related to the nitrogen cycle. Another group learned about the nitrogen cycle by creating a diagram online using internet searches to conduct research and then writing summary essays. Although both the experimental treatment and the control treatment used a constructivist approach to learning, there was a difference in learning that can be attributed to the kinds of activities used to teach the content. There was no difference between the two groups in the pretest. At posttest, the experimental group that used hands-on activities was able to draw twice as many components on their nitrogen cycle diagrams when compared to the control group who used the internet. The experimental group also answered more than half of the test questions correctly. The control group answered 37.7% of the test questions correctly (Townsend et al., 2007).

An extension specialist from Oregon State University wrote about improving science education by using 4-H experiential education to teach science using an inquiry process (Bordeau, 2004). The specialist stated that immersing learners in a process of using scientific knowledge to “do” something is an effective way to teach science. The National Science Educational Standards considered science inquiry to be a skill across all science content areas because the inquiry method of instruction could support any content learning (National Research Council, 1996).

Oregon’s 4-H school enrichment program created a Science Inquiry Action Model to depict the relationship between the 4-H experiential learning model and
the steps applied in science inquiry in an effort to move educators toward learner-centered educational opportunities.

Another study described how a science inquiry-based program might flow. Educators function like facilitators to walk learners through a process. It began with a needs assessment that determined the skills that learners brought with them and identified gaps in their knowledge base. Learners were then asked what they would like to know. Facilitators guided learners by framing questions using cognitive terminology and learners began to take ownership and guide their learning experience.

Conclusions drawn in the article stressed that inquiry-based activities were but one piece of a learner-centered program and it took time for both the educator and the learner to adjust. Educators needed to accept and become comfortable with a certain level of chaos in their classrooms and learners needed to accept initiative and become more engaged in designing their own learning (Bordeau, 2004).

4-H Educational Model and Curricula Development

The mission of 4-H was to provide youth development for young people and the adults who work with them so that they could realize their full potential of becoming effective, contributing citizens in their communities. 4-H experiences provided an opportunity to teach citizenship, leadership and life skills through participation in research-based, non-formal hands-on educational experiences (Virginia 4-H, n.d.).
The learning model that 4-H used to reach the mission was learner-centered and the model represents an on-going process. It began when a child joined 4-H and set his/her goals by selecting the project or experience in which s/he wished to participate. Cognition followed the goal setting and involved mental processes and introduced psychomotor skills. The practice step followed the cognition step and described the learner working through his/her project. The fourth step in the model was performance which in the case of 4-H would be the 4-H event like a horse show or public speaking event. After the event, the 4-Her was back at goal setting and could make new goals or revise the old and begin the cycle again. The double headed arrows represented the fluidity of the cycle (Schwertz, 1992). See Figure 2.1.

Elements unique to the 4-H model were represented in the model by SO, E and Affective. Significant others were the SO's on the model. These are the caring adults (4-H volunteers and extension agents) who made the 4-H experience available to young people. Significant others were important in youth
learning experiences because most young people were not self-directed learners. E stood for evaluation which should take place between every step of the model. Affective described the learning when a learner took his/her new knowledge and applied it in future situations (Schwartz, 1992).

Virginia’s 4-H curriculum process was based on research and established educational practices for youth development. 4-H programming was developed in response to specific needs of youth and was created to be developmentally appropriate for the wide age range of children eligible for 4-H (5-18) in order to provide a meaningful learning experience (Virginia 4-H Curriculum Development, 2004). Virginia’s curriculum process was designed to support long-term learning and was open to change. The Virginia curriculum process aligned itself with guidelines established in the National Handbook for Extension Youth Development Professionals (1992) for the development and implementation of 4-H curriculum (Virginia 4-H Curriculum Development, 2004). Those guidelines included:

- 4-H curricula were youth centered.
- 4-H curricula addressed issues that had the greatest impact on youth.
- Experiential education was the most effective way to teach people in non-formal settings.
- Youth were a vital resource in program development and implementation.
- Curricula allowed for maximum adult-youth partnerships and interactions.
- Community-based programs were most attuned to the needs of local people.
• School enrichment efforts were legitimate and appropriate to 4-H.
• Non-formal education held the interest of youth and allowed for the flexibility of programming.
• 4-H youth development programs were professionally managed by educators skilled in the principles of youth development.

4-H Science Curricula

The Cooperative State Research, Education and Extension Service (CSREES) and the United States Department of Agriculture (USDA) provided funding for and maintained data about 4-H enrollment and participation. The Annual 4-H Youth Development Enrollment Report from 2003 showed that nationally 4,114,522 youth participated in 4-H school-enrichment programs (Cooperative State Research, Education and Extension Service [CSREES], 2003). That made 4-H school enrichment the 4-H delivery mode that reached the most young people – 58% of the total 7,090,929 youth enrolled in 4-H. Of the total 4-H enrollment, 1,535,386 young people were participating in science and technology programs (CSREES, 2003).

The CSREES National 4-H Experiential Learning Design Team sponsored a study to find out more about how school enrichment and other delivery modes were used and viewed by extension staff in the field. The study used a descriptive survey and correlational research methods (Diem, 2001).

Findings from this study indicated that 86% of the respondents reported that they used school enrichment or in-school programs in their counties. The highest ranked purposes for conducting school enrichment were to reach youth
not reached by other delivery modes, to promote 4-H and to meet demand and
develop interest in longer-term delivery modes. The topics offered through
school enrichment were based on requests of teachers and school
administrators, the interest and expertise of 4-H staff and volunteers and the
curriculum standards of the school systems. Sixty-one percent of respondents
employed a balance of experiential learning and lecture/demonstration methods
and 31% used hands-on methods following the 4-H experiential learning model.
Two-thirds of the responding counties stated that no fees are charged and that
costs are absorbed by 4-H. Thirty-five percent said that equipment and
curriculum are loaned at no cost to the schools. One-fifth of respondents
reported that they only collected enrollment data but no impact data and the most
common evaluation method was informal observation or verbal feedback from
teachers (Diem, 2001).

Benefits of this delivery mode revealed through this study included: 4-H
had earned credibility in formal education arena, students have increased
knowledge and skills and a greater diversity of under-represented youth have
been served. Common problems revealed by this study included that traditional
clientele viewed school enrichment programs as something that diverted time
and funds from traditional 4-H programs and schools wanted free services
without a fair balance in the partnership through sharing funds, supervision and
supplies (Diem, 2001).

The National 4-H Council issued a mandate in 2007 to take an active role
in creating a new generation of youth who were equipped with the science and
technology skills that would make them competitive in a global workplace (National SET, 2008). In 2005, there were 5.9 million young people in the U.S. involved in 4-H SET projects. In an effort to address the nation's current challenge, the 4-H national science, engineering and technology (SET) mandate should involve one million new young people in 4-H SET projects over the next five years. The Cooperative Extension System research created resources so that 4-H could provide young people with hands-on learning experiences that “foster exploration, discovery and passion for the sciences” (National SET, 2008).

To accomplish that national 4-H SET mandate, many states were devising plans for their own SET programs. One goal of many state SET plans would be to improve the overall knowledge-base, confidence and capability of 4-H extension staff and volunteers in areas of Science Education.

The National Center for Science Teaching and Learning (NCSTL) and the National 4-H Network for Action in Science Technology (NNST) partnered to study ways to increase the impact of 4-H in-school science programs on learning in elementary school students (Horton & Konen, 1997). 4-H in-school science programs in Ohio were assessed to measure teacher satisfaction and sustained involvement. NCSTL and NNST researchers used that assessment to establish a model for delivering 4-H in-school science programs. The model 4-H in-school science program should include experiential teaching materials, compatible school and community partners, an introductory workshop for both teachers and partners, support for both teachers and partners during the workshop programs,
student materials and teaching supplies and program closure including evaluation activities and a celebration of accomplishments.

The program was piloted and in one county in Ohio that had good experience in developing partnerships between 4-H, community resources and schools. Each component of the model was included in the pilot. Conclusions and recommendations drawn from the pilot study and its evaluation indicated that the 4-H in-school science model appeared to be a valid approach for establishing meaningful science educational experiences. Roles and expectations of all partners needed to be clearly defined and adequate time needed to be taken to plan and implement the program. Emphasis should be placed on providing the necessary support and follow-up for teachers and partners during the program. The availability of classroom ready kits for science programs was also found to be valuable. The model showed promise in guiding 4-H in-school science programs across the country but additional study is recommended to determine if the model is effective in sustaining the involvement of community partners and teachers and in changing the way science is viewed and taught in elementary and middle schools (Horton & Konen, 1997).

4-H school enrichment programs were widespread and reached more youth than any other delivery mode. But for the school enrichment program to gain the credibility that more traditional delivery modes have earned, evaluation efforts would be needed to document the positive outcomes of in-school hand-on 4-H experiences (Diem, 2001).
Summary

Chapter II was a literature review of topics relevant to studying the effects of 4-H in-school hands-on curricula on science test scores for grades three through five. Specific topics were discovered by conducting the literature review and included the status of science education in the U.S., effects of experiential education and hands-on lessons, results of studies using hands-on activities to teach science and the philosophy and curriculum development processes for 4-H. Chapter III will provide details about the methods and procedures used in this study to collect the necessary data to make a comparison of instructional methods.
CHAPTER III

METHODS AND PROCEDURES

This experimental study was conducted to determine if there was a significant difference between the test scores of two groups of elementary school students who were taught using different materials and methods. Chapter III introduces the research population and describes the research variables studied. The instrument used to collect data will be described. The different classroom methods used with the experimental group will be described. Methods of data collection are described as well as the statistical analysis plan.

Population

The population of this experimental study was all of the third and fifth grade students at Cople Elementary School in Hague, Virginia, in Westmoreland County on the Northern Neck in two different school years – 2006-2007 and 2007-2008. Every member of each grade was used to create an average test score for that grade level. For the third grade, there were 69 students in 2007 and 60 students in 2008. For the fifth grade, there were 55 students in 2007 and 56 students in 2008.

Research Variables

The independent variable in this experimental study was instructional methods and materials used. The dependent variable was science SOL test scores for third and fifth graders. Science SOL test scores were compared after implementing different instructional methods to two different groups of students. The control group was composed of students who received their regular science
instruction. The experimental group was composed of students who experienced 4-H in-school hands-on science lessons as enrichment to their regular science instruction.

Instrument Used

The Standards of Learning for Virginia public schools described the Commonwealth's expectations for student learning and achievement in grades K-12. These standards represented the knowledge that a large group of educational stakeholders felt youth should acquire in public schools (Standards of Learning, n.d.). In elementary and middle schools in Virginia, SOL tests were given annually in grades 3, 5 and 8. A student's test results were considered when promoting that child to the next grade level. SOL test scores also affect a school's accreditation. These SOL tests have been selected to measure and compare the science knowledge gained by the control and the experimental groups.

Classroom Procedures

The control groups were in third and fifth grades in the 2006-2007 school year. These students received the regular science content for their grade level delivered by their classroom teachers.

The experimental groups were in third and fifth grades in the 2007-2008 school year. These students received the regular science content for their grade level delivered by their classroom teachers. SOL enrichment lessons were provided to the experimental groups in addition to the regular content. Hands-on
lessons focusing on science inquiry, the scientific method and experimental
design were provided once a month to each class in the third and fifth grade.
The 4-H Extension Agent delivered five twenty-five minute lessons in each
classroom and provided teachers with a brief extension of each lesson to be
completed in their classroom. On-line 4-H modules were also provided to the
third and fifth grades and were shared in the classroom to reinforce the science
lessons. The curricula used were the 4-H curricula: Virginia 4-H’s Science
Inquiry, Planes In Flight, Electricity and a Measuring Up publication; New
Jersey’s 4-H Science Discovery Series 1 & 2; Project Wild’s Surprise Terrarium
and 4-H Junior Master Gardener. All curricula used were correlated with
Virginia SOL’s for grades three through six. Third graders were tested on science
content from first through third grade. The fifth graders were tested on science
content from their fourth grade year and their fifth grade year. Lessons selected
for the fifth grade included fourth and fifth grade SOL’s. Descriptions of these
curricula and their relation to the Virginia SOL’s can be found in Appendix A.

Methods of Data Collection

The science SOL test scores for each grade level were provided by the
administration of Cople Elementary School. Test scores were provided without
student identification to protect the anonymity of the students.

Statistical Analysis

For each grade level, the test scores from the control group and the
experimental group were compared using a t-test. The t-test was used to
determine if there was a significant difference between the students who
received no hands-on SOL science enrichment and those students who did receive hands-on SOL science enrichment using 4-H curricula.

Summary

Chapter III defined the experiment. Information was presented about the study population and the research variables. The experimental classroom procedures were described as were the instruments used to measure knowledge. The methods of data collection were described. The statistical analysis plan was also presented. Chapter IV will present the specific findings of this study.
CHAPTER IV

FINDINGS

The problem of this study was to determine whether participation in 4-H hands-on in-school SOL enrichment lessons improved science SOL test scores for third and fifth graders. Science SOL test scores from a non-4-H year will be compared to a year when hands-on 4-H SOL enrichment lessons were used to complement regular science content.

Findings

Data were presented for each grade in each year. The test scores were an average of all students in that grade for each year. The number of students in each grade in each year was represented as n. Average science SOL test scores for each grade and each school year are presented in Table 4.1.

Table 4.1. Science SOL Test Scores

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>School Year</th>
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<td>2006-2007</td>
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<td>468.67</td>
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<td>3</td>
<td>2007-2008</td>
<td>60</td>
<td>464.72</td>
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<tr>
<td>5</td>
<td>2006-2007</td>
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<tr>
<td>5</td>
<td>2007-2008</td>
<td>56</td>
<td>456.43</td>
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Hypothesis 1

Results indicated that science test scores for third graders were not higher in a year when 4-H hands-on curricula were used. The third grade test scores were lower with 4-H hands-on lessons though not significantly (t=0.35 and critical t values for a one tailed test were 1.66 (p>.05) and 2.36 (p>.01)).
Hypothesis 2

For fifth graders, the test scores were higher when 4-H hands-on lessons were used to complement regular science content but not significantly (t=1.35 and critical t values were 1.66 (p>.05) and 2.36 (p>.01)).

Summary

This study involved comparing different instructional strategies. In the 2006-2007 school year, all students received traditional science instruction from their teachers. In 2007-2008, all students received that same traditional science instruction from their teachers complemented with hands-on instruction using 4-H curriculum. The experimental treatment was imposed to see if it made a difference in science SOL test scores. For the third grade, the test scores decreased with the addition of hands-on instruction. For the fifth grade, the test scores increased with the addition of hands-on instruction.

The findings presented in this chapter will be interpreted in Chapter V. The final chapter will include a summary of the research, conclusions drawn from the results and recommendations for implementing the findings and suggestions for additional research.
CHAPTER V
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter will revisit the problem of this study and the proposed hypotheses. The significance of the study is also restated to emphasize the importance of the undertaking. The limitations of the research and the study population are defined. The instrument used to measure any difference is explained and the details of the data collection are reviewed. The statistics used to measure any difference are described. Data are then interpreted, conclusions drawn and recommendations made.

Summary

The problem of this study was to determine whether participation in 4-H hands-on in-school SOL enrichment lessons improved science SOL test scores for third and fifth graders. Science SOL test scores from a non-4-H year will be compared to a year when hands-on 4-H SOL enrichment lessons were used to complement regular science content. To guide this study, the following hypotheses were projected:

H₁: Third graders who experienced 4-H hands-on in-school SOL enrichment activities had higher science test scores than in years when 4-H hands-on curricula were not used.

H₂: Fifth graders who experienced 4-H hands-on in-school SOL enrichment activities had higher science test scores than in years when 4-H hands-on curricula were not used.
This study was significant because in today's systemic administration of "No Child Left Behind" legislation, SOL test scores have become the driving force behind subject matter content in schools. Schools were reluctant to relinquish instructional time for in-school enrichment programs because they were so focused on SOL achievement.

Hands-on activities have been a variable of many research projects. These studies have proven that hands-on learning and experiential learning opportunities have the potential to increase knowledge and change behaviors.

4-H, the youth development program of Virginia Cooperative Extension, had in-school enrichment programs and curricula that were correlated with Virginia SOL's and focused on learning-by-doing. Hands-on learning was the central theme of 4-H educational programming. 4-H programming or training are offered at no cost in each county and city in Virginia.

This study was confined to science instruction of third and fifth graders at Cople Elementary School in Hague, Virginia, in Westmoreland County. 4-H science, engineering and technology curricula were used to provide hand-on lessons and activities. Science SOL scores for grades three through five were compared for the school years ending in 2007 and 2008. Every member of each grade was used to create an average test score for that grade level.

SOL tests have been selected to measure and compare the science knowledge gained by the control and the experimental groups. The science SOL test scores for each grade level were provided by the administration of Cople Elementary School. Test scores were provided without student identifiers to
protect the anonymity of the students. Average test results for each grade level were presented.

For each grade level, the test scores from the control group and the experimental group were compared using a t-test. The t-test was used to determine if there was a significant difference between the students who received no hands-on SOL science enrichment and those students who did receive hands-on SOL science enrichment using 4-H curricula.

Conclusions

Two separate hypotheses were predicted. The first related to the third grade and was as follows:

$H_1$: Third graders who experienced 4-H hands-on in-school SOL enrichment activities had higher science test scores than in years when 4-H hands-on curricula were not used.

Results indicated that science test scores for third graders were not higher in a year when 4-H hands-on curricula were used. The average scores for 2006-2007 were 468.67, while the average test scores for 2007-2008 were 464.72. The third grade test scores were lower with 4-H hands-on lessons though not significantly ($t=0.35$ and critical $t$ values for a one tailed test were 1.66 ($p>.05$) and 2.36 ($p>.01$)). Thus the hypothesis should be rejected.

The second predicted hypothesis was related to the fifth grade students and was as such:
H2: Fifth graders who experienced 4-H hands-on in-school SOL enrichment activities had higher science test scores than in years when 4-H hands-on curricula were not used.

For fifth graders, the test scores were higher when 4-H hands-on lessons were used to complement regular science content. The average test scores for 2006-2007 were 441.71, while the average test scores for 2007-2008 were 456.43. However, this was not significant (t=1.35 and critical t values were 1.66 (p>.05) and 2.36 (p>.01)). Based on these results, the second hypothesis should also be rejected.

Recommendations

All 4-H curricula used were correlated with grades three through five and the lessons were implemented in the science classes of grades three and five. Grades three and five were included in this study because those grades take science SOL tests. Results of this study indicated that combining hands-on lessons with traditional science content had a beneficial effect on fifth grade science SOL test scores, even though the resulting test score was not significantly different. These same lessons did not have the same positive outcome on third grade science SOL test scores. The same hands-on lessons were also used to complement fourth grade science instruction but fourth graders do not take a science SOL test. The fifth grade science SOL test includes fourth grade content.

Comments from the school's administrators that should be taken into consideration when interpreting results include: feedback from cooperating
teachers to assistant principal regarding lessons was all positive (regarding organization, relevance and developmental appropriateness), third graders took SOL tests for the first time and passing rates (number students passing/number of students taking the test) in all subjects were lower this year than past.

Based on the test score results and the administration comments, perhaps fifth grade is a more appropriate year to incorporate current 4-H hands-on science curricula. This may be because the curricula that was chosen was better written for higher grade levels even though it was correlated with grades three through six SOL's and/or because fifth graders are more accustomed to taking these formalized tests.

The increase in test scores can still be used to benefit and promote 4-H programs even though the difference was not statistically different. Those results can be used as a talking point when introducing a school system to 4-H and its programs as well as a program impact in reports for community members, leaders and faculty review.

Considerations for further study should include the allowance of ample time to incorporate more hands-on lessons throughout the entire school year. For this study, additional hands-on experiences were incorporated from January through May. There were five lessons instructed by the 4-H extension agent as well as a few complementary activities that were provided to the teachers to share with the students.

More lessons and perhaps more input from the teachers and administrators so that purposeful planning can allow for specific topics that have
traditionally tested low to be reinforced with hands-on activities. Training workshops about the 4-H program and its resources could be held for teachers and administrators. Train-the-trainer sessions related to the specific curricula could put the teachers in a better position to use the lessons themselves or to prepare the students for an outside instructor.

Another avenue to follow would be to follow the third graders of this study through their fifth grade year. 4-H in-school enrichment lessons could be implemented for each year in science through fifth grade. Science SOL test scores could be studied to see the effects of long term use of these 4-H curricula. The passing rates could be evaluated each year. When these third graders finish fifth grade, their test scores could be compared to the test scores of fifth graders who have never experienced 4-H hands-on lessons in school.

This study should serve as a building block for more research. For 4-H curricula to be more widely accepted in schools there needs to be data that indicates that it has positive impacts on the one thing that is currently driving instruction – SOL test scores. While this study did indicate that hands-on lessons can improve test scores, it would be more meaningful if the differences were statistically significant.
REFERENCES


Appendix A. 4-H Curricula Correlation with Virginia Science SOL's

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<tr>
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## Appendix B. Science SOL Test Scores

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