The Effectiveness of Oral Health Computer Assisted Instruction on Increasing the Oral Hygiene Status of Children

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THE EFFECTIVENESS OF
ORAL HEALTH COMPUTER ASSISTED INSTRUCTION
ON INCREASING THE ORAL HYGIENE STATUS
OF CHILDREN

by

B.S. December 1985, University of Bridgeport

A Thesis Submitted
to the Faculty of Old Dominion University
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CHAPTER 1
Introduction

Disease control education is essential for the prevention of oral diseases including dental caries, gingival diseases, and irreversible periodontal disease. Research has indicated that bacterial plaque is the primary etiological factor involved in the development of these diseases and that daily removal of the deposit reduces the incidence of all three diseases. Even though the etiology and prevention of the diseases are known, dental caries and periodontal disease are prevalent. The reason for the high prevalence of dental diseases may be due to the large number of individuals never receiving dental treatment. In the United States, approximately 50 percent of the population does not seek dental treatment and oral health instructions for various reasons including fear, access, and lack of motivation. Due to these factors, dental health educators have identified other sources for presenting dental health education including homes, schools, health fairs, and community outreach programs. Of these sources, schools provide a desirable environment for presenting oral health education.
because of access, convenience, and efficiency.

Oral health education may be presented by classroom teachers. Classroom teachers present oral health more often than dental personnel; therefore, a need exists for further oral health instructional development.\textsuperscript{5,7,9,20}

Individuals who do not receive dental treatment on a regular basis may need to receive dental education from other sources. Oral health educators may be dental personnel, family, or peers. Educators may use various teaching strategies such as slides, flipcharts, and models to encourage oral health behavioral changes.

Oral health educational presentations may be via traditional or nontraditional modes. Traditional modes are most frequently implemented through the use of lectures, film strips, slide presentations, discussions, and flip charts. Traditional teaching methods are more frequently used in educational settings than nontraditional methods.\textsuperscript{20,40} Nontraditional modes of oral health presentations may include the use of telecommunications, simulations, tele-type machines, inquiry, automated materials, and computers. Computers may be used for assisted instruction, simulations, or programming. Computer assisted instruction is the most commonly used method of nontraditional education in school systems.\textsuperscript{13,15,17,21}

Computer assisted instruction may be implemented for school, home, business, or personal purposes. Schools,
including many elementary and secondary schools, are implementing computers into the educational curriculum with daily use by students. Controversies, however, have developed concerning the significance of computers in education and their modes of effectiveness as compared with traditional methods. Research investigations have indicated conflicting results. Some researchers have found computers superior to traditional methods. Other researchers have found no significant differences between computer instruction and traditional instruction. The purpose of this study is to determine the effectiveness of computer assisted instruction on increasing the oral hygiene status of children.

Knowledge comprehension alone does not ensure that patients will establish effective routine oral health home care programs. Many individuals have the cognitive information necessary for implementing proper techniques for brushing and flossing; however, they are not motivated to make the appropriate behavioral changes in their daily plaque removal regimens. Research studies in the past have investigated motivational techniques for changing behavior.

Motivation has been identified as a significant factor in changing and enhancing behavior; without motivation a change in behavior may not occur. The purpose of motivation is to stimulate the individual to initiate a
change in behavior. Motivation may be influenced by effective teaching strategies presented by educators with enthusiasm. Various teaching methods may motivate children to actively participate in learning and change oral health behaviors.

Schools are implementing computer assisted instruction into their curriculum for student usage. There are a limited number of available research studies reporting the effects of computer assisted instruction in educating and motivating children. This study investigates the oral hygiene status of children after receiving traditional oral health lecture instruction, oral health computer assisted instruction, or no oral health instruction, as measured by the Personal Hygiene Performance Index.

**Statement of the Problem**

The specific research questions addressed in this study are:

1. Is there a difference among the Personal Hygiene Performance pretest mean and posttest means occurring one day and one month following oral health computer assisted instruction?

2. Is there a difference among the Personal Hygiene Performance pretest mean and posttest means occurring one day and one month following traditional oral health lecture
3. Is there a difference among the Personal Hygiene Performance pretest mean and posttest means occurring one day and one month following no oral health instructions presented?

4. Is there a difference between the Personal Hygiene Performance posttests means occurring one day and one month following oral health computer assisted instruction?

5. Is there a difference between the Personal Hygiene Performance posttests means occurring one day and one month following traditional oral health lecture instruction?

6. Is there a difference between the Personal Hygiene Performance posttests means occurring one day and one month following no oral health instruction?

7. Is there a difference in the Personal Hygiene Performance posttest scores one day following oral health education among computer assisted instruction, traditional oral health lecture instruction, and no oral health instructions?

8. Is there a difference in the Personal Hygiene Performance posttest scores one month following oral health education among computer assisted instruction, traditional oral health
Significance of the Problem

Bacterial plaque is the primary etiologic factor involved in the development of dental caries, gingivitis, and periodontal disease. Loe found that if plaque remains on the teeth for 14 days without any type of removal, gingivitis will develop; therefore, it is necessary for individuals to learn to implement effective plaque removal techniques.

Techniques for caries and periodontal disease prevention exist; however, these mechanical methods are not routinely practiced by most individuals. Internal and external variables influence individuals' behavior and responses in following instructions. External variables may be initiated by others—peers, family, teachers; whereas, internal variables are initiated by a need, or motive. Internalization is necessary for motivation to occur in an individual and for oral health care to become habitual.

Persons who do not have proper oral hygiene care need not only to be educated, but motivated to establish routine oral health care. Information or education may initiate a behavioral change in oral health care. Oral health education presented at an early age may help establish behavioral changes and patterns which can potentially
prevent dental diseases. Research on behavioral changes due to motivation are primarily focused on children because values and behavioral patterns are developed during the early years of life.

The majority of children do not receive dental treatment on a regular basis. The Health Interview Survey of 1978 concluded that only 49.9 percent of the population studied had been examined by a dentist within the year. Twenty nine percent of the individuals under the age of 17 in the study had never been treated by a dentist.

Children may receive oral health education from sources other than dental personnel. Individuals such as nurses, parents, teachers, and peers may be presenting oral health education to children; therefore, a need exists for further oral health instructional development to aid these individuals in presenting instructions accurately.

An oral health computer program may be effective in increasing children's dental health knowledge and changing oral health behaviors. Watkins identified several reasons for implementing an oral health computer program into a school's curriculum. Dental personnel would not have to present oral health education. The oral health computer program could be utilized by teachers who are not dentally knowledgeable and motivated for the benefit of their students. Also, a computer program allows students the opportunity to progress at their own rate. To complete the program the child must fully concentrate on and
participate with the program.

Computers may be utilized for reinforcement of information. Children can review the oral health computer program as many times as they wish for reinforcement and overlearning can be achieved through repetition. Overlearning enhances the internalization of oral health concepts which may increase the potential for behavioral changes to occur in the daily routine of plaque removal.

Dental personnel may also implement a computerized program for preventive dentistry. A computer may be used in the dental office for new patients, recalls, maintenance of periodontics, dental charting, and operative appliance maintenance. Additionally, the computer may be used to educate patients on effective plaque removal techniques.

An oral health computer program may be utilized to educate many people in different environments. An oral health computer program may be implemented in health fairs, school systems, hospitals, clinics, and private practice. Also, an oral health computer program may be marketed as software for use with home computers.

A large population of individuals can be reached and educated through the marketing of an oral health computer program. An oral health computer program can educate individuals and reinforce learning by motivating the individual to maintain his/her oral health by habitual routine home care.
Definition of Terms

The following terms are defined for use in this study:

1. **Children** - Students in the fifth grade at Northlanding Elementary School in Virginia Beach, Virginia.

2. **Computer Assisted Instruction** - A microcomputer software program, developed by the principal investigator, which includes basic information on the mechanical plaque removal techniques and maintenance of oral health. The oral health computer program is designed for educational use with fifth graders. Computer assisted instruction was the independent variable of this study.

3. **Dental Kits** - Toothbrush, unwaxed floss, toothpaste, and an oral health care pamphlet.


5. **Nontraditional Education** - Instructional methods that include automated equipment. For the purpose of this study, computer assisted instruction was selected as the nontraditional education mode.

6. **Oral Hygiene Status** - The amount of bacterial plaque present on teeth as measured by the Personal Hygiene Performance Index. Oral hygiene status was the dependent variable in this study.

7. **Personal Hygiene Performance (PHP) Index** - This index,
developed by Podshadley and Haley is a valid instrument for measuring patients' oral hygiene status. The patients' teeth are disclosed to locate plaque deposits. Six teeth are visually divided into five sections and examined for the presence of debris and plaque deposits. Each section is scored and then totalled for a final PHP score.

8. Plaque - A bacterial matrix which is the primary etiological factor involved in the development of dental caries, gingivitis, and periodontal disease. Plaque adheres to teeth, gingiva, calculus, and restorations. Plaque can be removed by mechanical methods such as brushing and flossing.

9. Posttests - Personal Hygiene Performance Indices occurring one day and one month following oral health instructions. Posttest one occurred one day following oral health instructions. Whereas, posttest two occurred one month following oral health instructions.

10. Research Assistant - One registered dental hygienist, presenter of the traditional oral health lecture instruction.

11. Toothbrush - A four row, diamond shaped head, nylon bristled toothbrush was provided for each subject in the dental kit to use for mechanical plaque removal.

12. Traditional Oral Health Education - Teaching oral health education with either lectures, slides, group
discussions, films, or flipchart. For the purpose of this study a slide-lecture oral presentation was used for traditional oral health lecture instruction.

Assumptions

The following assumptions were made for this study:

1. Dental plaque is an etiological factor in dental caries, gingivitis, and periodontal disease.

2. Subjects in the experimental group will be able to operate the computer after the presentation of instructions.

3. The Personal Hygiene Performance (PHP) Index is a valid and reliable instrument used for assessing oral hygiene status.

4. All subjects receive the same oral health education through either format, computer assisted instruction or traditional oral health lecture presentation.

5. Subjects will implement mechanical plaque removal techniques daily as instructed.

6. The principal investigator will be a reliable scorer throughout the pretest and posttests.

7. Differences in oral hygiene status will occur as a result of the oral health education.

8. All groups will be similar in pretest scores as indicated by the means and standard deviation.
Limitations

The following limitations were identified for this study:

1. The Hawthorne effect may occur because of the subjects' knowledge of participating in this research study.

2. The sample population was obtained at Northlanding Elementary School in Virginia Beach, Virginia. Generalizations of results may be limited to the study sample because of the lack of random selection of subjects from other school systems. Classrooms are organized according to the child's reading level. This may be a limitation since each group will be on a different reading level.

3. Situation-relevant variables will be different since one group will be working with computers and the other group will have a traditional educational experience. The noise level may be higher in the nontraditional group since the computers will be in operation during the class period.

4. Novelty effects - Dental kits may motivate the children to brush and floss because they are receiving a new toothbrush, toothpaste, floss, and an oral health pamphlet; however, all groups have received the same kit. Use of the computer may motivate children because of enjoyment, difference in teaching strategy, and the potential for self pacing.

5. A subject's dexterity and ability to remove plaque may
be reflected on Personal Hygiene Performance scores.

6. A threat of internal validity may occur because of the intact groups. Subjects may possess similar socioeconomic advantages, similar beliefs, attitudes, or values which may effect the dependent variable.

7. Statistical regression may occur due to the pretest-posttest design. High and low scores may regress towards the mean on retesting.

8. Maturity levels differ at the ages of ten and eleven; therefore, motivational levels and oral health values will differ.

9. Subjects may have removed dental plaque during the week of evaluations, but not on a regular basis.

10. Parents of subjects may remove dental plaque for the child during the weeks of evaluations.

11. The oral health computer assisted instruction program is not professionally developed; therefore, plaque scores might be influenced by the quality of the computer program.

**Hypotheses**

The following hypotheses were tested in this study:

1. There is no statistically significant difference at the 0.05 level between the pretest score and posttest one and posttest two scores of children who receive computer assisted instruction as measured by the Personal Hygiene Performance Index.
2. There is no statistically significant difference at the 0.05 level between the pretest score and posttest one and posttest two scores of children who receive traditional oral health instruction as measured by the Personal Hygiene Performance Index.

3. There is no statistically significant difference at the 0.05 level between the pretest score and posttest one and posttest two scores of children who do not receive oral health instruction as measured by the Personal Hygiene Performance Index.

4. There is no statistically significant difference at the 0.05 level between the posttest one and posttest two scores of children who receive oral health computer assisted instruction as measured by the Personal Hygiene Performance Index.

5. There is no statistically significant difference at the 0.05 level between the posttest one and posttest two scores of children who receive traditional oral health instruction as measured by the Personal Hygiene Performance Index.

6. There is no statistically significant difference at the 0.05 level between the posttest one and posttest two scores of children who do not receive oral health instruction measured by the Personal Hygiene Performance Index.

7. There is no statistically significant difference at the 0.05 level between the posttest scores one day
following oral health instruction between oral health computer assisted instruction, traditional oral health lecture instruction, and no oral health instruction as measured by the Personal Hygiene Performance Index.

8. There is no statistically significant difference at the 0.05 level between the posttest scores one month following oral health instruction between oral health computer assisted instruction, traditional oral health lecture instruction, and no oral health instruction as measured by the Personal Hygiene Performance Index.

Methodology

A nonrandomized three group pretest-posttest design was used to determine the short term effects of computer assisted instruction on increasing the oral hygiene status of children between the ages of ten and eleven years, over a one month period. Posttest one occurred one day following oral health instructions. Posttest two occurred one month following oral health instructions. Posttest scores were analyzed to determine if a difference existed over a short term of time. The pretest and posttest scores were analyzed to determine the difference in the means among groups.

Prior to implementation of this study, parent/guardian consent forms were signed to provide written consent for child participation. Following receipt of consent forms, the fifth grade coordinator assigned each class to one of
three groups. Group A received oral health computer assisted instruction. Group B received traditional oral health lecture instruction. Group C, the control group, received no oral health education until completion of the study.

Subjects were given a Personal Hygiene Performance pretest prior to implementation of oral health education to ensure similar groups. The Personal Hygiene Performance Index measures the amount and distribution of plaque deposits on the subject’s teeth using disclosing agents for increased visibility of the examiner.

Results were analyzed to determine statistically significant differences between the oral hygiene status of children with computer assisted instruction or traditional oral health instruction. Additional results were analyzed to determine if a difference existed in the oral health status between the pretest and posttest scores for both experimental and control groups.
 CHAPTER 2
Review of the Literature

Oral health education is a fundamental basis of preventive dentistry. The purpose of oral health education is to provide the information, techniques, and motivation necessary for the individual to prevent dental disease. The optimum result of oral health education is to initiate a change in the individual's behavior with a subsequent increase in oral health. Many individuals have the cognitive information needed for implementation of thorough plaque removal via mechanical techniques such as toothbrushing and flossing; however, dental health may not be valued. Individuals may not recognize a need and may lack internal value development; therefore, no motivation is present for a behavioral change to occur. In order for learning to affect behavior, motivation must be involved. Motivation is the force which moves the individual towards action.4

Previous studies have investigated oral health behaviors and oral health education methodologies.3-9, 13-17,19-26,29-31,37-39,45,46,48,49,53,54,64-68,72,75-77

Many different approaches have been used to change oral
health behaviors through education. These approaches include demonstrations, dental office education, classroom presentations, health fairs, and computer assisted instruction. Research in the area of computer assisted instruction is needed because of the limited information on the subject. A literature review relevant to an investigation of oral health computer assisted instruction must include both the principles of oral health behavior and principles and methods of oral health education including computer assisted instruction.

**Oral Health Behavior**

The purpose of oral health behavior modification is to attempt to change the individual's oral hygiene habits. Weinstein and Getz have divided the process of changing a behavior into six steps. The individual must follow through with all steps in order for initiation of a desired behavior or termination of a negative behavior. The individual must have a desire and recognized need for change in order for the behavior to occur. The first step is to identify and specify the problem. The most commonly identified problem is the difference between desired performance and actual performance.

Secondly, baseline data of a behavior is collected by determining the frequency of occurrence over a specified period of time. Following completion of this task, step three is implemented by identifying the individual's goals.
and objectives. Measurable intermediate objectives pertaining to the goal should be specified. Objectives should be stated in terms of increasing behavior rather than prohibiting the negative behavior or habit. Fulfillment of each objective may result in positive reinforcement for the individual.

Step four involves the planning of intervention methods to change a problem behavior. Methods of reinforcement may be used to encourage or inhibit a behavior. Positive reinforcement provides feedback which encourages the individual to continue the behavior; negative reinforcement discourages the behavior. Modeling, prompts, or guided action may be used to stimulate a initiation of specific behavior; fading or the gradual removal of prompts or guided actions will allow the behaviors to occur naturally without any stimulus.

The fifth step identified is monitoring and modifying the plan. Identification of the rate of progress is essential in determining whether or not modifications are needed. If modifications have been made and there is no other need for change, self-maintenance can be established. After self-maintenance occurs, a plan of termination is developed during step six. A plan to reduce the potential for backsliding is implemented so that the desired behavior becomes permanent.

A study conducted by Mager has determined that desired or actual performance may be a skill or management
deficiency. To determine the type of deficiency, two questions should be addressed: (1) Can the patient perform the desired behavior? and (2) Can the patient do it if his/her life depended on it? The first question is a skill deficiency question; the second is a management deficiency question. A skill deficiency involves a lack of knowledge in that specific area; however, a management deficiency involves a lack of motor skills development in that specific area. People with a skill deficiency may be able to perform the skill, but people with a management deficiency do not know how to activate the skill. Management deficiencies need step by step instruction in order to learn a skill; whereas, skill deficiencies need behavioral changes to occur.

Rosenstock\textsuperscript{80} established three principles of health behavior motivation. Principle one is identification of the problem's consequences and how to prevent the consequences. The second principle recognizes that a desire for change must be present in order to initiate a behavioral change. Third, non-health motives such as appearance or social approval may effect a change in behavior. Using these three principles, the patient's needs are determined and goals and objectives are established. The practitioner determines the information and skills needed to achieve these goals. Skills are provided through different teaching strategies and periodic review. Motivation may be attained through the
practitioner's warmth, sincerity, reinforcement, and acknowledgment of goal attainment.

Research has been conducted to evaluate the effect of motivation on oral health behavior. A study conducted by Kerebel et al.²⁹ investigated the effects of motivation on the oral health of 244 eight year old French schoolchildren from four schools over a three year period. Two schools were used as experimental groups with the other two schools being used as control groups. The purpose of this study was to determine the effectiveness of a school based plaque control program on dental caries rate. A pretest-posttest design was used to determine changes in dental caries and plaque deposits as measured by the DMF-def indices and the Silness and Loe Plaque Index. After the pretest, all groups received a prophylaxis treatment followed by application of topical fluoride every two months. In addition, the experimental groups received one daily session of supervised toothbrushing by a dental student and reinforced motivation as needed according to individual needs.

Results indicated that no statistically significant change occurred over a three year period in the oral hygiene status of the control group as measured by the Plaque Index and the DMF-def indices. The experimental group showed a statistically significant difference at the 0.05 level between the pretest and posttest plaque scores (0.93 - 0.57) as measured by the Plaque Index. Dental
caries reduction was statistically significant at the 0.01 level for the experimental group. Results concluded that oral health education and reinforcement is necessary to obtain a change in oral health behavior.

**Oral Health Education: Principles and Methods**

**Principles of Learning**

Instructional oral health techniques may vary according to the patient's needs. Five principles of instruction have been developed for teaching oral health education: (1) presenting the information in small increments, (2) allowing the individual to set their own pace, (3) supervising the patient's oral health behaviors, (4) providing immediate feedback, and (5) providing positive reinforcement. Based on the first principle, oral health education should be presented in small amounts because the individual can not focus on learning significant aspects of the skill when large amounts of information are presented; therefore, much of the information will not be retained. Permanent learning occurs at a more rapid pace when small increments of information are presented and repeated allowing the individual to internalize the information. Frequent practice sessions provide the opportunity for skill overlearning. An individual must master one skill prior to attempting another.

Self-pacing according to the individual's learning and
Retention rates is the second principle. Prior knowledge, motivation, and attentiveness determine the degree and rate of learning which occurs. Supervised practice, the third principle, and immediate feedback, the fourth principle, are the basics for skill mastery. Supervised practice allows immediate feedback for identification of errors and subsequent correction. As little time as possible should elapse between the action and reinforcement. Increased time between the two, results in a decrease in the retention rate of the skill. Positive reinforcement, the fifth principle, provides encouragement and increases the potential for successful performance of the skill. For a behavior to become habitual, positive reinforcement is necessary.23

In a study by Griffiths,16 three steps necessary for changing a behavior were identified. The first step involves creating or changing perceptions based on facts, experiences, or knowledge. Educators need to provide the knowledge for individuals to change their perceptions. Step two involves using motivational forces and finally making the decision to act. All three steps must occur in order for a behavior to change.

Sandell63 reviewed methods of dental health education to determine the most significant factors involved in improving oral health. Results of this review indicated that the most significant changes in oral health occur following oral health presentations to the school age
population. Health attitudes and habits are more easily developed during these formative years; therefore, many states require health education in the curriculum through law or the state board of education. Oral health programs are most frequently included as part of the health education class.

Educational Methods

Various oral health educational methods have been investigated to determine their effectiveness in changing oral health behaviors. Melcer reviewed oral health education literature related to the influence of education on improving the oral hygiene status of individuals. Methods described were chairside instruction, movie presentations, classroom lectures, small-group instructions, and individualized instructions. No one method of education was determined to be more effective than the others. Oral health education with reinforcement seemed to have a significant difference on the child's retention rate of oral health knowledge and behaviors.

The purpose of a study conducted by Huntley was to determine the effectiveness of a school dental health program three months following implementation. A two week school dental health program was presented to 125 fifth grade students. The program consisted of the "Toothkeeper Program" and "Level II Learning About Your Oral Health". A
within group pretest-posttest design was used to determine if any change in plaque scores occurred as measured by a pass-fail index. Plaque present on any tooth resulted in a failing score. A pass score was given for any tooth with no plaque deposits.

Posttests occurred during the two week program after the toothbrushing and flossing section of education. Posttest one occurred one day following flossing instructions. Posttest two occurred two days following flossing instructions. Posttest three occurred one week following flossing instructions; posttest four occurred nine days following flossing instructions. The final posttest occurred three months after education. Results were analyzed by a 5x5x2 factorial analysis of variance.

The number of individuals with plaque free scores increased during the two week program. No statistically significant difference was found between boys' and girls' performance; however, a significant difference (p<.01) occurred between experimental and control groups. No statistically significant difference was found between the fourth posttest and the third month following presentations posttest. Results indicated that oral health education improves a child's oral health. Further investigations using other scoring techniques might allow for the determination of individual oral health improvement since a pass-fail score method does not provide for degrees of improvement.
A two month study was conducted by Davis and Costanso\textsuperscript{12} to determine the most effective method of presenting flossing instructions for the removal of plaque deposits from proximal surfaces as measured by a PHP-M Index. A pretest-posttest design was used for 91 fifth grade students assigned to one of three groups: videotape flossing presentation, individualized flossing instruction, or no flossing instruction. Posttests were given one week and two months following flossing instructions. Results were analyzed by one way analysis of variance and the Student's \textit{t}-test. Results indicated that there was no statistically significant difference in posttests for any of the groups. Between the pretest and the posttest one week following the videotape presentation, a statistically significant increase in plaque scores occurred (t=4.25, p>.95). The other groups had no statistically significant difference. These results indicated a difference in the pretest and posttest for the group receiving videotape instructions; unfortunately, this group performed worse instead of better. An increase in plaque scores may have occurred due to a lack of retention or lack of motivation within subjects.

An investigation of 215 subjects with a mean age of 30 was conducted by Radentz \textit{et al.}\textsuperscript{58} to determine the effectiveness of individual chairside flossing instruction, a closed circuit television flossing instruction, and no flossing instruction in a pretest-posttest design.
Subjects were randomly assigned into one of the three groups: closed circuit televised flossing instructions, individualized chairside flossing instruction, and no flossing instructions. Only one session of flossing instructions occurred during the study. The examiner determined the number of teeth properly flossed in the two right quadrants for both pretest and posttest evaluations. The posttest occurred two weeks following flossing instructions.

Analysis using Dunnett’s test revealed a statistically significant difference at the 0.01 level between the pretest and posttest scores of Group I and II. No statistically significant difference at the 0.01 level was found between Group II, individualized chairside instructions, and Group III, televised instructions. Results indicated that using closed circuit television to present chairside instruction was more effective than the chairside instruction by a clinician. The closed circuit television may be more effective because the instructor’s personality and/or mannerisms do not interfere with the instructions being presented. A subject may be distracted by the clinician’s appearance or personality in live presentations causing loss of concentration and focus on the information.

The effectiveness of closed circuit television flossing instructions with reinforcement provided by individualized instructions was examined on 240 subjects to determine
flossing proficiency using a randomized two group pretest-posttest design. Subjects with a mean age of 28.5 years were randomly divided into either the control group or the experimental group. The experimental group received initial flossing instructions through a closed circuit television with supplemented individualized chairside instruction as reinforcement one week later. The control group received no oral health education. Three evaluations using the method of counting the number of properly flossed teeth occurred. A pretest and two posttests, one week after televised instruction and three weeks following reinforced instruction, were used for both groups. Analysis of pretest scores indicated that the experimental group could properly floss 7.5 percent of scored teeth. Posttest scores for the experimental group revealed that 73.7 percent of all teeth were properly flossed. Following reinforcement, the experimental group flossed 94.0 percent of their teeth properly. A statistically significant difference at the 0.01 level was found in the experimental group between examinations one and two, two and three, and one and three. The control group flossed 7.5 percent of all teeth properly during all three examinations; therefore, there was no statistically significant difference between all three exams. Results indicated that a combination of a video tape with chairside instruction is more effective than a video or chairside instructions alone.
An investigation comparing a movie and chairside instruction to present preliminary oral hygiene instruction for periodontal patients was conducted by Vande Voorde.75 One hundred seventy-five subjects were selected from a periodontal office and divided into one of four groups: individual chairside instruction, oral physiotherapy film strip instruction, control group, and combination of the film strip with chairside instructions. A posttest design was used; effectiveness of each instructional method was evaluated by a 38 question multiple choice true-false examination. The t-test indicated that there was a significant difference at the 0.05 level between individual chairside instruction and the film strip instruction. Results indicated that an individualized oral demonstration is more effective than a movie presentation; however, results may be invalid because of group differences, sample selection procedures, and lack of pretest scores. Group III, the control group, scored the lowest of any group.

Axelsson and Lindhe3 conducted a four year investigation involving 216 children, seven through fourteen years of age, to determine if a preventive, school-based oral health program is effective in improving plaque and gingival conditions. Subjects were divided into experimental and control groups according to age level. The experimental group received oral health education and plaque removal by a dental nurse once a week. The control
group received supervised brushing sessions once a month. Subjects' oral health status was evaluated annually using the Plaque Index, Gingival Index, and four bitewing radiographs. Results of the control group remained unchanged throughout the study. Gingival condition scores were not significantly different for either groups throughout the study. The Plaque Index scores for the experimental group decreased to a 0.3 plaque score during the first year and remained at this level. This study concluded that it is possible to establish and maintain oral health if oral hygiene instructions are reinforced with oral hygiene supervision.

Horowitz et al.19 conducted a three year, school-based study in a non-fluoridated community in Connecticut. A randomized groups pretest-posttest design was used to determine the effects of daily plaque removal supervision on the oral hygiene, gingival inflammation, and caries rate of 480 children. Baseline data was collected on subjects using the Personal Hygiene Performance Index (PHP) and Decayed, Missing and Filled Surfaces Index (DMF-S), and subjects were re-examined biannually throughout the duration of the study. Both experimental and control groups received toothbrushes for home use. Oral hygiene education including the etiology of plaque, modified scrub brushing technique, and flossing was presented to the experimental group on two consecutive days. Methods of brushing and flossing were reinforced
using models and films as aids. During the last six months of this study, children received supervision in their daily plaque removal techniques. Results indicated a significant mean plaque reduction of 14 percent, a gingival score reduction of 29 percent, and a mean caries score reduction of 15 percent from pretest scores in the experimental group. No significant change was found in the Personal Hygiene Performance Index or gingival scores of the control group. Horowitz concluded that oral health can be improved through education and reinforcement.

Houle conducted a five year study investigating the longevity of oral health education on the oral hygiene status of children in the fifth grade. A three group posttest design was used. School I received an oral health program based on reinforcement of both cognitive and behavioral skills. School I demonstrated better plaque removal and lesser plaque accumulation measured by the Personal Hygiene Performance Index. School II received traditional oral health education but lacked the same level of plaque removal as School I. Whereas, School III, the control group, received no oral health education. No statistically significant difference existed between the test and control schools at the completion of the study. These findings support the concept that behavioral change must be reinforced routinely.

Controversies have been found in the effectiveness of videotapes in changing oral health behaviors. 

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Davis and Costanzo\textsuperscript{12} found videotapes ineffective in changing oral behaviors; plaque scores increased after video flossing instructions. Radentz\textsuperscript{58,57} and Vande Voorde\textsuperscript{75} found movies effective in changing oral health behaviors.

Radentz's\textsuperscript{58} study showed televised instruction is superior to individualized instruction in changing individuals' flossing techniques. Whereas, Vande Voorde\textsuperscript{75} found individualized oral demonstration superior to a movie in increasing an individual's knowledge. Davis and Costanzo\textsuperscript{12} found individualized instruction ineffective in changing oral health behaviors. Many controversies have been found and no one method seems to be more effective than another in changing oral health behaviors or increasing dental knowledge.

Students learn at different rates; therefore, a need to individualize instruction is apparent. Computers offer individualized learning, self-pacing, reinforcement, active participation, and overlearning to increase knowledge retention.\textsuperscript{71}

Microcomputers are being more readily utilized as a teaching aid in schools and may encourage learning and behavioral changes. Scandura\textsuperscript{65} identified three purposes of computers in education: 1) learning the effects of computers, 2) learning to operate computers, and 3) using computers to promote learning. Studies have investigated the effectiveness of computer assisted instruction on
Research studies have resulted in contradictory findings on the effectiveness of computer assisted instruction in increasing cognitive knowledge. Kulik, Schwalb, and Kulik\textsuperscript{33} reviewed 48 separate research studies on the effectiveness of programmed instruction on secondary school children's learning. Conventional and programmed instruction were found to be equally effective; although, more recently conducted investigations found that students who receive computer assisted instruction score better on tests than students who received conventional instruction only. This may have occurred since the science and art of programming has significantly improved in the past few years.

Kulik, Kulik, and Bangert-Drowns\textsuperscript{34} also found in a review of 51 studies that students who receive computer assisted instruction score better on objective tests than students who receive traditional instruction only. Computer assisted instruction was also found to improve the speed at which students learn and increase the retention rate.

Researchers\textsuperscript{42,70} have found that material learned on the computer is retained longer than material learned through traditional methods of education. Malpass\textsuperscript{42} studied methods of instruction for word recognition and spelling skills in retarded children. Seventy-two children
(I.Q. 50-80) were randomly assigned to one of four groups: (1) self instructional module, (2) automated, (3) tutorial, or (4) classroom instruction. A pretest-posttest design was utilized to determine if a difference in knowledge occurred after instruction. Thirty days after instruction a posttest was given to determine the retention rate of knowledge. Analysis of variance determined that automated instruction was the most effective method causing retention of material.

Suppes and Morningstar\textsuperscript{70} investigated the use of computer assisted instruction on 41 fourth grade students' math abilities. Children reviewed the presented material on a tele-type machine daily. Stanford achievement tests were utilized for the pretest and posttest. A t-test determined that the tele-type machine is statistically significant at the 0.05 level in increasing students' knowledge.

A study by Tsai and Pohl\textsuperscript{78} was conducted to determine the effectiveness of three different teaching methods: traditional lecture, computer assisted instruction, and traditional lecture supplemented with computer assisted instruction. Subjects in three introductory computer programming courses were selected as the sample population. Enrollment for each class was between 45 and 54 students. The same instructor taught all three classes the same information; therefore, no teacher variable existed. An ex-post facto research design was used. Data
collection instruments used were: one hour exams, homework assignments, term projects, and a final exam. Instruction and scoring were implemented by the instructor. Data were analyzed by analysis of variance and Fisher's Least Significant Difference Test. No statistically significant difference was found between the groups when homework and term projects scores were analyzed. A statistically significant difference at the 0.05 level was found between the one hour exams and the final exam of the groups. Lecture reinforced with computer assisted instruction was proven to be the most effective method. Computer assisted instruction was found to be more effective than lecture. Instructor bias may have occurred and altered results.

Kollerbauer\textsuperscript{32} studied the effects of computers in secondary and compulsory Swedish schools. A questionnaire was distributed to students and instructors of all municipalities and county councils concerning the effectiveness of computer education. An increase in knowledge of computer facts occurred with the use of computers, and instructors noted that computers can stimulate realistic problems to encourage higher level thinking skills of students. Sweden has developed a national policy to implement computers in all schools for educational usage since computers are extensively used in society and encourage higher level thinking skills.

An evaluation of several educational software packages was conducted by O'Brien\textsuperscript{52}. Software programs can
address topics more readily than textbooks, because computer programs are developed and marketed more rapidly than textbooks. Computers may also introduce new issues and ideas to the classroom. Most important, computers enhance students to become active learners and produce higher levels of thinking.

Other research studies have found no statistically significant difference in knowledge levels between traditional education and computer education. Day and Payne conducted a study and concluded that computers provide individualized learning, self-pacing, flexibility of delivery, and less demands on faculty time.

Hoko determined that overall automated and human instructions are equally effective methods in presenting education after analyzing various research articles. Each instructional technique was found to have advantages and disadvantages. Humans are flexible, interactive, and adaptable to a variety of classroom situations; whereas, computers are reliable, tireless, specific, and provide immediate feedback.

A research study conducted by Norton and Reston determined the efficacy of computer education techniques: skills development, problem solving, and simulation. Three intact third grade classes were divided into one of three groups: skills development, problem solving, or simulation. Each group received a total computer
instruction period of 25 hours. A pretest-posttest design was utilized to determine if the method of instruction caused a change in knowledge. No statistically significant difference was determined by analysis of variance between the three different types of computer education techniques in posttest scores. A statistically significant difference occurred from pretest to posttest in all three groups indicating that computer education increases knowledge no matter what method of computer education is used.

Computer managed instruction and traditional lecture instruction were investigated to determine the effectiveness of each method on the cognitive performance of 82 nursing students. A quasi-experimental two group design was used in a first year health assessment nursing class. The first group consisted of 46 students who received computer managed instruction. Group two consisted of 36 students who received traditional lecture instructions. Each group's cognitive performance was measured by a 23 multiple choice midterm and a 17 multiple choice final. Descriptive statistics, correlations, and an analysis of variance were used to determine statistically significant differences in educational methods and attitudes of students concerning each method.

A one way analysis of variance determined no statistically significant difference at the 0.05 level between computer managed instruction and lecture instruction on midterm and final examinations. An attitude
questionnaire was completed by students in both groups. Results indicated 83 percent were either impartial or felt that computer managed instruction was ineffective for learning health assessment content. Sixty-nine percent preferred lecture instruction over computer managed instruction. Twenty-three percent suggested a combination of lecture instruction and computer managed instruction. Computer managed instruction was rated ineffective, frustrating, slow, and ineffective by students in the computer managed instruction group. Day and Payne concluded that computer managed instruction is just as effective as cognitive performance in teaching health assessment.

A study was conducted to determine the effectiveness of a computer program in increasing children's dental health knowledge. A three group pretest-posttest design was used consisting of 12 multiple choice questions. Six classes of 150 sixth grade children were divided into one of three groups: lecture, computer instruction, and computer instruction with one lecture reinforcement session. Educational oral health implementation consisted of a twenty minute period of oral health education.

The computer program "Tooth Talk," a game, used color, graphics, and sounds. The objective of the game was to clean all the teeth displayed on the monitor by answering each multiple choice dental question correctly. A ring would sound for a correct answer; a buzz for a wrong
answer. If a child answered all twelve questions correctly a smile would flash on the monitor with a fanfare playing.

Pretest scores of the three groups were similar in dental health knowledge: lecture group-34.5 percent, computer group-38.2 percent, and computer with lecture group-39.9 percent. The lecture group increased dental knowledge by 19 percent following education. The computer group and the computer with lecture group had a 29 percent increase in knowledge. Watkins\textsuperscript{76} suggested that the Health Board should investigate availability of oral health computer education programs in school systems due to the study's results.

Kearsley, Hunter, and Seidel\textsuperscript{27,28} evaluated the effects of computers in education. Through the evaluation of research it was concluded that learning is more exciting and satisfying with computers than traditional education. The variable that makes computer education just as effective or slightly better than other methods has not been isolated. Computers may be more effective because of active participation, reinforcement, self pacing, graphics, problem solving, or immediate feedback. Research is needed to determine which factors are involved in the effectiveness of computer assisted instruction.

**Summary**

Oral health education programs have been implemented to determine their efficacy in increasing oral health
behaviors. Controversies have developed concerning the effectiveness of increasing knowledge and retention rates of the traditional and nontraditional educational methodologies. These studies indicate that supervision and reinforcement are significant variables involved in the process of changing oral health behaviors with either teaching strategy. The effectiveness of computer assisted instruction in education has been questioned; therefore, further research is indicated.

Research studies relevant to the effectiveness of computer assisted instruction on behavioral changes were not evident when the review of literature was conducted; therefore, research is needed to determine the effectiveness of computer assisted instruction on behavioral changes.
CHAPTER 3
Methods and Materials

The present study was designed to determine the efficacy of oral health computer assisted instruction on improving the oral hygiene status of children. Bacterial plaque and oral debris were measured over a four week period by the Personal Hygiene Performance Index to determine if there was an increase in the children's oral hygiene status.

Sample Description
Sixty-five fifth grade students from the student population at Northlanding Elementary School in Virginia Beach, Virginia participated in this study. The sample population was investigated because the level of value development at this age may be indicative of the potential for significant behavioral changes via the oral health presentation. In addition, the physical dexterity necessary to attain proper brushing and flossing techniques has usually been achieved by age ten or eleven.

All children in the two experimental groups were involved in the oral health education presentations;
however, the researcher has excluded data from handicapped children with psychomotor and manual dexterity disabilities. Children with these handicaps may not be able to operate a computer or attain the dexterity needed for proper brushing and flossing.

**Research Design**

A three group, non-randomized, control group pretest-posttest design was utilized to determine the effects of oral health education on the oral hygiene status of children. The independent variables of this study, the two oral health instruction methods, included the following content: toothbrushing, flossing, nutrition, and the dental disease process. The dependent variable, bacterial plaque and oral debris, was measured by the Personal Hygiene Performance Index. This design investigates the effects of the independent variables on the dependent variable in the experimental groups and compares the differences among the experimental and control groups.

Groups were assigned as follows: Group A, oral health computer-assisted instruction; Group B, traditional oral health lecture instruction; and Group C, the control group, no oral health education until completion of the study.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Pretest</th>
<th>I.V.</th>
<th>Posttests</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>22</td>
<td>Y1</td>
<td>X1</td>
<td>Y2, Y3</td>
</tr>
<tr>
<td>B</td>
<td>20</td>
<td>Y1</td>
<td>X2</td>
<td>Y2, Y3</td>
</tr>
<tr>
<td>C</td>
<td>23</td>
<td>Y1</td>
<td>-</td>
<td>Y2, Y3</td>
</tr>
</tbody>
</table>

n = Number of Subjects

I.V. = Independent Variable

X1 = Traditional Oral Health Lecture Instruction
X2 = Oral Health Computer Assisted Instruction
The independent variables evaluated included the oral health computer assisted instruction and traditional oral health lecture instruction. After implementation, the variables were tested for effectiveness by measuring subjects' oral hygiene status with the PHP index.

One PHP pretest was administered to determine the subject's baseline oral hygiene status prior to implementing this study to insure similar groups. Posttest one was administered one week following the oral health instructions, while posttest two occurred one month following oral health instructions. Posttest one and two were used to measure the short term changes in the subject's oral hygiene status.

Methodology

Phase I Pre-implementation Phase:

The oral health computer assisted instruction program was developed by the principal investigator and contained identical educational content as the traditional oral health lecture instruction (Appendix A). The computer program required active participation of the student. Synthesized sounds were not included in the program for positive and negative reinforcement since the sounds might have inhibited the student's learning. Positive reinforcement statements were included for each correct answer. Wrong answer received an explanation of the correct answer. Students also participated by brushing and
flossing during the computer program.

To ensure validity of the program, the program was evaluated by three registered dental hygienists, a computer programmer, and a fifth grade instructor prior to the investigation and 100 percent approval was received from each evaluator (Appendix B).

Permission to conduct this research investigation at Northlanding Elementary School in Virginia Beach, Virginia was granted by the Virginia Beach Board of Education and the principal of Northlanding Elementary School following review of the application and research proposal. Prior to implementation, the principal investigator presented an orientation to all faculty and staff involved with this study. The purpose and procedures of the study were described as well as presentation of the oral health computer assisted instruction.

The fifth grade coordinator was responsible for randomly assigning the three fifth grade classes to one of the three research groups and for scheduling the evaluation sessions. The assignment of groups was not revealed to the principal investigator until completion of the study in order to reduce bias.

Parental consent forms were distributed by the teachers of each classroom. The consent forms were returned to the teacher within one week prior to implementation of the study. Students were not allowed to participate in this investigation without signed, returned forms. The
principal investigator reviewed and evaluated the consent forms for completeness prior to implementation of the study. Parents were contacted to ensure the return of all missing forms.

The pretest and posttests were performed by the principal investigator, a registered dental hygienist. Intrarater reliability of the examiner was established by determining the oral debris scores of twenty first year dental hygiene students on two successive days using the PHP index. The Spearman Rank Order Correlation was used to determine the relationship between the two PHP scores. A high correlation of 0.90 indicated intrarater reliability.

Phase II Implementation Phase

Pretest - One week following the return of the consent forms, a PHP Index pretest was performed on all subjects by the principal investigator. The examination sessions were conducted in the school's health clinic. Subjects entered the nurse's office individually to ensure privacy. Each subject was instructed to chew, swish, and expectorate the disclosing tablet, staining the plaque and oral debris deposits on his/her teeth. After the subject rinsed once with water, the six tooth surfaces used in the Personal Hygiene Performance Index were examined. The Personal Hygiene Performance score was recorded on the Old Dominion University, School of Dental Hygiene and Dental Assisting clinical forms (Appendix C).
Dental kits containing the following items were provided for implementation of the educational presentations: toothbrush, unwaxed floss, toothpaste, and a disease control pamphlet (Appendix D).

**Education Implementation** - Following the pretest, oral health education was presented to the experimental groups. Educational content of oral health computer assisted instruction and traditional oral health lecture instruction was identical. Stand-up mirrors, five inches in circumference, were located adjacent to each computer terminal to allow subjects in Group A to visually assess their mechanical plaque removal techniques as presented during the computer program. Subjects in the computer group were scheduled times for computer use.

Group B, the traditional oral health lecture instruction group, performed mechanical plaque removal procedures during the lecture presentation. The research assistant, a registered dental hygienist, delivered the oral health education lecture and assessed subjects' mechanical plaque removal techniques. To ensure validity of the study and reduce bias, the principal investigator was not involved with the oral health instructions.

**Posttests** - Twenty-four hours following the oral health education presentations, PHP posttest one was performed on all subjects by the examiner. The second PHP posttest was administered one month following presentation of the oral health education.
All information obtained during the investigation remained completely confidential. Publications which may follow the study will include no information which may violate the confidentiality within the investigation. All records containing subjects' names were destroyed at the completion of the investigation.

**Protection of Human Subjects**

The research proposal was submitted and approved by the Institutional Review Board for the Protection of Human Subjects, Old Dominion University.

1. **Sample** - The subject population consisted of three fifth grade classes from Northlanding Elementary School in Virginia Beach, Virginia, because Apple computers were available for student usage.

2. **Benefits** - The oral health education presentations may have increased the child's knowledge and awareness of oral health resulting in improved oral hygiene. The presentations also may motivate the child to increase the frequency and improved the quality of his/her dental disease control techniques. Dental disease may be reduced due to the increase in knowledge and improved oral care, decreasing the cost of future dental treatment. Benefits to the community have been assessment of the efficacy of computer assisted instruction in dental health education.

3. **Risks** - Potential risks involved in this study were minimal due to the research design. Only visual
examination procedures were used via mouth mirrors, disclosing tablets, and a light source. There were no instrumentation procedures utilized in this study except for the use of a mouth mirror.

4. Informed Consent Procedures - Subjects received parental/guardian informed consent to participate in this study. Parents returned signed consent forms within one week prior to implementation of this study to their child's classroom teacher. Subjects were able to withdraw from the study at any time (Appendix E).

5. Confidentiality - Confidentiality was maintained throughout the course of the study. Subjects were assigned a number; therefore, no names were used. Experimental data were identified by the use of assigned numbers only and maintained by the principal investigator. Consent forms were retained separately from all other research information by the fifth grade coordinator to ensure that names were not revealed. Subject data was reported in aggregate form only. Results from this investigation have been made available to subjects and the Virginia Beach Board of Education.

6. Risk-Benefit Ratio - The potential benefits outweigh any potential risks which may have occurred due as a result of this study.
Instrumentation

Subjects were evaluated on their oral hygiene status by the Personal Hygiene Performance Index (Appendix F). Prior to the plaque and oral debris evaluations, parents and subjects were notified of the scheduled weeks, but not the specific evaluation days. Notification of the exact day might have encouraged students to improve the quality of their brushing and flossing resulting in invalid scores.

The Personal Hygiene Performance Index is a simple and time efficient measuring instrument. Numerous studies have proven this index to be a valid and reliable indicator of plaque and debris accumulation. Evaluation of the plaque and debris was accomplished via a disclosing tablet and a mouth mirror. The following tooth surfaces were scored according to the stated criteria:

1. buccal, maxillary right first molar
2. facial, maxillary right central incisor
3. buccal, maxillary left first molar
4. lingual, mandibular left first molar
5. facial, mandibular left central incisor
6. lingual, mandibular right first molar

If the designated incisor was missing, the adjacent central incisor was substituted. The second premolar was substituted when the first molar was missing. If all incisors and premolars were missing, the subject was eliminated from the study.
Determination of the score for each tooth surface examined was accomplished by visually dividing each tooth into five sections. Each section was evaluated for the presence or absence of deposit. A score from zero to five was assigned to each section according to the following scale:

0 - No section has debris
1 - Debris present on 1 section
2 - Debris present on 2 sections
3 - Debris present on 3 sections
4 - Debris present on 4 sections
5 - Debris present on 5 sections.

The Personal Hygiene Performance score was calculated by totalling the debris scores for each tooth and dividing the sum by the number of surfaces scored. Interpretation of the score was as follows:

0 = Excellent Oral Hygiene
0.1 - 1.7 = Good Oral Hygiene
1.8 - 3.4 = Fair Oral Hygiene
3.5 - 5.0 = Poor Oral Hygiene.

**Statistical Analysis**

Analysis of variance, linear contrast tests, and paired t-tests were used to analyze data. Significance was established at the 0.05 level. Analysis of Variance and linear contrast test were used to determine if a
statistically significant difference occurred among the means of the groups. The t-test was used to determine if a significant difference occurred between two mean scores.
CHAPTER 4
Results and Discussion

Sixty-five fifth grade students, ages ten through eleven, from Northlanding Elementary School in Virginia Beach, Virginia participated in this study designed to compare the effectiveness of oral health computer assisted instruction on increasing the oral hygiene status of children. Subjects were divided into three intact groups according to classroom assignment. Twenty subjects, Group A, received oral health computer assisted instruction; 22 subjects, Group B, received traditional oral health lecture instruction; and 23 subjects, Group C, received no oral health instructions (Appendix G). The Personal Hygiene Performance Index was used to measure oral debris and bacterial plaque prior to, one day following, and one month following presentation of oral health instructions. Statistical analysis of the pretest mean scores using analysis of variance indicated no statistically significant difference at the 0.05 level among the three groups prior to the initiation of the oral health education. An assumption of similarity among groups was made (Table 1 and 2).
### Table 1

**Personal Hygiene Performance Index**

**Pretest Mean Scores**

<table>
<thead>
<tr>
<th>Group</th>
<th>Instructional Method</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Oral Health Computer Assisted Instruction</td>
<td>3.27</td>
<td>±.78</td>
</tr>
<tr>
<td>B</td>
<td>Traditional Oral Health Lecture Instruction</td>
<td>3.34</td>
<td>±.61</td>
</tr>
<tr>
<td>C</td>
<td>Control Group</td>
<td>2.89</td>
<td>±.67</td>
</tr>
</tbody>
</table>

### Table 2

**Results of Analysis of Variance**

**For Pretest Scores Among The Three Groups**

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>Degrees of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>2</td>
<td>2.55</td>
<td>1.27</td>
<td>2.82</td>
<td>*0.0670</td>
</tr>
<tr>
<td>Among</td>
<td>62</td>
<td>27.97</td>
<td>0.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>64</td>
<td>30.52</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Not significant at the 0.05 level*
The computerized Statistical Analysis System software program was used for data analysis. The analysis of variance, linear contrast tests, and paired t-tests were used to analyze the data.

**Results**

Data for hypothesis number one were examined to determine if a statistically significant difference at the 0.05 level occurred between the pretest and two posttest scores of Group A, children who received oral health computer assisted instruction, as measured by the Personal Hygiene Performance Index. Paired t-tests revealed a statistically significant difference between the pretest mean score of 3.27 and posttest one mean score of 1.13 (p=0.0001). A statistically significant difference also occurred between the pretest mean score of 3.27 and posttest two mean score of 1.35 (p=0.0001) (Table 3 and 4).

Data for hypothesis number two were analyzed to determine if a statistically significant difference existed at the 0.05 level between the pretest and two posttest scores of Group B, children who received traditional oral health lecture instruction, as measured by the Personal Hygiene Performance Index. Paired t-tests determined a statistically significant difference between the pretest mean score of 3.34 and posttest one mean score of 1.41 (p=0.0001). A statistically significant difference also occurred between the pretest mean score of 3.34 and
Table 3
Mean Scores For Pretest, Posttest One, and Posttest Two Of the Oral Health Computer Assisted Instruction Group

<table>
<thead>
<tr>
<th>Personal Hygiene Performance Evaluation</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>3.27</td>
<td>±.78</td>
</tr>
<tr>
<td>Posttest 1</td>
<td>1.13</td>
<td>±.54</td>
</tr>
<tr>
<td>Posttest 2</td>
<td>1.35</td>
<td>±.77</td>
</tr>
</tbody>
</table>

Table 4
Results of t-tests for Comparison of The Oral Health Computer Assisted Instruction Group's Pretest, Posttest One, and Posttest Two

<table>
<thead>
<tr>
<th>Personal Hygiene Performance Evaluation</th>
<th>Standard Error of Mean</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison of Pretest and Posttest 1</td>
<td>0.12</td>
<td>17.90</td>
<td>*0.0001</td>
</tr>
<tr>
<td>Comparison of Pretest and Posttest 2</td>
<td>0.17</td>
<td>11.39</td>
<td>*0.0001</td>
</tr>
</tbody>
</table>

*Significant at the 0.01 level

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posttest two mean score of 1.75 (p=0.0001) (Table 5 and 6).

Data for hypothesis number three were examined to determine if a statistically significant difference at the 0.05 level exists between the pretest and two posttest scores of Group C, children who did not receive oral health instructions, as measured by the Personal Hygiene Performance Index. Paired t-tests revealed that a statistically significant difference occurred between the pretest mean score of 2.89 and posttest one mean score of 2.46 (p=0.0008). A statistically significant difference also occurred between the pretest mean score of 2.89 and posttest two mean score of 2.47 (p=0.0005) (Table 7 and 8).

Hypotheses numbers four through six were examined to determine if a statistically significant difference occurred between posttest one and posttest two within each group. Data for hypothesis number four were analyzed to determine if a statistically significant difference at the 0.05 level occurred between the mean scores of posttest one and posttest two of Group A, children who received oral health computer assisted instruction, as measured by the Personal Hygiene Performance Index. A paired t-test determined no statistically significant difference between posttest one mean score of 1.13 and posttest two mean score of 1.35 (p=0.1355) (Table 9 and 10).

Data for hypothesis number five were analyzed to determine if a statistically significant difference occurred at the 0.05 level between the mean scores of
### Table 5
**Mean Scores For Pretest, Posttest One, and Posttest Two Of Traditional Oral Health Lecture Instruction Group**

<table>
<thead>
<tr>
<th>Personal Hygiene Performance Evaluation</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>3.34</td>
<td>±.61</td>
</tr>
<tr>
<td>Posttest 1</td>
<td>1.41</td>
<td>±.55</td>
</tr>
<tr>
<td>Posttest 2</td>
<td>1.75</td>
<td>±.71</td>
</tr>
</tbody>
</table>

### Table 6
**Results of t-test For Comparison Of The Traditional Oral Health Lecture Instruction Group's Pretest, Posttest One, and Posttest Two**

<table>
<thead>
<tr>
<th>Personal Hygiene Performance Evaluation</th>
<th>Standard Error of Mean</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison of Pretest and Posttest 1</td>
<td>0.16</td>
<td>11.92</td>
<td>*0.0001</td>
</tr>
<tr>
<td>Comparison of Pretest and Posttest 2</td>
<td>0.21</td>
<td>7.44</td>
<td>*0.0001</td>
</tr>
</tbody>
</table>

*Significant at the 0.01 level*
Table 7
Mean Scores For Pretest, Posttest One, and Posttest Two
Of the Control Group—No Oral Health Instructions

<table>
<thead>
<tr>
<th>Personal Hygiene Performance Evaluation</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>2.89</td>
<td>±.67</td>
</tr>
<tr>
<td>Posttest 1</td>
<td>2.46</td>
<td>±.67</td>
</tr>
<tr>
<td>Posttest 2</td>
<td>2.47</td>
<td>±.72</td>
</tr>
</tbody>
</table>

Table 8
Results of t-test For Comparison of the Control Group’s Pretest, Posttest One, and Posttest Two

<table>
<thead>
<tr>
<th>Personal Hygiene Performance Evaluation</th>
<th>Standard Error of Mean</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison of Pretest and Posttest 1</td>
<td>0.11</td>
<td>3.90</td>
<td>*0.0008</td>
</tr>
<tr>
<td>Comparison of Pretest and Posttest 2</td>
<td>0.10</td>
<td>4.06</td>
<td>*0.0005</td>
</tr>
</tbody>
</table>

*Significant at the 0.05 level

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Table 9

Mean Scores For Posttest One and Posttest Two of Group A Oral Health Computer Assisted Instruction

<table>
<thead>
<tr>
<th>Personal Hygiene Performance Evaluation</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posttest 1</td>
<td>1.13</td>
<td>±.54</td>
</tr>
<tr>
<td>Posttest 2</td>
<td>1.35</td>
<td>±.77</td>
</tr>
</tbody>
</table>

Table 10

Results of t-test for Comparison of The Oral Health Computer Assisted Instruction Group's Posttest One and Posttest Two

<table>
<thead>
<tr>
<th>Personal Hygiene Performance Evaluation</th>
<th>Standard Error of Mean</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison of Posttest 1 and Posttest 2</td>
<td>0.10</td>
<td>0.03</td>
<td>*0.9801</td>
</tr>
</tbody>
</table>

*Not significant at the 0.05 level
posttest one and posttest two of Group B, children who received traditional oral health lecture instructions, as measured by the Personal Hygiene Performance Index. A paired t-test determined a statistically significant difference between posttest one mean score of 1.41 and posttest two mean score of 1.75 (p=0.0352) (Table 11 and 12).

Data for hypothesis number six were analyzed to determine if a statistically significant difference existed at the 0.05 level between posttest one and posttest two mean scores of Group C, children who did not receive any oral health instructions, as measured by the Personal Hygiene Performance Index. A paired t-test determined no statistically significant difference between posttest one mean score of 2.46 and posttest two mean score of 2.47 (p=0.9801) (Table 13 and 14).

Data for hypotheses number seven and eight were analyzed for determination of statistically significant differences at the 0.05 level in posttest one and posttest two scores among computer assisted instruction, lecture instruction, and no oral health instruction. Data for hypothesis number seven were analyzed to determine if a statistically significant difference at the 0.05 level existed in posttest one mean scores among Group A, oral health computer assisted instruction; Group B, traditional oral health lecture instruction; and Group C, no oral health instructions, as measured by the Personal Hygiene
Table 11
Mean Scores For Posttest One and Posttest Two
Of Traditional Oral Health Lecture
Instruction Group

<table>
<thead>
<tr>
<th>Personal Hygiene Performance Evaluation</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posttest 1</td>
<td>1.41</td>
<td>±.55</td>
</tr>
<tr>
<td>Posttest 2</td>
<td>1.75</td>
<td>±.71</td>
</tr>
</tbody>
</table>

Table 12
Results of t-test For Comparison of the Traditional Oral Health Lecture Instruction Group's Posttest One and Posttest Two

<table>
<thead>
<tr>
<th>Personal Hygiene Performance Evaluation</th>
<th>Standard Error of Mean</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison of Posttest 1 and Posttest 2</td>
<td>0.15</td>
<td>2.25</td>
<td>*0.0352</td>
</tr>
</tbody>
</table>

*Significant at the 0.05 level
### Table 13
Mean Scores For Posttest One and Posttest Two
Of Group C - The Control Group

<table>
<thead>
<tr>
<th>Personal Hygiene Performance Evaluation</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posttest 1</td>
<td>2.46</td>
<td>±.67</td>
</tr>
<tr>
<td>Posttest 2</td>
<td>2.47</td>
<td>±.72</td>
</tr>
</tbody>
</table>

### Table 14
Results of t-test for Comparison of the Control Group's
Posttest One and Posttest Two

<table>
<thead>
<tr>
<th>Personal Hygiene Performance Evaluation</th>
<th>Standard Error of Mean</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison of Posttest 1 and Posttest 2</td>
<td>0.10</td>
<td>0.03</td>
<td>*0.9801</td>
</tr>
</tbody>
</table>

*Not Significant at the 0.05 level*
Performance Index. Analysis of variance determined a statistically significant difference among the three groups. Further statistical analysis, by linear contrast tests, determined a statistically significant difference between the posttest one mean scores of the oral health computer assisted instruction group (mean=1.13) and the control group (mean=2.46) (p=0.0001). A statistically significant difference also occurred between the posttest one mean scores of the traditional oral health lecture instruction (mean=1.41) and the control group (mean=2.46) (p=0.0001), as determined by linear contrast tests. Linear contrast tests determined no statistically significant difference between the posttest one mean scores of the oral health lecture instruction group (mean=1.13) and the oral health computer assisted instruction group (mean=1.41) (p=0.1506) (Table 15, 16, and 17).

Data for hypothesis number eight were analyzed to determine if a statistically significant difference at the 0.05 level existed in posttest two mean scores among Group A, oral health computer assisted instruction; Group B, traditional oral health lecture instruction; and Group C, no oral health instruction, as measured by the Personal Hygiene Performance Index. Analysis of variance determined a statistically significant difference occurred among the three groups. Linear contrast tests were utilized to determine statistically significant differences between groups. A statistically significant difference occurred
Table 15

Mean Scores for Posttest One Among The Three Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Posttest 1 Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Assisted Instruction</td>
<td>1.13</td>
<td>±.54</td>
</tr>
<tr>
<td>Traditional Lecture Instruction</td>
<td>1.41</td>
<td>±.55</td>
</tr>
<tr>
<td>No Oral Health Instruction</td>
<td>2.46</td>
<td>±.67</td>
</tr>
</tbody>
</table>

Table 16

Results of Analysis of Variance For Posttest One Among The Three Groups

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>Degrees of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>2</td>
<td>21.78</td>
<td>10.86</td>
<td>29.66</td>
<td>*0.0001</td>
</tr>
<tr>
<td>Within</td>
<td>62</td>
<td>22.75</td>
<td>0.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>64</td>
<td>44.52</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Statistically Significant at the 0.01 level
Table 17

Results of Linear Contrast Tests For Posttest One Among The Three Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>df</th>
<th>Sum of the Squares</th>
<th>F-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction of Computer Assisted Instruction and Lecture Groups</td>
<td>1</td>
<td>0.78</td>
<td>2.12</td>
<td>*0.1506</td>
</tr>
<tr>
<td>Interaction of Computer Assisted Instruction and Control Groups</td>
<td>1</td>
<td>18.9</td>
<td>51.6</td>
<td>**0.0001</td>
</tr>
<tr>
<td>Interaction of Lecture and Control Groups</td>
<td>1</td>
<td>12.6</td>
<td>34.3</td>
<td>**0.0001</td>
</tr>
</tbody>
</table>

* Not statistically significant at the 0.05 level.
**Statistically significant at the 0.01 level.
between Group A, oral health computer assisted instruction (mean=1.13); and Group C, no oral health instruction (mean=2.46) (p=0.0001). A statistically significant difference at the 0.05 level occurred between Group B, traditional oral health lecture instruction (mean=1.75); and Group C, no oral health lecture instruction (mean=2.47) (p=0.0020). No statistically significant difference existed between Group A, oral health computer assisted instruction (mean=1.35); and Group B, traditional oral health lecture instruction (mean=1.75) (p=0.0908) (Table 18, 19, and 20).

Discussion

All three groups were statistically equivalent in mean pretest scores; therefore, data results were analyzed within and between groups by analysis of variance, linear contrast tests, and t-tests. Results suggest that over a one month period, oral health instructional techniques significantly motivated children to improve their oral health because the oral hygiene status of children following oral health instructions increased. Both the oral health computer assisted group and the traditional oral health lecture instruction group showed statistically significant differences at the 0.01 level between pretest and two posttest scores. The oral hygiene status of the control group also improved as was reflected in statistically significant differences between pretest and
Table 18
Mean Scores For Posttest Two
Among The Three Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Assisted Instruction</td>
<td>1.35</td>
<td>±.77</td>
</tr>
<tr>
<td>Traditional Lecture Instruction</td>
<td>1.75</td>
<td>±.71</td>
</tr>
<tr>
<td>No Oral Health Instruction</td>
<td>2.47</td>
<td>±.72</td>
</tr>
</tbody>
</table>

Table 19
Results of Analysis of Variance for Posttest 2
Among The Three Groups

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>Degrees of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>2</td>
<td>13.93</td>
<td>6.96</td>
<td>12.43</td>
<td>*0.0001</td>
</tr>
<tr>
<td>Within</td>
<td>62</td>
<td>34.73</td>
<td>0.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>64</td>
<td>48.65</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Statistically Significant at the 0.01 level
Table 20

Results of Linear Contrast Tests
For Posttest Two Among
The Three Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>df</th>
<th>Sum of the Squares</th>
<th>F-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction of Computer Assisted Instruction and Traditional Lecture Groups</td>
<td>1</td>
<td>1.65</td>
<td>2.95</td>
<td>*0.0908</td>
</tr>
<tr>
<td>Interaction of Computer Assisted Instruction and Control Groups</td>
<td>1</td>
<td>13.3</td>
<td>23.8</td>
<td>**0.0001</td>
</tr>
<tr>
<td>Interaction of Lecture and Control Groups</td>
<td>1</td>
<td>5.82</td>
<td>10.4</td>
<td>**0.0020</td>
</tr>
</tbody>
</table>

*Not statistically significant at the 0.05 level
**Statistically significant at the 0.01 level

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posttest one mean scores, and between pretest and posttest two mean scores. An increase in oral hygiene status in the control group may have occurred because of the novelty effect of dental kits containing a toothbrush, toothpaste, floss, and an oral health instruction pamphlet provided to each subject. A reduction in plaque scores also may have occurred because of pretest-posttest sensitization, dependent variable measures, notification of evaluation weeks, or the Hawthorne effect. These factors also may have caused an increase in the oral hygiene status of children receiving oral health computer assisted instruction and traditional oral health lecture instruction.

The novelty effect of dental kits may have stimulated subjects to mechanically remove plaque more frequently and effectively than without new dental kits. The dental kit or plaque removal instructions may motivate children to brush and floss efficiently, thereby, increasing oral health because the dental kit and plaque removal techniques may be new to the children.

The Hawthorne effect may have been a variable influencing results of this study. The Hawthorne effect occurs when subjects are informed of their participation in a research study and changes in the dependent variable are due to this knowledge. In the present study, the children may have been motivated to mechanically remove plaque more effectively because they knew they were involved in a
research study.

The dependent variable measure, Personal Hygiene Performance Index, may have influenced subjects to brush and floss effectively since subjects were aware that their plaque was being measured. Pretest-posttest sensitization also may have occurred causing improved oral hygiene.

Notification of evaluation weeks through consent forms also may have motivated the children to increase oral hygiene behaviors. There is a high probability that parents might have encouraged children to brush and floss more frequently and thoroughly during evaluation weeks due to the misconception that the quality of parenting may be reflected through their children's oral hygiene status. Additionally, parents might have brushed their children's teeth during these weeks to insure high quality plaque removal. Children also may have mechanically removed plaque more frequently and effectively during evaluation weeks due to peer pressure. Children may brush and floss effectively during the evaluation weeks to represent oral health to other peers as indicated by the Personal Hygiene Performance evaluation and disclosing agent staining. Children might have been aware that peers would be able to evaluate a peer's oral hygiene status by identifying the amount of disclosing agent staining plaque deposits on the teeth. Also, children at this age are very sensitive to embarrassment and humiliation by peers which could have resulted following plaque evaluation. Children brushing
and flossing more frequently and thoroughly during evaluation weeks may have caused invalid Personal Hygiene Performance scores. The Personal Hygiene Performance scores may have not reflected true oral health behaviors that occur on a daily routine basis since subjects were aware of the evaluation weeks.

A statistically significant difference at the 0.05 level occurred in Group A, oral health computer assisted instruction, between the pretest and posttest one mean scores rejecting the null hypothesis (p=0.0001). A statistically significant difference at the 0.05 level also was found between the pretest and posttest two mean scores rejecting the null hypothesis (p=0.0001). An increase in oral hygiene status was found in the oral health computer assisted instruction group from pretest to posttest one and posttest two indicating more thorough plaque removal by students. An increase in the oral hygiene status may have occurred because students actively participated in instruction, self pacing was allowed, and immediate feedback and positive reinforcement were provided. An evaluation section within the computer assisted instruction program required subjects to determine an answer to specific oral health questions (Appendix A). Positive feedback responses such as "great job" were given for correct answers. Wrong answers received the correct answer with an explanation. Through the process students may have learned the oral health techniques and may have been
motivated which caused the change in oral health behaviors resulting in improved oral hygiene status. Other factors that may have influenced the students and effected their oral health behaviors included the novelty effect of dental kits, pretest-posttest sensitization, dependent variable measures, Hawthorne effect, human interaction, and notification of evaluation weeks. Parents may feel that the Personal Hygiene Performance scores may reflect their parenting skills.

A statistically significant difference at the 0.05 level occurred in Group B, traditional oral health lecture instruction, between pretest and posttest one mean scores rejecting the null hypothesis (p=0.0001). A statistically significant difference at the 0.05 level also occurred between the pretest and posttest two mean scores rejecting the null hypothesis (p=0.0001). The oral hygiene status of children increased after the traditional oral health lecture instructions as indicated by a plaque decrease. Disease control instructions and interaction with the dental hygienist may have motivated children to increase their oral hygiene behaviors including toothbrushing and flossing. The increase in the oral hygiene status also may have been influenced by the novelty effect of dental kits, pretest-posttest sensitization, dependent variable measures, Hawthorne effect, and notification of evaluation weeks.

The results from this research indicating that oral
health instructions increase the oral hygiene status of children substantiates the findings of previous investigations. Radentz found that flossing instructions improve individuals' flossing technique more significantly than no flossing instructions. Sandell also found that oral health instructions improve the oral hygiene status of children more significantly than no oral health instructions. A statistically significant increase occurred in the oral hygiene status of oral health instruction groups in the present study. This significant change may have occurred because the oral health instructions may have motivated children to implement presented brushing and flossing techniques.

No previous investigations have been conducted to determine the effect of computer assisted instruction on changing behaviors; however, researchers have determined that knowledge can be increased through the use of computer assisted instruction. Graphics, reinforcement, self pacing, and active participation involved in computer assisted instruction can increase knowledge and retention of information. An increase in the oral hygiene status of the oral health computer assisted instruction group in the present study also may have occurred because of computer assisted instruction. Graphics may have accurately represented the dental disease process and brushing and flossing techniques, motivating
children to implement the information presented on mechanical plaque removal techniques. Children in the oral health computer assisted instruction group were permitted to pace the instruction acceleration rate according to their own needs. This self pacing also may have encouraged learning of the presented information; therefore, initiating implementation of mechanical plaque removal techniques. Another factor related to computer assisted instruction that may encourage oral health behavior changes is active participation. Children in the oral health computer assisted instruction group actively participated in the oral health instructions by answering questions in the review sections and by implementing and evaluating their own oral health techniques throughout the program. The review section also allowed reinforcement of the presented information and positive feedback to questions answered correctly. Reinforcement and positive feedback may encourage children to implement the presented plaque removal techniques.

Sandell investigated the effects of oral health instructions on increasing oral health behaviors and found that the most statistically significant differences occurred in school aged children following oral health presentations. The age factor of the present study's target population also may have influenced an increase in the oral hygiene status of subjects since school aged children are most vulnerable to behavioral changes. The
school aged population is more susceptible to behavioral changes because habits are readily formed at this age. Oral health instructions may motivate children to make a change in behavior and develop improved mechanical plaque removal techniques which improve their oral hygiene status.

Results of a study conducted by Rosenstock indicated that a behavioral change may be influenced by the presenter or intervening individual's warmth and sincerity. Oral health behavior changes also may have occurred in all three groups in the present study due to the warmth and sincerity of the research assistant and principal investigator. Warmth and sincerity of the research assistant and principal investigator may have conveyed the importance of valuing oral health to subjects; therefore, motivating subjects to implement mechanical plaque removal techniques.

The present study's findings also might have been influenced by peer pressure, appearance, or social acceptance. Rosenstock found that peer pressure, appearance, or social approval can influence one to change oral health behaviors. An increase in oral health behaviors in the present study may have occurred because parents may have influenced their children to brush effectively during evaluation weeks due to the perception that the quality of parenting may be reflected by a child's plaque scores. Peer pressure also may have motivated children to mechanically remove plaque effectively prior to
evaluation sessions because other children may visually assess one another's oral hygiene by determining the amount of disclosing agent present on their teeth. Children may brush and floss effectively to avoid the embarrassment of poor oral hygiene by their peers; therefore, increasing their oral hygiene status.

No statistically significant difference was found between posttest one and posttest two scores of Group C, the control group. Children may have brushed and flossed their teeth to the best of their ability during both weeks of evaluations; therefore, posttest one scores and posttest two scores remained consistent.

A statistically significant difference at the 0.05 level was found between posttest one and posttest two of Group B, the traditional oral health lecture group, rejecting the null hypothesis (p=0.0352). The Personal Hygiene Performance Index scores increased from posttest one to posttest two as indicated by a plaque increase. This increase in plaque may have occurred because learned oral health techniques learned via the traditional oral health lecture instruction were not retained or children lost interest and oral health decreased as indicated by an increase in plaque scores.

Group A, the oral health computer assisted instruction group, showed no statistically significant difference between posttest one and posttest two; therefore, the null hypothesis was retained. Subjects' plaque scores may have
remained consistent because the information was retained by the students, the students actively participated in the computer program, immediate feedback was provided, and self pacing was encouraged in the present study. Previous research supports these results in that increased retention occurs following presentation of computer assisted instruction. Malpass conducted a research study investigating the effectiveness of classroom instruction, automated instruction, and tutorial instruction on students' knowledge retention. Automated instruction was found to be the most effective method in increasing knowledge retention in students. Suppes and Morningstar also found that automated machines effectively increase knowledge retention in students.

A decrease in the oral hygiene status of the traditional oral health lecture instruction group occurred between posttest one and posttest two; however, the oral hygiene status of the oral health computer assisted instruction group remained constant between posttest one and posttest two. Group A, the oral health computer assisted instruction group, was allowed to view the oral health program as long as was needed. Self pacing may have influence plaque scores of the oral health computer assisted instruction group to remain constant between posttest one and posttest two. Research has verified that self pacing may enhance the retention of oral health behaviors. Individuals learn at different rates;
therefore, self pacing is a necessity for optimal learning. Self pacing allows individuals to learn and retain information at their own rate. Information may not be learned and retained if self pacing is not allowed. The instructor may present the information at a rate too fast for individuals to internalize the information. Information also may be presented too slowly causing the learner to become bored and inattentive to the information. The traditional oral health lecture instruction group received oral health instructions via the research assistant's presentation; therefore, children were not allowed self pacing.

Data were analyzed to determine if a statistically significant difference at the 0.05 level occurred among posttest scores of the three groups. No statistically significant difference was found between Group A, oral health computer assisted instruction, and Group B, traditional oral health lecture instruction (p=0.1506). Changes in the oral health status were similar between the two groups indicating that neither method of instruction was superior. Both methods of presenting oral health instruction appear to be equally effective in motivating children to change oral health behaviors and improve the quality and frequency of oral debris and bacterial plaque removal.

A statistically significant difference was found in posttest one mean scores between Group C, the control
group, and Group B, traditional oral health lecture group, 
(p=0.0001). A statistically significant difference also 
ocurred in posttest one mean scores between Group C, the 
control group, and Group A, oral health computer assisted 
instruction (p=0.0001). The oral hygiene status of 
children who received instructions improved more than the 
control group. Instructions may have motivated children to 
remove bacterial plaque more effectively.

A statistically significant difference at the 0.05 
level also occurred in posttest two mean scores between 
Group B, traditional oral health lecture instruction, and 
Group C, the control group (p=0.0001). A statistically 
significant difference was found in posttest two scores 
between Group A, oral health computer assisted instruction 
group, and Group C, the control group (p=0.0001). The oral 
hygiene status of children who received oral health lecture 
instruction significantly increased as compared with those 
children who did not receive oral health instructions. The 
present findings indicating that presenting oral health 
instructions is more effective than no oral health 
instructions verify other research studies.³ ¹⁹ ⁵⁷ Oral 
health instructions may cause a behavioral change due to 
the information presented. Information on the prevention 
of dental diseases may motivate individuals to implement 
routine mechanical plaque removal techniques resulting in 
improved oral health.

Results of this investigation indicate that oral health
computer assisted instruction and traditional oral health instruction are equally effective methods in enhancing oral health behavioral changes. Kulik, Schwalb, and Kulik found that recently developed computer programs enhanced learning more significantly than traditional methods because of advancement in the art and science of developing computer programs. Development of the computer program used in the present study was not by a professional programmer; therefore, the computer program may not have been sophisticated enough to produce a significant difference between educational techniques. A professionally developed oral health computer assisted instruction program may result in more significant oral hygiene scores indicating less plaque and better oral hygiene status.

Based on the results of this study, several conclusions can be offered. Oral health computer assisted instruction and traditional oral health lecture instruction are equally effective methods in motivating children to remove plaque as determined by this study; however, presenting oral health instruction is more effective in causing oral health behavioral changes than no oral health instructions. Oral health computer assisted learning may result in longer retention rates and increased oral health behaviors than may result following traditional oral health lecture instruction methods. Plaque scores increased from posttest one to posttest two in the traditional oral health lecture
group; whereas, the oral health computer assisted
instruction group's posttest one and posttest two scores
remained consistent. Oral health behavioral changes also
may have occurred due to the novelty effect,
pretest-posttest sensitization, Hawthorne effect, human
interaction, dependent variable interaction, and
notification of evaluation weeks.

These findings on the effectiveness of computer
assisted instruction may add to knowledge in the dental and
education fields because the effect on behavioral changes
from computer assisted instruction has not been previously
investigated. It has been determined that there is a
statistically significant difference in increasing the oral
hygiene status of children through the presentation of oral
health instructions regardless of the method used.
CHAPTER 5
Summary and Conclusions

Dental health education is a significant factor involved in the prevention of dental diseases. Research indicates that bacterial plaque is the etiological factor of dental disease and that daily removal of plaque may prevent dental disease. No single method of presenting dental education has been determined to be the most effective in motivating individuals to prevent dental caries, gingivitis, and irreversible periodontal disease by daily plaque removal.

The present study attempted to determine the effectiveness of computer assisted instruction using a pretest-posttest design in increasing the oral hygiene status of children over a one month period. The three intact group used were: Group A, oral health computer assisted instruction; Group B, traditional oral health lecture instruction; and Group C, no oral health instruction. The Personal Hygiene Performance Index was used to determine the amount of plaque and debris present for each subject during the pretest and two posttests. Posttests occurred one day and one month following
instructions.

Data results were analyzed by one way analysis of variance and t-tests to determine significant differences between educational methods. The following hypotheses revealed no statistically significant differences at the 0.05 level; therefore, the tested hypotheses were retained:

Hypothesis Four. There is no statistically significant difference at the 0.05 level between the posttest one and posttest two scores of children who receive computer assisted instruction as measured by the Personal Hygiene Performance Index.

Hypothesis Six. There is no statistically significant difference at the 0.05 level between the posttest one and posttest two scores of children who do not receive oral health instructions as measured by the Personal Hygiene Performance Index.

Other findings from statistical analyses revealed a statistically significant difference at the 0.05 level; therefore, the following tested hypothesis were rejected.

Hypothesis One. There is no statistically significant difference at the 0.05 level between the pretest and posttest one, and pretest and posttest two scores of children who receive oral health computer assisted instruction as measured by the Personal Hygiene Performance Index.

Hypothesis Two. There is no statistically significant
difference at the 0.05 level between the pretest and posttest one and posttest two scores of children who receive traditional oral health instruction as measured by the Personal Hygiene Performance Index.

**Hypothesis Three.** There is no statistically significant difference at the 0.05 level between the pretest and posttest one and posttest two scores of children who do not receive oral health instruction as measured by the Personal Hygiene Performance Index.

**Hypothesis Five.** There is no statistically significant difference at the 0.05 level between the posttest one and posttest two scores of children who receive traditional oral health instructions as measured by the Personal Hygiene Performance Index.

**Hypothesis Seven.** There is no statistically significant difference at the 0.05 level between the posttest scores one day following oral health instruction between computer assisted instruction, traditional lecture instruction, and no oral health instruction as measured by the Personal Hygiene Performance Index.

**Hypothesis Eight.** There is no statistically significant difference at the 0.05 level between the posttest scores one month following oral health instruction.
health instruction between computer assisted instruction, traditional lecture instruction, and no oral health instruction as measured by the Personal Hygiene Performance Index.

Considering the results as well as the limitations of this study, the following conclusions are offered:

1. Oral health computer assisted instruction and traditional oral health lecture instruction are effective methods for improving oral health behavior in children.

2. The novelty of dental kits provided to each subject for the purpose of a study may motivate children to increase their oral hygiene status.

3. Oral debris scores will not remain consistent following traditional oral health lecture instruction over a one month period possibly due to lack of retention, interest, or motivation.

4. Participation in a research study may effect the oral hygiene status of children who do not receive oral health instruction due to the Hawthorne effect, pretest-posttest sensitization, and notification of evaluation weeks.

5. Oral health computer assisted instruction and traditional oral health lecture instruction are equally effective instructional methods in improving the oral hygiene status of children.

As a result of this study, the following
recommendations for future study are offered:

1. This investigation should be replicated to verify the results.

2. A study designed to investigate the effect of reinforcement should be conducted with the computer assisted instruction available for reinforcement whenever deemed necessary by children.

3. An investigation utilizing a randomized sample population should be done to provide generalizable results.

4. Investigations designed to determine the long term effects that oral health computer assisted instruction has on children's oral hygiene status are needed.

5. An investigation utilizing various grade levels to determine the age in which children are most adaptive to oral health behavior changes is warranted.

6. An investigation should be conducted without notifying subjects of evaluation days or weeks. Notification may encourage subjects to remove plaque more thoroughly during these days or weeks; therefore, resulting in invalid plaque scores.

7. An investigation eliminating dental kits should be conducted because dental kits may cause a novelty effect and motivate children to brush
and floss effectively.

This investigation indicated that computer assisted instruction is an effective method of presenting oral health instructions. The oral hygiene status of children utilizing traditional oral health lecture decreased between one day and one month following instruction; therefore, oral health computer assisted instruction may be more effective in increasing the oral hygiene status of children.

Results of this study may increase the market for oral health computer programs in various settings, such as, school systems, health fairs, and dental offices, because the computer program is effective in motivating individuals to change oral health behaviors while increasing their oral hygiene status. Oral health instructions may be presented by someone other than dental personnel. Because of the convenience and access, individuals may review the computer program as many times as deemed necessary to internalize information and initiate oral health behavioral changes.
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APPENDIX A
EDUCATIONAL CONTENT
A Guide to Oral Health

1. You can have a healthy smile with the proper care and maintenance of your mouth.

2. Bacterial plaque is a soft colorless, sticky film which is constantly forming on your teeth and gums.

3. When plaque combines with sugar it creates an acid.

4. The plaque's acid destroys the tooth's structure causing dental caries.

5. Plaque also causes gum inflammation and can destroy supporting bone. Gingivitis occurs when plaque causes the gums to become red and inflammed.

6. Periodontal disease is a breakdown of supporting tissues and bone. Symptoms are: bleeding gums, swollen gums and loosening of teeth.

7. Disease Process Review
   What is the number one cause of most dental diseases? Plaque
   What does plaque and sugar create? Acid
   Gingivitis is a redness and inflammation of the Gums
   Periodontal disease is the breakdown of the supporting tissues and Bone

8. Brushing
   Cavities, gingivitis and periodontal disease can be prevented by proper brushing and flossing daily.

9. Hold your toothbrush at a 45 degree angle and place it where your teeth and gums meet. Move the brush back and forth in a gentle scrubbing motion to remove plaque.

10. Brush with short, angled strokes to remove plaque on the outer and inner surfaces of the upper and lower teeth.

11. Tilt the toothbrush vertically and make up and down strokes on the inside surface of the front teeth.
   For the chewing surfaces hold the toothbrush bristles against the teeth's chewing surface and use a scrubbing
motion to remove plaque from the grooves.

12. **Brushing Review**
   What angle do you form with your toothbrush and tooth? 45 degree angle
   What do you remove from your teeth and gums by brushing? Plaque
   The chewing, outer, and _______ surfaces of teeth are brushed. Inner

13. **Flossing**
   Flossing removes plaque and debris from between teeth.

14. Take about 18 inches of dental floss. Wrap the ends around your middle fingers with one inch between the index fingers and thumbs.

15. Slide the floss between two teeth. Curve the floss around the side of the tooth. Slide the floss gently under the gum until you feel a resistance.

16. Move the floss up and down the side of the tooth several times. Repeat this procedure for each tooth. Move the floss between your fingers to obtain a clean section of floss.

17. Don't forget to floss behind the last teeth in your mouth.

18. **Flossing Review Section**
   What do you use to clean between your teeth? Floss
   Slide the floss between your teeth and use an up and _______ motion. Down
   Curve the floss around the _______ of the tooth. Side

19. **Nutrition**
   Certain foods can cause dental decay due to their ingredients.

20. Some foods contain sugar which causes dental decay. These foods are cariogenic because they cause dental decay.

21. Foods that are healthy for your teeth do not contain sugar. Some healthy foods are vegetables and fruits.
Foods that cause dental decay contain ___________.

Sugar

Is popcorn a good or bad good for your teeth? Good

Which of the following is a healthy food: donut, apple, cake, or candy? Apple

Dental disease can be prevented by eating healthy foods, brushing, and ____________ daily.

Flossing

23. Visit your dental office for an examination every six months. Proper oral care - brushing, flossing, and nutrition - can help prevent dental caries, gingivitis, and periodontal disease.
AN ORAL HEALTH COMPUTER ASSISTED INSTRUCTION EVALUATION

Please check either yes or no for each criteria.

The oral health computer program:

1) Conveys basic concepts, techniques, and principles of toothbrushing.  yes  no

2) Conveys basic concepts, techniques, and principles of flossing.  yes  no

3) Material is presented on the target population's (fifth graders) level.  yes  no

4) Information is presented accurately.  yes  no

5) Visual aids accurately represent information.  yes  no

6) Organization of the material presented.  yes  no

7) Program may motivate children for better oral health.  yes  no

Suggestions and Recommendations: 

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
APPENDIX C
PERSONAL HYGIENE PERFORMANCE EVALUATION FORMS
Personal Hygiene Performance Index

Subject Number: ______

Key to Scoring Each Tooth:

0 = no sections display debris
1 = debris present on 1 section
2 = debris present on 2 sections
3 = debris present on 3 sections
4 = debris present on 4 sections
5 = debris present on 5 sections

Scoring Formula:

\[ \text{PHP} = \text{sum of debris scores} \]

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SCORE ________
Proper Brushing and Flossing are Important.

Of course, you want your teeth to look clean and feel fresh. But the most important objective of good oral hygiene is to keep teeth healthy. Proper brushing and flossing clean away plaque that forms daily on your teeth. Plaque is an invisible film that harbors bacteria, and contributes to tooth decay and periodontal disease.

How to Brush

Position the toothbrush at roughly a 45 degree angle to the gum line. Brush thoroughly with short, gentle, back and forth strokes. Each stroke should be about half-a-tooth wide.

Brush the inside and outside surfaces thoroughly — and be careful not to miss those hard-to-reach back teeth!

Brush the inside surfaces of the upper and lower front teeth with the front part of the brush. Brush the chewing surfaces of all teeth. Don’t press too hard or the brush will "mat down" and, therefore, won’t work as well as it should.

How to Floss

Cut off 18 inches of floss and wrap it around your middle fingers, leaving about one inch to work with.

Use a gentle swaying motion to insert the floss between your teeth. Avoid "snapping" it against the gums. Just ease the floss between the teeth until it reaches the gums.

Gently position the floss under the gums and gently scrape the sides of each tooth away from the gum line.

Special Instructions . . .

The brushing and flossing techniques described on the inside are generally accepted as effective for most people. However, your dentist or hygienist may feel that the condition of your teeth and gums dictates a different method that is better suited to your special needs. Be sure to follow such instructions carefully.
October 1986

Dear Parent:

A research project investigating the benefits of computer assisted learning in dental health education will be conducted at Northlanding Elementary School. The benefit to your child may be improved dental health because of the oral hygiene instructions presented in the study. The benefits to the dental community may be an increase in the knowledge of dental education. Your child will receive oral hygiene instructions (brushing and flossing) through a classroom presentation or a dental computer program. This study will require the participation of your son/daughter over a five week period for a total of 45 minutes. The sessions will occur as follows:

- Session 1: Oral hygiene evaluation - 5 minutes
- Session 2: Oral hygiene education - 30 minutes
- Session 3: Oral hygiene evaluation - 5 minutes
- Session 4: Oral hygiene evaluation - 5 minutes.

Each child in the study will be given a toothbrush, dental floss, toothpaste, and an oral hygiene instruction pamphlet.

If you would like your son/daughter to be included in this study, please complete the consent form enclosed and return this to your child's homeroom teacher by Wednesday, November 5, 1986.

If you have any questions concerning this project, you may contact me at 440-0114 or at work 440-4310. I look forward to working with you and your child. Thank you for your cooperation.

Sincerely,

Claudia Michalak, C.D.A., R.D.H., B.S.
Graduate Student
School of Dental Hygiene and Dental Assisting
Old Dominion University

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INFORMED CONSENT FORM

Project Name:  "The Effectiveness of Oral Health Computer Assisted Instruction on Increasing the Oral Hygiene Status of Children."

Principal Investigator:  Claudia Michalak, CDA, RDH, BS

Date:  November 8, 1986

Your child is invited to participate in a study to investigate the effectiveness of an oral health education program on the oral hygiene status of children. Bacterial plaque and oral debris will be evaluated on each child. Fifth grade students have been selected to participate in this study. The physical dexterity necessary to attain proper brushing and flossing techniques has usually been achieved by age 10 or 11. In addition, proper oral health care may become valued, resulting in significant changes in the child's routine dental care.

Your child will participate in one of the three following groups: Group A, oral health computer education; Group B, slide-lecture oral health presentation; or Group C, the control group. Group A and B will receive oral health education during the implementation phase of the study. Group C will receive oral health education at the completion of this study. Each child will receive an oral health kit containing a toothbrush, toothpaste, dental floss, and an instructional pamphlet. The oral health programs will be identical in content. A registered dental hygienist will present the oral health programs consisting of tooth and floss techniques, nutrition, and the dental disease process.

Three oral hygiene examinations will be performed on each child by the principal investigator to determine the amount of oral debris present in the child's mouth. The principal investigator will instruct each child to chew, swish and expectorate (spit) a disclosing tablet to stain any oral debris present on the teeth. This disclosing tablet is the same type of tablet which can be purchased over the counter in any grocery or drug store without a prescription for home use. It is also used in dental offices to stain the plaque and oral debris for dental education. The disclosing tablet temporarily stains plaque and oral debris red and may be removed by brushing and flossing. After the child rinses once, six teeth will be visually examined, with a disposable mouth mirror. Only one child will be examined in the nurse's office at a time to ensure privacy.
This study will require the participation of your child over a five week period. Your child will be scheduled for an oral health education presentation and oral hygiene examinations during the following sessions:

**Week of November 17, 1986:**
- **Session 1:** Oral hygiene examination 1 (nurse’s office)-5 minutes
- **Session 2:** Oral health education presentations (classroom)-30 minutes
- **Session 3:** Oral hygiene examination 2 (nurse’s room)-5 minutes

**Week of December 15, 1986:**
- **Session 4:** Oral hygiene examination 3 (nurse’s room)-5 minutes

I understand that the study will involve four sessions totaling 45 minutes. Each session will occur at Northlanding Elementary School.

The benefit to your child may be improved dental health because of the oral hygiene instructions presented in this study. The benefits to the dental community may be an increase in the knowledge of effective dental health education methods. Your child will receive oral hygiene instructions (brushing and flossing) through a classroom lecture or an oral health computer program.

Potential risks in this study are minimal because the oral health examination will be performed with disposable mouth mirrors by a registered dental hygienist. Each child will be instructed to use the disclosing tablet during the oral hygiene examination.

I acknowledge that I have been informed of any potential risks to my child associated with his/her participation in this research as stated in this form.

Confidentiality will be maintained through two mechanisms concerning your child’s participation in this study. Number one, the principal investigator and the registered dental hygienist presenting the oral health programs will not be informed of the child’s name. Each child will be assigned a number for record keeping and data collection. Secondly, the data collection forms will be identified through number only and kept by the principal investigator. Consent forms will be retained separately from all other research by the fifth grade coordinator to ensure that names will not be revealed.

The investigation and the nature of my child’s participation has been described to me completely and I understand the explanation.
I understand that my child may withdraw from this study at any time during this study.

I understand that participation in the study is strictly voluntary and no monetary compensation will be given. I understand that nonparticipation will not affect my child’s status in the school.

Each child will receive an oral health kit containing a toothbrush, toothpaste, dental floss, and an instructional pamphlet.

I understand that the results of this study may be presented orally or published, but my child's name will not be revealed.

I acknowledge that I may obtain a copy of the results of this research project and that upon making my request a copy will be provided.

I have been informed that I have the right to contact the Old Dominion University Institutional Review Board for the Protection of Human Subjects should I wish to express my opinions regarding the conduct of this study.

If you have any questions concerning this project, you may contact Claudia Michalak at 440-0114 or at work 440-4310. Thank you for your cooperation.

This is to certify that I ________________________, give permission for my child ___________________________ to participate in a study entitled "The Effectiveness of an Oral Health Computer Program on the Oral Hygiene Status of Children" at Northlanding Elementary School, under the supervision of the principal investigator, Claudia Michalak.

____________________  ______________________
Signature of Parent/Guardian  Date:

My signature certifies that I have explained all procedures involving this study to my child. My child gives her/his consent to participate in this study and agrees to perform all necessary procedures to the best of his/her ability.

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Signature of Parent/Guardian  Date:

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**MEAN** 2.89 2.46 2.47
## Sample Population

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