THE EFFECTS OF AN EXPERIENTIAL LEARNING MODEL OF EDUCATION ON SECOND GRADE STUDENTS' FRUIT AND VEGETABLE KNOWLEDGE, PREFERENCE AND CONSUMPTION

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Sondra McDaniel Parmer

Certificate of Approval:

____
David Shannon
Professor
Educational Foundations,
Leadership, and Technology

____
Jill Salisbury-Glennon, Chair
Associate Professor
Educational Foundations,
Leadership, and Technology

____
Barbara J. Struempler
Professor
Nutrition and Food Science

____
Joe F. Pittman
Interim Dean
Graduate School

THE EFFECTS OF AN EXPERIENTIAL LEARNING MODEL OF EDUCATION ON SECOND GRADE STUDENTS' FRUIT AND VEGETABLE KNOWLEDGE, PREFERENCE AND CONSUMPTION

Sondra McDaniel Parmer

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THE EFFECTS OF AN EXPERIENTIAL LEARNING MODEL OF EDUCATION ON

SECOND GRADE STUDENTS' FRUIT AND VEGETABLE KNOWLEDGE,

PREFERENCE AND CONSUMPTION

Sondra McDaniel Parmer

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Signature of Author

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Date of Graduation

VITA

Sondra McDaniel Parmer, daughter of Dr. Randall McDaniel and Mrs. Linda Jordan, was born on August 8, 1965, in Gainesville, Florida. After graduating from Auburn High School in 1983, she attended Auburn University where she received her Bachelor of Arts degree in Foreign Language/International Trade in 1988. After obtaining her degree, she worked with the Job Training Partnership Act (JTPA) program as a technical assistant at a regional planning commission in North Carolina. She moved back to Auburn and was employed as the Director of the Foster Grandparent Program for Lee and Russell Counties. Subsequently, she moved into a position with the Expanded Food and Nutrition Education Program (EFNEP) as the first Area EFNEP Agent hired in the state of Alabama with the Alabama Cooperative Extension System. She returned to school at Auburn University and received a Master of Science degree in Human Development and Family Studies in 1999. She continues her work with Extension and is presently employed as the Project Manager of the Nutrition Education Program (NEP). She is married to Gregory A. Parmer and they have two children; a daughter, Erin Elizabeth-Lin White and a son, Jacob Dalton Parmer.

DISSERTATION ABSTRACT

THE EFFECTS OF AN EXPERIENTIAL LEARNING MODEL OF EDUCATION ON SECOND GRADE STUDENTS' FRUIT AND VEGETABLE KNOWLEDGE, PREFERENCE AND CONSUMPTION

Sondra McDaniel Parmer

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An experiential education model utilizing a school garden project and classroom nutrition education was explored for its influence on fruit and vegetable knowledge, preference and consumption among 115 second grade students. Students were assigned to one of three groups: (1) a nutrition education and gardening (NE+G) intervention group, (2) a nutrition education only (NE) intervention group or (3) a control group (CG). The intervention consisted of 10 classroom lessons per subject (gardening and nutrition education). In addition, experiential learning activities were conducted through planting, growing and harvesting vegetables in a school garden in the NE+G group.

Pre- and post-assessment tools were used and included self-report questionnaires to measure fruit and vegetable knowledge, interview-style taste and rate items to measure

fruit and vegetable preference and lunchroom observations to measure fruit and vegetable consumption. Responses were statistically analyzed to determine effects of the experiential model of learning and classroom instruction.

A mixed model analysis of variance (ANOVA) design demonstrated that students in the NE+G group (n=39) and the NE group (n=37) exhibited significantly greater improvement in nutrition knowledge, taste ratings and willingness to try fruits and vegetables than did the control group (n=39). Moreover, students in the NE+G group were more likely to choose and consume vegetables in a lunchroom setting at post-assessment than either the NE or CG groups.

School gardens as an experiential learning component of nutrition education can increase fruit and vegetable knowledge, preference and consumption among children. These findings suggest that school administrators, classroom teachers and nutrition educators should work closely together to implement school gardens to allow for hands-on learning opportunities as a way to influence dietary habits at an early age.

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I. INTRODUCTION

Over the past three decades, the prevalence of obesity in the U.S. has tripled for older children ages 6–11 years and adolescents ages 12–19 years (Hedley, Ogden, Johnson, Carroll, Curtin, & Flegal, 2004). An estimated 9.18 million U.S. children and adolescents ages 6–19 years are considered obese. If obesity levels continue at the current rate, the lifetime risk of being diagnosed with type 2 diabetes at some point in their lives is 30% for boys and 40% for girls (McGinnis, Gootman, & Kraak, 2006). Moreover, obesity puts children at greater risk for cardiovascular disease, hypertension and cancer.

The effects of childhood obesity are devastating to the health and well-being of our children now and throughout adulthood. A recent special report (Olshansky et al., 2005) suggests that the United States could be facing its first sustained drop in life expectancy in the modern era due to obesity. The authors suggest that unless steps are taken to curb excessive weight gain, younger Americans will likely face a greater risk of mortality throughout life than previous generations. In recent years, there have been many calls for methods and programs to help address this childhood obesity epidemic (Serrano & Cox, 2005; Story, 1999). To date, prevention is recognized as one of the best methods for controlling the rapid increase in childhood obesity (American Academy of Pediatrics, 2003; Fowler-Brown & Kahwati, 2004; Moran, 1999). One means of prevention, increasing fruit and vegetable consumption, may offer some hope for combating obesity, and thus lessening the onset of many cancers and diabetes. However, these fruits and vegetables need to be introduced early in life in order for children to develop positive dietary habits (Traahms & Pipes, 2000).

One means to accomplishing an early introduction to fruits and vegetables is through nutrition education in school settings. In order to be effective, this nutrition education needs to be theoretically based, of a sufficient duration to affect change, and contain developmentally appropriate activities (Contento, Balch, Bronner, Lytle, Maloney, Olsen, & Swadener, 1995; Hertzler & DeBord, 1994). Reviews of nutrition education projects aimed at increasing fruit and vegetable consumption have identified a need for increased numbers of interventions that meet these criteria. Further, interventions containing environmental components have also been advocated (Reynolds, Baranowski, Bishop, Gregson, & Nicklas, 2001).

The experiential learning model offers a viable framework for nutrition education for school-aged children. This model allows children to learn and construct meaning through experiencing real-life situations (Dewey, 1938; Piaget, 1972). Experiential learning offers the student a more learner-centered approach which often produces deeper and more enduring learning than many more formal approaches to education. Montessori (1964) promoted gardening as an experiential learning method that proved to be successful with children. She recognized both the academic and social benefits that children received through gardening education.

Current research into classroom gardening has supported Montessori's perspective on the benefits of gardening for children (Center for Ecoliteracy, 1999; Klemmer, 2002). However, this research has been limited in scope. Research into the academic benefits of gardening has focused primarily on mathematics and science education (Civil & Kahn, 2001; Wotowiec, 1979). The gardening activities that have been associated with these academic areas have lent themselves well to providing experiential learning opportunities.

Research into the relationship between gardening and improved nutrition behaviors in children is in its infancy. Despite the fact that some preliminary research indicates positive dietary outcomes as the result of gardening, few studies have rigorously evaluated gardening as a teaching method. Initial studies have illustrated the positive effects that school-based gardening projects can have on nutrition knowledge and behavior (Cavaliere, 1987; Lineberger & Zajicek, 2000; Morris, Neustadter, & Zidenberg-Cherr, 2001). However, there remains a paucity of research into the link between gardening and dietary behavior. There is a need for additional research in this area to: (a) improve upon current research designs, (b) demonstrate the positive impacts of gardening as a function of developmental level, (c) develop more sensitive assessment tools, (d) improve the assessment tools that are currently available, (e) develop more integrated nutrition and gardening curricula, (f) develop better teaching methods, (g) include more data on fruit consumption related to gardening and (h) provide replication of the current research.

Thus, this study sought to address some of these research needs by investigating the relationship between gardening as an experiential learning process and fruit and vegetable knowledge, preference and consumption behavior in an elementary school-aged population. To that end, the research project sought to synthesize relevant research from the disciplines of educational psychology, horticulture, and nutrition education in order to study the effects of school gardens on children's fruit and vegetable knowledge, preference and consumption.

II. LITERATURE REVIEW

Prevalence of Obesity

We are currently faced with an obesity epidemic in the United States. In 2000, an estimated 30% of U.S. adults aged 20 years and older, nearly 59 million people, were obese, defined as having a body mass index (BMI) of 30 or more (National Health and Nutrition Examination Survey 1999-2000). In the past two decades, rates of overweight and obesity have doubled for children and tripled for adolescents. The percentage of overweight among children and youth has soared to the 15% range (Hedley, Ogden, Johnson, Carroll, Curtin, & Flegal, 2004). Alabama is a strong contributor to the U.S. having the highest percentage of obese people among any country in the world. Alabama, with 24.5% of adults obese, is among the top seven states for obesity in the nation. Alabama has an additional 37.2% of residents who are overweight. Overweight is defined separately from obesity, indicating an individual's BMI is between 25 and 29.9.

Accompanying these large percentages of obese and overweight individuals is a high rate of obesity-related diseases. Being overweight or obese increases the risk for the top U.S. causes of death and disability including heart disease, stroke, cancer, and diabetes. Across the country, obesity carried a $117 billion price tag in 2000, accounting for 9% of the nation's total health care costs (Finkelstein, Fiebelkorn, & Wang, 2003). The Centers for Disease Control and Prevention (2004) estimates that if current obesity trends continue, one-third of all children, and one-half of African-American and Hispanic children born in 2000 will develop diabetes. Alabama has the highest diabetes rate in the nation with 9.6% of Alabamians estimated to have the disease. In addition to the diabetes rates, the Alabama age-adjusted death rate rankings for obesity-related diseases also are among the highest in the nation: fifth for heart disease, seventh for stroke, and tenth for diabetes (Hataway, Reese, & Chapman, 2005).

The impact of obesity on children is great and the health risk is quite damaging. Risk factors for heart disease, such as high cholesterol and high blood pressure, occur with increased frequency in overweight children and adolescents compared to children with a healthy weight. According to a recent study in the New England Journal of Medicine (Olshanskyet al., 2005), life expectancy for the average American could decline by as much as five years unless aggressive efforts are made to slow the rising rate of obesity. Eisenson (2003) reports, "Researchers are predicting that, instead of seeing heart disease happening in their 50s and 60s, our kids might be subject to heart disease as early as their 20s..." Type 2 diabetes, previously considered an adult disease, has increased dramatically in children and adolescents. Overweight and obesity are closely linked to Type 2 diabetes. Furthermore, overweight and obesity are known risk factors for stroke, gallbladder disease, osteoarthritis, sleep apnea and other breathing problems, and some forms of cancer (e.g., uterine, breast, colorectal, kidney, and gallbladder) (National Institute of Diabetes and Digestive and Kidney Diseases, 2005).

Finally, the most immediate consequence of overweight as perceived by the children themselves is social discrimination. This is associated with poor self-esteem and depression. Children who experience psychological abuse from their peers often develop extremely low self-esteem, which may eventually evolve into a serious state of depression. Schwimmer, Burwinkle, and Varni (2003) compared quality of life scores of obese children with those of healthy, normal-weight children and children with cancer who have had chemotherapy. Obese children were five and a half times as likely to report an impaired quality of life as healthy, normal-weight children. Even more shocking, severely obese children rated their quality of life as about the same as children with cancer who have been treated with chemotherapy. Obese children often feel isolated and lonely. Because of this alienation, they may fail to develop key life and social skills, which can negatively-affect their lives well into adolescence or even adulthood.

Causes of Obesity

The causes of overweight and obesity are complex. The Centers for Disease Control and Prevention (2004) assert that there are three primary factors influencing overweight or obesity. The first factor is behavior. Quite simply, weight is gained by an imbalance of energy. This is defined as eating too many calories while not getting enough physical activity. A person gains weight when energy input exceeds energy output.

The second factor contributing to overweight and obesity is an individual’s environment. Home, work, school, or community can provide barriers to or opportunities for an active lifestyle. Today's youth spend far more time in front of a television or computer screen than in years past. Studies have shown that children watch, on average, 25 hours of television a week (Anderson, Crespo, Bartlett, Cheskin, & Pratt, 1998; Özmert, Toyran, & Yurdakök, 2002). Today’s youth are not more than moderately active on a regular basis, neither at home or at school. Physical education classes have been cut back, or even eliminated, at some of our nation's schools.

The third factor influencing overweight and obesity is genetics. Heredity is considered to play a role in determining how susceptible people are to overweight and obesity. Biological relatives tend to resemble each other in many ways, including body weight. Individuals with a family history of obesity may be predisposed to gain weight. Genes also influence how the body burns calories for energy or stores fat. Of the three primary factors influencing obesity, the behavioral and environmental factors are the main contributors to overweight and obesity and provide the greatest opportunities for prevention and treatment.

In the *Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity* (U.S. Department of Health and Human Services, 2001), it is suggested that, similar to adult causes of obesity, overweight in children and adolescents is generally caused by lack of physical activity, unhealthy eating patterns, or a combination of the two, with genetics and lifestyle both playing important roles in determining a child's weight. Prevention is the best hope for decreasing the prevalence of this condition. In many obese people, the roots of their disorder can be traced back to childhood. Obesity tends to "track" throughout life meaning that its presence at any age will increase the risk of persistence at subsequent ages (Power, Lake, & Cole, 1997; Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). While most obese infants will not remain so, they are at increased risk of becoming obese children. These children are, in turn, more likely to become obese adolescents, who are then very likely to remain obese adults. Thus, prevention of obesity at an early stage of development is critical.

Fruit and Vegetable Consumption

One method of preventing obesity is to influence an individual's eating behaviors by creating an imbalance of energy intake. By consuming fewer calories than are expended, an individual should experience weight loss. Increasingly, researchers are examining the relationship between obesity and consuming a diet high in fruits and vegetables (Lin & Morrison, 2002; Rolls, Ello-Martin, & Tohill, 2004). As part of the nutritional approach to combat obesity, fruits and vegetables can play an integral role because of their low fat, low energy contributions to healthy eating. Because fruits and vegetables are high in water and fiber, incorporating them in the diet can reduce energy density, promote satiety, and decrease energy intake.

Research findings have been mixed in determining the role that fruits and vegetables play in reducing the incidence of obesity. In a review of weight management intervention studies, Rolls, Ello-Martin, and Tohill (2004) found that interventions that include education to increase fruit and vegetable consumption in combination with decreasing energy intake is an effective strategy for weight management. Moreover, in a study of long-term dietary variety and its potential association with energy intake and body fatness in adult men and women; McCrory, Fuss, Saltzman, and Roberts (2000) found that obesity is associated with consumption of foods high in energy density. These researchers concluded that adding low-calorie fruits and vegetables to the diet is a viable weight-loss strategy for adults.

However, in a study conducted by the United States Department of Agriculture's (USDA) Economic Research Service (Lin & Morrison, 2002), findings associated with fruit and vegetable intake and obesity were more varied. In their study, individuals' fruit and vegetable intakes were compared with their corresponding body mass indices. The researchers examined data from the USDA's *1994-96 Continuing Survey of Food Intakes by Individuals* (CFSII), a national database of food consumption data. Findings suggested an inverse relationship between fruit consumption and body mass index, in that people who ate more servings of fruit each day had lower body mass indices. However, the researchers found no consistent relationship between vegetable consumption and body mass index, especially among children. The authors suggest that one reason for this finding may be the preparation method for the vegetables as a contributor to higher body mass index. Both fruits and vegetables are low-fat foods when consumed in their natural state. The authors suggest that Americans may be eating most of their fruits raw or in juices, without additional sauces or fried coatings. In contrast, Americans may be deep-fat frying their vegetables (e.g., potatoes into french fries), topping them with high-fat dressings or sour cream, or including them in high-fat mixtures. Thus, further research is needed for more definitive insight into the relationship between obesity and fruit and vegetable consumption.

It is well documented that fruit and vegetable consumption tends to be low in children and adolescents. Estimates indicate that only one in five children eat five or more servings of fruit and vegetables per day as recommended by the National Cancer Institute and other national health organizations (Kann, Warren, Harris, Collins, Williams, Ross, & Kolbe, 1996; Krebs-Smith, Cook, Subar, Cleveland, Friday, & Kahle, 1996).

In addition to the potential benefits to weight management, fruit and vegetable consumption has been found to be an important protector against many chronic diseases such as cancer and diabetes (Steinmetz & Potter, 1996). These diseases once were thought of as "adult" diseases. However, research has shown a relationship between childhood nutrition habits and increased risks for these diseases in adulthood (American Dietetic Association, 2004; Brady, Lindquist, Herd, & Goran, 2000; Krebs-Smith, Cook, Subar, Cleveland, Friday, & Kahle, 1996; Traahms & Pipes, 2000).

Much work has been devoted to determining the etiology of cancer and specific risks related to cancer. Although no specific cause has been specified, research has shown that diet contributed to roughly one-third of all cancer incidence and mortality (Diet and Health, 1989). Furthermore, an important link between childhood nutrition and the onset of cancer during adulthood has been discovered (Brady, Lindquist, Herd, & Goran, 2000). Epidemiological data suggest that eating patterns during childhood are important determinants of cancer risks as adults (Krebs-Smith, Cook, Subar, Cleveland, Friday, & Kahle, 1996). Low consumption of fruits and vegetables consistently has been associated with high incidence of cancer in numerous epidemiological studies (Block, Patterson, & Subar, 1992; Steinmetz & Potter, 1996; Willet & Trichopoulos, 1996). The quarter of the population with the lowest dietary intake of fruits and vegetables has roughly twice the cancer rate for most types of cancer when compared with the quarter with the highest intake (Block, Patterson, & Subar, 1992). In addition, high intakes of fruits and vegetables are associated with a lower risk of cancer at most sites, specifically lung and stomach cancers (American Dietetic Association, 2004; Healthy People, 2000, 2010; Krebs-Smith, Cook, Subar, Cleveland, Friday, & Kahle, 1996; Reynolds, Hinton, Shewchuk, & Hickey, 1999; Steinmetz & Potter, 1996). Many cohort and case control studies have shown the risk of cancer to be reduced by half with high intakes of fruits and vegetables when compared to low intakes of fruits and vegetables (Steinmetz & Potter, 1996).

The understanding of the mechanism for the effectiveness of fruits and vegetables in cancer rates is not entirely clear. Micronutrient deficiency is one explanation for the effect of fruits and vegetables on cancer (Ames, 1998). Deficiency in several micronutrients has the potential to distort metabolism and damage DNA. This damage to DNA may result in cancer-producing agents at the cellular level.

The current mechanism most widely given credence for the effectiveness of fruit and vegetable intakes on cancer is through the additive and synergistic effects of phytochemicals in the fruits and vegetables themselves. Human cells are constantly exposed to a variety of oxidizing agents. A balance between oxidants and antioxidants is required for optimal health. An overproduction of oxidants can cause an imbalance, leading to oxidative stress (Liu & Hotchkiss, 1995). Oxidative stress can cause oxidative damage to large biomolecules such as lipids, proteins, and DNA, resulting in an increased risk for cancer (Ames & Gold, 1991; Liu & Hotchkiss, 1995). To prevent or slow the oxidative stress, sufficient amounts of antioxidants need to be consumed. Fruits, vegetables, and whole grains contain a wide variety of antioxidant compounds or phytochemicals.

Phytochemicals are chemicals found in plants that have been linked to reducing the risk of major chronic diseases. It has been estimated that more than 5,000 individual phytochemicals have been identified in fruits, vegetables, and grains (Liu, 2004). The most commonly studied phytochemicals are the phenolics and the carotenoids. Phenolics are found most often in the following commonly-eaten fruits with amounts in descending order – cranberries, apples, red grapes, strawberries, pineapples, bananas, peaches, lemons, oranges, pears, and grapefruit. Among the common vegetables consumed in the United States, broccoli contains the highest total phenolic content, followed by spinach, yellow onion, red pepper, carrot, cabbage, potato, lettuce, celery, and cucumber (Chu, Sun, Wu, & Liu, 2002). Lycopene and β-carotene are examples of carotenoids. Orange vegetables and fruits, including carrots, sweet potatoes, winter squash, pumpkin, papaya, mango, and cantaloupe, are rich sources of the carotenoid β-carotene. Tomatoes, watermelons, pink grapefruits, and apricots are the most common sources of lycopene.

In addition to reducing the risk of cancer, fruit and vegetable intake has been demonstrated to have a relationship with a decreased risk for developing diabetes (Ford, Mokdad, Giles, & Brown, 2003; National Center for Chronic Disease Prevention and Health Promotion; Steinmetz & Potter, 1996). One study found that proper nutrition along with physical activity lowered individuals' chances of acquiring Type 2 diabetes (National Center for Chronic Disease Prevention and Health Promotion, 2005). In another study, suboptimal concentrations of vitamins A and E partially explained an individual's increased risk for diabetes (Ford, Mokdad, Giles, & Brown, 2003). Fiber is another component in fruits and vegetables known to protect against diabetes (Steinmetz & Potter, 1996). With such substantial evidence, it is essential that children today increase their fruit and vegetable consumption to help decrease their risk for developing cancer and diabetes.

Fruit and Vegetable Intake Recommendations for Children

To decrease risks of developing such chronic diseases, children must meet recommendations that have been set for fruit and vegetable intake. For children ages four to eight with a daily intake of 1,400 calories, the United State Department of Agriculture's Dietary Guidelines for Americans (2005) suggest three cups of fruits and vegetables should be eaten each day, with half coming from fruits and half coming from vegetables. Within the vegetable group, children should be encouraged to choose one and a half cups of their vegetable servings from dark green vegetables per week.

With the abundance and availability of fruits and vegetables in our society, intakes should easily reach recommended levels. However, these recommended intakes of fruits and vegetables have not been found. A range of results have been found when attempting to measure exact fruit and vegetable intakes in children. These variations inevitably occur due to methodology of data collection.

Dennison, Rockwell, and Baker (1998) conducted a cross-sectional study of two-year-old and five-year-old children in a general primary care health center. Mean dietary intakes were calculated from seven days of written dietary records. Findings indicated that preschool-aged children consumed, on average, 80% of the recommended fruit servings/day, but only 25% of the recommended vegetable servings/day. Fruit juice contributed about 50% of the total fruit servings.

Brady, Lindquist, Herd, and Goran (2000) collected three dietary recalls each on children ages seven to 14 years participating in a study investigating the development of obesity. The researchers concluded that only 5% of the children met the recommended intake of fruit per day. In the same study, a higher percentage of children consumed the recommended number of servings of vegetables per day; 30% of males and 13% of females consumed three to five servings of vegetables per day. Both of these intakes are well below the recommended levels for fruits and vegetables among a youth population.

Because consumption of fruit and vegetables is low among youth, and because dietary behavior developed in childhood may track into adulthood, interventions to increase fruit and vegetable consumption in children are important and might help reduce risks associated with obesity.

Additionally, children's overall diet is found to decline most significantly between the age groups of two to three and four to six. During this period, the percentage of children having a good diet as defined by the Healthy Eating Index falls from 35% to 16%, and the percentage having a diet that needs improvement rises from 60% to 75% (Center for Nutrition Policy and Promotion, 1998). The deficient dietary quality of young children is the indicator of the pervasive problems associated with eating patterns of modern youth.

Dietary Habits

Young children's eating patterns are influenced by their family, peers, media, and the environment (Traahms & Pipes, 2000). Research has shown that the food habits developed during childhood will be followed throughout adolescence and continue into adulthood (Traahms & Pipes, 2000; Healthy People 2010, 2000). Thus, childhood food habits are critical since they can encourage good nutritional habits that may decrease the prevalence of many nutrition-related concerns for young children. These nutrition-related concerns for young children include: proper growth and development; immediate and long term health problems such as heart disease, cancer and diabetes; the prevalence of dental caries; and the growing number of overweight children (Traahms & Pipes, 2000). These nutrition-related concerns are wide-ranging and contain serious outcomes for the developing child. By increasing the consumption of dairy products, fruits and vegetables;

decreasing consumption of soft drinks; and increasing participation in regular physical activity within the child population, the prevalence of these nutrition-related concerns could be dramatically reduced. By developing good nutrition and physical activity habits as a child, a basis is formed that can carry over into the child's adolescent and adult life and result in improved health issues (American Dietetic Association, 2004).

It is important to note that these dietary and physical activity habits are not innate abilities, but rather, must be learned beginning in early childhood. Numerous research studies have shown that children are not born with good nutritional habits, but must learn how to choose nutritious foods through education and experience (Escobar, 1999; Price, Randell, & Sims, 1995).

Developmental Capabilities and Children's Dietary Practices

In addition to the influence of external factors such as family, peers, media and the environment, children's dietary practices also are influenced by their developmental stage. The years between the ages of two and six are marked by rapid social, intellectual, and emotional growth and offer challenges related to feeding young children. Physical growth slows overall, with a decrease in growth rate reflected by a decrease in appetite and less interest in food (Sigman-Grant, 1992).

Adding to the challenge of feeding young children is the emotional growth that takes place while they are toddlers. Toddlerhood marks the beginning of children's attempts to establish independence. As a result, children engage in power struggles with parents and caregivers. These conflicts often erupt during feeding situations, with toddlers refusing to eat until they get what they want and with adults torn between their need to control the situation and their desire to ensure that their child is well nourished (Satter, 1999).

As children progress into the preschool years, their emotional development continues to affect the feeding situation. Preschoolers are generally less fearful than toddlers and more eager to expand their limits and to explore their world. They behave more consistently and are likely to be active in seeking attention and approval from adults. Thus, their eating patterns become more established, and their food preferences are highly influenced not only by adults, but also by peers (Sigman-Grant, 1992). Birch (1980) found that children as young as three and four years could be persuaded to change their selection and consumption of different vegetables as a result of eating meals with their peer group whose preferences differed initially from their own.

Development of Food Preference

One estimate has indicated that 25% to 50% of the variation in food consumption among individuals can be attributed to preference alone (Pilgrim, 1961). A study of young Mohawk children found that food preferences explained over 70 percent of the variation in dietary behavior (Harvey-Berino, Hood, Rourke, Terrance, Dorwaldt, & Secker-Walker, 1997). Another study provided evidence of a strong correlation between food preferences and food choices in children as young as three years. This research also suggested that food preferences may have an even greater effect on children's food choices than on adults' choices (Birch, 1979).

Young children are capable of learning to like and accept a wide variety of foods, and this learning occurs rapidly during the first few years of life. Understanding the contribution of early learning and experiences to the development of food-acceptance patterns (e.g., which food and how much of each an individual chooses to eat) can help foster development of healthful patterns.

Familiarity and Food Choices

Children tend to prefer foods that are familiar, compared with foods that are not, regardless of the foods' sensory characteristics (Sullivan & Birch, 1990). Birch, Johnson, and Fisher (1995) have investigated children's tendency to reject what is new and how this tendency might be altered. The researchers' conclusion was that changing rejection to acceptance can be as simple as providing a child with opportunities to sample a new food. However, having a child move from rejection to acceptance of new foods is a relatively slow process that may require as many as ten exposures to a new food (Sullivan & Birch, 1990). Building on previous research in this area, Skinner et al (1998) found that two- to three-year-olds liked over 80% of food items that had been offered to them. The authors' findings suggest that caregivers should expose children to a variety of nutritious foods to try and perhaps accept into their diet.

Nutrition Education for Young Children

One method of exposure of a variety of nutritious foods to children is through nutrition education efforts. The goal of nutrition education is to provide educational programs to increase the likelihood that people will make healthy food choices consistent with the most recent dietary advice as reflected in the Dietary Guidelines for Americans (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2005) and the MyPyramid (U.S. Department of Agriculture, 2005). It is the position of the American Dietetic Association (Shafer, Gillespie, Wilkins, & Borra, 1996) that nutrition education is essential for the public to achieve and maintain optimal nutritional health. The Association further notes that "nutrition education should be an integral component of all health promotion, disease prevention, and health maintenance programs, through incorporation into all appropriate nutrition communication, promotion, and education systems."

Lifelong beliefs and habits about food and health are established in early childhood. A child's day-to-day experiences with food and eating mold the way he thinks and feels about nutrition for the rest of his life. Although young children are not developmentally or cognitively ready to take over responsibility for their diets and health behaviors, they are capable of understanding basic nutrition and health concepts; they are interested in their growing bodies and staying healthy; and they are forming beliefs and attitudes about nutrition and health based on their daily experiences with food and eating (Singleton, Achterberg, & Shannon, 1992).

The impact of nutritional habits formed in childhood on current and future health has underscored the importance of nutrition education for young children. Although nutrition education is important throughout life, nutrition education tailored to the young child may have the greatest potential for change not only because of the impact of early nutrition on health, but also because of the tremendous learning readiness of young children. Children's natural interest and curiosity about food and their bodies provides an excellent opportunity to provide learning experiences for children about nutrition and health. Nutrition education for children illustrates the relationship between food and health, helps children understand their growing bodies and how to take care of themselves through positive eating, exercise, and health behaviors, and exposes them to a variety of learning experiences about where food comes from and how it can be prepared.

Numerous studies have indicated the important role that a nutrition educator plays in helping children to obtain and to develop healthy eating knowledge and behaviors (American School Health Association, 1997; Celbuski & Farris, 2000; Escobar, 1999). Nutrition educators work to effectively teach children about food and nutrition and apply that knowledge to promote optimal health and growth. A logical venue to provide children nutrition education is in school environments. A recent review of research on overweight in young children found that early intervention can be effective in reducing the incidence of childhood overweight and that schools can be influential partners in childhood healthy weight initiatives (National Institute for Health Care Management, 2004).

Nutrition education in school environments for young children is implemented in numerous ways. Additionally, nutrition education resources written and developed for young children deal with a variety of topics concerning good eating habits and creating a healthy lifestyle. Effective educational strategies with young children are ones which provide ample opportunities for experimentation, discovery, and self-learning. According to the National Association for the Education of Young Children (1997), children should be involved with actual food in order to learn about nutrition. Hands-on nutrition activities help children develop healthy eating habits and can complement other learning, for example math, science, language, social development, cooperation, and respect for culture. Achterberg (1988, p. 3) notes that "meaningful learning is more likely to occur in an interactive context that fosters positive feelings" and that "learning in one context can affect learning in another context, especially if these contexts generate the same kind of feelings."

Lytle (1995) examined studies of current nutrition education efforts directed toward school-aged children. Her findings indicated two major approaches for nutrition education programs within school settings. The first approach termed knowledge-based nutrition education has the goal to enhance the knowledge, skills, and attitudes needed by children to understand broad, contemporary food and nutrition issues and to select a diet that is good for their general health using a food group approach. The second approach focuses education on disease prevention and enhancement of overall health through diet. Both approaches have been found to have merit with a school-aged audience.

Hertzler and DeBord (1994) designed and tested four lessons for developmentally appropriate food and nutrition skills for young children in an effort to determine their effectiveness. The authors promoted the importance of tailoring nutrition education materials to the developmental skills of young children, including muscular development as well as math and language readiness levels. Their findings yielded several recommendations for implementing nutrition curricula for young children: (a) a nutrition plan such as the Food Guide Pyramid should be central to planning nutrition concepts and activities, (b) actual teaching methods need to be appropriate to the child's learning level and "telling" should only be used in emergencies, (c) parental involvement and family processes are vital to reinforce nutrition activities, and (d) nutrition education materials should complement children's developmental levels and be easily adapted for generating activities.

Ciliska, Miles, O'Brien, Turl, Hale Tomasik, and Donovan (1999) conducted a systematic review to identify nutrition education that was effective in specifically increasing fruit and vegetable consumption in children and adults. The review concluded that the most effective interventions: (a) gave clear messages about increasing fruit and vegetable consumption, (b) incorporated behavioral theories and goals, providing a consistent framework for implementation and evaluation, (c) provided longer, more intensive interventions rather than one or two contacts, (d) actively involved influential people such as family members and teachers, and (e) had a greater impact on those whose knowledge or intake were lower at the beginning. The implications of this review led the authors to conclude that there is a current shortage of effective nutrition education and there must be an investment in human resources to plan, implement and evaluate public health nutrition interventions.

A similar review examined the effectiveness of school-based intervention research funded under the National Cancer Institute's 5-A-Day for Better Health Program (Reynolds, Baranowski, Bishop, Gregson, & Nicklas, 2001). These interventions were specifically targeted at increasing fruit and vegetable consumption through school-based interventions. Findings from the review indicated that the school-based interventions reviewed were successful in increasing fruit and vegetable consumption among children and adolescents. However, the authors recognized a need for further development of programs for children in kindergarten through third grade. Specifically, a call was issued for increased "environmental components" to interventions to increase fruit and vegetable consumption for these audiences. Although "environmental components" were not defined, it can be assumed that any outdoor study, such as gardening, would qualify.

Other reviews of school-based nutrition education programs (Contento, Balch, Bronner, Lytle, Maloney, Olsen, & Swadener, 1995; Reynolds, Baranowski, Bishop, Gregson, & Nicklas, 2001) have found that school-based nutrition education programs based on sound educational theory produced more desirable results that are more readily evaluated. A theoretical framework provides a guideline for the educational activities conducted in the school-based program. Moreover, a theoretical framework allows the educator to recognize successes through targeted evaluation.

Theoretical Framework

One means of providing developmentally appropriate nutrition education experiences is through the experiential model of learning. The experiential learning model stresses non-predictable learning which occurs in process or emergent form. The foundations of experiential learning were articulated by Dewey as he attempted to outline his "progressive" approach to education (1938).

Philosophical traditions and the pedagogical theories and practices of 18th and 19th century philosophers and educators can be noted in Dewey's writing (Dewey, 1910, 1916, 1938) which included concepts regarding the relationship between experience and learning. Among the many concepts that Dewey espoused were: the interaction and continuity of experience; the creation of new knowledge, awareness, and ability; the integration and expansion of perception; and the development and understanding of self-direction (Wilson & Burket, 1989).

Dewey provided his model of experiential learning in *Experience and Education* (1938). Dewey believed that learning transforms the impulses, feelings, and desires of concrete experience into purposeful action. Dewey's model integrated experience, concepts, observations, and actions. He developed several principles that created an "intimate and necessary relation between actual experiences and education," free expression and cultivation of the individuality, free activity, learning through experience, acquisition of skills and techniques as means of attaining ends. These principles allowed participants to make the most of their present opportunities and acquaintance with a changing world (Dewey, 1938, pp. 19-20).

Dewey's emphasis on the primacy of experience was first described in the 18^{th} century by Rousseau in his classic book, *Emile*, in which he introduced the concepts of experiential learning into the field of education. "Put the problem before him [the learner] let him not be taught science, let him discover it" (Rousseau, 1762, pp. 130-131). Rousseau believed that teachers should provide participants with opportunities to observe nature, experience nature, and learn on their own. He contended that "God makes all things good," (Rousseau, 1762, p. 5) and educators served children best when they recognized their innate goodness and encouraged children to follow their individual interests and experiences of their choice. The inception of the child-centered educational concepts of today can be found in Rousseau's early writings on children's innate wisdom (Day, 1994).

The experiential learning model, in which experience is central to the learning process, may offer potential for developing a learning atmosphere in which human experiences can be shared and interpreted through dialogue (Kolb, 1984). According to the experiential learning theory, "a holistic integrative perspective on learning" can be developed which combines experience, perception, cognition, and behavior (Kolb, 1984). Thus, the most influential proponent of the experiential approach is Dewey.

Another proponent of the experiential learning approach is Jean Piaget, a developmental psychobiologist. He suggested that ideas were not fixed elements of thought, but were formed and reformed through experience. The experiential learning model builds on his notion that learners are co-creators of learning as they construct knowledge in context.

Piaget created a developmental theory which concluded that intellectual development is the result of the interaction of hereditary and environmental factors. A central component of Piaget's developmental theory of learning and thinking is that both involve the participation of the learner. Knowledge is not merely transmitted verbally but must be constructed and reconstructed by the learner. Piaget asserted that for a child to know and construct knowledge of the world, the child must act on objects and it is this action which provides knowledge of those objects (Sigel & Cocking, 1977), organizes reality and acts upon it. The learner must be active; he is not an empty vessel to be filled with facts.

According to Piaget, intellectual growth involves three fundamental processes: assimilation, accommodation, and equilibration. Assimilation involves the incorporation of new events into preexisting cognitive structures. Accommodation means existing structures change to accommodate to the new information. This dual process, assimilation-accommodation, enables the child to form schemata. Equilibration involves the person striking a balance between himself and the environment, between assimilation and accomodation. When a child experiences a new event, disequilibrium sets in until he is able to assimilate and accommodate the new information and thus attain equilibrium. There are many types of equilibrium between assimilation and accomodation that vary with the levels of development and the problems to be solved. For Piaget, equilibration is the major factor in explaining why some children advance more quickly in the development of logical intelligence than do others (Lavatelli, 1973).

A Piagetian-inspired curriculum emphasizes a learner-centered educational philosophy. The teaching methods which most American school children are familiar with, teacher lectures, demonstrations, audio-visual presentations and programmed instruction, do not fit in with Piaget's ideas on the acquisition of knowledge. Piaget espoused active discovery learning environments in our schools. Intelligence grows through the twin processes of assimilation and accomodation; therefore, experiences should be planned to allow opportunities for assimilation and accomodation. Children need to explore, to manipulate, to experiment, to question, and to search out answers for themselves.

In a Piagetian teaching model, children are allowed to make mistakes and learn from them. Learning is much more meaningful if the child is allowed to experiment on his own rather than listening to the teacher lecture. The teacher should present students with materials and situations and occasions that allow them to discover new learning. In his book, *To Understand Is to Invent,* Piaget (1972) stated the basic principle of active methods can be expressed as follows: "to understand is to discover, or reconstruct by rediscovery, and such conditions must be complied with if in the future individuals are to be formed who are capable of production and creativity and not simply repetition" (p. 20). In active learning, the teacher must have confidence in the child's ability to learn on his own.

Kolb’s book, *Experiential Learning* (1984) provides more recent information on the experiential learning model. Derived from Dewey’s earlier cyclical model, Kolb's cycle consists of four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation.

Two quite different bodies of literature have grown out of the works of Kolb and Dewey. A number of edited volumes by Boud et al (Boud, Cohen & Walker, 1993; Boud, Keogh, & Walker, 1985; Boud & Miller, 1996) and Weil & McGill (1990), also an early text by Schon (1983), provide numerous studies and examples of learning from experience. In these volumes, it is clear that the reflective stage in Kolb's model (and other such models) is taken very seriously, as illustrated by the title of the oldest of these volumes: *Reflection: Turning Experience into Learning* (Boud et al, 1985). Indeed, similar with Kolb's theory, learning is assumed not to occur at all unless there is active and intentional reflection. Throughout nearly all these books, the role of the teacher is seen as critical in helping students turn their experience into learning.

The other body of literature, which is on experiential education, exemplified in the edited volume by Warren, Sakofs, Hunt, and Jasper (1995), similarly focuses upon the importance of the teacher for helping typically young students interpret various experiential opportunities that are engineered or developed as part of their formal training. In these writings, Kolb is never cited, but much theoretical significance is given to Dewey (e.g., 1910, 1929, 1938), in terms of his cyclical model as well as his emphasis upon the importance of creating learning opportunities around the interests and relevant experiences of students. Again, as with Kolb and Boud, the creation of learning depends not on "experience" per se, but upon the intervention of a teacher who helps students understand that experience. Thus, the critical importance of intentional reflection is similarly embraced by practitioners of experiential education, stemming directly from John Dewey’s belief that:

> The crucial educational problem is that of procuring the postponement of immediate action upon desire until observation and judgment have intervened…[which] then give direction to what is otherwise blind. . .(Dewey, 1938, p. 69).

Not all writings on experiential learning stress the importance of a mediator or guide. Many books have been written to simply emphasize the other Deweyan message, that experiential learning, or learning first hand by doing, produces deeper and more enduring knowledge than isolated classroom or second-hand learning. Eisner (1994), Hopkins (1994), and Reed (1996) all argue that formal education, which is inordinately dependent upon book-learning is really quite shallow and relatively ineffective. The theoretical importance of these writings is that they call into question the use of formal learning as a benchmark against which to assess experiential learning. It could well be that Dewey and Kolb's view of experience as somehow "raw" and undigested ("blind" in the words of Dewey above) needing the civilizing force of intentional reflection to make it meaningful is wrong. Certainly, this conception of experience seems directly contradicted by some of these writings, as well as by several writers who describe how first-hand experiences on the job provide learning opportunities that are otherwise simply unavailable (see e.g., Burnard, 1991, on nursing; Scannelli & Simpson, 1996, on the value of student internships; Calder & McCollum, 1998, on vocational learning;). Eisner (1994) illustrates these ideas by having the reader examine a picture of two people interacting in a restaurant and then asking them to read a well-written description of the picture. He then asks which experience is richer, and it is patently obvious that infinitely more information is conveyed by the picture than the prose piece. In other words, these writers clearly see educational value in experience itself and are not prepared to state that such experiences constitute learning only if they are subjected to additional thought.

Montessori's Experiential Learning Using Gardening

Early in the twentieth century, Montessori (1964) was one of the first educators to recognize that children are experiential learners. She created specific environments where children could construct their own knowledge, environments later referred to as child-centered classrooms. Her systematic, creative work with children in poor neighborhoods in Rome, Italy, not only met its original purpose of preventing vandalism, but additionally had the unanticipated effect of transforming the children into avid learners. Through supervised play, her curriculum provided opportunities to produce art, handle animals and grow plants. Children also were able to learn manners, cleanliness, and aspects of proper diet (Montessori, 1964).

Montessori believed that children's natural inclination was towards work. She referred to children's activities as "the work of the child," rather than play. She also believed that children have a spontaneous interest in learning and finding structure and order in their lives. These inclinations, she believed, can best be cultivated by providing appropriate supervised environments (Montessori, 1964).

From her work with inner-city children in Rome, Montessori came to believe that teaching children to work in gardens would lead them to contemplate nature intelligently, and to develop moral understandings. She wrote of English educators who also believed that children's participation in gardens fostered a moral education, what they referred to as the "first notions of household life" (Montessori, 1964, p. 155).

Montessori (1964) outlined specific benefits she identified for children in garden participation. First, they were "initiated into observation of the phenomena of life…as interest and observation grow, [children's] zealous care for the living creatures grows…and [they] can be brought to appreciate the care which mother and teacher take of [them]" (1964, pp. 156-157).

Secondly, auto-education (a child doing things independently without the interventions of the teacher) was developed through garden participation. Children knew they must care for plants by watering and feeding, so that seeds would sprout, and plants would grow and continue to thrive. Montessori wrote "Between the child and the living creatures which he cultivates there is born a mysterious correspondence" which instilled a sense of responsibility for the growing things under his or her care (1964, p. 157).

The third benefit Montessori (1964) found in gardening work, was that children developed patience and confidently expected things to grow and mature, "which is a form of faith and of philosophy of life" (p. 159). Progress among the plants in a garden were seen to instill "peaceful equilibrium…and the first germs of wisdom which so characterized the tillers of the soil" (p. 159).

Fourth, Montessori (1964) felt that children derived a "feeling for nature, maintained by the marvels of nature…a sort of correspondence arises between the child's soul and the lives which are developed under his care" (p. 161). She believed that children developed confidence in living things, and union with the universe. Further, Montessori wrote of these living things giving back much more than they received, providing beauty and variety to enjoy.

The last benefit mentioned by Montessori (1964) was that children came into harmony with other members of the human race by tending for gardens. "When [man] discovered the secret of intensifying the production of the soil, he obtained the reward of civilization" (p. 160).

Montessori believed that gardens were a way to make school subjects more interesting and meaningful to students. Her work illustrated how gardens create an environment that allows for creative thought, active learning, and interpersonal skill. She demonstrated that the garden is a living entity that served as an excellent resource to teach subjects while allowing students to learn in an environment that is atypical to the sterile classrooms to which most students are accustomed.

The Benefits of Youth Gardening Experiences

Montessori's practices and beliefs have been recognized as having great merit for young children and have been adopted in current classroom gardening activities. Specific research into classroom gardening projects has revealed a variety of positive outcomes on students on such variables as academic achievement, interpersonal skills, self-esteem, environmental attitudes and nutritional effects. School gardens present endless possibilities to integrate various subject areas; hence, school gardens provide an environmental context for interdisciplinary teaching of core subject areas. Not only do these outdoor environments offer opportunities to learn math, science, language arts, social studies, health, and art, but they also offer a real-life setting that excites students about learning (Center for Ecoliteracy, 1999; Klemmer, 2002).

To plant and maintain a garden, most of the classroom academic skills must be applied. For example, mathematics can be used to measure planting areas, growth of plants, appropriate spacing for planting, or in record keeping. By using the metric scale to do such measurements, gardening offers a relatively smooth and fun approach to learning the metric system (Wotowiec, 1979). Civil and Kahn (2001) developed a garden theme to explore the relationship between everyday knowledge and school mathematics. Through work in a school garden, fourth and fifth grade students were able to associate math concepts such as area, volume, and unit measurement with authentic, real life situations. The authors concluded that a strong connection was made between the children and their understanding of mathematics. The authors also alleged that the students' participation in the garden project became personal and meaningful, thereby increasing their response in the study of mathematics. While this research was not presented with strong empirical evidence, it does provide support for the use of gardens as an innovative teaching method to support positive student academic outcomes.

Garden projects have been shown to positively impact special populations of children. Sarver (1985) described a gardening project for eight to twelve-year-olds with learning disabilities. Some of the positive effects noted were enhanced nonverbal communication skills, developing awareness of the advantages of order and structure, seeing the value of becoming agents of change, discovering the concept of growth, learning how to participate in a cooperative effort, and forming positive relationships with adults. From a questionnaire study, Kaiser (1976) concluded that including a gardening program in school projects for autistic, mentally retarded, and emotionally disturbed children had a positive effect on self-esteem levels, self-awareness, issues of responsibility, development of communication skills, and work concepts. Poroshina (1985) wrote about a Soviet Union summer work program for mentally retarded children in which gardening played a major role. Participants displayed positive self-regard, greater self-reliance, and improved behavior. Psychological benefits of gardening were studied by Kaplan (1973) who reported that even the least experienced gardeners found satisfaction in achieving tangible outcomes and developing an interest that they could sustain over a long period of time.

Environmental attitudes also have shown to be affected by garden programs. Skelly and Zajicek (1998) evaluated the effects of a school gardening program in which second and fourth grade teachers used a cross-disciplinary gardening curriculum for one semester. The project goal was to integrate environmental education using gardening as a vehicle. The authors conducted pre- and post-tests with 237 children using the Children's Environmental Response Inventory to assess environmental attitudes. Students in gardening classrooms scored significantly better than those in control classrooms on measures of appreciation for the environment and concern about human impact. The results also revealed that second graders had a greater change in positive environmental attitudes than fourth graders. The authors concluded that hands-on environmental education enables children to have a greater potential for understanding what they learn and to relate it to the environment.

A community gardening project, The Green Brigade, has been conducted in Texas (Cammack, Waliczek, & Zajicek, 2002) to combine horticulture activities and education with juvenile offender rehabilitation. The researchers were interested in the effect of the gardening project on this population’s horticulture knowledge and environmental attitude. The participants of this study took part in horticulture classes and gardening work experience during a 16-week period. Pre- and post-data revealed that horticulture knowledge and environmental attitudes improved as a result of this education and gardening experience. The authors suggested that the findings for this population were favorable on several dimensions. The increase in knowledge could potentially help the participants in future job placement and the improved environmental attitude could lead to more positive involvement in the community.

Gardening as a Means to Developing Healthy Nutrition Attitudes

Research documenting the benefits and effects of garden programs on nutrition attitudes for children is limited. However, several researchers have begun to examine the link between classroom gardens and children's attitudes toward nutrition, beginning with the planning of a garden. Whiren (1995) interviewed sixty children between the ages of three and five to provide their expected characteristics of a garden for a children's garden on the campus of Michigan State University. Her findings indicated that children were interested in having three main components: flowers, fruits, and vegetables. When asked about gardening activities they would consider important, the children listed eating vegetables as an enjoyable aspect associated with gardening. The author concluded that children should be recognized as a fundamental stakeholder in the development of a garden.

In another project, elementary school children in Tucson, Arizona participated in a gardening education program, "Sow and Grow," in which they invested time and "tender loving cultivation" (TLC) in school vegetable gardens (Cavaliere, 1987). One of the benefits cited in this study was learning to like healthy foods. Garden participation was a tremendous motivator. What the children grew themselves had a "high intrinsic value…young gardeners are very likely to decide that these garden-fresh vegetables are delicious!" (Cavalier, 1987, p. 21). During this project, children received positive reinforcement for eating fruits and vegetables. Eating a variety of healthy foods became a family affair in Cavaliere's school project (1987). Families were influenced by their children "to serve a more healthful diet" (Cavaliere, 1987, p. 21).

Using an integrated curriculum, a public school in Vermont had school children in grades one through four participate in a hands-on, inquiry-based gardening program (Canaris, 1995). The purpose of the garden was to improve nutrition habits and nutritional awareness for these students. Teachers, parents, students and volunteers developed a "snack garden' as a way to introduce healthier snacks into the classroom. Comments from parents and teachers indicated that the children gained a strong appreciation and understanding of healthier snacks and even requested fruits and vegetables for snacks at home. In addition to the nutrition gains, the author highlights the numerous other academic and social benefits the children experienced including math, science, business, horticulture, art, community partnership, and cooperation.

While these studies contribute valuable information to our understanding of how children benefit nutritionally from gardening, the research findings of these studies lack statistical evaluation. These studies are primarily descriptive in nature and emphasize the children's beliefs and attitudes related to gardening and nutrition, without empirical evidence to support the dialogue. Few studies employ empirically-based research designs that examine the effects of gardening on children's nutrition attitudes and dietary behavior.

Morris, Neustadter, and Zidenberg-Cherr (2001) used a pilot study to examine the feasibility of garden-based education programs for elementary school students. Specifically, these authors explored if first-grade students involved in a school-based garden project would improve their nutrition knowledge and dietary patterns.

Ninety-seven first-grade students participated in six classrooms divided between two schools, employing an intervention and control group research design. Individual interviews were conducted with the students to determine nutrition knowledge and preference using pre- and post-tests. The nutrition knowledge assessed was food group and vegetable identification. Preference and willingness to taste were assessed through actual vegetable tasting. The intervention consisted of nutrition lessons designed by the individual participating teachers and used by the teachers throughout the school year integrated into the standard education curriculum. In addition, students at the intervention site participated in a gardening experience that included planting, maintaining, and harvesting vegetables from fall and spring gardens.

Findings from this study indicated that the students in the intervention group increased their nutrition knowledge ability to visually identify the food groups according to the Food Guide Pyramid, but no difference was found in the intervention group's ability to correctly name the vegetables. In addition, the students in the intervention group were more willing to taste the vegetables than were the students in the control group. Vegetable preference did not significantly differ between the two groups. The authors concluded that vegetable gardening was an effective means of increasing children's willingness to taste vegetables.

Three primary limitations to this study were discussed and included age, assessment sensitivity, and curriculum. These authors suggested that future studies should be conducted with a "slightly older group of students" as a way to increase data to be collected that was limited in this study due to developmental abilities. Second, it was proposed that the sensitivity of the testing instruments needs to be improved in order to detect smaller changes. And last, the authors recommended utilizing a more comprehensive curriculum to better synthesize the important aspects of nutrition and gardening.

In a study specifically examining nutritional attitudes and behaviors regarding fruits and vegetables, Lineberger and Zajicek (2000) found significant changes in an elementary school-aged population as a result of direct gardening experiences. The subjects for this study included 111 third and fifth grade students. The authors measured the students' nutritional attitudes regarding fruits and vegetables with a pre- and post-fruit and vegetable preference questionnaire divided into three sections targeting vegetables, fruit, and fruit and vegetable snacks. In addition, the nutritional behaviors regarding fruits and vegetables were evaluated through 24-hour recall journals.

After gardening, children had a stronger preference for vegetables. However, this finding did not hold true for fruit preference. Students also had more positive attitudes towards fruit and vegetable snacks after gardening, with female and younger students having the greatest improvement in snack attitude scores. However, fruit and vegetable consumption was not found to significantly improve due to gardening.

The authors suggest that this lack of improvement in consumption may have been due to teacher administration of the testing and measurement methods for indicating behavior. In addition, the authors contend that changing consumption behavior is a complex process and more comprehensive interventions with a strictly behavioral focus may be warranted.

Morris and Zidenberg-Cherr (2002) evaluated the effectiveness of a one-year nutrition program that combined classroom gardening with a nutrition education component. These authors were interested in the impact this combined program had on the nutrition knowledge and vegetable preference of upper elementary school-aged children. Pre- and post-tests were administered to a sample that included 237 fourth grade students from three schools. Students in the first school were designated as the control subjects and received no intervention. Students in the second school received only a classroom nutrition education component. Students in the third school received both the in-class nutrition lessons and hands-on gardening activities. Nutrition knowledge was measured using a 30-item questionnaire developed by the authors to correspond to the nutrition and gardening curriculum. This questionnaire was completed as a class in a group setting. Vegetable preference was measured individually with the students tasting and rating their preferences for six different vegetables.

The authors found that the children's nutrition knowledge increased in both of the intervention groups, while no knowledge change was detected in the control group. In addition, the children in both of the intervention groups increased their preferences for certain vegetables (i.e., carrots, broccoli). The children in the intervention group containing the gardening component had a further increase in vegetable preference (i.e., snow peas, zucchini) over the other two groups. The results of this research lend support to the inclusion of vegetable gardens within the school setting. Based on their research, the authors recommend that administrators of school garden projects include a wide variety of vegetables and fruits, although fruit preference was not included in this study, in their garden programs.

Summary of Literature Review

The literature review summarizes research that has clearly shown establishing good nutrition habits at an early age is important to healthy child outcomes. Obesity is pervasive in young children and is devastating to the health and well-being of our children. Concomitant with obesity are greater risks for diseases such as cardiovascular disease, hypertension, diabetes, and cancer. Prevention of obesity is recognized as the best method for controlling its rise. Increasing fruit and vegetable consumption may offer one approach to combating obesity as well as lessening the onset of many cancers and reducing diabetes. In order to increase fruit and vegetable consumption, these foods need to be introduced early in life in order to develop positive dietary habits (Traahms & Pipes, 2000).

One method to accomplish this introduction is through nutrition education in school settings. In order to be effective, nutrition education needs to meet certain criteria including being theoretically based, of a sufficient duration to affect change, and containing developmentally appropriate activities that incorporate meaningful learning for the child (Contento, Balch, Bronner, Lytle, Maloney, Olsen, & Swadener, 1995; Hertzler & DeBord, 1994). Reviews of nutrition education projects aimed at increasing fruit and vegetable consumption have identified a need for increased numbers of interventions meeting these criteria, as well as interventions containing environmental components to improve learning opportunities (Reynolds, Baranowski, Bishop, Gregson, & Nicklas, 2001).

The experiential learning model offers a viable framework for nutrition education to school-aged children. This model allows children to learn and construct meaning through experiencing real-life situations (Dewey, 1938; Piaget, 1972). Experiential learning offers the student a learner-centered approach to education that produces deeper and more enduring learning than do more formal approaches to education. Montessori (1964) promoted gardening as an experiential learning method that proved to be successful with children. She recognized the academic and social benefits children received through education with gardening.

Current research into classroom gardening has supported Montessori's perspective on the benefits to children from gardening (Center for Ecoliteracy, 1999; Klemmer, 2002). However, this research has been limited in scope. Research into the academic benefits of gardening has primarily focused on mathematics and science education (Civil & Kahn, 2001; Wotowiec, 1979). The gardening activities associated with these academic areas lend themselves well to providing experiential learning opportunities.

The relationship between gardening and improved nutrition behaviors in children is in the early stages, with minimal studies having been conducted. Despite the fact that preliminary research indicates positive dietary outcomes related to gardening, few studies have rigorously evaluated this teaching method. These initial studies have illustrated the positive effects school-based gardening projects can have on nutrition knowledge and behavior (Cavaliere, 1987; Lineberger & Zajicek, 2000; Morris, Neustadter, & Zidenberg-Cherr, 2001). And yet, there is much research to be done to more closely examine the link between gardening and dietary behavior. Future research areas include: (a) improving upon current research designs, (b) demonstrating positive impacts with different age groups, (c) developing more sensitive assessment tools, (d) improving the assessment tools currently available, (e) developing more integrated nutrition and gardening curricula, (f) developing better teaching methods, (g) including more data on fruit consumption related to gardening, and (h) providing replication support to the current research.

Thus, the present study seeks to address some of these research needs by conducting further research into the relationship between gardening as an experiential learning process and fruit and vegetable knowledge, preference, and behavior in an elementary school-aged population. The major goal of this research project is to bring together the disciplines of educational psychology, horticulture, and nutrition education in order to study the effects of school gardens on children. To accomplish this research project, the following hypotheses are proposed.

Hypothesis 1. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased knowledge of the six MyPyramid food groups.

Hypothesis 2. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased knowledge of common nutrients found in foods.

Hypothesis 3. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased knowledge of nutrient functions within the body.

Hypothesis 4. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased ability to identify fruits and vegetables with the correct name.

Hypothesis 5. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased ability to identify six presented fruits and vegetables with the correct name (i.e., carrot, broccoli, spinach, zucchini, cabbage, and blueberry).

Hypothesis 6. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to a greater preference for fruits and vegetables as evidenced by an increased willingness to taste fruits and vegetables.

Hypothesis 7. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to a greater preference for fruits and vegetables as evidenced by an increased rating of tasted fruits and vegetables.

Hypothesis 8. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to a greater preference for six specific fruits and vegetables as evidenced by an increased rating of the six tasted fruits and vegetables (i.e., carrot, broccoli, spinach, zucchini, cabbage, and blueberry).

Hypothesis 9. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased positive preferences for fruit.

Hypothesis 10. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased positive preferences for vegetables.

Hypothesis 11. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased vegetable choices in an elementary school cafeteria environment.

Hypothesis 12. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased vegetable consumption in an elementary school cafeteria environment.

III. MANUSCRIPT

INFLUENCES OF SCHOOL GARDENING ON FRUIT AND VEGETABLE KNOWLEDGE, PREFERENCE AND CONSUMPTION IN SECOND GRADE STUDENTS

INTRODUCTION

Over the course of the last three decades, rates of obesity tripled for older children ages 6–11 years and adolescents ages 12–19 years.[1] An estimated 9.18 million American children and adolescents ages 6–19 years are considered obese. If obesity levels continue at the current rate, the lifetime risk of being diagnosed with type 2 diabetes at some point in their lives is 30% for boys and 40% for girls.[2] Moreover, obesity puts children at greater risk for cardiovascular disease, hypertension and cancer.

The effects of childhood obesity are devastating to the health and well-being of children now and throughout adulthood. A recent special report suggests that the United States could be facing its first sustained drop in life expectancy in the modern era due to obesity.[3] The authors suggest that unless steps are taken to curb excessive weight gain, younger Americans will likely face a greater risk of mortality throughout life than previous generations. In recent years there have been many calls for methods and programs to help address this childhood obesity epidemic.[4,5] To date, prevention is recognized as one of the best methods for controlling the rapid increase in childhood obesity.[6-8] One means of prevention, increasing fruit and vegetable consumption, may offer some hope for combating obesity, and thus lessening the onset of many cancers and diabetes. However, these fruits and vegetables need to be introduced early in life in order for children to develop positive dietary habits.[9]

One means to accomplishing an early introduction to fruits and vegetables is through nutrition education in school settings. In order to be effective, this nutrition education needs to be theoretically based, of a sufficient duration to affect change, and contain developmentally appropriate activities.[10,11] Reviews of nutrition education projects aimed at increasing fruit and vegetable consumption have identified a need for increased numbers of interventions that meet these criteria. Further, interventions containing environmental components have also been advocated.[12]

The experiential learning model offers a viable framework for nutrition education for school-aged children. This model allows children to learn and construct meaning through experiencing real-life situations.[13,14] Experiential learning offers the student a more learner-centered approach which often produces deeper and more enduring learning than many more formal approaches to education. Montessori promoted gardening as an experiential learning method that proved to be successful with children.[15] She recognized both the academic and social benefits that children received through gardening education.

Current research into classroom gardening has supported Montessori's perspective on the benefits of gardening for children.[16,17] However, this research has been limited in scope. Research into the academic benefits of gardening has focused primarily on mathematics and science education.[18] The gardening activities that have been associated with these academic areas have lent themselves well to providing experiential learning opportunities.

Research into the relationship between gardening and improved nutrition behaviors in children is in its infancy. Despite the fact that some preliminary research indicates positive dietary outcomes as the result of gardening, few studies have rigorously evaluated gardening as a teaching method. Initial studies have illustrated the positive effects that school-based gardening projects can have on nutrition knowledge and behavior.[19-21] However, there remains a paucity of research into the link between gardening and dietary behavior. There is a need for additional research in this area to: (a) improve upon current research designs, (b) demonstrate the positive impacts of gardening as a function of developmental level, (c) develop more sensitive assessment tools, (d) improve the assessment tools that are currently available, (e) develop more integrated nutrition and gardening curricula, (f) develop better teaching methods, (g) include more data on fruit consumption related to gardening and (h) provide replication of the current research.

Thus, this study sought to address the relationship between gardening as an experiential learning process and some of these research needs. Specifically, the relationship between gardening and fruit and vegetable knowledge, preference and consumption was investigated in an elementary school-aged population. To that end, the research project sought to synthesize relevant research from the disciplines of educational psychology, horticulture and nutrition education in order to study the effects of school gardens on children’s fruit and vegetable knowledge, preference and consumption.

METHODS

Design and Participants

This study was conducted from September, 2005 to March, 2006 using six, second grade classes in one elementary school in the Southeastern United States. The six classes were divided into three groups. Two classes served as the treatment group receiving nutrition education and gardening (NE+G). Two classes served as a nutrition education only (NE) treatment group. Two classes served as the control group (CG). Group designations were based on requests by individual classroom teachers. Permission to work in the school with these teachers and students was granted by the principal and parental consent was obtained for students before allowing their participation in the study. All procedures were reviewed and approved by the Institutional Review Board at Auburn University.

Participants

A total of 115 second grade students participated in the study (76 intervention, 39 control) over a 20-week period. Participants were selected using a nonrandomized, convenience type sampling method. Children in the nutrition education and gardening group (n = 39; mean age = 7.3; 46% female) participated in a pre-assessment, one hour of nutrition education lessons every other week, one hour of gardening lessons and experience every other week and a post-assessment. Children in the nutrition education only group (n = 37; mean age = 7.5; 27% female) participated in a pre-assessment, one hour of nutrition education lessons every other week and a post-assessment. Children in the control group (n = 39; mean age = 7.4; 28% female) participated in the pre- and post-assessments only.

Intervention Materials

Two existing curricula were identified for use with the intervention groups. One curriculum, *Pyramid Café*, was a ten-lesson nutrition education curriculum developed for second grade students that tells the story of five friends who open up a restaurant and teach other children about good nutrition.[22] Accompanying the curriculum are personal workbooks that are provided to each student for completing nutrition activities. Numerous modifications were made to update the curriculum based on the new MyPyramid[23], the food guidance system that is currently recommended by the United States Department of Agriculture.

The second curriculum that was used was *Health and Nutrition from the Garden*, a gardening-focused curriculum which was originally written for use with the Junior Master Gardener program .[24] This curriculum is designed to teach basic gardening skills that include growing techniques, food safety, healthy eating tips and nutritious snack food preparation. The curriculum was not used in its entirety in the present study, but rather, nine lessons were included to guide the gardening component of the research. In addition to the two primary curricula, nutrition resources and supplemental gardening also were used during the nutrition education and gardening education components of the study. These included items such as a pocket wall chart with plush figures illustrating the plant life cycle and children's garden-themed storybooks (e.g., *The Very Hungry Caterpillar* by Eric Carle).

Gardening Component

In addition to receiving classroom nutrition and gardening education, one treatment group (two classes) participated in a hands-on gardening experience throughout the course of the study. These participants were involved in plotting, planting, maintaining and harvesting a garden located on the school grounds. A schedule was developed that allowed all students access and meaningful time in the garden during the study. The participants designed the layout of the garden, planted vegetables (carrots, broccoli, spinach and cabbage), maintained the garden and harvested the vegetables. Time in the garden included experiences such as understanding soil needs and plant health, pest management and recognizing vegetables ready to be harvested.

Evaluation Tools

Three separate instruments were used to assess participants' fruit and vegetable knowledge, preference and consumption. All three evaluations were conducted as both pre- and post-assessments. These assessments included: the fruit and vegetable survey, the fruit and vegetable preference questionnaire and a lunchroom observation form. All data collection was performed by the primary author.

Fruit and vegetable survey. The fruit and vegetable survey is a compilation of a variety of instruments that have been used to measure both fruit and vegetable preference and knowledge. The survey was read aloud to the whole class of students in an effort to control for varied reading levels and involved the participants for 30 minutes.

Fruit and vegetable preference was measured using an instrument that was originally developed at University of Texas.[25] The instrument was revised by Lineberger and Zajicek[20] and it was this revised section on preference that was used in the present study. The preference section of this questionnaire consisted of 15 items (e.g., apple, tomato, green beans) that were rated on a three-point scale. Participants were able to rate these 15 food items using one of three faces, which included happy, neutral and sad. Each column of face pictures is identified with corresponding text, ☺ = "I Like this a Lot," 😐 = "I Like this a Little" and ☹ = "I Do Not Like this," respectively. These items were collapsed into a fruit preference scale and vegetable preference scale for analysis.

Fruit and vegetable knowledge on this survey was measured using an instrument adapted from Struempler and Raby.[26] Three nutrition knowledge topics were assessed which included the placement of foods in MyPyramid food groups, nutrient-food associations and nutrient-job associations. This knowledge section of the questionnaire contained 16 items and consisted of two different question formats. Six items were questions related to the six food groups of MyPyramid. These questions asked the participant to circle the food picture and typed food name out of four choices that did not belong to a food group. Ten items were nutrient-food relationship and nutrient-job association items which were asked in a matching format. Nutrient-food relationship items asked participants to match common nutrients to foods, such as matching *calcium* to *milk*. Nutrient-job association items asked participants to match common nutrients to tasks performed in the body, such as matching *calcium* to *makes bones strong*.

Fruit and vegetable preference questionnaire. Food preference data were collected using a methodology that was originally developed by Birch and Sullivan[27] and also was used by Domel et al[25] and Morris et al.[21] This methodology is considered developmentally appropriate for this age group. Using this methodology, students are asked to taste different fruits and vegetables, and then to rate their level of enjoyment of the taste. This food preference collection method is compatible with the experiential learning aspect of the research study. The questionnaire by Domel et al provided unobserved preference survey data and Birch's methodology added a direct observation of preference collection method. By using both methodologies, it was hoped that stronger preference data were collected. Participants completed the assessment independently to avoid the influence of peer pressure. This preference questionnaire involved the participant for 15 minutes.

To begin administering the preference questionnaire, each participant was presented with a tray of five vegetables and one fruit. Carrots were the first food presented as a way to introduce the assessment in the least threatening manner. It was assumed that most of the children would be familiar with carrots and would feel comfortable in identifying them and tasting them. In addition to carrots, the choices for tasting included broccoli, spinach, zucchini, cabbage and blueberries. Four of the five vegetables (carrots, broccoli, spinach and cabbage) are classified as cool season vegetables and were planted and grown in the fall school garden.

All of the vegetables and blueberries were presented to the participants raw and plain. Dips and sauces were not used to ensure the taste rating of the vegetables and the fruit reflected only that item and not the dip or sauce. Each of the vegetables was cut up and all foods were put in 2-ounce portion cups for tasting (Figure 1). Each participant was provided with a fresh set of tasting samples in addition to a napkin. In addition, a tray containing each of the vegetables in its whole form also was available to show the participant what each item looked like coming out of the garden and to aid in identification of the individual food items (Figure 2).

During the assessment, participants were asked to answer a series of three questions pertaining to each of the presented vegetables and blueberries. The questions and answers were recorded in an interview style. The investigator read each question to the participant and marked the response on a form. The participant was not required to write anything for this assessment.

The first of the three questions asked the participant to identify the vegetables or blueberries, after being shown the item in its cut-up and whole forms. All answers, right or wrong, were recorded. The second question asked whether or not the participant would like to taste the item. No participant was coerced to taste test any of the food items. It was made clear at the beginning of the interview that the participant was under no obligation to taste any of the items. If the participant did taste the item, the third question asked for a rating of his/her preference of the item on a five-point scale utilizing a facial hedonic scale modified from that used by Birch.[28]

Lunchroom observation. The lunchroom environment at the elementary school used in the present study included free choice related to lunchroom fare and was also self-serve. There are two possible lunchroom meals, school plate lunch and grab-and-go lunch. The school plate lunch consisted of a meat and a choice of fruits and vegetables and milk. The student was allowed to serve himself as many vegetables as he would like and the cost of the meal was determined by the number chosen. The vegetables changed daily and a salad bar was available every day. The grab-and-go lunch consisted of a deli box containing a sandwich, bag of chips, individually-wrapped carrots with dip and a whole fruit.

Participants were observed for two lunch meals at pre-assessment and two lunch meals at post-assessment. Three variables were examined in the lunchroom observation assessment and recorded on a one-page tick sheet.[29] First, the investigator recorded what type of lunch was chosen by the participant (school lunch, grab-and-go or home lunch).

Second, the investigator recorded what vegetable items, if any, were chosen by the participant. And third, the investigator recorded whether the participant actually ate the chosen vegetables. Eating the vegetable was defined by the majority of the portion being eaten.

Statistical Analysis

All data were analyzed using SPSS, Version 14.0.[30] Descriptive analyses were conducted to describe the sample and to determine the percentage of participants who could identify and were willing to try the six presented fruit and vegetables. Scales were assessed for internal reliability using the Cronbach Coefficient Alpha. Three broad categories, nutrition knowledge, fruit and vegetable preference and fruit and vegetable consumption, were analyzed separately using the fruit and vegetable survey, the fruit and vegetable preference questionnaire and the lunchroom observation. A mixed model analysis of variance (ANOVA) was used to compare the mean scores among groups at pre-test and post-test. When significant interactions were found, paired *t* tests were conducted to determine whether differences occurred within groups over time. Post- hoc tests were conducted when significant main effects were found. The chi-square test of independence was used to examine differences in participants' ability to identify individual fruit and vegetable items between pre- and post-tests.

RESULTS

Reliability

Internal consistency as calculated by Cronbach's Coefficient Alpha (α) was used to determine the reliability of four nutrition knowledge scales and one fruit and vegetable preference scale. The three nutrition knowledge scales consisted of information on food groups (pre- $\alpha = .76$; post- $\alpha = .79$), nutrient-food association (pre- $\alpha = .58$; post- $\alpha = .82$), nutrient-job association (pre- $\alpha = .40$; post- $\alpha = .72$) and fruit and vegetable identification (pre- $\alpha = .15$; post- $\alpha = .59$). Cronbach's Alpha for the fruit and vegetable preference scale was .84 (pre) and .83 (post). To determine the consistency of question responses over time, pre- and post-assessment alphas are reported. These reliability data are consistent with the reliability data from the instruments' original authors.

Nutrition Knowledge

From the questionnaires that were administered, four knowledge scales were analyzed both at pre- and post-test. These four knowledge scales included: information on individual food groups (six items), nutrient-food association (five items), nutrient-job association (five items) and fruit and vegetable identification (six items) (Table 1).

Results of a mixed model ANOVA indicated there was a significant main effect in food group knowledge [$F(1,112) = 16.11$, $P < .001$], however an interaction effect with group assignment was not found. Overall, participants experienced a significant increase in their food group knowledge from pre-test to post-test, but this increase can not be attributed to group assignment.

For knowledge of nutrient-food association, there was a significant main effect for treatment [$F(1,112) = 54.48$, $P < .001$], as well as a significant interaction [$F(2,112) = 11.84$, $P < .001$]. The results of paired *t* tests indicated that participants in both treatment groups (NE+G and NE) experienced significantly greater improvement gains (NE+G, $t = 6.6$, $P < .001$; NE, $t = 5.3$, $P < .001$) in nutrient-food association knowledge over time than did participants in the control group (CG, $t = .3$, $P = .733$).

For nutrient-job association, there was a significant main effect for treatment [F(1,112) = 28.69, $P < .001$], as well as a significant interaction [F(2,112) = 12.05, $P < .001$]. The results of paired *t* tests indicated that participants in both treatment groups (NE+G and NE) demonstrated significantly greater improvement gains (NE+G, $t = 5.2$, $P < .001$; NE, $t = 4.3$, $P < .001$) in nutrient-job association knowledge over time than did participants in the control group (CG, $t = .9$, $P = .351$).

For fruit and vegetable identification, there was a significant main effect for treatment [F(1,78) = 58.73, $P < .001$], as well as a significant interaction [F(2,78) = 28.08, $P < .001$]. The results of paired *t* tests indicated that participants in both treatment groups (NE+G and NE) exhibited significantly greater improvement gains (NE+G, $t = 9.5$, $P < .001$; NE, $t = 2.3$, $P < .01$) in fruit and vegetable identification over time than did participants in the control group (CG, $t = .5$, $P = .603$).

A chi-square test of independence was performed to examine the relation between the participants' ability to identify individual fruits and vegetables presented at pre- and post-test (Table 2). The relation between these variables was significant only for spinach ($\chi^2 = 18.73$, $P = .001$], zucchini ($\chi^2 = 22.70$, $P < .001$) and cabbage ($\chi^2 = 17.16$, $P < .001$). Participants in the NE+G group were better able to identify these particular vegetables at post-test as compared to pre-test, than were the participants in the NE and CG groups.

Fruit and Vegetable Preference

From the questionnaires, two preference items and two preference scales were analyzed at pre- and post-assessment (Table 1). These questions included information on a participant's willingness to taste a presented fruit or vegetable and individual ratings of

For participants' willingness to try fruit and vegetables, there was a significant main effect for treatment [F(1,78) = 8.85, $P < .001$], but not a significant interaction. A Bonferroni adjustment revealed that participants in both treatment groups (NE+G and NE) were significantly more willing to try fruits and vegetables ($P < .05$) than were participants in the control group (CG).

For participants' ratings of tasted fruit and vegetables, there was a significant main effect for treatment [F(1,75) = 17.63, $P < .001$], as well as a significant interaction [F(2,75) = 14.45, $P < .001$). The results of paired *t* tests indicated that participants in both treatment groups (NE+G and NE) rated fruits and vegetables significantly higher (NE+G, $t = 5.3$, $P < .001$; NE, $t = 2.7$, $P < .001$) at post-test as compared to pre-test than did participants in the control group (CG, $t = 1.2$, $P = .227$).

From the fruit and vegetable preference questionnaire, change scores were calculated for the individual rating scores of the six tasted fruit and vegetables (carrot, broccoli, spinach, zucchini, cabbage and blueberry) presented at pre- and post-test (Table 3). The results of paired *t* tests indicated that participants in the NE+G and NE groups had a greater increase in taste rating scores of carrots, broccoli, zucchini and cabbage over time than did those in the control group. In addition, participants in the NE+G group gave a higher taste rating for spinach from pre-test to post-test than did either the NE or CG groups.

Neither fruit preference nor vegetable preference scores indicated any significant differences between groups.

Fruit and Vegetable Consumption

From the lunchroom observation, vegetables chosen and consumed were used to calculate choice and consumption scores (Table 1). The results of paired *t* tests indicated that participants in the NE+G treatment group were more willing to choose vegetables associated with a school lunch ($t = 3.19$, $P < .01$) at post-test compared to pre-test than were participants in the NE group ($t = 1.83$, $P = .082$) and control group (CG, $t = .73$, $P = .466$). Consumption scores compared with paired *t* tests indicated two changes. First, the control group ate significantly fewer vegetables ($t = -2.64$, $P < .001$) at post-test as compared to pre-test. Second, the NE+G group ate significantly more vegetables ($t = 3.04$, $P < .01$) at post-test as compared to pre-test. The NE group had no change in consumption.

DISCUSSION

Increasing children's consumption of fruits and vegetables is considered to be critical to teaching good nutritional habits and to halting the alarming increase in childhood obesity. The findings of the present study elucidate the positive influences of nutrition education and school gardening experiences on the dietary behavior of young children. These results indicated that the interventions of nutrition education or nutrition education and school gardening experiences effectively improved the fruit and vegetable knowledge, preference and consumption of second grade participants.

In a review of nutrition education study outcomes, Lytle found that 71% of studies reporting on knowledge outcomes showed significant gains in knowledge for the treatment group as compared to the control group.[31] Furthermore, the School-Health

Education Evaluation allowed that 10 to 15 hours were needed to expect "large" effects in program specific knowledge.[32] The results of the present study corroborated with both of these reviews. In the present study, nutrition knowledge increased significantly ($P < .001$) more in the nutrition education and gardening and nutrition education only groups than in the control group in all areas except MyPyramid food groups. Significant change was not found as the scores on the MyPyramid food groups section of the questionnaire were very high at pre-assessment. This finding indicates that the children were either already knowledgeable about foods commonly found in the five major food groups or the food choices in the test items were not challenging enough for this age group. By participating in 28 weeks of nutrition education, the participants in the treatment groups did, however, demonstrate a statistically significant increase in their knowledge of nutrient-food association, nutrient-job association and fruit and vegetable identification.

With regards to fruit and vegetable identification, statistically significant gains also were found in specifically tested vegetables for the participants in the nutrition education and gardening treatment group. These participants were better able to identify spinach ($P < .01$), zucchini ($P < .001$) and cabbage ($P < .05$) after participation than were the participants in the other two groups. It is important to note that spinach and cabbage were actually grown in the garden while zucchini was not. This finding suggests that although the participants had not had "hands-on" experience with zucchini they were better able to remember the name through the education component than the participants in the other two groups.

Fruit and vegetable preferences also were examined in the present study. The results of the assessment method that required participants to taste and then rate an individual fruit and vegetable yielded significant changes. However, the results of the assessment method that required participants to mark an answer on a survey instrument did not yield significant changes. This discrepancy suggests a need for more effective survey instruments if that is the methodology that will be used to evaluate young children's food preferences. This study suggests that it may be better to use the "taste and rate" methodology with this age group in order to get more precise data.

Participating in the gardening and nutrition education programs improved participants' preferences for several vegetables. Participants in the NE+G and NE groups increased their preferences for carrots, broccoli, zucchini and cabbage. In addition, participants in the NE+G group also increased their preference for spinach. The only item that did not result in an increase in preference was the blueberry. However, it is important to note that all three groups began with high preference ratings for this particular item. Further, when examining food preferences from a developmental systems perspective, a perspective derived from evolutionary biology; Birch suggests that young children are genetically predisposed to prefer fruit due to sweetness.[33] Since the blueberry was the only fruit included in the study, it would be interesting for future research to include a greater and more varied fruit selection in an effort to determine whether gardening could influence fruit preference.

Fruit and vegetable preference was also operationalized in this study as the change in a participant's willingness to taste a fruit or vegetable. Participants in the NE+G and NE groups had significant gains in their willingness to taste fruits and vegetables as compared to participants in the CG group. This finding suggests that experiential learning and classroom nutrition education had a positive effect on fruit and vegetable preference in this study. In experiential education, the student becomes more actively involved in the learning process than in more traditional, didactic forms of education. In addition, the classroom component allowed students to receive general nutrition education to increase awareness and understanding of basic age-appropriate nutrition principles. These results suggest that the experiential learning and nutrition education curricula seemed to foster a greater willingness to taste presented fruits and vegetables in the study.

The school environment greatly influences fruit and vegetable intake among children. As the variety of food and beverage choices increases and students have more access to a la carte type foods (e.g., pizza, chicken nuggets, chips and sodas), they consume fewer servings of fruits and vegetables.[34] Schools have made significant progress in meeting USDA nutrition requirements since the mid-1990s but need to make improvements both in meeting the nutrition requirements and in promoting students' healthy eating choices, according to national studies of school lunches.[35]

It was hypothesized that the participants in the NE+G group would be more likely to choose and eat vegetables during lunch time at post-assessment compared to pre-assessment than would the participants in the NE and CG groups. This condition presented a real-life, authentic setting in which actual behavior could be assessed after participating in the present study. The results of the lunchroom observations indicated that at post-assessment the participants in the NE+G group were more likely to choose vegetables in the school lunchroom meal than were participants in the NE and control groups as compared to pre-assessment. This finding would suggest that experiential gardening plays a key role in positively influencing children's choice of vegetables to eat, particularly in a lunchroom setting.

In a review of school-based nutrition education intervention, Reynolds, Baranowski, Bishop, Gregson and Nicklas found that school-based nutrition education interventions can be used to produce increases in fruit and vegetable consumption among children.[12] Findings from the present study are in line with the results of this review. The NE+G group was more likely to consume the chosen vegetables at post-assessment than were the NE and CG groups as compared to pre-assessment. Moreover, participants in the control group ate significantly fewer vegetables at post-test as compared to their consumption at pre-test. This result would imply that the experiential gardening component may have been a contributor to this consumption behavior change.

LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

Many of the limitations in this study related to the challenges of conducting a research-based intervention under the constraints of real-world conditions in an elementary school setting. First, the ideal research design would have utilized a randomized controlled trial with a larger sample size. Second, plant selections in the garden were limited by seasonal issues. While summer gardens tend to yield vegetables that are traditionally more palatable to children as compared to fall and winter gardens, a fall garden was necessitated due to the school calendar year. Third, winter weather can impede gardening activities, thus had a summer garden been possible, adjusted findings may have applied. Fourth, the time available for students and teachers to work in the garden were limited by academic activities. Fifth, the present study was conducted with a predominantly white subject population of second grade students. Therefore, the results may not be generalizeable to other populations. There remains a need for future research into the effects of experiential gardening as a nutrition intervention. It is suggested here that we need further research into the effects of experiential gardening using a larger sample size, a randomized controlled trial, a summer garden and more ethnically diverse and older subject populations.

CONCLUSION

We are currently facing an obesity epidemic in America. In an effort to decrease obesity and overweight among America's children, nutrition educators need to strive to educate our children about the many benefits of healthy levels of fruit and vegetable intake. To that end, nutrition education should be a staple of the accepted school curricula. The results of the present study provide support for nutrition education through experiential gardening in school settings with young children. Experiential gardening has been demonstrated to yield an increase in children's nutrition knowledge, preference and behaviors regarding their fruit and vegetable consumption. Thus, experiential gardening appears to be an effective intervention for increasing young children's fruit and vegetable intake, and may serve as a vehicle to combating the obesity epidemic among American children.

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Table 1. Fruit and Vegetable Knowledge, Preference and Consumption Mean Scores by Group of Second Grade Students Participating in a Nutrition Education and Gardening Intervention

	Experimental Groups						Control Group		
Variable	**Group 1: Nutrition Education + Gardening (n = 39)**			**Group 2: Nutrition Education Only (n = 37)**			**Group 3: Control Group (n = 39)**		
	Pre (SD)	**Post (SD)**	**Change**	**Pre (SD)**	**Post (SD)**	**Change**	**Pre (SD)**	**Post (SD)**	**Change**
Nutrition Knowledge									
MyPyramid Food Groups	3.69 (1.8)	5.20 (1.2)	1.51	4.08 (1.7)	4.75 (1.9)	.67	4.03 (1.8)	4.46 (1.3)	.43
Nutrient – Food Association	1.46 (1.1)	3.56 (1.6)	2.10***	1.67 (1.5)	3.70 (1.8)	2.03***	1.82 (1.4)	1.92 (1.3)	.10
Nutrient – Job Association	1.25 (1.0)	2.97 (1.9)	1.72***	1.27 (1.3)	2.64 (1.6)	1.37***	1.71 (1.2)	1.46 (1.0)	-.25
F&V Identification	3.14 (.70)	4.89 (.87)	1.75***	3.03 (.64)	3.44 (.80)	0.41**	2.88 (.86)	2.96 (1.0)	.08
Fruit and Vegetable Preference									
Willingness to Taste	4.82 (1.6)	5.50 (1.0)	.68	5.11 (1.1)	5.33 (1.2)	.22	3.84 (2.1)	4.23 (2.0)	.39
Ratings of Tasted F&Vs	3.45 (.91)	4.38 (.45)	.93***	3.85 (.78)	4.15 (.58)	.30***	3.99 (.65)	3.82 (.45)	-.17
Fruit Preference	2.59 (.41)	2.60 (.30)	.01	2.70 (.30)	2.73 (.28)	.03	2.59 (.38)	2.57 (.33)	-.02
Vegetable Preference	2.08 (.53)	2.03 (.53)	-.05	2.20 (.55)	2.14 (.62)	-.06	2.10 (.48)	1.98 (.46)	-.12
Vegetable Choice and Consumption									
Vegetable Choice	.41 (.32)	.62 (.24)	.21**	.36 (.36)	.48 (.18)	.12	.42 (.37)	.40 (.18)	-.02
Vegetable Consumption	.70 (.44)	1.0 (.00)	.30**	.64 (.45)	.64 (.45)	0	.83 (.32)	.50 (.50)	-.33***

*p<.05
**p<.01
***p<.001

Table 2. Participant's Ability to Identify Fruits and Vegetables

	Pre (%)	Post (%)	Change (%)	χ^2
Carrot				1.917
NE+G	97	100	3	
NE	100	100	0	
CG	100	100	0	
Broccoli				.360
NE+G	93	100	7	
NE	93	100	7	
CG	89	92	3	
Spinach				18.733**
NE+G	10	61	51	
NE	10	19	9	
CG	0	12	12	
Zucchini				22.707***
NE+G	3	54	51	
NE	3	15	12	
CG	7	8	1	
Cabbage				17.161*
NE+G	27	79	52	
NE	7	26	19	
CG	18	19	1	
Blueberry				6.407
NE+G	90	96	6	
NE	90	85	-15	
CG	71	65	-6	

*p<.05
**p<.01
***p<.001

NE+G=Nutrition Education and Gardening
NE=Nutrition Education Only
CG=Control Group

Table 3. Participant's Mean Rating of Tasted Fruits and Vegetables Within Three Groups

	Pre (SD)	Post (SD)	Change (%)	P
Carrot				
NE+G	4.04 (.75)	4.71 (.46)	.66	<.001
NE	4.23 (.75)	4.59 (.59)	.36	<.01
CG	4.37 (.76)	4.42 (.60)	.05	
Broccoli				
NE+G	3.30 (1.52)	4.30 (.97)	1.00	<.001
NE	3.17 (1.20)	3.72 (1.01)	.55	<.01
CG	3.40 (1.17)	3.20 (1.39)	-.20	
Spinach				
NE+G	3.00 (1.10)	4.21).63)	1.21	<.001
NE	3.43 (1.16)	3.48 (1.12)	.05	
CG	3.67 (.88)	3.00 (1.04)	-.66	
Zucchini				
NE+G	3.42 (1.30)	4.16 (.95)	.73	<.01
NE	3.50 (1.30)	4.09 (.86)	.59	<.05
CG	3.93 (1.22)	3.60 (.98)	-.33	
Cabbage				
NE+G	3.30 (1.14)	4.48 (.84)	1.17	<.001
NE	4.00 (.92)	4.36 (.84)	.36	<.01
CG	3.94 (1.12)	3.56 (1.09)	-.38	
Blueberry				
NE+G	4.50 (1.05)	4.77 (.61)	.27	
NE	4.56 (.96)	4.68 (.90)	.13	
CG	4.76 (.66)	4.59 (.87)	.11	

NE+G=Nutrition Education and Gardening
NE=Nutrition Education Only
CG=Control Group

Figure 1. Fruit and Vegetables Presented in Cut-up Form for Tasting

Figure 2. Fruit and Vegetables Presented in Whole Form for Identification

IV. FINDINGS

The goal of this research study was to determine the effects of a hands-on gardening and nutrition education program on fruit and vegetable knowledge, preference and consumption among elementary school children participating in a 28-week classroom and experiential learning program. Two intervention groups and one control group were established to investigate these effects and included a nutrition education and gardening (NE+G) group, a nutrition education only (NE) group and a control group (CG).

To meet this goal, twelve hypotheses were developed to guide statistical analysis. Based on these hypotheses, the following results were found:

Hypothesis 1. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased knowledge of the six MyPyramid food groups.

A mixed model analysis of variance (ANOVA) was performed to compare overall knowledge scores on MyPyramid food groups within the two treatment and one control groups. A significant difference on MyPyramid food group knowledge was found [$F(1,112) = 16.11$, $p < .001$], but the effect was not dependent on group [$F(2,112) = 2.76$, $p = .107$]. Thus, this hypothesis was not supported.

Hypothesis 2. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased knowledge of common nutrients found in foods.

A mixed model analysis of variance (ANOVA) was performed to compare overall knowledge scores on nutrient-food associations within the two treatment and one control groups. An overall significant effect [$F(1,112) = 54.48$, $p < .001$] was found for the knowledge scores. A significant interaction effect [$F(2,112) = 11.84$, $p < .001$] also was found for the knowledge score dependent on group. Based on this result, paired *t* tests were conducted and determined that the two treatment groups, NE+G and NE, had significantly higher changes in scores ($t = 6.66$, $p < .001$ and $t = 5.35$, $p < .001$, respectively) over time than did participants in the control group ($t = .3$, $p = .733$). Thus, this hypothesis was supported.

Hypothesis 3. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased knowledge of nutrient functions within the body.

A mixed model analysis of variance (ANOVA) was performed to compare overall knowledge scores on nutrient-job associations within the two treatment and one control groups. An overall significant effect [$F(1,112) = 28.69$, $p < .001$] was found for the knowledge scores. A significant interaction effect [$F(2,112) = 12.05$, $p < .001$] also was found for the knowledge score dependent on group. Based on this result, paired *t* tests were conducted and determined that the two treatment groups, NE+G and NE, had significantly higher changes in scores ($t = 5.29$, $p < .001$ and $t = 4.30$, $p < .001$, respectively) over time than did participants in the control group ($t = .9$, $p = .351$). Thus, this hypothesis was supported.

Hypothesis 4. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased ability to identify fruits and vegetables with the correct name.

A mixed model analysis of variance (ANOVA) was performed to compare overall knowledge scores on fruit and vegetable identification within the two treatment and one control groups. An overall significant effect [$F(1,78) = 58.73$, $p < .001$] was found for the knowledge scores. A significant interaction effect [$F(2,78) = 28.08$, $p < .001$] also was found for the knowledge score dependent on group. Based on this result, paired *t* tests were conducted and determined that the two treatment groups, NE+G and NE, had significantly higher changes in scores ($t = 9.57$, $p < .001$ and $t = 2.38$, $p < .01$, respectively) over time than did participants in the control group ($t = .5$, $p = .603$). Thus, this hypothesis was supported.

Hypothesis 5. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased ability to identify six presented fruits and vegetables with the correct name (i.e., carrot, broccoli, spinach, zucchini, cabbage, and blueberry).

A chi-square test of independence was performed to examine the relation between the participants' ability to identify individual fruits and vegetables presented at pre- and post-test. The relation between these variables was significant only for spinach (χ^2 = 18.73, P = .001], zucchini (χ^2 = 22.70, $P < .001$) and cabbage (χ^2 = 17.16, $P < .001$). Participants in the NE+G group were better able to identify these particular vegetables at post-test as compared to pre-test, than were the participants in the NE and CG groups. Thus, this hypothesis was partially supported.

Hypothesis 6. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to a greater preference for fruits and vegetables as evidenced by an increased willingness to taste fruits and vegetables.

A mixed model analysis of variance (ANOVA) was performed to compare overall preference scores on willingness to try fruits and vegetables within the two treatment and one control groups. A significant difference on willingness to try scores was found [$F(1,78) = 8.85$, $p < .01$], but the effect was not dependent on group [$F(2,78) = .87$, p = .420]. A Bonferonni adjustment revealed that participants in both treatment groups (NE+G and NE) were significantly more willing to try fruits and vegetables ($p < .05$) than were participants in the control group. Thus, this hypothesis was supported.

Hypothesis 7. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to a greater preference for fruits and vegetables as evidenced by an increased rating of tasted fruits and vegetables.

A mixed model analysis of variance (ANOVA) was performed to compare overall preference scores on ratings of tasted fruit and vegetables within the two treatment and one control groups. An overall significant effect [$F(1,75) = 17.63$, $p < .001$] was found for the ratings scores. A significant interaction effect [$F(2,75) = 14.45$, $p < .001$] also was found for the ratings score dependent on group. Based on this result, paired *t* tests were conducted and determined that the two treatment groups, NE+G and NE, had significantly higher changes in scores ($t = 5.33$, $p < .001$ and $t = 2.74$, $p < .001$, respectively) over time than did participants in the control group ($t = 1.2$, $p = .227$). Thus, this hypothesis was supported.

Hypothesis 8. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to a greater preference for six specific fruits and vegetables as evidenced by an increased rating of the six tasted fruits and vegetables (i.e., carrot, broccoli, spinach, zucchini, cabbage, and blueberry).

From the fruit and vegetable preference questionnaire, change scores were calculated for the individual rating scores of the six tasted fruit and vegetables (carrot, broccoli, spinach, zucchini, cabbage and blueberry) presented at pre- and post-test. The results of paired *t* tests indicated that participants in the NE+G and NE groups had a greater increase in taste rating scores of carrots, broccoli, zucchini and cabbage than did those in the control group. In addition, participants in the NE+G group gave a higher taste rating for spinach from pre-test to post-test than did either the NE or CG groups. Thus, this hypothesis was partially supported.

Hypothesis 9. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased positive preferences for fruit.

A mixed model analysis of variance (ANOVA) was performed to compare overall fruit preference scores within the two treatment and one control groups. No significant differences were found within or between groups. Thus, this hypothesis was not supported.

Hypothesis 10. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased positive preferences for vegetables.

A mixed model analysis of variance (ANOVA) was performed to compare overall vegetable preference scores within the two treatment and one control groups. No significant differences were found within or between groups. Thus, this hypothesis was not supported.

Hypothesis 11. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased vegetable choices in an elementary school cafeteria environment.

The results of paired *t* tests indicated that participants in the NE+G treatment group were more willing to choose vegetables associated with a school lunch ($t = 3.19$, $p < .01$) than were participants in the NE group ($t = 1.83$, $p = .082$) and control group (CG, $t = .73$, $p = .466$). Thus, this hypothesis was supported.

Hypothesis 12. Participation in the classroom garden and nutrition education curricula and the experiential gardening process is related to increased vegetable consumption in an elementary school cafeteria environment.

Consumption scores compared with paired *t* tests indicated two changes. First, the control group ate significantly fewer vegetables (t = -2.64, p < .001) at post-test as compared to pre-test. Second, the NE+G group ate significantly more vegetables (t = 3.04, p < .01) at post-test as compared to pre-test. The NE group had no change in consumption. Thus, this hypothesis was supported.

Overall Conclusions

This research demonstrates that implementing school gardens can have positive effects on children's dietary behavior related to fruits and vegetables. Children who participated in the experiential gardening program and classroom nutrition education were more open to tasting fruits and vegetables than were those who were in the control group. Moreover, children participating in both the gardening curriculum and experience and the nutrition education curriculum improved on almost all variables related to knowledge gain, preference and consumption for fruits and vegetables.

Experiential learning was long ago advanced by Dewey (1933) and suggests that the context in which students learn needs to be as authentic to the "real world" as possible. Teachers must become facilitators of knowledge rather than simply the dictators of knowledge. This involves the teacher encouraging student interaction with their environment. Engaging in hands-on activities leads to a better understanding of instructional content by providing students with meaningful, concrete experiences. Developing a school garden can be a valuable instructional strategy for implementing experiential learning activities.

School gardens have been empirically tested for their positive effects on academic issues such as math (Civil & Kahn, 2001; Wotowiec, 1979), language arts (Ross & Frey, 2002) and science (Mabie & Baker, 1996). Research into their impact on health and nutrition issues has been more limited; however, this study clearly demonstrates a positive effect on dietary knowledge, preference and behavior. School policy makers, administrators, teachers and parents should consider the value of implementing a garden in the school environment for future healthy students.

Recommendations for Future Research

Further study of the influence of garden-based learning in the lives of children is needed to better understand its value and impact. In the future, different ways to incorporate this form of learning may be explored in order to widen its scope and range in different contexts.

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APPENDIX A

PARENTAL CONSENT FORM

Auburn University

Auburn University, Alabama 36849-5221

Educational Foundations
Leadership and Technology
4036 Haley Center

Telephone: (334) 844-4460
FAX: (334) 844-3072

PARENTAL CONSENT/MINOR ASSENT FOR
An Investigation into an Experiential Model of Education

Your child has been invited to participate in a research study investigating the relationship between a hands-on gardening experience and the knowledge, preference, and behavior associated with fruit and vegetable intake in a second grade population. This study is being conducted by Sondra M. Parmer, Graduate Student, under the supervision of Dr. Jill Salisbury-Glennon, Associate Professor. We hope to learn whether or not gardening experience can influence second grade students' preference for eating fruits and vegetables in order to establish healthy eating habits. Your child was selected as a possible participant because she or he attends second grade at Rainbow Elementary School, where the research is being conducted.

If you decide to allow your child to participate and your child agrees to participate, your child will be asked to complete three assessments. The total time involvement for these assessments will be 45 minutes per student both at pre- and post-assessment time. The three assessments are:

1. Your child will participate in a pre- and post-survey regarding his or her fruit and vegetable knowledge, preference and behavior. The survey will be completed two times; first, prior to any education and second, after all education is completed. Both times, the survey will be completed with your child's classroom as a group and should take approximately 30 minutes each time. The survey will be read out loud to the group and each child will be asked to respond by circling a response on the survey form.
2. Your child will be asked if he or she will taste certain fruits and vegetables. If she or he tastes the fruits and vegetables, she or he will be asked to rate how they taste. This tasting evaluation will be collected as pre- and post-assessments in a one-on-one session with the researcher and should last approximately 15 minutes each time.
3. Your child will be observed by this researcher in the lunch room two times (before and after the education) to determine which, if any, fruits and vegetables your child chooses to eat in the school lunch offering.

Your child also will participate in one of the educational groups listed below. All educational activities will be conducted as in-class activities.

____
Parent/Guardian Initials
(required for all non-signature pages)

HUMAN SUBJECTS
OFFICE OF RESEARCH
PROJECT #05-173 EP 0510
APPROVED 10/21/05 TO 10/20/06

A LAND-GRANT UNIVERSITY

Auburn University

Auburn University, Alabama 36849-5221

Educational Foundations
Leadership and Technology
4036 Haley Center

Telephone: (334) 844-4460
FAX: (334) 844-3072

1. **Nutrition Education and Gardening Experience Group** – During the initial 20 weeks (Period 1), children in this group will receive:
    a. 10, one-hour weekly lessons of nutrition education,
    b. 10, one-hour weekly lessons of gardening education, and
    c. 15 minutes weekly of hands-on gardening experience.
2. **Nutrition Education Only Group** – Children in this group will receive:
    a. 10, one-hour weekly lessons of nutrition education during the initial 20 weeks (Period 1),
    b. 10, one-hour weekly lessons of gardening education for a 10-week period (Period 2) following the initial 20 weeks,
    c. 30 minutes weekly of hands-on gardening experience during Period 2.
3. **Control Group** – During the 10-week period (Period 2) following the 20-week Period 1, children in this group will receive:
    a. 10, one-hour weekly lessons of nutrition education,
    b. 10, one-hour weekly lessons of gardening education, and
    c. 30 minutes weekly of hands-on gardening experience.

All three groups receive the same amount and type of nutrition education, gardening education and hands-on gardening experience. The difference between the groups is when the activity occurs (Period 1 vs. Period 2).

At the completion of the 20-week period (Period 1), a random sample of all parents will be asked to complete a short survey. If you agree to participate and are chosen to complete the survey, it will be sent home with your child. The survey is anticipated to take 15 minutes to complete.

Because food tasting will be part of the data collection process, it is important for me to identify any known food allergies in the participating children. According to the Food Allergy and Anaphylaxis Network (www.foodallergy.org), 90% of all food allergic reactions are caused by the following eight foods: milk, egg, peanut, tree nut (e.g., cashews, walnuts), fish, shellfish, soy and wheat. All foods provided for tasting during the research project will be fruits and vegetables and will not include any of these foods that induce the majority of food allergies. If your child has a known food allergy, please list this allergy on the bottom of this returned form in the space provided. This will ensure that your child will not be exposed to any know known food allergen during this project.

____
Parent/Guardian Initials
(required for all non-signature pages)

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In order to reduce any risk of anxiety associated with participating in the taste testing portion of this project, participation will be strictly voluntary among those students who have returned parental consent forms. It will be a perfectly acceptable response for a student to choose not to taste any or all of the foods provided.

All participating students will receive valuable education and will have the benefits of this education provided by the classroom teacher in an engaging format. They will be exposed to nutrition topics such as the new USDA food guidance system (MyPyramid), healthy snacks, importance of fruits and vegetables in the diet, and food-nutrient links. Students will be exposed to gardening education and hands-on gardening experience to include such topics as soil types, vermi-composting (worm bins), growing conditions, weather, plant cycles, and flower and fruit production. This paragraph outlines the intended benefits, however, I cannot promise that the students will receive any or all of the benefits described.

Any information obtained in connection with this study and that can be identified with your child will remain confidential. Data will remain in a locked and secure area available only to the research team and will be destroyed upon completion of use. Information collected through your child's participation may be used to fulfill an educational requirement (my personal dissertation), published in a professional journal, and/or presented at a professional meeting. If so, none of the identifiable information will be included. Your child may withdraw from participation at any time, without penalty. In addition, your child may withdraw any of his data which has been collected about him at any time, without penalty.

Your decision whether or not to allow your child to participate will not jeopardize his or her future relations with Auburn University, the elementary school, the teacher, or your child's grades in the class. Children who do not participate will be given other in-class activities to do while the research and education are conducted.

____
Parent/Guardian Initials
(required for all non-signature pages)

Page 3 of 4

HUMAN SUBJECTS
OFFICE OF RESEARCH
PROJECT #05-173 EP 0510
APPROVED 10/21/05 TO 10/20/06

A LAND-GRANT UNIVERSITY

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If you have questions at any point in this process, I invite you to ask them by contacting Sondra Parmer, 334-844-2231, parmesm@auburn.edu, or Dr. Jill Salisbury-Glennon, 334-844-4460, salisji@auburn.edu. You will be provided a copy of this form to keep. For more information regarding your rights as a research participant, you may contact the Office of Human Subjects Research or the Institutional Review Board by phone 334-844-5966 or email at hsubjec@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU AND YOUR CHILD MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO PARTICIPATE.

____
Student's Name

____
Student's Signature Date

____
Parent or Guardian signature Date

____
Print Name

List of known food allergies for this student: ______________________________

____

____

Page 4 of 4

HUMAN SUBJECTS
OFFICE OF RESEARCH
PROJECT #05-173 EP 0510
APPROVED 6/21/05 TO 6/20/06

A LAND-GRANT UNIVERSITY

APPENDIX B

DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS

DEMOGRAPHIC CHARACTERISTICS OF STUDENTS PARTICIPATING IN FRUIT AND VEGETABLE SURVEY
(n=115)

Characteristic	**n**	**%**
Gender		
Male	80	70
Female	35	30
Age		
7	73	63
8	42	37
Prior Gardening Experience	93	81
Location of Prior Gardening Experience		
Home	67	72
School	13	14
Relative's House	26	28
Friend's House	10	11
Where Learned Most about Plants		
Home	52	45
School	37	32
TV	12	11
Books/Magazines	14	12

APPENDIX C

LESSONS FROM THE NUTRITION EDUCATION CURRICULUM,

PYRAMID CAFÉ

Lessons from the Nutrition Education Curriculum, *Pyramid Café*

Lesson	Title	Key Objectives
1	Nutritious Foods Keep Me Healthy	To learn the names and key foods in the five food groups
2	The Story of The Pyramid Café	To understand how a variety of food keeps the body healthy
3	Meet the Milk Group	To learn that calcium is found in the milk group and what it does in the body
4	Learn About the Meat Group	To learn that protein is found in the meat group and what it does in the body
5	Visit the Vegetable Group	To learn that vitamins are found in the vegetable group and what they do in the body
6	Make Friends with the Fruit Group	To learn that vitamins are found in the fruit group and what they do in the body
7	Go for the Grain Group	To learn that carbohydrates are found in the grain group and what they do in the body
8	The “Others” Category	To learn what foods are classified as others and to only eat small amounts of these foods
9	What’s a Body-Building Lunch?	To understand how to combine foods to make body-building meals
10	Planning Body-Building Lunches	To plan body-building lunches that the children will eat

APPENDIX D

LESSONS FROM THE GARDENING CURRICULUM,

HEALTH AND NUTRITION FROM THE GARDEN

Lessons from the Gardening Curriculum, *Health and Nutrition from the Garden*

Lesson	Title	Key Objectives
1	What a Plant Needs to Grow	To become familiar with the needs of plants
2	From Seed to Plant/Small and Large	To understand the plant life cycle and garden spacing
3	Rules 'n Tools	To establish rules for the garden to make it a safe place to learn and to establish a gardening schedule
4	Paper Pots	To create pots from recycled material in which to propagate plants from seed
5	Touchy-feely/Pies and Shake, Rattle and Roll	To understand soil texture and the properties of different soil types
6	Who Goes There?	To learn the basics of Integrated Pest Management
7	How a Seed Grows	To understand the four stages of growth from seed to plant
8	Food Storage Gardens	To learn that gardening provides fruits and vegetables over time
9	Just Enough Carrots	To practice math concepts of comparing amounts using carrots
10	Party Confetti Salad	To demonstrate the preparation of a salad using vegetables harvested from the garden
Extension Activity 1	Tops and Bottoms	To create awareness and understanding of root vegetables
Extension Activity 2	Book Kit	Garden-themed children's literature provided for group and individual activities
Extension Activity 3	Veggie Friends Kit	Plush vegetables with faces for use in journaling and show and tell

APPENDIX E

FRUIT AND VEGETABLE PREFERENCE QUESTIONNAIRE

Fruit and Vegetable Preference

Name: ____

Date: ____

Carrot

1. Can you identify the item?

   Yes ________ No ________ Item Name Given: ______________

2. Do you want to taste the item?

   Yes ________ No ________

3. If tasted, please rate the taste on the following chart:

_____ hate it _____ don’t like it _____ don’t mind it _____like it _____ love it

Broccoli

4. Can you identify the item?

   Yes ________ No ________ Item Name Given: ______________

5. Do you want to taste the item?

   Yes ________ No ________

6. If tasted, please rate the taste on the following chart:

_____ hate it _____ don’t like it _____ don’t mind it _____like it _____ love it

Spinach

7. Can you identify the item?

   Yes ________ No ________ Item Name Given: _______________

8. Do you want to taste the item?

   Yes ________ No ________

9. If tasted, please rate the taste on the following chart:

_____ hate it _____ don't like it _____ don't mind it _____like it _____ love it

Zucchini

10. Can you identify the item?

    Yes ________ No ________ Item Name Given: _______________

11. Do you want to taste the item?

    Yes ________ No ________

12. If tasted, please rate the taste on the following chart:

_____ hate it _____ don't like it _____ don't mind it _____like it _____ love it

Cabbage

13. Can you identify the item?

    Yes ________ No ________ Item Name Given: _______________

14. Do you want to taste the item?

    Yes ________ No ________

15. If tasted, please rate the taste on the following chart:

_____ hate it   _____ don't like it   _____ don't mind it   _____like it   _____ love it

Blueberry

16. Can you identify the item?

Yes ________   No ________   Item Name Given: ______________

17. Do you want to taste the item?

Yes ________   No ________

18. If tasted, please rate the taste on the following chart:

_____ hate it   _____ don't like it   _____ don't mind it   _____like it   _____ love it

APPENDIX F

FRUIT AND VEGETABLE SURVEY

Fruit and Vegetable Survey

Name: ______________________________ Date: ____________________

For questions 1-5, circle the answer that best describes you.

1. I am a

   Girl
   Boy

2. How old are you?

   6
   7
   8

3. Have you ever worked in a garden before?

   Yes
   No

4. If you have worked in a garden before, where was the garden?

   Home
   School
   A relative's house (grandparent, aunt, etc.)
   A friend's house

5. Where do you learn the most about plants?

   At home, from my family
   At school
   From TV
   From books and/or magazines

For questions 6-20, circle the face that best shows how you feel:

	I Like This A Lot	I Like This A Little	I Do Not Like This
6. Fruit Juice	☺	😐	☹
7. Apple	☺	😐	☹
8. Tomato	☺	😐	☹
9. Orange	☺	😐	☹
10. Grapefruit	☺	😐	☹
11. Lettuce (Green Salads)	☺	😐	☹
12. Radish	☺	😐	☹
13. Squash	☺	😐	☹
14. Broccoli	☺	😐	☹
15. Carrot	☺	😐	☹
16. Strawberry	☺	😐	☹
17. Grapes	☺	😐	☹
18. Watermelon	☺	😐	☹
19. Cabbage	☺	😐	☹
20. Green Beans	☺	😐	☹

For questions 21-27, circle the best answer.

Think about the meals you eat on most school days.

21. Do you eat breakfast in the morning on most school days?
    a. Yes
    b. No

22. Do you eat supper in the evening on most school days?
    a. Yes
    b. No

Think about the fruits and vegetables you eat on most school days.

23. For **breakfast** on most school days do you:

a. Drink juice?	Yes	No
b. Eat a fruit?	Yes	No
c. Eat a vegetable?	Yes	No

24. For **lunch** on most school days do you:

a. Drink juice?	Yes	No
b. Eat a fruit?	Yes	No
c. Eat a vegetable?	Yes	No

25. For **supper** on most school days do you:

a. Drink juice?	Yes	No
b. Eat a fruit?	Yes	No
c. Eat a vegetable?	Yes	No

26. For a **snack** on most school days do you:

a. Drink juice?	Yes	No
b. Eat a fruit?	Yes	No
c. Eat a vegetable?	Yes	No

Foods can be put into 6 food groups.
Think about what foods go into each group.

For questions 27-32, circle the food that does not belong in the food group listed.

27. **Grain group**


waffle

noodles

apple

oatmeal

28. **Vegetable group**


broccoli

carrot

cabbage

pear

29. **Fruit group**


strawberries

pineapple

watermelon

corn

30. **Meat group**


turkey

chicken

potato

ham

31. **Milk group**


cheese

cracker

pudding

yogurt

32. **Fat, oil, and sweets group**


hamburger

butter

cupcake

candy

Think about nutrients in foods.

For questions 33-37, put the letter next to each nutrient in the blank beside the correct food.

33. _____	Milk	a. Vitamin C
34. _____	Bread	b. Calcium
35. _____	Fruits and Vegetables	c. Protein
36. _____	Meat	d. Sugar
37. _____	Soft Drink	e. Carbohydrates

Think about how nutrients work in your body.

For questions 38-42, put the letter next to each nutrient in the blank beside the correct job.

38. _____	Helps eyes see in the dark	a. Vitamin C
39. _____	Heals cuts and bruises	b. Calcium
40. _____	Makes bones strong	c. Protein
41. _____	Makes muscles strong	d. Vitamin A
42. _____	Gives you energy	e. Carbohydrates

APPENDIX G

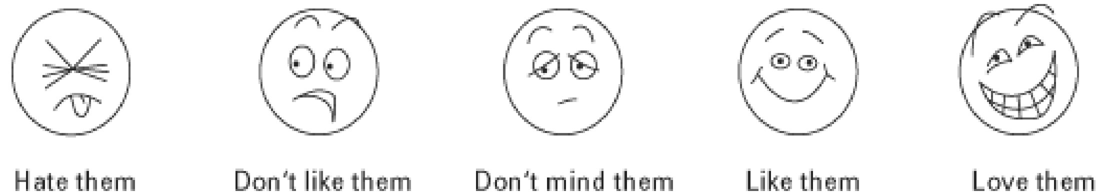
LUNCHROOM OBSERVATION FORM

Lunchroom Observation Form

Wednesday	home lunch	ate home lunch	school lunch	grab and go	chose pot	chose peas	chose fruit 1	chose fruit 2	chose salad	ate pot	ate peas	ate fruit 1	ate fruit 2	ate salad
Student A														
Student B														
Student C														
Student D														
Student E														
Student F														
Student G														
Student H														
Student I														
Student J														
Student K														
Student L														
Student M														
Student N														
Student O														
Student P														
Student Q														
Student R														
Student S														

APPENDIX H

FACIAL HEDONIC SCALE USED FOR RATING TASTED FRUIT AND VEGETABLES


Hate them
Don't like them
Don't mind them
Like them
Love them