Positive Youth Development and Agricultural Capacity Building in The Bahamas

by

Ezralee Rolle

Report submitted to the Faculty of

Virginia Polytechnic Institute and State University

in partial fulfilment of the requirements for the degree of

Master of Agricultural and Life Sciences

2018

Virginia Polytechnic Institute and State University

Graduate Committee

Chair of Committee: Dr. Tiffany Drape

Committee Members: Dr. Richard Rateau

Dr. Hannah Scherer

Abstract

Food security and "access to sufficient, safe, and nutritious food" (FAO, 2017) in The Bahamas has been compromised by the lack of meaningful and reliable food security programs, and sustainable, self-sufficient food systems (IICA, n.d). The FAO (2014) cited insufficient access of youth to knowledge, information and education as the number one challenge facing agricultural progression. A comprehensive response to meeting the challenges within the agricultural sector requires the investment in youth development in science, technology, engineering and math (STEM) related programs to bridge the gap between science and agriculture and create the capacity needed to improve the Bahamian agricultural industry.

This study examines the role of positive youth development (PYD) programs in improving 4-6 grade students' science aptitudes and helping to build capacity for agricultural development in The Bahamas. Thirty-seven (n=37) students from two primary schools on Andros, Bahamas, participated in the PYD project *Soil to Supper.* A pre/post-test questionnaire was administered to collect data on students' knowledge in science and agriculture before and after participation in the project. Results from this study showed that positive youth development (PYD) programs significantly increase students' scientific knowledge and agricultural skills. Knowledge gained in science and agriculture through participation in PYD programs could strengthen capacity building and agricultural development by providing skill-building, leadership, and competency developmental opportunities for youth.

Keywords: PYD, Capacity-building, Agriculture.

Acknowledgements

I dedicate my work to my loving and supportive daughter, Ryley.

I would like to thank my family and friends for their moral support throughout my graduate work. A heartfelt thank you to my colleagues and students at The Bahamas Agriculture and Marine Science Institute (BAMSI). A special note of thanks to Dr. Tiffany Drape, Committee Chair and Assistant Professor of Agricultural, Leadership, and Community Education at Virginia Tech, Dr. Hannah Scherer, Committee Member and Assistant Professor and Extension Specialist at Virginia Tech, and Dr. Richard Rateau, Committee Member and Assistant Professor of Agricultural, Leadership, and Community Education at Virginia Tech.

Table of Contents

Introduction 6

Statement of the Problem 8

Purpose and Objectives 8

Review of Literature 9

- Importance of Science in Agriculture...9
- Capacity Building in Agriculture through BAMSI...10

Theoretical Framework 12

- PYD and Science...14
- PYD and Capacity Building...14
- Agricultural Education Models 16

Research Question... 17

Methodology...17

- BAMSI and PYD in Agriculture..17
- Participant Selection 18
- Establishing Vegetable Garden...19
- Curriculum Design...19
- Lesson Engagement...21
- Assessments..22
- Data Collection..24

Data Analysis..24

Results...27

Discussion...28

Limitations..33

Conclusion..34

Recommendations..36

References 39

Table 1: *Skewness and Kurtosis Tests*...49

Table 2: Levene's Tests……………………………………………………………………..…………….……………..49

Table 3: Two paired sample t-test………………………………………………..……………………………….50

Table 4: Pre-Tests/Post-tests Means……………………………………….……………………………………..50

Table 5: Points Allocation for Pre/Post-Tests ……………………………………………………………………..51

Figure 1: Science Objectives vs. Agricultural Practice………………………………….…………………..51

Appendix A: Parent Consent Letters………...52

Appendix B: Pre/Post-Tests…………………...54

Introduction

Food security is one of the greatest challenges faced by developing nations (Omotayo et al., 2018; Dermody et al., 2018; Sibhatu & Qaim, 2017). Reliance on foreign aid and markets for daily sustenance has led to the persistence of poverty, chronic global hunger, and malnutrition. The World Food Program (2017) estimates that 842 million people do not eat enough to maintain healthy lifestyles and a third of all child deaths are linked to hunger. The inability of nations to provide “access to sufficient, safe, and nutritious food” (FAO, 2017) directly impedes its social and fiscal progression. As a result, the nation becomes vulnerable to health-related crisis and economic ruin. The way forward as contended by many researchers and economist is agriculture. Anecdotal evidence and basic economic data from recent decades suggest that agriculture plays a pivotal role in the national economy of developing countries (Awokuse, & Xie, 2015). The Inter-American Institute for Cooperation in Agriculture ([IICA], (2014), likewise supports the correlation between rural prosperity and agricultural development in that agriculture is one of the most effective poverty-reduction strategies to invest in.

Like many developing countries, The Bahamas has conceded this notion of agricultural development to induce industrialization and economic growth. In 2013, the government of The Bahamas approved a 20-year plan: *Rebuilding Bahamian Agriculture* to address the escalating food import bill which had exceeded US$1 billion dollars. Subsequently, Agri-Vision 2021 (Eneas et al., 2017) was approved and released as a 5-year Food and Nutrition Security Plan to feed both Bahamians and the millions of annual visitors. IICA also suggested that The Bahamas is lacking meaningful and reliable food security programs that guarantees the Bahamian population’s access to nutritious food. It is critical that the government recognize and address challenges that hinder sustainable, self-sufficient food systems and provide local, healthy, and replenishable food products for its vulnerable population (IICA, n.d).

There are limitations to agriculture in The Bahamas inclusive of the low academic level among farmers, and deficiencies in vocational training in modern farming technology. Further there are shortages of man power, low productivity, and an aging farming community which forecast a challenging future for the agricultural sector. A comprehensive response to these problems requires agriculture to rise above the concerns of production and consider what would be “better” food and agricultural production systems (Giovannucci et al., 2012). Stakeholders have called for agricultural scientists, technologists and extension agents to assists farmers to develop their competency in an effort to improve agricultural production. Therefore, agriculture needs a wide-ranging process of innovation that will develop new production, organizational, and knowledge paradigm shifts for meeting competitiveness and sustainability challenges (IICA, 2014). One such focus is the intentional and committed investment in Positive Youth Development (PYD) programs to assists in addressing deficiencies of the agricultural sector.

A critical aspect of any developmental plan is sustainability. Kesavan (2015), defined sustainable development as “development that meets the needs of the present without compromising the ability of future generations, to meet their own needs.” Youth are viewed as a significant agent of sustainable development of a society (Bite et al., 2015). The FAO (2014) identified youth education and development as a key component in building modern, efficient, and inclusive food systems. The FAO (2014) also cited insufficient access of youth to knowledge, information and education as the number one challenge facing agricultural progression. The investment in youth development in science, technology, engineering and math (STEM) related programs can bridge the gap between education and agriculture and create the capacity needed to improve the Bahamian agricultural industry.

Statement of the Problem

Food import is the largest source of food for Caribbean Community (CARICOM) populations. As a Small Island Developing State (SIDS), The Bahamas, like other CARICOM nations, is a food deficit country and imports an estimated US $1.0 billion dollars annually in food products (Agri-Vision 2021, 2017). With less than 20% of the national food bill being supplied by local farmers, food security poses a real problem in The Bahamas. There is a lack of efficiently trained professionals and entrepreneurs, who are willing and able to elevate the standards of farming technology to move the sector forward.

Purpose Statement

The purpose of this study is to evaluate the Bahamas Agriculture and Marine Science Institute's (BAMSI) collegiate 4-H *Soil to Supper* pilot project as a viable PYD model to build capacity for the advancement of agriculture in The Bahamas. This study will:

- assess knowledge gained after completion of the *Soil to Supper* curriculum,
- explore the ability of the *Soil to Supper* project to increase science aptitudes and build capacity for the agricultural industry in the Bahamas, and
- determine the replicability of the *Soil to Supper* pilot project as a sustainable PYD model.

Review of Literature

Importance of Science in Agriculture

Agriculture today is seen as an applied science, a multi-faceted discipline, a business and a vocation, focused primarily on food production (Ramharacksingh, 2011). Human curiosity and ingenuity have led to major scientific breakthroughs that have altered agricultural systems. The key role of science in agriculture has been to help generate novelties that produce more with less land and less effort (Douthwaite, 2001) in a sustainable manner. Developments in science and technology have had profound impacts on worldwide agricultural production, including the Green Revolution. The introduction of new high yielding varieties (HYVs) of wheat, rice and maize, (Farmer, 1986) exponentially increased global food yield, and eradicated the threat of mass famine and starvation in places such as Mexico, India and the Philippines (Conway, 1999; Perkins, 1997). The adoption of modern agricultural technologies, including the use of chemical fertilizers, irrigation, and high yield variety of crops, nearly doubled crop production worldwide helping to feed a growing global population (Encyclopaedia of Food and Culture, 2003) during the late 1960's.

Science has made significant contributions to agriculture through advances in chemistry, biology, and genetics. Notable examples include the Mendelian laws of inheritance which formed the basis of crop improvement through hybridization of plants (Kesavan, 2015). The discovery of chromosomes by Wilhelm von Nageli in 1842 gave rise to the genetic modification of crops to become resistant to herbicides and pests (Frizell-Armitage, 2016). Paul Muller also demonstrated the insecticidal action of the dichlorodiphenyltrichloroethane (DDT), which was readily accepted as an ideal insecticide to destroy a wide spectrum of agricultural and domestic pests (Muller, 2006; Kesavan, 2015).

The Green Revolution and many other scientific advances, whether ethically or commodity driven, have significantly and irreversibly compromised the quality and resilience of natural ecological and food systems. Novelties used to radically induce agricultural outputs just a century ago, have been suggested to have contributed to environmental degradation, depletion of genetic diversity, impairment of ecosystems services (Kesavan, 2015), deterioration of soil fertility and global climate change. The new challenges confronted by the agricultural industry must be met with new responses and new innovations to combat the threat of global food insecurity.

Capacity Building in Agriculture through BAMSI

Capacity is "the ability of people, organizations, and society as a whole to manage their affairs successfully" (UNDP, 2010). Capacity development is "the process whereby individuals, organizations and society as a whole unleash, strengthen, create, adapt and maintain capacity over time" (INTRAC, 2006). Substantial recent progress has been made to build agricultural capacity in The Bahamas. During the past five years agriculture has moved to the forefront with the development of BAMSI being the most subsidized government initiative to catalyse agricultural development. Government expenditure for the development of BAMSI is reported to exceed US $80 million in subsidies. Currently, BAMSI receives US $7 million dollars annually as a budgetary allowance to develop its agricultural potential.

BAMSI is an academic and development institution which operates a number of integrated components viz: i) academic and skills training; ii) commercial/tutorial farm producing select crops and livestock, iii) an associated farm and extension program, and iv) a value-adding and agro-processing, marketing and distribution arm. The overall objectives of the Institute are to: i) develop a mechanism to address the food and nutrition security of The Bahamas, ii) meet the goal of the 20-year plan in reducing the high food import bill through an Import Substitution and policy programme and iii) diversify the Bahamian economy and thereby to elevate the Agricultural Sector to be the third pillar of the economy. The establishment of BAMSI heralds a roadmap for the development of local capacity to increase local food production and to ensure the food and nutrition security of the country.

To this end, BAMSI facilitates quality engagements with national and international agencies, plan and integrate strategies to strengthen technical and problem-solving capabilities in agriculture, and facilitate formal training of individuals in modern, science-based agricultural practices. BAMSI is projected to make the country more self-sufficient in food production by building agricultural capacity through training students, farmers and fisherfolk, while conducting research to develop sustainable models.

Conceptual /Theoretical Framework

The theory guiding this work is Positive Youth Development (PYD) (Lerner, 2004). PYD also served as the framework for the development of the curricula, Soil to Supper. PYD originates from interests among developmental scientists to understand how contextual characteristics (such as social, cultural, political and ecological factors) alter adolescent behaviour and development as they undergo physical and biological changes. Variations in human development and behaviour can be linked to developmental changes within the brain due to interactions with the environment. Developmental scientists call this susceptibility to change, plasticity (Houwer, 2015). It is suggested that PYD programs provide the foundational support during these critical periods in adolescent development that can contribute to healthy youth behaviour and development (Catalano et al., 2004). PYD framework encompasses psychological, behavioural, and social characteristics that reflect what is call the “Five Cs” (Eccles, & Gootman, 2002; Lerner, 2004) of youth development. The “Five Cs” include *competence, confidence, connection, character, and caring/compassion* which represents positive attributes displayed by youth and indicates healthy developmental outcomes. Zarrett and Lerner (2008) asserts that a child or adolescent who develops each of these “Five Cs” is thriving and eventually develop a “sixth C,” that is, *contribution* to self, family, community, and civil society.

The PYD model supports youth empowerment by aligning strengths in youth with resources for healthy development and position functioning (Hameed et al., 2017). The PYD approach attempts to create a supportive structure that offers youth positive, asset-building experiences and meaningful, supportive relationships (Norton and Watt, 2014) that in turn will develop critical awareness to effectively collaborate for the betterment of their communities (Ledford et al., 2013). Research shows (Bell et al., 2009; Russell, 2001) that when students are involved in community-building and service-learning activities they develop civic responsibility. They are also empowered to take ownership of their communities and are more motivated to become problem solvers and make life-long contributions to their communities.

Apart from identifying positive developmental outcomes, the PYD framework can help adults better understand, educate, and engage children in productive activities since it focuses on treatment and prevention of maladaptive tendencies in youth (Damon, 2004) and provides opportunities for youth empowerment. The developmental systems theory-based model of PYD, recognizes the importance of community-based, structured, out-of-school-time (OST) activities (Balsano et al., 2009) to provide youth with competency building experiences. Scheduled programs rich in organized time with adult supervision, and developmentally appropriate skill building opportunities are catalysts to positive youth development (Bartko & Eccles, 2003; Mahoney, Larson, Eccles, & Lord, 2005).

In a longitudinal study, Lerner and Lerner (2013), discovered structured OST learning, leadership experiences, and adult mentoring received through participation in PYD programs, played a vital role in helping youth achieve success. Vandell et al., (2007) postulates that youth involved in PYD programs excel beyond their peers and are four times more likely to surpass the “Five C’s” of positive youth development and make meaningful contributions to their communities. Heinze et al., (2010) report that PYD programs provide caring and supportive relationships along with prospects for youth to increase skill building, strength identification, and personal growth, which in sum can enhance overall youth competencies.

PYD and Science

A key challenge to the development of agriculture in The Bahamas is the lack of trained professionals to advance the industry forward (Arisoy, 2007). An essential component of the developmental plan is to stimulate youth interests and involvement in agricultural vocations (FAO, 2014). Any comprehensive approach to developing capacity in agriculture should consider deficiencies in pre-tertiary schools and educational institutions. Important prerequisites include addressing competency deficits in science, math and other STEM related subjects, creation and implementation of relevant and responsive curriculum and instruction materials, provision of suitable models to attract and strengthen youth involvement in science and agricultural initiatives, and a focused and deliberate approach to destigmatize agricultural occupations and improve youth perception. PYD programs can assists in bridging the gap between agriculture and science education and provide supportive frameworks on which innovation and diversification of Bahamian agricultural systems can be built.

PYD for Capacity Building

The lack of access to information, resulting in the inadequacy of knowledge and technical skills create barriers to agricultural progression in The Bahamas. PYD programs create opportunities for youth to connect with exciting advances in STEM related disciplines (Kress, 2014). Through PYD models, youth develop skills, attitudes and behaviors that support their own personal leadership development as well as the development of their communities. The *Social Change Model for Leadership Development* (Higher Education Research Institute, 1996) promotes the values of self-knowledge, personal empowerment and citizenship through collaboration and inclusive processes. Students are empowered and motivated to facilitate social change and make significant contributions to the advancement of agriculture when they are given experiences that align with their developmental potential. Limitations to youth involvement in agriculture can be remedied through PYD initiatives thereby contributing to sustainable changes in the local agriculture sector. Such considerations, including the reform of social, political and economic frameworks, are worthwhile interventions to support innovation and diversification of The Bahamian agricultural system.

Participation in after school programs, cooperative learning models, and interactions with competent adults have been shown to benefit children's social and academic development (Child Study Journal, 2003). Research on teaching revealed that 80% of most instruction has been lecture, across disciplines (Greenberg, 1991), and that 95% of talk-time in the classroom belonged to the teacher (Freiburg & Driscoll, 1996). With experiential or inquiry-based learning approaches being relegated by standardized tests and traditional lecture-based teaching, the competency of future professionals comes into question. The educational opportunities provided to students should align with research about the characteristics and needs of young adolescents regarding their physical, psychological, and moral development (Payne & Edwards, 2010). PYD programs become essential in providing experiences that focus primarily on real-world problem-solving strategies rather than on course credit or specific job skills training (Kendall, 1990). Such programs add enrichment opportunities for students far beyond traditional classroom instruction since they engage students in non-traditional learning experiences.

Agricultural Education Models

Agriculture in the Classroom

Agriculture in the Classroom (AITC) (USDA, 2011) is a concept that can help BAMSI (and by extension, The Bahamas) in its goal to improve agricultural capacity. The AITC program was formally established in 1982 by the United States Secretary of Agriculture to address the decline in farm populations and to increase awareness of agriculture within public schools (Lesser et al., 2003). AITC programs align with educational standards to integrate accurate agricultural information into the instruction of social studies, science, mathematics, language arts and other required subjects (National Agriculture in the Classroom, 2011a). In recognizing the interrelated disciplines of agriculture and education more can be done to provide opportunities for agricultural integration into the classroom. Promoting knowledge of food and agriculture in the K-12 classroom creates greater capacity building potential by increasing the number of young people who might consider vocations in the food industry.

National 4-H Program

For more than a century, 4-H has been reaching youth around the world with after-school science education (Kahler & Valentine, 2011), substantially bridging the gap between scientific knowledge and experiential learning. 4-H provides in-school enrichment programs, after-school programs, clubs, and camps that offer a variety of science education opportunities, from agricultural and animal sciences to rocketry. 4-H science programming creates the spark to ignite a passion for science (Kahler & Valentine, 2011). To address the critical challenge of national food security through the advancement of agriculture, The Bahamas must strengthen its focus on advanced curricula and robust programs that provide youth with the resources and experiences needed to be successful in science-related vocations (Kahler & Valentine, 2011).

Research Questions

The questions guiding this research were:

1. What scientific knowledge and agricultural skills did students report based on pre/post-tests assessments after participation in the PYD pilot project *Soil to Supper*?
2. How can participation in the PYD pilot project *Soil to Supper* support capacity building for agricultural development in The Bahamas?

Methodology

BAMSI and PYD in Agriculture

A critical component of BAMSI is the provision of a cadre of trained graduates who will form the basis for the facilitation of an agricultural advisory/outreach programme. This agricultural extension programme will lead to the expansion of trained agricultural personnel through which a new culture for the production of crops and livestock will be channelled.

BAMSI's collegiate 4-H club is a student member-based club for agriculture and positive youth development. In Fall 2017 BAMSI's collegiate 4-H members developed and implemented a pilot project called *Soil to Supper* on the island of North and Central Andros. Patterned after global 4-H models, the *Soil to Supper* pilot project employed hands-on learning and inquiry-based strategies to support agricultural leadership and community development through youth empowerment. The goal of the *Soil to Supper* project was to build capacity for local agriculture on the island of Andros by encouraging youth participation and leadership in agriculture-based projects. BAMSI students and affiliates acted as agriculture advisors using scientific knowledge and practices to teach agricultural skills to primary level students.

<u>Participant Selection</u>

A convenience sample of students from Mastic Point and Stafford Creek Primary schools was selected to participate in the *Soil to Supper* project. Considerations for student participation included i) school's proximity and accessibility to BAMSI's faculty and students ii) students' age range, iii) suitable area on campus for establishment of garden plots, and iv) school's, parent's, and student's willingness to participant in the *Soil to Supper* project. A total of 74 (N) students participated in Soil to Supper in grades 4-6 with 37 included in data analysis. Mastic Point included 53 participants and Stafford Creek 21 participants. The project lasted 25 weeks; from September 2017 to March 2018. Thirty-seven students completed all the pre- and post-tests and were used for the analysis of data. Students who did not complete all the lessons and assessments were not included in the analysis.

Consent letters were sent to principals and parents of participating schools to secure school and student involvement. Agreement was sought on the following: i) calendar of school events, ii) weekly engagement time and length of each session, iii) location of production plots, iv) proposed number of student participants, and v) existing equipment/tools available for use in *Soil to Supper* project.

Establishing Vegetable Garden

BAMSI 4-H worked with student participants to establish farm plots. Twenty-four planter pots were used at each school farm to grow five crops. Tomatoes, lettuce, eggplants, peppers, and cabbages were planted. Each planter pot was filled with soil, manure and potting mix and served as the medium for which crop seedlings were planted. Crops were chosen based on i) availability, ii) climate and season favourability, iii) length of time needed to mature and harvest, and iv) market viability. BAMSI 4-H club members worked alongside students to establish and maintain vegetable gardens.

Curriculum Design

The Soil to Supper curriculum was created by the researcher in collaboration with BAMSI faculty and 4-H club members. Curriculum framework was built around the PYD model and incorporated important components for adolescent development. The curriculum included five lessons; i) farm skills, ii) crop management, iii) water management, iv) soil management and v) the food industry (See Appendix B). The curriculum was designed to build on students' prior knowledge and to support the Ministry of Education's (MOE) science syllabus. Considerations for curriculum development included the MOE's science education learning objectives for grades 4 - 6 in areas related to agriculture. The curriculum centred around increasing student knowledge of the value-added process of agricultural goods while gaining the scientific knowledge and skills to support science education objectives and by extension the agricultural industry.

The *Change Model of Leadership Development* (Higher Education Research Institute, 1996) assumes that leadership is a collaborative and social process that is based on values of trust and a desire to bring about positive change. The *Soil to Supper* project provided leadership opportunities by creating avenues for students to effect positive changes in their environments while they develop their own character and competencies (Fletcher & Varus, 2006). The program created challenging and enriching activities to support and extend student knowledge and skill capabilities. Students were afforded the opportunity to learn important leadership skills, including building effective communication and teamwork, as they worked together to care for and maintain their vegetable gardens. By communicating the goals and outcomes of the *Soil to Supper* project to their peers, teachers and parents, students were empowered with the ability and autonomy to be change agents in their schools and communities.

Positive engagement between students and competent, caring adults was achieved through weekly lesson engagements in formal and informal settings. In these sessions leadership values were encouraged. The curriculum facilitated prolonged engagements with BAMSI student advisors so that student participants could form trusting and meaningful relationships with their advisors and became comfortable in their learning environments. Students were also encouraged to ask questions, make suggestions and relay their concerns to their advisors as they became partners in their own learning experience. The *Soil to Supper* curriculum supported youth-adult partnership by working along with students to plant and grow their vegetable gardens. Collaborative exchange was encouraged in formal and informal lessons to help students develop cognitive and social skills (Weimer, 2012).

The *Soil to Supper* curriculum supported the building of positive life skills through its PYD framework and experiential learning approach. Adhering to the experiential learning theory (Kolb, 1984), the *Soil to Supper* curriculum allowed students to transfer theoretical knowledge gained through formal and informal learning experiences to practical knowledge by growing their vegetable gardens.

The curriculum included objectives for each lesson, an overview of the content, key terms, and suggested activities. The curriculum content majorly focused on science related to agriculture, in addition to practical farming skills. Content supported both the MOE science-based learning objectives as well as PYD *Soil to Supper* project objectives. That is, to increase science aptitudes. It is believed that competencies, knowledge, and skills gained, can be directed into agriculture as a capacity building tool. The curriculum acted as a support guide for student advisors and provided them with guidelines on what each lesson should entail. This ensured consistency and accuracy of information at both participating schools.

Lessons and Engagements

The purpose of the lessons was to teach scientific knowledge and skills that are important for the advancement of agriculture using a hands-on learning approach. The lessons included pre-tests, post-tests, and fieldtrips. Formal lessons were taught in the school's atrium or designated classroom. Lessons were followed by practical engagements on the farm plots where students' learning was enforced, and technical skills were applied. Students learned how to grow and maintain their vegetable gardens using sound agricultural and scientific knowledge.

Assessments

To help answer the research questions, students were given pre-tests/post-tests as a formative assessment tool to evaluate changes in their knowledge of agriculture/farming over the course of the *Soil to Supper* curriculum. The pre-tests/post-tests design allowed measurement of student knowledge to be done before and after the lessons. With this method, an overall change in student scientific and agricultural knowledge was evaluated.

Pre-tests/post-tests design was the preferred method to measure the degree of change that occurred among participants since educators have concluded that the use of a pre/post-test can yield exceptionally compelling information on what students have learned during a course or program (Suskie, 2004). Pre-tests allowed the instructors to determine students' entry level knowledge (Boyas et al., 2012), giving insight on how the *Soil to Supper* curriculum can be adjusted in future studies to better meet student needs. Each assessment consisted of five questions and was based on the objectives and content covered in the *Soil to Super* curriculum. Pre-tests/post-tests assessments included selected-response (multiple-choice, matching) questions and constructed-response (short answer) questions. The question types varied to suit differences in students reading and writing skills, comprehension, and spelling. Student age groups was also an important consideration in the design and implementation of both the lessons and pre/post-tests formats. Lesson and assessment formats were tailored to upper primary level to reduce discrepancy in the range of student participants and to ensure consistency between schools.

Multiple-choice and matching question formats were used since they test knowledge quickly within large groups, can be used to provide quick and reliable feedback, and can be automatically scored and analysed with regard to difficulty and discrimination (Roberts, 2006). In reference to test reliability and validity, selected-response questions are generally more reliable than other assessment formats since test takers are more likely to receive similar scores if they retake (for example) a multiple-choice test than if they retake a constructed response or performance-based test (Croft et al., 2015). Multiple-choice tests also cover a broad range of content standards in a relatively short amount of time, and typically have more validity evidence (La Marca, 2001) providing a good sample of the test taker's knowledge (Livingston, 2009) and accurate test scores. In consideration of the age-group tested, multiple-choice and matching question formats were favourable options because they provided feedback to students and supported and guided their thought processes as they interpreted and attempted to answer questions.

Constructed-response questions, in addition to selected-response questions was used in each pre-test/post-test evaluation. Constructed-response questions have been shown (Livingston 2009; Baldwin, 2008; Hogan & Murphy, 2007) to induce students' deduction and reasoning abilities as they are required to construct responses based on their own cognitive capabilities. It was determined by Osterlind and Merz (1994) that offering constructed-response test items in addition to selected-response, would provide information on the examinees achievement, ability and aptitude beyond what is learned from the selected-choice format.

Data Collection

Data was collected through pre-tests/post-tests format at the beginning of each lesson. Students were given post-test of the previous lesson followed by the pre-test of the next lesson prior to the lesson being taught. Each student was assigned two booklets, one booklet headed "Pre-Test: What Do You Know?" and a second booklet headed "Post-Test: What Do You Know Now?" (see Appendix B). Tests were administered in school's atrium or designated classroom. BAMSI student facilitators read each question aloud prior to students completing the assessment to decrease response error. Students were given adequate time to complete pre-tests/post-tests, but consideration was given to students if extra time was needed. Students were monitored and prompted of which lesson they were to complete prior to start time. Each lesson was numbered one through five with the lesson topic at the top of each page (See Appendix B). At the end of each tests, student booklets were collected and filed in designated pre-tests/post-tests folders. Evaluation of students' agricultural knowledge and understanding of farming was done throughout the length of the BAMSI 4H *Soil to Supper* project through informal teaching and learning opportunities. However, for this study, evaluation of the pre-tests/post-tests questionnaires was used as primary data to answer research question one: *What scientific knowledge and agricultural skills did students report based on pre/post-tests assessments after participation in the PYD pilot project Soil to Supper?*

Data Analysis

This study assessed knowledge gained in pre-tests and post-tests scores before and after participation in the PYD program *Soil to Supper*. In this study, the term *knowledge gained* represented actual improvement in tests scores over the span of the *Soil to Supper* project. Students' inconsistency in remaining after school to participate in the Soil to Supper project decreased the number of valid pre/post-tests submissions to n=37 participants successfully completing both pre-tests and post-tests for the five lessons. The independent variable (PYD *Soil to Supper* curriculum) was the treatment used at both schools to evaluate the dependent variable (knowledge gained) of student participants. Knowledge gained was calculated by subtracting correct answers from students' pre-tests with correct answers from students' post-tests. The means of both the pre-tests and post-tests were calculated. I hypothesized that "If students participated in the PYD *Soil to Supper* program then students' pre/post-tests scores would increase significantly representing knowledge gained in science and agriculture."

- The *null hypothesis* (H_0) assumes that the *true mean difference* (μ_d) is equal to zero (H_0: $\mu_d = 0.00$), assuming no statistically significant difference in pre/post-tests scores.
- The *two-tailed alternative hypothesis* (H_1) assumes that the *true mean difference* (μ_d) is not equal to zero (H_1: $\mu_d \neq 0.00$), assuming a significant difference in pre/post scores.

Scores from both schools were combined and knowledge gained assessed by calculating the means of the pre-tests and post-tests of each lesson (see Table 1). Data analysis was based on 5 data sample sets from the 5 lessons taught. To determine if differences between the two means were statistically significant the paired two sample for means t-test was done. This method was chosen because it examines the relationship between two population means and can be used to analyse differences within small sample sizes. From this method the p-value for pre/post-tests was calculated and compared to the level of significance *alpha* (α) 0.05. Values less than α denoted an increase in knowledge gained over the course of the *Soil to Supper* project (i.e. H_1: $p < 0.05$), while values greater than or equal to α represented no significant improvement in knowledge gained (i.e. H_0: $p \geq 0.05$).

The Student t-tests makes a few assumptions (Maverick, 2018) about the sample data that must be adhered to in order to validate the results of this study. These assumptions include:

- the scale of measurement applied to the data collected follows a continuous or ordinal scale,
- the data is collected from a representative, randomly selected portion of the total population,
- the data, when plotted, results in a normal (bell-shaped) distribution curve, and
- a homogeneous, or equal, variance exists when the standard deviations of samples are approximately equal.

For this study the measurement scale for data collection was numeric and continuous. All pre/post-tests samples were collected and calculated independently without replacement. The assumption of normality of data distribution was satisfied by estimating the skewness and kurtosis levels. The skewness levels were calculated at *M*=0.716 (pre-tests) and *M*=0.0391 (post-tests), kurtosis mean levels were estimated at *M*=0.329 (pre-tests) and *M*= -0.901 (post-tests). Levels for both pre-tests and post-tests were in the maximum allowable values for a t-test; i.e., skewness < |2.0| and kurtosis < |9.0| (Posten, 1978, 1984). In consideration of early theoretical findings, the two-sample t-test is fairly robust against violations of the normality assumption (Borneau, 1960; Neave & Granger, 1968; Bartlett, 1935). To determine whether the variances of the two sample tests were approximately equal, a Levene's Test of Homogeneity of Variances (see Table 2) was conducted where p=0.625. Since the *p-value* of the Levene's test was greater than α 0.05, it is assumed that the null hypothesis is supported and that there is no significant difference between the variances of the two sample populations.

Results

A paired sample t-test was conducted to compare student knowledge gained before and after participation in the PYD *Soil to Supper* project. For the five lessons combined, there was a significant difference between students mean pre-tests (M=160.0; SD=84.97) and post-tests (M=240.4; SD=98.42) scores (see Table 5). The overall difference in mean pre/post-tests scores revealed substantial improvement (i.e. knowledge gained) in student performance. This difference was statically significant, having a calculated probability value of $p<0.001$. When compared to the significance value *0.05*, the null hypothesis (i.e. H_0: $p \geq 0.05$) of no significance in mean pre/post-tests was rejected, *(t)*36 = -8.77, $p<0.001$. Therefore, the alternative hypothesis (i.e. H_1: $p<0.05$) that participation in the PYD *Soil to Supper* program significantly increased student knowledge in science and agriculture was found to be true. A Pearson's *r* data analysis revealed a strong positive correlation, r = 0.985 between students' pre/post-tests scores. Results showed an increase of tests scores with each lesson taught between pre and post-tests (see Table 5).

Pre-tests and post-tests means, standard deviations, and percent difference in knowledge gained for each lesson were calculated and displayed in Table 4. The table shows percentages of correct responses for the pre-tests and post-tests and the percent differences between them. For each lesson there was an increase in pre/post-tests scores. The difference between means scores was statistically significant for each of the five lessons, having a probability value of $t(37)=-8.77$, $p<0.001$. Overall, the mean pre-tests scores (percentage correct responses) was 41.9%, compared to mean post-tests score of 64.9%. On average, students showed an increase in knowledge gained of 23% after participation in the *Soil to Supper* program. Lessons 3 and 4 showed the lowest percentage difference in pre/post-tests scores. The t statistic for these lessons had the lowest value, $t(37)=-5.46$ and $t(37)=-4.78$ respectively. Although there was an increase in post-tests scores (lesson 3 and 4), the results showed that the treatment had the least impact on knowledge gained. Lessons 1, 2 and 5, showed the greatest increase in student knowledge. Percent difference in tests scores was calculated at 27.3, 27.1, and 26.2 respectively. These differences also had the highest *t-value* providing supporting evidence against the null hypothesis (see Table 4).

Discussion

To answer the research questions guiding this study, the results of this revealed statistically significant difference in knowledge gains after student participation in the PYD *Soil to Supper* project. Improvements in student knowledge was shown consistently for each of the five lessons taught, having a calculated probability value of $t(37)=-8.77$, $p<0.001$ (see Table 3). Correct responses in pre/post-tests increased 23% on average and students' overall mean score increased 80.4 points, from mean pre-tests ($M=160.0$, $SD=84.97$) and post-tests ($M=240.4$; $SD=98.42$) (see Table 4). The increase in knowledge was attributed to students' participation in PYD *Soil to Supper* project. Students' learning was influenced by their exposure to content covered during the program, as well as the way the content was presented to them. The PYD model used for students' engagement in OST activities exposed youth to caring, competent and committed adults, and helped to increase their developmental assets and improve learning outcomes. These findings are important because they support learning outcomes through PYD.

Lessons 1, 2 and 5, showed the greatest percent increase in student knowledge (*M*=26.9%) (see Table 4). Lessons 1 and 5 focused more on agricultural practices than science objectives. All five of the questions asked (lessons 1 and 5) pertained to skills and knowledge acquired due to practical engagements on farm plots along with experiential learning activities (see Figure 1) . In *Lesson 1: Farm Skills*, students' scores increased significantly from mean pre-tests (*M*=4.32; *SD*=1.88) and post-tests (*M*=7.05; *SD*=1.79), showing the highest improvement of 27.3% in knowledge gained (see Table 4). The objectives for this lesson focused on identification and use of garden tools, farm safety, and healthy farming and hygiene practices (see Appendix B). In *Lesson 5: Food*, students' scores increased significantly from mean pre-tests (M=5; SD=2.1) and post-tests (*M*=7.76; *SD*=2.13), showing the third highest improvement of 26.2% in knowledge gained (see Table 4). The objectives for this lesson focused on crops, food products, and the food industry (see Appendix B). The increase in youth farming skills and agricultural knowledge is an important part of the agricultural developmental plan of The Bahamas. Theoretical knowledge enforced with hands-on practical educational experiences were used to develop better understanding of content and to achieve curriculum objectives.

Kidane and Worth (2013) suggest that the accessibility and utilization of instructional resources during agricultural science lessons had positive impacts on students' knowledge and attitudes towards the subject. The authors further posit that teaching and learning of agriculture in pre-tertiary education was greatly impeded by lack of fields and science laboratories for practical experiences to facilitate learning. Darko, et al., (2016) also concluded that lack of school gardens, animal farms, educational trips, demonstration plots, and well-equipped laboratories greatly impede practical work in agricultural science. The utilization of practical resources during the *Soil to Supper* project to facilitate agricultural education aligns with these findings, in that students attained significantly higher scores after exposure to hands-on, real-world agricultural learning experiences.

In Lesson 2: *Soil*, students' scores increased significantly from mean pre-tests (*M*=2.72; *SD*=1.14) and post-tests (*M*=4.62; *SD*=1.62), showing the second highest improvement of 27.1% in knowledge gained (see Table 4). The objectives for this lesson focused on soil profile, soil components and the importance of soil in crop production (see Appendix B). Objectives for Lesson 2 was mainly science-based, with only one of the five questions relating to the practice of agriculture. Students showed low base-line knowledge of soils and soil components as a medium for crop growth, scoring on average only 38.9% correct response in pre-tests (see Table 4). This low baseline knowledge could be attributed to limited practical exposure to the subject content during classroom-based lessons. The *Science Community Representing Education* ([*SCORE]*, 2018), described science as an empirical subject, where learning is often more effective when it incorporates hands-on experiences that contribute to increasing knowledge and conceptual understanding. The PYD *Soil to Supper* project encouraged interactive teaching methods, such as demonstrations and fieldwork to support students' understanding of science and agriculture. This approach proved to be successful as participants scored on average, 66% correct responses in post-test (see Table 4).

Lessons 3 and 4, showed the lowest percent increase in student knowledge (*M*=17.3%). Lessons 3 and 4 focused more on science objectives than agricultural practices (see Figure 1). Four of the five questions asked (lessons 3 and 4) subscribed to students' knowledge of scientific properties and processes. In Lesson 3: *Water*, students' scores increased marginally from mean pre-tests (*M*=1.81; *SD*=1.02) and post-tests (*M*=3.18; *SD*=1.39), with an overall improvement of 19.7% in knowledge gained (see Table 4). The objectives for this lesson focused on the chemical structure of water, water properties and their importance to plant growth, fresh water sources and conservation (see Appendix B). Students showed low base-line knowledge of water and water properties, having the lowest average score of 25.8% correct responses in pre-tests (see Table 4). Although students did show improvement in post-tests results, the mean percent knowledge gained was still below average at 45.5% correct responses.

In Lesson 4: *Crops*, students also showed a slight increase in pre/post-tests mean scores, from mean pre-tests (*M*=7.75; *SD*=2.95) and post-tests (*M*=10; *SD*=2.44), with the lowest overall improvement of 14.9% in knowledge gained (see Table 4). The objectives for this lesson focused on various parts and characteristics of plants and their functions, plant biological processes and plants as food source (see Appendix B). Noteworthy is the fact that despite having the lowest improvement in correct pre/post-tests responses, students showed the highest base-line knowledge of 51.7% in pre-tests scores. Students' scores increased slightly in post-tests results to 66.6% correct responses. The high base-line score could be a result of students' exposure to previous *Soil to Supper* lessons, particularly lessons 2 and 3 that incorporated information on plant parts and processes. For example, Lesson 3 provided information about the function of roots and stems in the acquisition and transport of water from the soil to the leaves for photosynthesis. High base-line scores could also be credited to students' exposure to subject content during classroom-based lessons and activities on plants as specified in the MOE science curriculum. Both mechanisms would contribute to participants knowledge and high base-line results.

Lessons that focused specifically on students' scientific knowledge (Lessons 2, 3, and 4) had the lowest percent improvement overall, with the exception of Lesson 2. Students did not perform as well on the science knowledge questions in the pre and post-tests. Paired with the Soil to Supper curriculum to support the science, there was an improvement in the science-based question scores from students. Lower overall results in students' science aptitude questions could be due to their attitude towards science and lack of interest in learning scientific processes. However, increase in science aptitude post-tests shows that students' science abilities can improve if their learning is supported by experiences that spark their interests and appeals to their sense of curiosity. Students perception of science as being difficult or irrelevant tends to result in the development of a general negative attitude towards science (William et al., 2008). It is stated that attitudes of students towards science is one of the key factors affecting the students' science achievements (Çibir & Özden, 2017). PYD projects such as *Soil to Supper* can shift the negative view of agriculture and science among students and help to build a healthy perception of science and agriculture education. The increase interest in science and science vocations can create tributary channels for BAMSI, strengthening agricultural capacity and development.

Limitations

The study seeks to understand the correlation between PYD programs and agricultural development. However, small population size (n=37) of students that actively participated in the research creates limitations to interpreting the implications of the results in regard to the larger population. Generalizations to a large degree will have to be made to address agricultural development on a national scale.

Data collection relied on students' ability to remain after school to participate in the Soil to Supper project. This created challenges in that student participation was inconsistent due to bus scheduling, school activities, and out-of-school/sick days. Data collection was also sometimes disrupted by students having to leave abruptly during lessons and test taking. These limitations decreased the number of valid pre/post-tests submission by 50%, having only n=37 active participants as oppose to qualified population of n=74. Constraints on students time as well as their sporadic attendance to lessons and informal training could have affected study results. If more time were available to engage students consistently throughout the length of the project, coupled with consistent attendance, more accurate results could have been achieved and reported.

More research must be done in The Bahamas regarding PYD and agricultural development. There is limited access to data relevant to The Bahamas to address the assumptions made in this study, including students lack motivation and interests in agriculture, and students' attitude towards agriculture. The study would need to be replicated for reliability and validity purposes.

Conclusion

The purpose of this study evaluated the Bahamas Agriculture and Marine Science Institute's (BAMSI) collegiate 4-H *Soil to Supper* pilot project as a viable PYD model to build capacity for the advancement of agriculture in The Bahamas. The study's objectives were to:

Objective 1: assess knowledge gained after completion of the Soil to Supper curriculum.

The results of this study showed that students had significant gains in knowledge after completion of the *Soil to Supper* project. Students showed learning improvements in each of the five pre/post-tests. Tests scores increased 23% on average and students' overall mean score increased 80.4 points from mean pre-tests (M=160.0, SD=84.97) and post-tests (M=240.4; SD=98.42) (see Table 4).

Objective 2: explore the ability of the Soil to Supper project to increase science aptitudes and build capacity for the agricultural industry in the Bahamas.

The increase in student scientific knowledge and practical agricultural skills displayed by participants has capacity building potential for The Bahamian agricultural industry. Previous research shows that the positive youth development (PYD) framework that supports the *Soil to Supper* pilot project, can make transformative changes to youth knowledge, attitude and behaviour, through empowerment, skill building, and experiential learning opportunities. Strengthening students' science knowledge-base and teaching them how to use scientific knowledge to effect positive changes through agricultural initiatives like *Soil to Supper*, can intensify youth involvement in agriculture and encourage youth to choose science and agricultural vocations.

Objective three: determine the replicability of the Soil to Supper pilot project as a sustainable PYD program.

PYD's *Development Systems Theory – The 5C's* (Lerner & Lerner, 2013), focuses on contextual characteristics that support positive youth developmental behaviour. The theory is founded in the developmental psychology literature and the brain's plastic nature, or ability to change throughout one's life. The PYD theory subscribes a strengths-based approach to adolescent development, viewing youth as 'resources to be developed' rather than 'problems to be solved' (Lerner, Brown, & Kier, 2005). This approach places youth at the center of program activities, as experiences are tailored to suit their developmental needs.

The program model makes clear, three fundamental inputs needed to support PYD outcomes. Highlighting, competency building, positive relationships and partnerships with adults, and opportunities for youth to engage in leadership and community development initiatives. These broad-base contexts allow for diversity in program planning and objectives, making the PYD model adaptable and suitable for a wide-range of program designs and outcomes. Program planning can include various tools of assessment, implementation and evaluation to achieve the five developmental outcomes: caring, character, connection, confidence and competence.

The *Soil to Supper* pilot project can be replicated and serve as a sustainable PYD program. Using the curriculum as a guide to develop and implement program activities and opportunities for youth to enhance their knowledge and skills, can translate into positive outcomes for youth participants. Critical examination of the PYD model to determine how to translate the guiding theory into practical experiences for youth must be considered before program is replicated. Program leaders must have a clear understanding of how youth engagements and experiences facilitate the development of the 5C's.

Recommendations

Recommendations for future work as a practitioner involve longitudinal studies that support empowerment and education for youth. Expanding models of support similar to 4-H and AITC and piloting programming similar to these would increase the initiatives for youth and increase the number of youths exposed to education about agriculture. Sustainable development in agriculture necessitates youth development. While systems have been put in place to drive Bahamian agricultural production forward, a focused plan is needed to include the role of youth in the development of the agricultural sector. Research (Çibir & Özden, 2017; William et al., 2008; Arisoy, 2007; Freedman 1997) concludes that programs focusing on increasing youth knowledge and agricultural capabilities are worthwhile investments to agricultural growth.

Since this curriculum was written and implemented once, it would be recommended that the curriculum be tested and continue to be refined with other age appropriate audiences in The Bahamas. Further refining of the assessments and lessons is necessary in order to address issues in the lack of learning reported based on the pre and post-tests. The study shows that youth respond well to PYD programs that challenge their thinking and exposes them to new opportunities for learning and development. Research that addresses the PYD components of the curriculum would be worthwhile in understanding and incorporating PYD models in future agricultural initiatives. Participants of the *Soil to Supper* pilot project showed significant improvements in science knowledge and practical agricultural skills. This study aligns with research (Awokuse, & Xie, 2015) that support youth engagement in agriculture as the way forward for developing countries like The Bahamas. More programming should be offered to expand youth involvement in agriculture and to provide educational and motivational programs, like *Soil to Supper*, to attract youth to the industry.

Continued work on implementing PYD programming will be paramount for both school-based and out-of-school programs. PYD programs such as *Agriculture in the Classroom* can be utilized to expose students to agriculture education and help them realize critical connections across subject disciplines. Such programs can also be used to strengthen agriculture classroom lessons and provide hands-on activities and scientific inquiry methods to improve knowledge gains and motivate students to pursue science and agricultural professions. As youth learn about these areas, their confidence increases and their capacity to lead agricultural development in The Bahamas expands.

Bringing attention to this project and other projects similar to this to government officials would be recommended. Since The Bahamas continues to build infrastructure, showing the curriculum and results could be used to impress the importance of agriculture education on decision and policy makers in the country. The lack of PYD programs in agriculture makes way for the pervasion of negative stereotyping of agricultural careers and professions. The stigma attached to agriculture perpetuates the underdevelopment of the industry by discouraging youth involvement. Government officials would benefit from this information and could use it as leverage to expand agricultural youth development programs related to careers and professional opportunities in agriculture. Such programs can also be used to destigmatize agricultural vocations.

In The Bahamas, research needs to be done to determine what youth know versus their misconceptions, the degree to which they are involved in agriculture currently, and their overall attitude towards agriculture. PYD is a new concept for The Bahamas and program leaders must understand and apply theoretical principles to maximize youth development potential. Workshops and professional development forums for those already involved in agriculture education is needed to impart new and modern strategies to delivering science-based, agricultural knowledge and practices. Empowering educators and program leaders to adopt hands-on, experiential learning models, could improve student performance in agricultural and science subjects. Likewise, increasing students' motivation and willingness to participate in agriculture-based projects and initiatives.

References

Agri-Vision 2021. (2017). *The Bahamas Agriculture and Marine Science Institute.* Nassau*:* Bahamas.

Arnold, M. & Silliman, B. (2017). From theory to practice : A critical review of positive youth development frameworks. *Journal of Youth Development, 12*(2), 1-20

Arısoy, N. (2007). *Examining 8th grade students' perception of learning environment of science classrooms in relation to motivational beliefs and attitudes*. Unpublished Theses in Middle East Technical University, Ankara, Turkey.

Awokuse, T. O., & Xie, R. (2015). Does agriculture really matter for economic growth in developing countries? *Canadian Journal of Agricultural Economics, 63*(1), 77-99. doi:10.1111/cjag.12038

Balsano, A. B., Phelps, E., Theokas, C., Lerner, J. V., & Lerner, R. M. (2009). Patterns of early adolescents' participation in youth development programs having positive youth development goals. *Journal of Research on Adolescence, 19*(2), 249259. doi:10.1111/j.15327795.2009.00595.x

Bartko, W. T., & Eccles, J. S. (2003). Adolescent participation in structured and unstructured activities: A person-oriented analysis. *Journal of Youth and Adolescence*, *32*, 233–241.

Bartlett, M., S. (1935). The effect of non-normality on the t distribution. *Mathematical Proceedings of the Cambridge Philosophical Society, (31)*2, 223-231.

Bell, P., Lewenstein, B., Shouse, A. W., & Feder, M. A. (Eds.). (2009). *Learning science in informal environments: People, places, and pursuits.* Washington, D.C.: The National Academies Press.

Bite, D., Kronberga, G., Kruzmetra, Z., & Janmere, L. (2015). Youth capability in the context of sustainable development. *Economic Science for Rural Development Conference Proceedings,* (38), 81-91.

Boyas, E., Bryan, L. D., & Lee, T. (2012). Conditions affecting the usefulness of pre- and post tests for assessment purposes. *Assessment & Evaluation in Higher Education*, *37*(4), 427-437. doi:10.1080/02602938.2010.538665

Boneau, A., C. (1960). The effects of violations of assumptions underlying the t-test. *Psychological bulletin, (37)*1, 49-64.

Building life skills through afterschool participation in experimental and cooperative learning. (2003). *Child Study Journal*, *33*(3), 165-174.

Catalano, R. F., Berglund, M. L., Ryan, J. A., Lonczak, H. S., & Hawkins, J. D. (2004). Positive youth development in the United States: Research findings on evaluations of positive youth development programs. *The Annals of the American Academy of Political and Social Science, 591*, 98-124.

Capacity Development: A UNDP Primer, 2010

Campbell, J. R. (1999). *Cognitive processes elicited by multiple-choice and constructed-response questions on an assessment of reading comprehension*. Doctoral Dissertation, Temple University. (UMI No. 9938651)

Carver, R. L. (1998). Experiential education for youth development. *Youth Development, 4*(4), 1-20.

Çibir, A., & Özden, M. (2017). Elementary school students' attitudes towards science: Kutahya sample. *Eğitim Bilimleri Araştırmaları Dergisi - Journal of Educational Sciences Research, 7*(2), 27-43.

Conway, G. (1999). *The doubly Green Revolution: Food for all in the 21st century*. Ithaca, New York: Cornell University Press.

Croft, M., Guffy, G., & Vitale, D. (2015). Reviewing your options: The case for using multiple choice test items. *ACT Research and Policy, Issue Brief*. Retrieved from www.act.org/research-policy

Darko, R. O., Offei-Ansah, C., Shouqi Y., & Jun-ping, L. (2015). Challenges in teaching and learning of agricultural science in selected public senior high schools in the Cape Coast Metropolis. *Agricultural Science, Science and Education Centre of North America. 3*(1), 13-20.

Damon, W. (2004). What is positive youth development? *The Annals of the American Academy of Political and Social Science*, *591*, 13–24.

Dermody, B. J., Sivapalan, M., Stehfest, E., van Vuuren, D. P., Wassen, M. J., Bierkens, M. P., & Dekker, S. C. (2018). A framework for modelling the complexities of food and water security under globalisation. *Earth System Dynamics*, *9*(1), 103-118. doi:10.5194/esd-9 103-2018

Dewey, J. (1938). *Experience and education*. New York: Collier Books.

Douthwaite, B. (2001). *The role of science in sustainable agriculture*. Social Issues Research Center. Retrieved http://www.sirc.org/articles/sustainable_agriculture.shtml

Eccles, J. S., & Gootman, J. A. (Eds.). (2002). *Community programs to promote youth development*. Washington, DC: National Academy Press.

Eccles, J., Midgley, C., & Adler, T. F. (1984). Grade-related changes in the school environment: Effects on achievement motivation. *Advances in Motivation and Achievement*, *3*, 283 331.

Encyclopaedia of Food and Culture. (2003). *Green Revolution*. Retrieved http://www.encyclopedia.com/plants-and-animals/agriculture-and horticulture/agriculturegeneral/green-revolution

Eneas, G. (2013). *Agriculture in The Bahamas: Historical Development 1492 – 2012*. Media Enterprises. Nassau; NP

Freedman, M. P. (1997). Relationship among laboratory instruction, attitude toward science, and achievement in science knowledge. *Journal of Research in Science Teaching, 34*, 343- 357.

Farmer, B. H. (1986). Perspectives on the 'Green Revolution in South Asia. *Modern Asian Studies. 20*(01): 175–199. doi:10.1017/s0026749x00013627.

Fletcher, A., & Varvus, J. (2006). *Guide to social change led by and with young people*. Social Learning and Community Engagement Projects. Retrieved https://digitalcommons.unomaha.edu/cgi/viewcontent.cgi?article=1024&context=slce guides

Food and Agriculture Organization. (2014). *Youth and agriculture: Key challenges and concrete solutions*. Retrieved http://www.fao.org/3/a-i3947e.pdf

Food and Agriculture Organization. (2017). *State of Food Insecurity in CARICOM Caribbean*. Retrieved from http://www.fao.org/3/a-i5131e.pdf

Frizell-Armitage, A. (2016). *Plant artificial chromosome technology*. Global Plant Council. Retrieved https://blog.globalplantcouncil.org/future-directions/plant-artificial chromosome-technology/

Galvan, C., & Parker, M. (2011). Investigating the reciprocal nature of service-learning in physical education teacher education. *Journal of Experiential Education*, *34*(1), 55-70. doi:10.5193/JEE34.1.55

Giovannucci, D., Scherr, S., Nierenberg, D., Hebebrand, C., Shapiro, J., Milder, J., & Wheeler, K. (2012). *Food and Agriculture: the future of sustainability. A strategic input to the Sustainable Development in the 21st Century (SD21) project*. New York: United Nations Department of Economic and Social Affairs, Division for Sustainable Development

Heinze, H. J., Jozefowicz, D. M. H., & Toro, P. A. (2010). Taking the youth perspective: Assessment of program characteristics that promote positive development in homeless and at-risk youth. *Children and Youth Services Review, 32*, 1365-1372.

Higher Education Research Institute. (1996). *A social change model of leadership development guidebook. Version III*. Los Angeles, CA: Higher Education Research Institute.

Hogan, T. P., & Murphy, G. (2007). Comparative review: Recommendations for preparing and scoring constructed-response items: What the experts say. *Applied Measurement in Education*, *20*(4), 427-441. doi:10.1080/08957340701580736

Houwer, R. (2015). *Changing Leaders, Leading Change: A Leadership Development Model for Marginalized Youth in Urban Communities*. Retrieved from http://youthrex.com/demystifying-positive-youth-development-pyd/

INTRAC (2006). *Investigating the mystery of capacity building, learning from the Praxi Programme.* Conference Paper, James and Wrigley, Oxford, 2005.

Johnson, A. M., & Notah, D. J. (1999). Service learning: History, literature review, and a pilot study of eighth graders*. The Elementary School Journal*, *99*(5), 453–467.

Joshi, A., Kale, S., Chandel, S., & Pal, D. K. (2015). Likert scale: Explored and explained*. British Journal of Applied Science & Technology, 7*(4): 396-403.

Kahler, J., & Valentine, N. (2011). Stemming the gap. *Education Digest*, *76*(6), 54-55.

Kendall, J. C. (1990). *Combining service and learning: An introduction. In J. C. Kendall (Ed.), Combining service and learning: A resource book for community and public service*. Raleigh, NC: National Society for Experiential Education.

Kesavan, P. C. (2015). Shaping science as the prime mover of sustainable agriculture for food and nutrition security in an era of environmental degradation and climate change. *Current Science* (00113891), *109*(3), 488-501.

Kidane, T. T., & Worth, S. H. (2013). Attitude of students in the formal education sector towards agricultural education and training in South Africa. *Journal of Human Ecology, 44,* 53- 63.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development.* Englewood Cliffs: Prentice-Hall.

Kress, C. (2014). Transformational education: The 4-H legacy. *Reclaiming Children and Youth 23*(3), 5-9.

Lerner R. M. (2004). *Liberty: Thriving and civic engagement among American youth*. Thousand Oaks, CA: Sage Publications.

Lerner R. M., Brown J. D., Kier C. (2005). *Adolescence: Development, diversity, context, and application*. Toronto: Pearson.

Lerner, R., & Lerner, R. V. (2013). The positive development of youth: Comprehensive findings from the 4-h study of positive youth development. *Institute of Applied Research in Youth Development.* Retrieved from https://4-h.org/wp content/uploads/2016/02/4-H-Study-of-Positive-Youth-Development-Full-Report.pdf

Lesser, V. M., Newton, L., & Amer, S. (2003). *National summary of Agriculture in the Classroom programs survey: 2001/2002*. Corvallis, OR: Oregon State University Survey Research Centre. Retrieved from http://www.agclassroom.org/naitc/pdf/ summary_report.pdf

Mahoney, J. L., Larson, R. W., Eccles, J. S., & Lord, H. (2005). Organized activities as development contexts for children and adolescents. In J.L. Mahoney, R.W. Larson, & J.S. Eccles (Eds.), *Organized activities as contexts of development* (pp. 3–22). Mahwah, NJ: Erlbaum.

Maverick, J.B. (2018). *What assumptions are made when conducting a t test?* Investopedia. Retrieved https://www.investopedia.com/ask/answers/073115/what-assumptions-are made-when-conducting-ttest.asp

McAuliffe, G. J. (2002). Student changes, program influences, and adult development in one program of counsellor training: An Exploratory Inductive Inquiry. *Journal of Adult Development*, *9*(3), 205.

Meadows, R. (2013). Initiative promotes youth development, healthy living, science literacy. *California Agriculture*, *67*(1), 9-12.

Muller, P. H. (2006). *Encycl. Br*.; Retrieved from https://www.britannica.com/biography/Paul Hermann-Muller

National Agriculture in the Classroom Organization. (2011a). *Agriculture in the Classroom White Paper*. Retrieved from http:// http://www.agclassroom.org/naitc/pdf/white_paper.pdf

National Commission on Service-Learning. (2002). *Learning in deed: The power of service learning for American schools*. Retrieved from http://www.wkkf.org/knowledge-center/ resources/2002/10/learning-in-deed-the-power-of-service-learning-for-american schoolsfullreport.aspx

National Middle School Association (NMSA). *This we believe: Keys to educating young adolescents*. Westerville, Ohio: National Middle School Association, 2010.

Norton, C., & Watt, T. (2014). Exploring the impact of a wilderness-based positive youth development program for urban youth. *Journal of Experiential Education*, *37*(4) 335-350.

Omotayo, A. O., Ogunniyi, A. I., Tchereni, B. M., & Nkonki-Mandleni, B. (2018). Understanding the link between households' poverty and food security in South West Nigeria. *Journal of Developing Areas*, *52*(3), 27-38.

Osterlind, S. J., & Merz, W. R. (1994). Building a taxonomy for constructed-response test items. *Educational Assessment*, *2*(2), 133.

P.Fitzgerald-Moore and B.J. Parai. *The Green Revolution*. (Web. n.d.) Retrieved from http://people.ucalgary.ca/~pfitzger/green.pdf

Páivi M. Tikka, Markku T. Kuitunen & Salla M. Tynys (2010). Effects of educational background on students' attitudes, activity levels, and knowledge concerning the environment. *The Journal of Environmental Education*, *31*(3), 12-19, DOI: 10.1080/00958960009598640

Payne, K., & Edwards, B. (2010). Service learning enhances education for young adolescents. *Phi Delta Kappan*, *91*(5), 27-30.

Perkins, J.H. (1997). *Geopolitics and the Green Revolution*. Oxford University Press.

Peterson, D. J., Newman, M. E., Leatherman, J., & Miske, S. (2014). Engaging youth, serving community. *Reclaiming Children & Youth*, *23*(3), 37-40.

Posten, H.O. (1978). The robustness of the two-sample t-test over the pearson system. *Journal of Statistical Computation and Simulation, 6*(5), 295-311.

Posten, H.O., Yeh, H.C. & Owen, D.B. (1982). Robustness of the two-sample t-test under violations of the homogeneity of variance assumptions. *Communications in Statistics: Theory and Methods 11*, 109-126.

Ramharacksingh, R. (2011). *Agricultural science for CSEC Examinations*. Towns Road, Oxford: Macmillan Publishers Limited.

Roberts, T. (2006). The use of multiple choice tests for formative and summative assessment. *Eighth Australasian Computing Education Conference* (ACE2006), 175-180.

Russell, S. T. (2001). The developmental benefits of nonformal education and youth development. Focus Monographs, 4-H Center for Youth Development, UC Davis, 1–10. Retrieved from http://4h.ucanr.edu/files/1231.pdf

SCORE. (2018). *Practical work in science: a report and proposal for a strategic framework*. Retrieved http://www.score-education.org/media/3668/report.pdf

Sibhatu, K. T., & Qaim, M. (2017). Rural food security, subsistence agriculture, and seasonality. *Plos One*, *12*(10), 1-15. doi:10.1371/journal.pone.0186406

Suskie, L. 2004. *Assessing student learning: A common sense guide*. Bolton, MA: Anker Publishing Company.

Terry, A. W., & Bohnenberger, J. E. (2003). Service-learning: Fostering a cycle of caring in our gifted youth. *Journal of Secondary Gifted Education*, *15*, 23-32.

The Interamerican Institute for Cooperation in Agriculture (IICA). *Food Security in The Bahamas*. (Web n.d.) Retrieved from: http://legacy.iica.int/Eng/regiones/caribe/bahamas/Documents/IICA%20WEBPAGE%2FOOD%0SECURITY.pdf

The International Institute for Cooperation in Agriculture (ICCA). (2014). *Agriculture Opportunities for Development in The Americas*. San Jose: Costa Rica

United Nations Educational, Scientific, and Cultural Organization (UNESCO). Education for sustainable development. Available online: http://www.unesco.org/new/en/education/themes/leading-the-international-agenda/education-for-sustainable development/mission.

USDA: Agriculture in the Classroom. (2011). *United States Department of Agriculture: Agriculture in the Classroom*. Retrieved from http://agclassroom.org/about/index.htm

UNDESD. (2014). Sustainable development. Retrieved from http://www.unesco.org/new/en/beirut/areas-of-action/education/sustainable development/

van Linden. J. A., & Fertman, C. I. (1998). *Youth leadership: A guide to understanding leadership.* San Francisco: Jossey-Bass Inc.

Vandell, D. L., Reisner, E. R., & Pierce, K. (2007). *Outcomes linked to high-quality afterschool programs: Longitudinal findings from the study of promising afterschool programs.* Retrieved from https://files.eric.ed.gov/fulltext/ED499113.pdf

Weimer, M. (2012). *10 ways to promote student engagement*. Faculty Focus: Higher Ed Teaching and Learning. Retrieved https://www.facultyfocus.com/articles/effective teaching-strategies/10-ways-to-promote-student-engagement/

World Food Program. (2017). *Hunger Facts*. Retrieved from https://www.wfp.org/share-a hunger-fact

Zarrett, N., & Lerner, R. M. (2008). Ways to promote the positive development of children and youth. *Child Trends Research-to-Results Brief*. Publication 2008-11.

Table 1. *Skewness and Kurtosis Tests for Normality of Data Distribution*.

	Pre-tests	*Post-Tests*	
Mean	160	Mean	240.4
Standard Error	38.00263149	Standard Error	44.01658778
Median	160	Median	261
Mode	#N/A	Mode	#N/A
Standard Deviation	84.97646733	Standard Deviation	98.42408242
Sample Variance	7221	Sample Variance	9687.3
Kurtosis	0.329471058	Kurtosis	-0.901282868
Skewness	0.715888545	Skewness	0.039108572
Range	220	Range	252
Minimum	67	Minimum	118
Maximum	287	Maximum	370
Sum	800	Sum	1202
Count	5	Count	5

Table 1. Skewness and Kurtosis tests measures the distribution of data collected and shows normal data distribution within range for a t-test to be conducted.

Table 2. *Levene's Test of Homogeneity of Variances.*

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Pre_Diff	5	304	60.8	2600.2
Post_Diff	5	383.6	76.72	2329.852

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	633.616	1	633.616	0.257042319	0.625836	5.317655
Within Groups	19720.208	8	2465.026			
Total	20353.824	9				

Table 3. Summative two paired sample t-test for means for pre/post-tests.

SUMMARY			*Alpha*	*0.05*		*Hyp Mean*	
Groups	*Count*	*Mean*	*Std Dev*	*Std Err*	*t*	*df*	*Effect r*
Pre-test	37	160	84.9765				
Post Test	37	240.4	98.4241				
Difference	37	-80.4	-13.448	6.01	-8.7744	4	0.985

t-TEST

	p-value	*t-crit*	*lower*	*upper*	*sig*
Two tail	0.00093	2.77645	-	-	yes

Table 4. Pre-Tests/Post-tests Means, Standard Deviation, and Differences.

		Pre-tests			Post-tests					
Lesson	*n*	*M*	*SD*	*Correct Resp. (%)*	*M*	*SD*	*Correct Resp. (%)*	*Diff. (%)*	*t*	*df*
1	37	4.32	1.88	43.2	7.05	1.79	70.5	27.3	-10.66	36
2	37	2.72	1.14	38.9	4.62	1.62	66	27.1	-8.66	36
3	37	1.81	1.02	25.8	3.18	1.39	45.5	19.7	-5.46	36
4	37	7.75	2.95	51.7	10	2.44	66.6	14.9	-4.78	36
5	37	5	2.1	50	7.62	2.13	76.2	26.2	-7.84	36

Note: the changes in the differences column represent the percent difference in correct responses in pre/post-tests scores. *$p<0.001$

Table 5. Points allocation for pre/post-tests.

Lessons	**Total possible points**	**Pre-tests**	**Post-tests**
1	370	160	261
2	259	101	171
3	259	67	118
4	555	287	370
5	370	185	282
StDev		84.97647	98.42408
mean		160	240.4

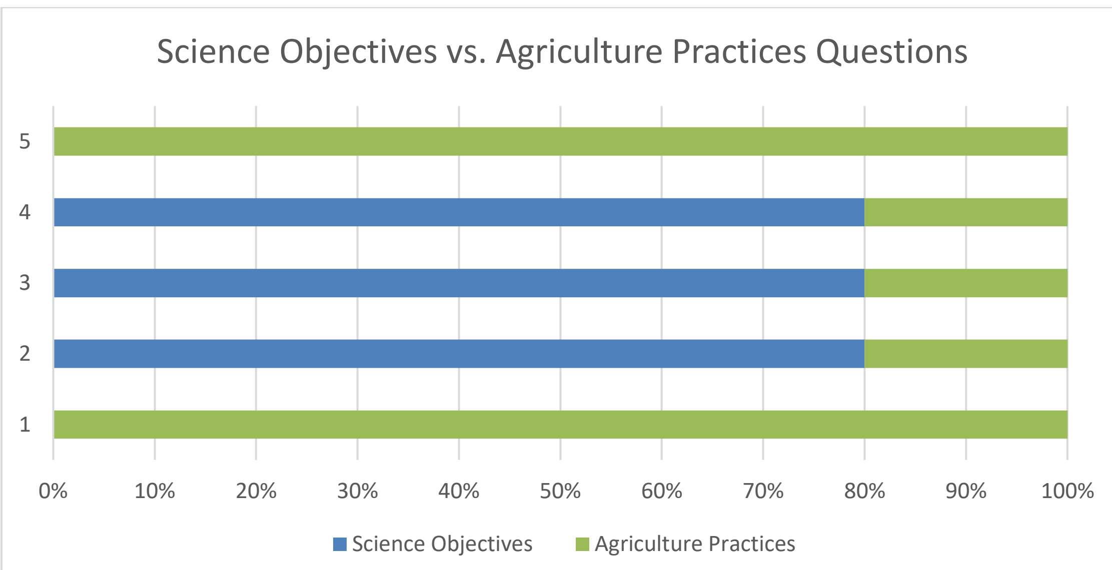

Figure 1. Questions from lessons 1-5 were broken down to assess scientific knowledge or agricultural practices. Results were assessed to determine student knowledge gained in science against knowledge gained in agricultural skills.

Appendix A

Parents' Consent Letters

Dear Parent/Guardian,

Your child is invited to participate in the Soil to Supper Project at Mastic Point Primary School. Your child will work along with the Collegiate 4 H BAMSI club students on a schoolyard farm plot. The farm plot is part of an 8 weeks project that is designed to raise awareness in 4 grade-6 grade children about the importance of agriculture in The Bahamas. The sessions are conducted after school, 3:00 pm - 3:45 pm on Thursdays until February 23, 2018.

Your child will have a field trip to BAMSI to visit the College farm and view as part of the project. This fieldtrip will happen during school hours on January 25th, 2018.

At the end of growing period in February 2018, your child will visit BAMSI's campus for a presentation. This event is open to the public and we would hope to see you there too.

Please sign this letter below if you allow your child to participate in Soil to Supper Project. Kindly note, BAMSI is not providing transportation home for the students.

Sincerely,

Bahamas Agriculture and Marine Science Institute   Mastic Point Primary School

----

I, as a parent/guardian agree to allow my child to participate in the Soil to Supper Project with the students of Collegiate 4 H Club of BAMSI and go on the field trip to the BAMSI farm. Also, I grant to The Bahamas Agriculture and Marine Science Institute (BAMSI), the right to take photographs of my child in connection with the Soil to Supper Project and Collegiate 4-H BAMSI Club and allow the photos of my child to be used with or without my name and for any lawful purpose to publicize, advertise and publish content in print and website.

Parent/Guardian Name____

Child's name: ____ Date: ____________________________

Dear Parent/Guardian,

Your child is invited to participate in the Soil to Supper Project at Stafford Creek Primary School. Your child will work along with the Collegiate 4 H BAMSI club students on a schoolyard farm plot. The farm plot is part of an 8 weeks project that is designed to raise awareness in 4th – 6th grade children about the importance of agriculture in The Bahamas. The sessions are conducted after school, 2:00 pm – 3:00 pm on Fridays until February 23, 2018.

Your child will have a field trip to BAMSI to visit the College farm and view as part of the Project. This field trip will happen during school hours on January 26th, 2018.

At the end of growing period in February 2018, your child will visit BAMSI's campus for a presentation. This event is open to the public and we would hope to see you there too.

Please sign this letter below if you allow your child to participate in Soil to Supper.

.

Sincerely,

Bahamas Agriculture and Marine Science Institute Mastic Point Primary School

---

I, as a parent/guardian agree to allow my child to participate in the Soil to Supper Project with the students of Collegiate 4 H Club of BAMSI and go on the field trip to the BAMSI farm. Also, I grant to The Bahamas Agriculture and Marine Science Institute (BAMSI), the right to take photographs of my child in connection with the Soil to Supper Project and Collegiate 4-H BAMSI Club and allow the photos of my child to be used with or without my name and for any lawful purpose to publicize, advertise and publish content in print and website.

Parent/Guardian Name____

Child's name: ____ Date: __________________________

Appendix B

Pre-Test: What Do You Know?

What Do You Know?

Name: ____________ Grade: ____________

School ______________________________

SOIL TO SUPPER

Lesson 1: Farm Skills **date**__________

1. Which of these do you not need to plant crops?
   a. spade c. trowel
   b. hand fork d. hammer
2. Why do you think farmers use tools?
   a. Farmers need tools to grow plants.
   b. Tools make Farmers planting crops easier.
   c. Farmers like having new tools.
   d. Tools are good to fix broken things.
3. Circle all of the farm safety rules that you should always obey.
   a. wear closed toe shoes c. wear gloves
   b. don't run with tools d. play with tools
4. How will following safety rules help to keep you and your friends safe?
   ____
5. Write 2 practices that would ensure good hygiene on the farm.
   ____

Lesson 2: Soil **date**__________

1. Where do most Farmers plant their crops?
   a. in dirt c. in sand
   b. in water d. in soil
2. Scientists believe that soil is alive! What parts of the soil do you think is alive?
   a. Insects c. sand
   b. stones d. dead leaves
3. Circle all of the organic things found in soil.
   a. leaves c. dead bugs
   b. rocks d. animal feces
4. Name 1 way that soil helps plants grow?
   ____
5. How is soil different from dirt?
   ____

Lesson 3: Water **date**__________

1. What 2 elements make up water?
   a. hydrogen and oxygen c. zinc and carbon
   b. carbon dioxide d. helium and oxygen
2. Where does fresh water come from in The Bahamas?
   a. creeks c. rainfall
   b. ground d. blue holes
3. How does water move from the roots of plants all the way to the leaves?
   a. capillary effect c. dissolution
   b. photosynthesis d. digestion
4. Why is it important to use fresh and not salt water to water plants?
   ____
5. Name 2 ways that you can conserve water on your school farm
   ____

Lesson 4: Crops **date**__________

1. What part of the plant develops into fruits?
   a. seeds c. roots
   b. flowers d. leaves
2. Match the plant part with its function or special job.
   a. root 1. make seeds
   b. stem 2. take in water
   c. leaf 3. carry nutrients
   d. flower 4. make food
3. What parts of the plant do we eat? Give an example for each plant part.
   Tomatoes ____________
   Cabbage ____________
4. Name 3 features that can help you identify plants from other living things.
   ____
5. Crops are plants that are grown on a large scale for commercial use. Name the 5 crops that you grew in your school farm plot that you normally buy from the grocery store.
   ____

Lesson 5: Food **date**__________

1. How do farmers make money or revenue from the crops that they grow?
   a. sell them c. eat them all for dinner
   b. feed them to pigs d. use them for compost
2. Circle all of the things that can be made from crops?
   a. bread c. bio-fuels
   b. juice d. clothes
3. On your school farm you grew tomatoes, cabbages and lettuce. How can these products be processed or changed to add value? That is, what foods can be made from the crops that you grew on your farm?
   a. tomatoes ____________
   b. cabbages ____________
   c. lettuce ____________
4. Name one way extension officers help farmers?
   ____
5. Tell us how the food you eat gets from the farm on your plate at dinner?
   ____

Positive Youth Development and Agricultural Capacity Building

Post-Test: What Do You Know Now?

What Do You Know Now?

Name: __________________ Grade: ____________

School_________________________________

SOIL TO SUPPER

Lesson 1: Farm Skills **date____________**

1. Which of the these do you not need to plant crops?
   a. spade c. trowel
   b. hand fork d. hammer
2. Why do you think farmers use tools?
   a. Farmers need tools to grow plants.
   b. Tools make Farmers planting crops easier.
   c. Farmers like having new tools.
   d. Tools are good to fix broken things.
3. Circle all of the farm safety rules that you should always obey.
   a. wear closed toe shoes c. wear gloves
   b. don't run with tools d. play with tools
4. How will following safety rules help to keep you and your friends safe?
   ____
   ____
   ____
5. Write 2 practices that would ensure good hygiene on the farm.
   ____
   ____
   ____
   ____

Lesson 2: Soil **date__________**

1. Where do most Farmers plant their crops?
   a. in dirt c. in sand
   b. in water d. in soil
2. Scientists believe that soil is alive! What parts of the soil do you think is alive?
   a. Insects c. sand
   b. stones d. dead leaves
3. Circle all of the organic things found in soil.
   a. leaves c. dead bugs
   b. rocks d. animal feces
4. Name 1 way that soil helps plants grow?
   ____
   ____
   ____
5. How is soil different from dirt?
   ____
   ____
   ____
   ____

Lesson 3: Water **date____________**

1. What 2 elements make up water?
   a. hydrogen and oxygen c. zinc and carbon
   b. carbon dioxide d. helium and oxygen
2. Where does fresh water come from in The Bahamas?
   a. creeks c. rainfall
   b. ground d. blue holes
3. How does water move from the roots of plants all the way to the leaves?
   a. capillary effect c. dissolution
   b. photosynthesis d. digestion
4. Why is it important to use fresh and not salt water to water plants?
   ____
   ____
   ____
5. Name 2 ways that you can conserve water on your school farm
   ____
   ____
   ____
   ____

Lesson 4: Crops **date____________**

1. What part of the plant develops into fruits?
   a. seeds c. roots
   b. flowers d. leaves
2. Match the plant part with its function or special job.
   a. root 1. make seeds
   b. stem 2. take in water
   c. leaf 3. carry nutrients
   d. flower 4. make food
3. What parts of the plant do we eat? Give an example for each plant part.
   Tomatoes ____________________________
   Cabbage ____________________________
4. Name 3 features that can help you identify plants from other living things.
   ____
   ____
   ____
5. Crops are plants that are grown on a large scale for commercial use. Name the 5 crops that you grew in your school farm plot that you normally buy from the grocery store.
   ____
   ____
   ____
   ____
   ____

Lesson 5: Food **date___________**

1. How do farmers make money or revenue from the crops that they grow?
   a. sell them c. eat them all for dinner
   b. feed them to pigs d. use them for compost
2. Circle all of the things that can be made from crops?
   a. bread c. bio-fuels
   b. juice d. clothes
3. On your school farm you grew tomatoes, cabbages and lettuce. How can these products be processed or changed to add value? That is, what foods can be made from the crops that you grew on your farm?
   a. tomatoes __________________________
   b. cabbages __________________________
   c. lettuce __________________________
4. Name one way extension officers help farmers?
   ____
   ____
   ____
5. Tell us how the food you eat gets from the farm on your plate at dinner?
   ____
   ____
   ____
   ____
   ____
   ____
   ____