Agriculture in the Classroom: Lesson Plans Designed to Demonstrate How Students Can Apply Their Science Skills through Agriculture

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Abstract

The purpose of this study was to develop lesson plans to help teachers help high school students use agriculture to apply science skills. The developing of the lesson plans was achieved through visits to campus museums and through various field trips. After the lesson plans were developed, three were piloted with students in the Minority Students Apprenticeship in Agriculture (MSAA). After the lesson plans were piloted students gave their feedback and the lesson plans were revised for future references. After the piloting of the lesson plans, many conclusions were drawn on how to agriculture can be used to apply science skills.

Introduction

Many teenagers view agriculture as production and traditional farming. Agriculture and related sciences are closely linked to issues related to self sufficiency and homeland security. It is one of the single most important fields for an independent nation. Agriculture is needed to provide useable and safe water and to supply food for the nation. Agriculture is also a means of everyday life. Plants and animals are also used to make clothes and tools that are necessary for everyday life. Agriculture as a discipline will continue to be vital to human survival, without agriculture human cannot survive and live a life of self sufficiency. This paper will examine ways in which teachers can encourage high school students to apply their science skills using agriculture as a base.

Literature Review

Science in the classroom has gone through many reforms in the past years. In the 1950’s and 1960’s leaders of schools eliminated technology from the curriculum in efforts to teach science as inquiry (Yager, 2000). With this approach open-ended questions were given and students were taught by direct instruction. Science in the curriculum went under many reforms over the next few years. In the 1970’s, many people blamed science for political, societal, and environmental crisis that characterized the time (Yager, 2000). In 1978, Project Synthesis was developed by the US Government in response to the issue of curriculum reform. Project Synthesis proposed four major goals for modern science education. The goals are as follows:

Goal 1: Personal Needs. Science education should prepare individuals to utilize science for improving their own lives and coping with an increasingly technological world.
Goal 2: Societal Issues. Science education should produce informed citizens prepared to deal responsibly with science-related societal issues.
Goal 3: Career Awareness. Science education should give all students awareness of the nature and scope of a wide variety of science and technology-related careers open to students of varying aptitude and interests.

Goal 4: Academic Preparation. Science education should allow students who are likely to pursue science academically as well as professionally to acquire the academic knowledge appropriate for their needs (Yager, 2000).

Project Synthesis also found that science and technology must be reintegrated to understand national issues and how they affect us as individuals. By reintegrating science and technology, students are shown that science and technology coexist and forms a tight bond that help students better understand the scientific world around them.

Presently, another problem, exist with science education. Studies have shown that standardized tests are not an accurate way of testing students. These tests are poor measurements of students learning. Few textbooks have been found that approach any aspect of content or instruction in ways consistent with current reforms and research (Yager, 2000). There are also unshared visions of the goals of current educational reforms. Factors were proposed by Reinsmith in 1993 of how learning should be contextualized, discussed, and debated by every science teacher (Yager, 2000). Some of Reinsmith’s factors are that authentic learning comes through trial and error.

Traditional tests are poor indicators of whether an individual has learned something (Yager, 2000). Sometimes a standard test is needed, but these tests are not always a true representation of the students learning ability. As an alternative, subject specific tests can be given. With these tests, students are tested only on the specific subject matter that should be known. To combat the issue of standardized testing, criteria reference testing and creative assessments must be created to identify mastery of concepts. A major challenge of being a science educator is keeping the students interested and getting students able to think critically, master problem solving, use reason, make decisions based on evidence and apply science to everyday life.

Global Learning and Observations to Benefit the Environment (GLOBE) is an interactive science program for primary and secondary school students. It was started in 1996, by science educators and scientists. In the GLOBE program students learn about the environment and the importance it plays in everyday life. Numerous agricultural experiments like hydrology, atmosphere, land cover, and soils are included in the program. Schools that participate in the GLOBE program record and track their data on the internet, demonstrating the importance of the integration of technology in implementing the curriculum.

As a follower of John Dewy, students should learn with hands on approach. That is the best way for students to learn and understand science. The basic core of agricultural education instruction consists of three intra-curricular components 1) classroom instruction, 2) experimental learning through supervised experiences, 3) leadership activities (Dailey, Conroy, Shelly-Tolbert, 2001). This was evident in Oregon where students who had agriculture integrated into the curriculum test scores significantly increased (Balschweid & Thompson, 2000). An increase in test scores is also attributed to teachers who are enthusiastic about integrating agriculture into the curriculum. Research shows that students who are in classrooms where agriculture is integrated are more likely to think critically and have a deeper understanding in math and science.
Methodology

*Bug Camp*

As a part of understanding the offerings of The Pennsylvania State University’s College of Agricultural Sciences I observed several events, starting with the Bug Camp. On the insect field trip the campers were very enthusiastic. They ranged in ages from seven to eleven years old. Before the field trip, the campers were very interested in insects and they understood advanced entomological concepts. They asked questions about what they did not know and what they wanted to know more about. The campers were not afraid to give incorrect answers. On the field trip, the campers’ interest ranged from butterflies to the plants that the butterflies fed on. While at the park, the campers were eager to find an insect they had learned about. In one instance, a camper was interested in a caterpillar and what kind of butterfly or moth it will evolve into. Upon placing the caterpillar back in its habitat the camper was cautious because they had learned that certain caterpillars fed on certain plants. The camper had learned and processed this information in less than five minutes before removing the caterpillar. While in the Butterfly Garden the campers were willing to smell plants such as mint and hops. They also had stories to share with the group about experiences with plants that they or someone in their family had experienced. The campers had a natural enthusiasm for collecting insects. They never gave up when they were not able to catch an insect that they desired.

The Bug Camp’s staff played a major role in keeping the students enthusiastic. The staff members that were enthusiastic about the day’s activities had campers that were more enthusiastic. The staff members that had a genuine interest in the activities had motivated campers. The interesting thing about the camp was that all activities I believe could have also to high school students.

*Walter Biddle Saul High School*

The second field trip was a campus visit with the students of Walter Biddle Saul High School of Agriculture in Philadelphia, PA. The students’ visit consisted of a series of visits to the various departments within the College of Agricultural Sciences. These students had a genuine interest in agriculture and planned to obtain a Bachelor of Science degree in an agriculture discipline. The students’ career interests were different, but they all had the same foundation. The students that majored in Turfgrass wanted to manage golf courses, baseball fields, football fields and other athletic fields. Students interested in Animal Science wanted to become Veterinarians, some wanted to do research with animals, others wanted to teach. The career opportunities are endless.

The W.B. Saul High School students were knowledgeable of the animals that are housed on Penn State’s campus. They knew the different varieties of cows, sheep, horses, and deer. When they visited the Agriculture and Biological Engineering department, they understood the importance of agriculture in producing more efficient fuel. Efficient fuel was needed to keep the air clean in the environment. In ABE the students learned the importance of biological systems which included microbes, plants, and animals were explained to the students. Food processing was also hinted upon in the discussion.
During the visit to the Horticulture Department, careers such as Landscape Management and Horticulture were discussed with the students. The importance of these careers was explained to the students. Landscape Management included more than landscaping grounds. Students in the major had to be efficient in Computer Aided Drafting (CAD) a skill that is possessed by many engineers. This was just a few examples of how technology and agriculture are integrated.

It was amazing that the students from Saul High School had learned about the importance of agriculture in America’s society at such a young age. They understood and recognized the endless career possibilities that one could explore and have in the field of agriculture.

Frost Entomology Museum

Several museums on Penn State’s campus illustrate the importance of agriculture and related sciences. The museums also demonstrate ways in which science can be applied using agriculture as a base. The Frost Entomology Museum is located on Penn State’s campus. It is a small museum about 900 square feet that houses both mounted and live insects and animals. The mounted insects as well as the live come from all around the world. The museum is small but also quite interesting. It houses a live glass bee hive. The glass bee hive is connected to the outdoors so that the bees can enter and leave as they please. The bees need to have an outlet to the outdoors because these bees collect pollen. The only way that pollen can be collected by the bee is by getting it from flowering plants. The glass hive is a great simulation of how a bee colony operates. It is interesting trying to identify the queen bee in the colony. The bee colony brings to life all lessons that have been learned or taught about bees and socialized behavior.

Tarantulas and cock roaches can also be found in the museum. The museum has many slides, mounted, and preserved animals that can be used as a great teaching tool. When groups visit the museum, they are given a taxonomic data matrix key to help classify the insects or animals that are before them. This gives adults and children real life situations of how animals are classified. The insect museum is important to agriculture because it simulates and demonstrates insects’ behavior in their natural habitat. It also simulates the cohabitation of insects in their natural environment.

Matson Museum of Anthropology

The Matson Museum of Anthropology is very important in understanding the importance of agriculture throughout history. The museum tells why food is important to people around the world. Throughout history and different cultures, agriculture plays an important role in their society. Many foods that were once native to only one group of people were infused into the others’ cuisine. For example, potatoes were a food that was native to the people of the Americas. Once the people of the Americas interacted with the Europeans, the potato was taken back to Europe and it became a major part of the diet of the poor people, especially those people living in Ireland. In some cultures plants were used for food, as well as a means of making dyes, and material for weaving and clothing. Animals were used as a means for making tools, clothing, musical instruments, and food. The museum also has a display that tells how humans evolved from hunters and gathers into industrialized people. Agriculture played an important role in this transformation.
Many thousands years ago, humans were hunters and gathers. They live in groups called bands that consist of no more than a hundred people. The bands are self sufficient and their movement depended on the availability of plant and animal species (Matson Museum of Anthropology, 1989). Hunters and gathers in the past were able to occupy a land for much of the year because the climate was more temperate. The nomadic behavior of the hunters and gathers caused the spread and occupy all habitable parts of the world.

Groups in South America were the first people to become horticulturists about 10,000 years ago. They were the first people to cultivate crops and domesticate animals (Matson Museum of Anthropology, 1989). Much time was taken to transition to an agricultural culture. Major shifts in human societies and domestication was needed. Most importantly, reliance on predictable food sources with high yields was associated with the development of sedentary communities (Matson Museum of Anthropology, 1989). The agriculture society also brought about longer life expectancies. People also stayed in the villages longer periods of time. Famine and crop failure also became more common because the people became reliant on the food that they were growing, whereas in the past, hunters and gathers took food shortage as a sign that it was time to move. The development of agricultural economies set the stage for the population growth that has continued to the present (Matson Museum of Anthropology, 1989). The agricultural society was the beginning of the development of the modern, industrialized world.

*Earth and Mineral Science Gem Museum*

In the Earth and Mineral Science Gem Museum, agriculture also plays an important role. Georgius Agricola, who was considered the founder of geology as a discipline was important to the fields of geology. He first noticed that rocks are laid in consistent strata that can be easily traced. This information was important to those agriculturists because it helps explain why certain plants can only grow in certain regions or altitudes. He also stressed the importance for knowing the rocks of the Earth. In his first book, *De Ortu et Causis Subterraneorum* (1546), Agricola discovered wind and water as powerful geological forces.

The importance of wind goes beyond Agricola and his findings. Meteorology is also very important in the agriculture field. Weather patterns make it possible for farmers to be able to grow crops. These patterns also dictate which foods animals will feed off. In the Weather Station located on campus, there are three main ways of predicting weather. One way was with satellite images. These images are taken with a satellite that orbits with the Earth. The satellite images give an overall weather pattern. These images are good indicators of recent weather and the images can tell what has passed through an area and what is coming in the near future. Radar images are very similar to satellite images. Instead of a satellite orbiting above the Earth, radar beams are rotating on the ground. Unlike the satellite images, the radar images can intercept anything in its way, including birds and insects. The last model that was used to forecast weather was the Forecast Model. This model consists of four distinctively different models that can predict weather patterns up to seventy-two hours. The weather predictions were based upon temperature changes, and weather balloons. Weather balloons float in the atmosphere and observe the different stratospheres. With accurate weather predictions, farmers can know when it is best to make hay, plant as well as pick crops. Long term forecasts can help a farmer to determine if a certain crop was going to be planted or not. Not only does rain and lack of rain play an important role in agriculture, clouds also play an important role. Although clouds are not as treacherous, they control the rate of photosynthesis and the amount of solar energy that can
come to the Earth’s surface. Clouds can also affect temperature both day and night. Some clouds depending on size can be an indicator of a storm.

**ABE/ASM**

There are many majors in the College of Agricultural Sciences. Many of the disciplines in the College of Agricultural Sciences can be compared to other non-agricultural majors. Agricultural and Biological Engineering (ABE) helps prepare students for careers involving the application of engineering principles to agricultural and biological production systems, processing systems, and conservation of land and water resources (http://www.cas.psu.edu/). Many areas were covered in the ABE discipline. Students are still proficient in math, physics, and engineering programs. ABE covers various fields including food engineering, soil and water management, resource management and utilization. Agricultural Systems Management (ASM) combines agricultural sciences, engineering technologies, natural resources, and business and management principals. ASM emphasizes the systems aspects of integrating technology to solve problems related to food and fiber production processing, and delivery (http://www.cas.psu.edu/).

**AgriBusiness Management**

AgriBusiness Management is a program that combines agriculture and business management. Students are multifaceted and afforded opportunities to work in the business management field. They have the opportunities to work for corporations such as Heinz Foods and Hershey Foods because of their business and agriculture background. In Environmental and Renewable Resource Economics students are taught to use the ideas and methods of economics to understand the forces that lead people to act in ways that either help or degrade the environment (http://www.cas.psu.edu/). They also help communities and government agencies find ways to protect the environment and conserve natural resources.

**AEE**

In Agricultural and Extension Education students take technical courses in agriculture, food, and natural resources, along with professional courses in education, leadership development, and communication (http://www.cas.psu.edu/). There are three specializations under Agricultural and Extension Education. The first specialization is Production. Under the umbrella of Production students were prepared to teach in specialized areas, such as general agriculture, horticulture and forestry. The second specialization is Environmental Science. Under the umbrella of Environmental Science students were prepared to teach in specialized areas of agriculture that emphasize natural resources and environmental science. The last specialization in AEE was Leadership Development and Communication. Under this final option, students are taught various communication styles within social, cultural, political, and organizational contexts. Students gain knowledge about leaders and leadership practices, this knowledge help students obtain their goals.

Students who major in Agricultural Sciences are able to choose various courses in the College of Agricultural Sciences that meets their specific needs. Students have the option in
gaining a broad background in one specific area or creating a academic program that is not offered in the College of Agricultural Sciences.

Biology, hydrology, chemistry, and physics are all combined to study soil processes in Environmental Soil Science. Soil processes are important because they shape, preserve, and protect the environment. In Turfgrass Science, basic and applied science, business management courses, and internship were combined to prepare students for careers in turfgrass management. Students were prepared for careers in sod production, sales and service, research technician, and various types of field management such as golf courses and athletic fields.

Animal Science

Animal Science is the study and integration of all disciplines that relate to the function and care of animals for the benefit of humankind by providing companionship, food, fiber, and research (http://www.cas.psu.edu/). Two options are available to Animal Science major students. The first option is Science. Here, students are prepared for positions in animal and related sciences. Career opportunities that are available are research technicians, food inspectors, laboratory animal caretakers, and public relations personnel. The second option is Business/Management. Students are able to choose concentrations in marketing, economics, financing, and accounting. With these concentrations students are able to enter positions in agribusiness organizations and animal and food production companies. Food Science covers many disciplines. Food Science majors are knowledgeable from both science and technology to the distribution of food. Food Scientists assures the availability, abundance, affordability, and safety of food. This assurance plays an important role in the health, welfare, and economic status of individuals and nations.

Forest Science

The Forest Science major provides education for foresters at the professional level. As a Forest Science major students are able to pursue careers in Forest Biology, Forest Management, Urban Forestry, and Watershed Management. A major in Wildlife and Fisheries Science provides an integrated program of study for students interested primarily in conservation and management of wildlife and fish species and their environments (http://www.cas.psu.edu/). Horticulture majors study the science, technology, and business of producing, improving, and using fruits, vegetables, flowers, and ornamentals (http://www.cas.psu.edu/). Horticulture majors can find career opportunities in landscaping, production, marketing, pest management, among many other careers. Landscape Contracting majors study the art and technology of the landscape industry. There are two options available to Landscape Contracting majors. The first option is the Design/Build, in which students can focus on the design and construction of landscapes. The second option is Landscape Management, in which students concentrate on plant establishment and landscape maintenance.

Summary

All of the disciplines in the College of Agricultural Sciences indicate the importance of agriculture. The museums visited demonstrate ways in which agriculture is integrated into daily lives. Many things that are done in science are related to agriculture in some way. Without
knowledge of agriculture, students cannot appreciate the many things that occur in their daily lives.

Lesson Plans

A total of sixteen lesson plans was created to demonstrate how agriculture can be used to apply science skills. These lesson plans were based upon various museum visits that were taken on The Pennsylvania State University’s campus. The lesson plans are adapted from the Global Learning and Observations to Benefit the Environment (GLOBE) Teacher’s Manuel and various internet sites. These lesson plans emphasize the various ways in which agriculture is used in everyday life; they also demonstrate the importance of agriculture in various career fields.

A lesson plan should be clear and concise so that anyone can follow and understand the lesson that is being taught. It should also be well planned that if a teacher was absent; someone could come in and teach the lesson without difficulty. The lesson plans were created by following a template. The categories can be changed according to what is being taught. The lesson plans, created in junction with the College of Agricultural Sciences, have nine categories. The categories are as followed:

1. Title.
2. Grade Level. In this category all grade levels that can follow the lesson are listed.
3. Estimated Time. For the College of Agricultural Sciences, most labs should be no longer than fifty to fifty-five minutes or the equivalence of one class period.
4. Purpose. The reason for the lesson or lab is given.
5. Objective. The skills and understandings that students should gain by the end of the lesson is given.
6. Materials. All materials that are used in the lesson or lab are listed.
7. Procedure. All procedures that the students must perform are listed in an organized, clear, and concise manner. This is the most important section because if the procedure section is not clear and organized the lab or lesson plan may not be taught effectively.
8. Assessment. Students’ knowledge is tested about the subject matter that was taught. Sometimes a test or a quiz is given; at other times students are assigned a specific task that reflects their understandings of the material.
9. Closure. As a way to self-assess the lab, a closure section is added to each lesson plan. This section closes the lesson out and it gives students a chance to give their opinions on the materials being taught. In this section students were encouraged to tell what they liked or did not like about the lab. They are also encouraged to tell changes that should be made to the lab in order to make the lesson more appealing to their peers.

Pilot Test

Three lesson plans will be piloted with students enrolled in the Minority Student Apprenticeships in Agriculture (MSAA) which is sponsored by Penn State University Park College of Agricultural Sciences. These students are rising Pennsylvania seniors who have at least “B” grade averages. They are enrolled in high schools that prepare students for college. MSAA students must have interests in biological or physical sciences. The students are also
members of under-represented ethnic/racial groups in the agricultural sciences including Black/African Americans, Hispanic Americans, and Native American/American Indian.

Results

Lesson 1

In the first lesson plan that was piloted, students were taught about clouds, its affect on weather, and how weather affects the environment, particularly plant growth. In the original lesson plan, a trip to the Weather Station was included, but it had to be canceled because the trip was not possible due to timing conflicts. After the deletion the lesson plan time was decreased from ninety minutes to fifty to fifty-five minutes. Some revisions were added to the lesson plan. Students recommended a quick cloud project because some students had questions about cloud properties. They also suggested extending time outside. The time should have been split as one hour inside and thirty minutes outside. Other suggestions that were made were including the importance of economics in relation to plant production. Students were interested in discovering how the price of plants and crops are affected by the abundance or lack there of a certain crop, and how this abundance can directly be related to the weather patterns. They also wanted more independent projects to be given concerning cloud makeup. Overall, the students’ enjoyed the lab and they were able to understand the correlation between clouds, weather, and plant growth.

Lesson 2

In the second lesson plan, the students were food detectives. In the lab, students were asked to find information about how and where food is grown in a prepared food product. The group of five students was split into two groups. One group was composed of three students and the other group was composed of two students. The original plan each group was to have separate computers, but only one computer was available, so the students had to share. In the original lesson plan, the groups were to take one of the ingredients from their Food Detective Ingredient Chart and write a newspaper article or a story for children that included: how the ingredient is grown, where that food typically is grown, how it is handled and transported, and other foods that contain the ingredient, along with any interesting facts about that food. After one group had completed the Ingredient Chart, a discussion was started about the differences between vegetables and fruits. In the discussion, students had a peak interest in how onions and carrots are planted because seeds for the two vegetables are not found when they are eaten. They also wanted to know how vinegar, another ingredient in the prepared food, was made. The students interests in the planting of the vegetables and the making of vinegar was very keen and it was only befitting that the lesson plan was changed to cater to their interests.

At the conclusion of the lesson students gave their feedback on the lab. They favored the deletion of the article and story and the addition of the extra research. The alternate was more interesting to the MSAA students. They also thought the lab could have been more challenging. Challenges could have come through the search of chemical compositions of the ingredients and through the finding of actual farms that produced the ingredients. They also felt that one
computer was a hindrance. Overall, they enjoyed the lab because it made them take a closer look at the ingredients in foods.

Lesson 3

In the last lesson plan that was piloted, the MSAA students had to use a Taxonomic Data Matrix Key to classify six insects into their proper order. Then the students created a Dichotomous Key, which in turn help them create their own Taxonomic Data Matrix Key which was specific to the insects they used. In the original lesson plan, the students were to be in groups of three, but the students worked independently because only six students were used. Since each student worked independently, six insects were used instead of five. This lab was unlike any other lab that had been piloted. The students had to think and examine the insects. This lab required much concentration. The lab was a sample of what the students will do in college if their interest were in biological sciences. Upon completion of the lab, the students did not have much criticism. However, one student though that the lab should not have included insects because they do not like working with insects, another student thought that the lab was boring, and others thought that the lab was too challenging. The last student to give feedback on the lab thought that the lab was very interesting because they wanted to pursue an agriculture discipline.

With the feedback that was given, only the time was changed in the lab. The time was increased from fifty minutes to ninety minutes.

Conclusion and Recommendations

Agriculture can be effectively incorporated into the science curriculum. From the lesson plans that were piloted, students thought critically about many science as well as agriculture concepts. In the Food Detectives lab, the MSAA students’ inquiry went from onion and carrot seeds to the making of vinegar. Teachers also have to be flexible when teaching a lesson. At times lessons have to be changed depending upon students’ responses. When the MSAA students had a growing interest in onion and carrot seeds, the lesson was changed to include the research of where the seeds were found. While researching the carrots, the students found information on the making of baby carrots. To everyone surprise, baby carrots are cut from carrots and not grown. The changing of the lesson kept the students’ interest. They also wanted to know how vinegar was made. Another change was made to include the students finding the making of vinegar.

At times it was not as easy to accommodate the students’ request. In the insect lab, the students had the think critically about the insects that were being examined. They had outside sources that they could have referred to if they needed additional help. The purpose of the lab was to demonstrate to students that sometimes labs and concepts will not be fun, but they have to get done. If the instructor was not available, they were encouraged to use outside sources. The lab was one that was needed to pursue any career in biological sciences, but it is one that has to be appreciated. The lab also prepared them for what they may face in college. Most students did not like the lab because it was not as interactive as other labs. But the lab was very important.
Behavior became a problem with this lab. Since some students were not interested in the lab, they played with the microscopes and the lights. Some students lost focus and doodled on paper. Some students were faster than others, for those students, questions about the lab were asked so they would not get too bored. Students who had previously lost focus regained it when the answers were given and the Dichotomous Key and data matrix were created. In the assessment, students were to create a Dichotomous Key and a Taxonomic Data Matrix on their own. With some students having problems, the matrix and the key were created as a class. Some students criticized the lab for being too challenging, they suggested that the lab should have started easier and then gotten harder. At times it is not always possible, harder concepts have to be introduced, but they can be understood effectively with the integration of easier concepts. Although they complained, they still understood advanced entomological concepts, and some student left inspired.

After the piloting of the lesson plans, it was discovered that the lesson plan titles should have been more specific. The title should reflect the relationship between the topic, lecturette, and the actual lesson plan. The lesson plans were suggested for grade levels nine through twelve. In actuality, grade levels should be taken into consideration when developing a lesson plan. Seniors in high school will be able to understand some concepts better than some ninth graders because of academic levels. Lectureettes should be given in all lessons to give students adequate background knowledge and to ensure that all students have the same understandings before performing a lab.

The most important thing learned from writing and piloting labs is to always expect the unexpected. To teach, a person has to be able to be flexible and make quick decisions. When put in unfavorable conditions, a teacher has to be able to take its resources and use them wisely. A teacher must also be able to change their lesson plan to keep students interested in the lesson. When a change is not possible a teacher has to be able to keep students interested so they can understand the concepts that are being taught. Overall, teaching is a very demanding profession. Lessons have to be taught and prepared in a way that students of different learning capabilities are all taught effectively. The students should also have a good understanding of the concepts. That can be difficult. Some labs that were piloted, some students where thought they were easy, others actually learned something new from the lab. Other labs that students thought were boring, other students thought were interesting and saw as being very useful. As long as one person came out of the lab inspired and the others have learned, a teacher has been successful in the implementation of a lesson plan.
References


Websites

