The Effects of Incorporating Biotechnology Labs with the Infectious Agents and Disease unit in Comprehensive Science class on Student Achievement and Engagement

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Abstract

The purpose of this action research is to determine the effects of incorporating biotechnology education and labs into the Infectious Agents and Disease unit for Comprehensive Science on student achievement and student engagement. For this project, students will be required to apply newly acquired lab skills in order to conduct a virus microarray to diagnose diseases. The students will participate in a real-world investigation to track the spread of a disease, describe its effect on victims, and summarize how biotechnology and genetics contribute to treatment and/or finding cures. Student achievement will be determined by comparing student performance for pre-test and post-test, by monitoring report cards grades for science, and by surveying students about perceived increase in academic performance. Student engagement will be determined by conducting periodic observations to track and monitor the level and type of student engagement for the class during various instructional activities and by feedback concerning daily activities from student journals.

Rationale

My particular area of focus for the action research is infectious agents and diseases. I grew up in a small town in Arkansas. My family lived in public housing for all of my childhood. We did not have health insurance, only Medicaid benefits. As a result, we did not always receive a high quality of health care. It seemed to me that because we were Medicaid recipients, that we sometimes received drugs and treatments somewhat experimental in nature. I know that there is a specific procedure in place before drugs are approved for distribution for treatment. However, because most drugs and treatments were tested primarily with white males, detrimental or negative effects on women and minorities were not usually discovered until after mass distribution and follow up studies from the FDA. In addition, some diseases and conditions are more prevalent among certain minority groups, ethnicities, and women. Diseases that affect blacks at a higher rate than whites include diabetes; lung scarring and lung disease; high blood pressure, which also leads to increased heart disease, stroke, and kidney disease; asthma; influenza; pneumonia; and various forms of anemia (DeNoon, 2005). These diseases and conditions may not be studied to the extent that those diseases
and conditions affecting the more affluent and majority population of the United States are studied. (DeNoon, 2005)

As a science teacher in an urban middle school, I interact with students who are mostly minorities. In addition, most of the students are classified as low socioeconomic status. Many have no health insurance, only Medicaid. I can see the familiar pattern of health care issues plaguing the community surrounding the school. The students often talk of relatives suffering from high blood pressure, obesity, anemia, diabetes, influenza, pneumonia, stroke, asthma, etc. In addition to these diseases and conditions, there is also a high incidence of sexually transmitted diseases such as herpes, AIDS, HIV, HPV, syphilis, etc. I feel that I have an obligation to educate the students about these diseases, treatments and the search for cures, how diseases are spread, etc. Science content for the Comprehensive Science I, II, and III courses at the middle school level does not adequately address all of these areas. Instruction for the students does include content about viruses and disease spread. Other content blocks contain information about genetics and heredity. Topics such as genetic engineering and stem cell research are barely addressed. These science concepts and science content are never taught together. So, it is difficult for students to see how each plays a vital part in preventing disease spread, screening and detection, treatment, and finding cures for diseases. In order for students to truly benefit from science instruction and to promote science literacy and public engagement with science, I must ensure that instruction is relevant to the students’ real lives in the real world (Feinstein, 2011). By addressing the science content for infectious agents and diseases in connection with diseases and conditions that affect my students, their relatives, and the surrounding community of the school, it is my hope that this instruction becomes highly relevant for them. Maybe, some students may aspire to seek science careers in an attempt to address these issues that plague their communities.

In order to assist students in acquiring the knowledge of the science concepts and content for this unit, Marzano (1998) suggests that to enhance understanding of details instruction should be presented in the form of a story or an elaborated description and to represent understanding in both linguistic and non-linguistic forms such as notes, outlines, semantic maps, pictures, charts, etc. For this reason, the
content will be presented as a real life collaborative investigation to determine what disease is impacting the community surrounding the school. Students will be provided the opportunity to represent understanding by completing data charts, making project boards, diagramming and journaling. Students will also have the opportunity to practice real life biotechnology skills in order to determine the cause for disease, to conduct screening and detection, and to assist with treatment. The purpose of this action research is to determine the effects of incorporating biotechnology education and labs into the Infectious Agents and Disease unit for Comprehensive Science on student achievement and student engagement.

**Action Research Intervention**

For this action research intervention, I will provide instruction to 6th, 7th, and 8th students in the Science Technology Engineering and Math (STEM) club. I will develop a unit to incorporate Biotechnology content from Bench to Bedside with the curriculum content for the Infectious Agents and Diseases unit for the Comprehensive Science I and II courses. The unit will last for approximately 2 weeks. I will adapt the Viral Quest curriculum materials to make them age appropriate for my students. The instructional unit will include content related to various ways that diseases spread (vectors) and inherited diseases; lab skills for conducting a virus array to identify diseases affecting victims; presentations about various diseases and conditions affecting members of the community surrounding the school to include treatment, genetic screening, prevention, stem cell research, etc.; movie viewing of Extraordinary Measures to describe the process of bringing medicines and technology from bench to bedside; and exploration of biotechnology careers. The unit will conclude by giving students the opportunity to attend a fieldtrip to the Junior Science, Engineering and Humanities Symposium (JSEHS). While at JSEHS, the students are challenged and engaged during research lab tours and by faculty research lecturers. The students can interact with UF faculty, graduate students, and undergraduate students to explore university-level research, learn about science majors and, discover career opportunities. The students will also have the opportunity to observe hands on demonstrations from UF pre-professional organizations and science clubs.
Connection to Bench to Bedside Summer Institute

Pipetting Lab, Dr. Lawrence’s Viral Quest, and Dr. Kassidy Chauncy’s Microarray Lab Kit, DNA Transformation Lab (Pglo Lab), Stem Cell Lab, Virtual Microarray lab, Virtual Cloning, and Virtual Stem Cell Lab.

Data Collection and Analysis

Data collected will include both quantitative and qualitative measures. In order to determine if student achievement has improved, I will compare student performance for pre and post assessments for the unit, performance for presentations using rubrics, and student perception of improved academic achievement based upon student responses to survey and interviews. Student engagement will be tracked and monitored by conducting periodic participation observations to determine the level and type of student engagement during various instructional activities and from student responses in daily lesson journals. For type of student engagement, I will track whether students are off task or not engaged in the learning, passively engaged (just listening), actively engaged (writing notes), or authentically engaged (participating in discussions, questioning, charting results, writing responses, etc.). The engagement form will consist of a seating chart and codes for different types of engagement activities. I will track engagement during various class segments such as during teacher instruction, during group work, during individual practice, during presentations, during video viewing, etc. to determine if there is a difference in the type of engagement and the level of overall engagement. For level of engagement, I will calculate the percent of students who are engaged for each of the types described above. This information will be displayed in chart and graph form for various instructional activities. Tracking the data in this way will enable me to make informed decisions about which activities the students enjoy most and which are beneficial to promote improved academic achievement. In addition to conducting observations to track student engagement, I will also use journals to allow students to comment on the effectiveness of various instructional activities to comment
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about their likes and dislikes. The journals will also be used to record students’ observation about their perceived academic performance. This information will be displayed in chart and graph form as well.

Literature Cited

http://www.webmd.com/hypertension-high-blood-pressure/features/why-7-deadly-diseases-strike-blacks-most


Budget and Budget Justification

Money for Bus to attend JSEHS event --$350

Permissions

No permission required, except for fieldtrip