The Influence of Biomedicine Activities on Attitude and Achievement of High School Students

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Abstract

This action research paper describes how new biomedicine activities can be introduced into a high school classroom. The purpose of introducing these new activities is to improve student's attitude and achievement toward the field of biomedicine and biotechnology associated with the field. Hands on laboratory experiments, lectures, research and virtual gaming will be executed in order to determine the achievement and attitudes of two High school honors biology classes. Students will also be exposed to biomedical careers, lab equipment and techniques used in the field. The expectation of this research is to take a well rounded approach in order to gain interest and better inform students about the field of biomedical sciences. The techniques acquired are from the University of Florida's CPET: Biomedical explorations and Mission Biotech programs.

Keywords: biomedicine, biotechnology, virtual gaming

Rationale

Biomedicine is a difficult subject to incorporate in the classroom. The topics are complex and difficult to understand without extensive background information and preparatory measures. Many students have a negative attitude toward the subject of biomedicine and the labs associated with DNA and protein structure have become repetitive and ineffective. Biotechnology is often overlooked by teachers because of its complexity. Factors that constrain the teaching of biotechnology include; a lack of expertise by teachers in the content area; a lack of experience in appropriate learning activities; a scarcity of resources and curriculum materials; and insufficient teaching time (Dawson and Schibeci, 2003). Any teacher you ask will tell you that there are very few comprehensive labs that can be used to reinforce student understanding of biomedical processes.

Most of the materials and lessons in this study have been acquired from the Biomedical Explorations: Bench to Bedside program offered by University of Florida's Center for Precollegiate Education and Training (CPET) program. The programs CPET offers have been enormously important to my classroom and incorporating current scientific research over the past three years. Dawson and Schibeci (2003) made the statement in the above paragraph because they have not yet witnessed amazing programs like CPET's Biomedical Explorations. This program has opened doors for many teachers, including myself; it has allowed teachers to incorporate more interactive hands on learning activities for biomedicine. CPET has also made lab equipment and resources available that are not easily attainable for high school science teachers.

Biotechnology is such an important field. It is the basis for the future of medicine. Without all the hard work doctors and scientist have contributed our quality of life would not be significant to the world. Cures and long lasting treatments are well within our grasp. Many people do not know there are current clinical trials to cure many diseases and disorders and therefore do not know how to make educated decisions about science and how it affects our future.

> "There is a sense of disquiet amongst people in many countries about the use and uses of cloning and gene technology. It is important that the community is well informed about the practical applications of biotechnology, especially those applications related to human health, forensics, agriculture and the environment. Education in schools about biotechnology issues can help to ensure that young people have the knowledge and skills to enable them to contribute to public debate and make informed decisions (Dawson, 2006)."

By enhancing the students' knowledge and understanding about biomedicine, fears and misconceptions can be alleviated. Students that understand genetic screening and cloning genes will be able to make more of a contribution to society in the future; they will be able to assist in teaching the public or possibly becoming a research scientist. The students will be more accepting and understanding of gene cloning used for genetic therapies that can help treat life threatening diseases such as Pompe disease and many others that can kill unless treated.

This study will also incorporate Mission Biotech's virtual game. The purpose of this game is to stop a viral outbreak using biotechnology applications. The idea of virtual gaming can help the students relate to the biotechnology lessons they learn and give them practice using their newly learned knowledge. Virtual games can help to bring players together competitively and cooperatively in the virtual world and in the social community of its players. (Williamson Shaffer, 2005). Virtual world can help students understand complex concepts without losing the connection between abstract ideas and the real world problems they can be used to solve. Virtual worlds of games are powerful because they make the player or students develop understanding and the students can easily engross themselves into an avatar (Williamson Shaffer, 2005). Virtual gaming is a new, fun way to help students become engrossed in learning new topics. Virtual games may help the students by softening the blow and allowing the students to understand biomedicine without getting overwhelmed by an otherwise difficult topic.

The purpose of this study is to determine the efficacy of a biotechnology unit by measuring achievement of multiple intelligence activities (video gaming, current research, labs and presentations) and student attitudes toward biotechnology.

Action Research Intervention

Following the execution of this action research the students will be able to; understand current research in medicine, make informed decisions about current research, have an understanding of careers related to biomedicine, show an appreciation for the biomedical field, and have a basic understanding of biomedical procedures.

The first activity will be a pipetting exercise that allows the students to practice using colored dye and 96 well plates to create different designs (1 day). Then a genetic screening lab will be done which includes; preparing digests, using and analyzing gel electrophoresis, and recording the banding pattern on a pedigree (3 days). Lastly, Mission Biotech software will be used to participate and learn through powerpoints, worksheets and virtual gaming. Biotechnology will be incorporated such as; DNA and RNA structure, DNA extraction, PCR and interpreting PCR, reverse transcription, biotechnology equipment, hazardous and safety techniques and career information (15 careers).

Connections to Bench to Bedside summer institute

Mission Biotech will be involved the lesson plans and research. Mission Biotech experts will provide lap tops and software that allow the students to work on the interactive video game. The Bench to Bedside team will be providing practice pipetting stations (96 well plates) kit and Genetic screening protocol kit.

Data collection and analysis

Data collection techniques include journal entries to collect student opinion, tests, quizzes, worksheets and surveys. Likert scale surveys will be used to assess student's attitude toward the biotechnology unit. Likert scales and science reflection journals will be used to analyze student's attitudes over the entire duration of the unit. Graphs will be used to display improvement of the students using pre and post likert scale assessments. All other data (tests, quizzes) will be analyzed using mean, median, mode, range using pre and post assessments.

Literature cited

Dawson, V. (2007). *An Exploration of High School (12–17 Year Old) Students' Understandings Of, and Attitudes Towards Biotechnology Processes. Research Science Education* 37: 59-73.

Dawson, V., & Schibeci R. (2003). *Western Australian High School Students' Attitudes Towards Biotechnology Processes. Journal of Biological Education* 38.1: 10.

Williamson Shaffer, David, Squire, K.R., Halverson, R. and Gee, J.P. (2005*). Video Games and The Future of Learning.*" *Phi Delta Kappan* O 87.2 106.

Budget and justification

Lesson three in mission biotech uses strawberries to extract DNA (20 dollars). I will need e-gels for the genetic screening lab (60 dollars). I will also need printer ink to allow for printing (black and color) of worksheets (60 dollars). My projected budget is about 140 dollars.

Permissions

Parents will need to sign permission for students to be allowed to play the Mission Biotech game. I also will have a media release for parent and students to sign.

Lesson: Exploration of Biomedical Science
Grade: 9th grade honors biology
Content emphasis: Science
Target benchmarks: SC.912.L.14.52, SC.912.L.16.3, SC.912.L.16.5, SC.912.L.16.7, SC.912.L.14.2, SC.912.L.16.12, SC.912.N.1.3
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Lesson Preparation

Learning goals:

- The students will be able to demonstrate core concept in biotechnology including cellular biology, DNA, RNA and viruses.
- The students will be able to interact with laboratory equipment through virtual and classroom setting.
- The students will be able to identify careers in biotechnology.
- The students will be able to understand viruses and how they are spread.

Estimated time:

This is a series of lessons that will take about three weeks.

Materials/ resources:

Mission biotech will be providing software for computers. University of Florida's Center for Pre-collegiate education (CPET) will be providing lab equipment loans.

Teacher preparation:

Software needs to be installed on computers. Teacher resources disk for mission biotech has several worksheets that need to be printed. There are also PowerPoint lessons that can be used or edited to fit any classroom. Laboratory equipment needs to be borrowed from CPET (appropriate paperwork must be filled). Lab set up and preparation is very important for classroom activities to go smoothly.

Lesson procedure and Evaluation

Introduction:

Students will have a review of cell structure and function, DNA and RNA will be reviewed also. A pre test will be given to check for previous knowledge of biomedical science concepts and techniques.

Exploration:

(The activities below are all adapted from the Mission Biotech teacher resources guide and the University of Florida's CPET Biomedical explorations program. Please contact me or Julie Boker (CPET) at Julie@cpet.ufl.edu and Troy Sadler (Misson Biotech) at tsadler@coe.ufl.edu)

- Day 1- Students will be given pretest and a PowerPoint about viruses will be given. Virus NPR video and worksheet will be shown.
- Day 2- reflection on viruses (5-10 minute discussion) ie. Why does a flu vaccine need to be developed every year? Equipment lesson will be given.

- Day 3- Introduction to virtual game play/ Mission Biotech software. Students will be able to experiment with the game after some guidance about how to advance through the levels.
- Day 4- DNA Extraction lesson. Guiding questions; what are the steps of DNA extraction? How do the material used in strawberry DNA extraction lab compare and contrast to those use in Mission biotech? Perform DNA extraction on a strawberry. The previous day they were able to perform mission biotech's DNA extraction so this will show a different way extraction can occur.
- Day 5- Game play day. Students should be able to complete level one.
- Day 6- PCR lesson part 1. Play Bio-Rad PCR song. Make sure the students know the steps of PCR, what is needed and what it is used for.
- Day 7- Game play continues where ever the student left off.
- Day 8- PCR lesson part 2 and analysis lesson using PowerPoint and worksheet/ workbooks completed in groups of 2-3 students. Quiz will follow.
- Day 9- Game play, students should be able to complete level two. Quiz will follow completion of level two.
- Day 10- Careers lesson part 1, overhead of biotechnology fact sheet with a student copy of career profiles. Students will be asked to write a position statement addressing questions like; why does this career appeal to you, what qualifications do you have that would make you a perfect candidate, what would you want to accomplish as an employee of that position?
- Day 11- Game play complete level three. Quiz to follow level threes completion.
- Day 12-Careers lesson Part 2-3; students will be creating posters of different careers using a fact sheet.
- Day 13-Post test including all information
- Day 14-Genetic Screening lab. Students will be required to; prepare digests, prepare and load gel electrophoresis, run gel and analyze gel.
- Day 15- Pedigree will be created from lab of previous day's gel electrophoresis.

Application:

This lesson plan is extensive and very complicated. It will be challenging to execute on the teacher end as well as the students. Once completed the students will have a better understanding over all about what biomedicine is. These students will be able to me more informed decisions about future issues that may arise in the medical field. Medicine and science have advanced greatly and will continue to become more crucial in society. They will understand the advantage to processes such as cloning and gene therapy.

Assessment:

Assessment strategies include but are not limited to; checklists, quick writes, daily laboratory notebook reflections, quizzes and tests at the end of each lesson or level completed in the game. The virtual video game (mission biotech) has embedded assessments that questions the students before they move on to the next part of the game. If they do not answer correctly they are instructed to go back and review the information.