

Using Forensic Science and Biotechnology to Promote Student Engagement, Interest,
and Achievement

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Abstract

The purpose of this action research will be to incorporate forensic science and biotechnology components in the chemistry classroom. The goal of this study is to promote student engagement, interest, and achievement by creating a relevant learning environment. Forensic and biotechnology themes will be used in conjunction with chemistry content to promote interest and assist students in making these connections. Students overall engagement and interest will be observed by the instructor and assessed through surveys and student interviews. Class discussions will be used to monitor student interest and level of understanding, and tests will evaluate students' achievement in the content area.

Rationale

Students today have grown up in a digital age in which information is handed to them on a silver platter. Teachers have the challenging issue on how to engage these individuals and how to provide relevance between school content and real life situations (Guzzetti, 2009). I am a recent college graduate, and can truly relate to my students in their desire for relevance. There is a plethora of information made available to us, and we need only to sort out what we want to imbed in our memory. We choose what we believe is relevant to our lives and discard the rest. Many students take this approach in school. Unfortunately, I believe several students have a misguided view of science that it **cannot** be relevant to their lives. I want to alter this thinking and encourage a positive viewpoint on the realm of science.

I have spoken to several students about their thoughts towards the subject of chemistry. They see it as an intimidating subject that has no relevance, and therefore no reason for it to be stored in memory (Gabel, 1999). When I was in high school, I shared that same belief. Chemistry was believed to be useless merely because I could see no point to the class other than a method of torture. Fortunately, my high school and college instructors altered my mindset by appealing to my interests. "Individual interest influences students' selective attention, effort, and willingness to persevere in a task, and their activation and acquisition of knowledge" (cited in Nieswandt, 2007, p. 910). Through this action research study, I want to appeal to my students' interests and provide relevance through forensics and biotechnology in hopes that it will assist them in their learning.

The topic of relevance was highly important in our high school last year with the onset of our new principal. We teachers were given the task to provide our students with the "rigor" and "relevance" of each lesson. "Relevance refers to activities that give students satisfaction and meet their needs, including the chance to achieve personal learning goals. In order to capture students' attention and activate their motivation to learn, teachers must consider the relevance of each topic" (Staver, 2007, p. 17). I believe this to be a crucial fact when developing our instructional methods to effectively teach our students. If we want students to learn the material, we need them to be motivated to allow this information to enter their brains.

This has proven to be a challenge for me as I strive to make invisible atoms and molecules relevant to our adolescent generation. Chemistry instruction tends to occur on an abstract level, which is very difficult to grasp for several individuals (Gabel, 1999). Through forensic science, I hope to spark an interest in science amongst students and to assist them in understanding the abstract subject of chemistry and seeing its relevance in their lives. "To address this problem, we use forensic science to positively motivate students and increase their interest level" (Funkhouser and Deslich, 2000, p. 32). "Research even supports that forensic activities have resulted in students' increased engagement and enthusiasm for science" (Guzzetti, 2009, p. 193).

The purpose of this action research is to use forensic science and biotechnology as a means to bring relevance into the high school chemistry curriculum in order to promote student engagement, interest, and achievement. I will provide laboratory activities that involve forensic and biotechnology components, current research that will prompt critical thinking and discussions amongst students, and case studies to assist students in seeing relevance in the subject. Surveys, tests, and student interviews will be used to assess student engagement and achievement pertaining to these activities. In addition to this research, it is my hope that students will gain interest in the field of chemistry, biotechnology, or other sciences and pursue careers in the future.

Action Research Intervention

I plan to implement forensic science and biotechnology into the high school chemistry curriculum in order to promote engagement and relevance to increase student achievement in the subject. To engage the students, I will use a variety of resources pertaining to these topics such as labs, case studies, and open discussions. I will choose one standard high school chemistry class to observe and collect data for this study.

One of the most important concepts to understand in chemistry is the **scientific method**. I plan to provide students with a forensic case in which they must use scientific inquiry to gather data in order to obtain a hypothesis of potential suspects. Students will be placed in groups of four to read, discuss their findings, and write reasons to support their claims in their lab notebook. This will engage students in the chemistry material as they work cooperatively in this case and provide relevance as they strive to find the answer to the problem.

In another lab, students will be provided with actual "evidence" from a forensic case that they must analyze through various **separation methods** such as paper chromatography, filtration, and gel electrophoresis. Students will also be asked to run a gel to analyze the DNA of their potential suspects. The students will narrow down their suspects to identical twins. A discussion regarding DNA will then be used to provide students with information about the importance of DNA and current research in biotechnology that is being done.

Students will be asked to determine which twin committed the crime through analysis of their DNA and other evidence given regarding the suspect. Information describing Type 1 Diabetes will be provided in the evidence—the students must determine if this is Type 1 or Type 2 Diabetes through Internet research. A lab will then be conducted to analyze which twin has Type 2 Diabetes. Involvement in these labs will engage students and allow them to see relevance in the separation methods learned in the course.

Upon completion of the diagnosing diabetes lab, a discussion regarding diabetes and glycogen storage disorder will be conducted amongst the students. The PowerPoint presentation given by Dr. Weinstein will be used to inform students about current research developments pertaining to glycogen storage disorder.

Throughout the course of the school year, other forensic lab activities and case studies will be used to promote student engagement in the chemistry course. Increased engagement will assist students in creating relevant connections that can assist them in learning the material.

Connections to Bench to Bedside Summer Institute

I plan to use ideas and information pertaining to biotechnology provided at the Bench to Bedside Summer Institute throughout the progression of this action research study. The materials for the southern blot lab and diabetes lab will be provided through this program. In addition, references and PowerPoint presentations from professors at the summer institute will be used to promote discussions on current research pertaining to DNA and diabetes.

Data Collection and Analysis

Qualitative and quantitative data will be taken in this action research study. Qualitative data will be used to gather information about student engagement and interest in chemistry. This will be obtained through student interviews, Likert surveys, and a teacher journal in which I document observations of students' responses to activities and topics, and their level of engagement in the lab and discussions.

In order to assess student achievement, I will gather quantitative data through unit tests and pre and post tests. These will provide me with a means to evaluate the amount of learning obtained through these activities. I will also use students' lab summaries in their notebooks to evaluate their level of comprehension after each activity performed. At the end of each lab, students will be asked to rate themselves on a scale from 1-5 (1 being the lowest and 5 being the highest) on their level of confidence in the material.

I will collect students' tests and personal ratings to assess their confidence in the material. In order to gauge the effectiveness of instruction and activities, I will analyze the relationship between student ratings and their actual test scores. This data will be entered in Microsoft excel and displayed through the use of data tables and graphs.

Literature Cited

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Guzzetti, B. (2009). Thinking Like a Forensic Scientist: Learning with Academic and Everyday Text. *Journal of Adolescent & Adult Literacy*, November 2009, 192-203.

Holt, R. (2005). *Forensics and applied science experiments* (Teacher ed.). Austin: Holt, Rinehart and Winston.

Nieswandt, M. (2007). Student Affect and Conceptual Understanding in Learning Chemistry. *Journal of Research in Science Teaching*, 44(7), 908-937.

Staver, J. (2007). *Teaching Science*. Belley, France: Imprimerie Nouvelle Gonnet.

Budget and Budget Justification

I will obtain a Dr. Lawrence's southern blot lab, diagnosing diabetes lab, and a crime scene DNA kit through the Bench to Bedside equipment locker. Other materials obtained throughout the course of this study will be documented and submitted at the end of the study.

Permissions

The assistant principal over the science department will be contacted to ensure this study can be conducted.