

The impact on critical thinking and writing skills when biotechnology activities and a case study approach are incorporated into a high school anatomy course.

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**ABSTRACT:** The purpose of this paper is to share the results of a study focused on incorporating a case-study approach and biotechnology activities to observe the impact on critical thinking and writing skills of high school anatomy students. This method tracked five high school students chosen according to their reading FCAT level one through five. The students were challenged with two case studies, two virtual labs, one hands-on lab, and a science article. The students were assessed using the two case studies, the hands-on lab and the science article. All answers were graded for correctness and the 0. extended writing responses were graded with a writing rubric. The assigned student numbers correlate with their Reading FCAT scores. Student one, three and four struggled the most with the hands-on lab but overall writing and critical thinking improved. Student two gradually improved skills throughout the study. Student five remained fairly consistent. It was surprising that so many students struggled with the hands-on lab since many students generally do better with kinesthetic activities. Overall, all students improved or remained consistent with their writing and critical thinking skills during this study.

**RATIONALE:** In the short time I have been teaching I have noticed my students have issues with problem solving, even if they have been given the background knowledge on the subject area. After some observation, I noticed that it was their lack of critical thinking skills that seemed to be part of the problem. When students are faced with an application of knowledge situation they either shut down or turn to others to do the work for them. It is as though they refuse to think on their own. This is disturbing, what will they do when they are in the real world and their boss tells them to solve a problem? Another issue I have run into is their lack of writing skills. They have trouble putting what they learn into words even though this is an excellent processing skill. How will they communicate in the professional and social world since so much is going towards more written communication?

Students today need more than a vocabulary list and a few lectures to remember information. I have tried the repetition approach which helps but I'm still not achieving the results I would like. Even after introducing words, playing games with the words, using the words in writing strategies and them seeing in several other ways before the test many of them still have trouble with completely comprehending the word when used in a new context. They have become so accustomed to simple regurgitation and repetition that it is all they know. I want my students to move beyond memorizing when it comes to learning and understanding course material.

After some research, "humans appear to have an innate ability and predisposition to organize and represent their experiences in the form of stories" (Jonassen, 2002, p.66). All I could say to myself was "duh". What do teenagers do when they hang out together? TELL STORIES. How did we learn as children about right and wrong? STORIES. How do we learn from each other as adults when we discuss our problems? STORIES. This makes so much sense.

I have turned to a case study approach because "despite the dominance of logical forms of exposition in academic disciplines, it is the narrative form of explanation that "just plain folks" use in their everyday negotiations of meaning and problem solving" (Jonassen, 2002, p.66 ). Telling stories has several important functions that would be useful in an educational setting. Several that stand out to me are it "is a method of negotiating and renegotiating meanings, helps us to learn, helps us to conserve memory,

and permits us to remember the unusual” (Jonassen, 2002, p.66). “Advantages of using case studies in science classes are that there are greater gains in critical thinking and learning in students” (Chaplin, 2009, p.72 ).

Case studies are a form of active learning that exercises the students’ ability to think critically, to engage in problem solving and to improve communication skills (Kunselman, 2004). These skills are critical in the professional world and it makes sense that it would be an integral part of any classroom environment. A survey of college faculty showed that they perceived case-based instruction to be effective in improvement of student critical thinking (Noblitt, 2010). A meta-analysis showed that case-study method did improve students’ application of knowledge and higher-order thinking skills (Noblitt, 2010). All of the above mentioned research has simply reinforced my previous thoughts of bringing the case-study approach to my classroom. Case study method and hands-on activities will be the best strategies to enhance my students’ critical thinking and writing skills while also preparing them for the professional world. The data I collected showed that most of the students tracked showed improvement.

**ACTION RESEARCH INTERVENTION:** The students will start with a case study on homeostasis called A Case Study on Homeostasis – Hyperthermia. I am expecting that they will have little background knowledge about the topic so this would be my base assessment of their critical thinking and writing ability. They will be given a question not discussed in class about the case study to write about so that I have an evaluation tool to grade with the writing rubric. The second case study will be on tissues that have been damaged from a shark attack. This case study is called Shark Attack from the National Center of Case Study Teaching in Science. We will have covered most of the tissue chapter before they are introduced to this study. This case study will be the intermediate evaluation since they will have some background knowledge but no hands-on reinforcement. This will also be assessed with the writing rubric. At this point I want to do use Dr. Darwiche’s power point to introduce stem cells. I want the students to see how stem cells could be used to help the shark attack victims’ various tissue damage. I plan to use the nature of stem cells and create-a-stem cell virtual lab activities to assist with reinforcement before doing the Science Take-Out Stem Cell Lab. I will use the article; Stem cells know where they want to go: Pluripotent cells are not all equal from Science Daily as a final evaluation tool. I will create a question that they will all have to answer based on their reading and use the writing rubric to grade their answers. I plan on this research to be done during the period of September 2011 through October 2011.

**CONNECTIONS TO BENCH TO BEDSIDE SUMMER INSTITUTE:**

- Dr. Houda Darwiche’s Power Point presentation about stem cells
- The Nature of Stem Cells web activity
- Create a Stem Cell Virtual Lab
- Stem Cell Science Takeout lab

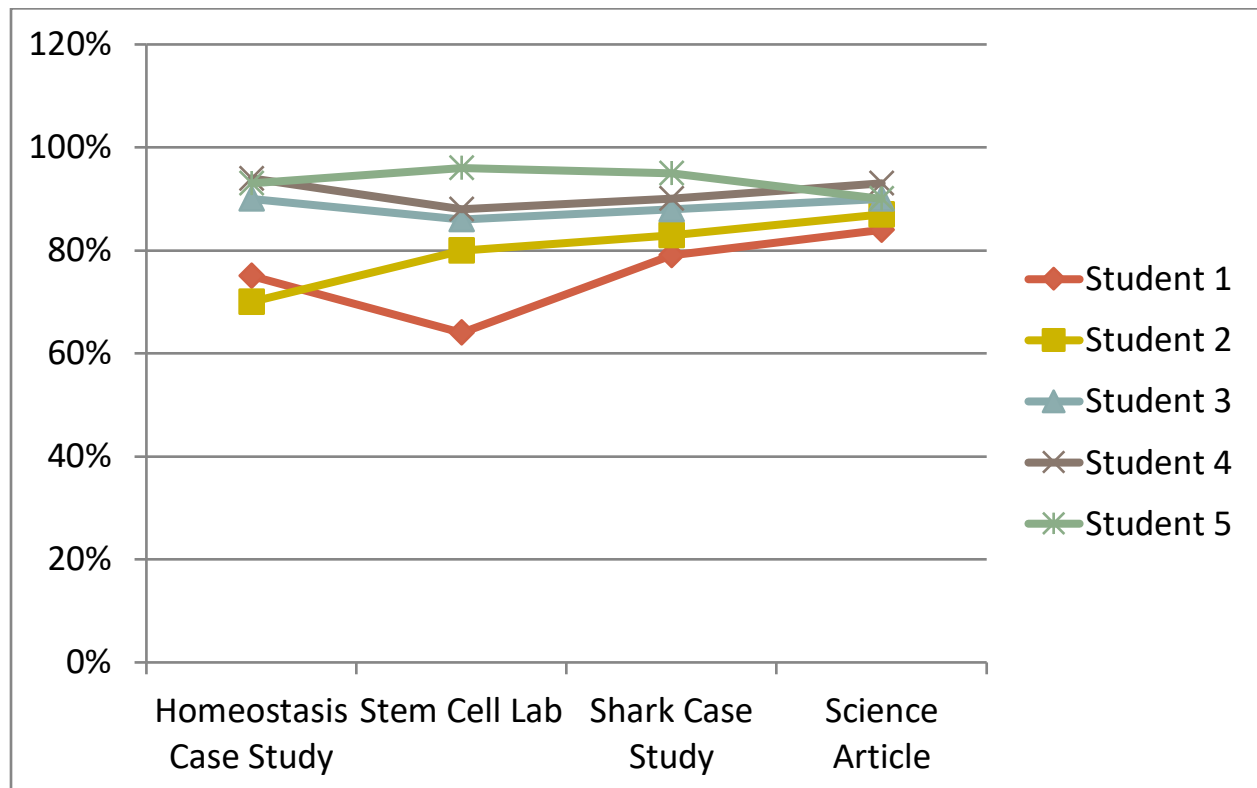
**DATA COLLECTION AND ANALYSIS:** I chose five students to track according to their reading FCAT level (1-5), one student per level. The students were challenged with two case studies. The first case study was A Case Study on Homeostasis-Hyperthermia. The students’ background knowledge and learned knowledge from lecture was challenged with critical thinking questions. The second case study was

Shark Attack. The students now had knowledge of homeostasis and what the body does to remain in that perfect state. The students were able to see the shark attack occur on a DVD, then read about the attack and were once again asked critical thinking questions. Several questions were difficult because there was little background knowledge or lecture to help them with this case. All questions were critical thinking which required a lot of writing on their part in order to get the question correct.

After learning about stem cells through lecture and two virtual activities the students performed the Science Take-out Stem Cell Lab which was hands-on and done in groups. The students had to individually write answers to certain questions so that I had individual data to see how well they understood the information.

The students were then asked to read the Science Daily article; Stem cells know where they want to go: Pluripotent cells are not equal. Students were asked to answer the questions; How do stem cells know where they want to go? Why pluripotent cells are not considered equal? There was a four sentence minimum on the answer for each question. All answers were graded for correctness and the extended writing responses were graded with a writing rubric.

Outcomes: student number correlates with FCAT Reading level



The assigned student numbers correlate with their Reading FCAT scores. Student one, three and four struggled the most with the hands-on lab but overall writing and critical thinking improved. Student two gradually improved skills throughout the study. Student five remained fairly consistent. It was surprising that so many students struggled with the hands-on lab since many students generally do better with

kinesthetic activities. Overall, all students improved or remained consistent with their writing and critical thinking skills during this study.

#### **LITERATURE CITED:**

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#### **BUDGET:**

- \$200 Stem Cell Science Takeout lab supplies

**PERMISSIONS:** The principal, parents and students were informed of the research being performed. Permission was granted pending no names were used.

**Modifications from original proposal:** The only modification I made to my research was using HHMI Stem Cell Lecture on DVD. The lecture was done with animations and in a way that was easy for high school students to understand.

**Learnings from your Action Research:** I was amazed at how interested the students were in stem cells. It was a topic that they did not know much about. Many of them were unaware of stem cells and their many possibilities. They were interested to know that not all stem cells are embryonic. I had several students that gave me ugly looks when I brought up stem cells until they learned more about where they came from and what they could be used for. It was great to see them really thinking about how useful stem cells are for people. They had good questions and one student decided to do her English research paper about stem cells so that she could learn more.

One thing I would change is doing an article in the beginning to get a better baseline for comparisons. I would like to get an average baseline instead of just the one time evaluation.

I have done the action research process before and I know that a lot is learned by the process. I enjoy doing them to find the teaching strategy that best benefits my student's needs.

**Dissemination:** I have shared this information via email and in conversation with colleagues, administration and district level personnel so that they are aware of how important labs can be for every level of students reading and writing skills.

I am not interested in writing a journal article or sharing at a conference. I enjoy using my collected information to better myself as a teacher for my students. Students are different everywhere and research helps me see those student needs and what works best for them.