Running head: ACADEMIC EMOTIONS IN STUDENT ACHIEVEMENT

Academic Emotions in Student Achievement:
Promoting Engagement and Critical Thinking through Lessons in Bioethical Dilemmas

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Abstract: This project explored the role of students’ emotions in academic settings through the development and implementation of classroom lessons in bioethical dilemmas. The following general research questions were addressed: 1) What role do academic emotions play in student learning? 2) What is the effect of students’ existing beliefs on the academic emotions they experience when faced with controversial subject matter in biology? 3) Can lessons in bioethical dilemmas be used to promote student engagement and critical thinking? 4) Can lessons in bioethical dilemmas be used to help students learn biological concepts? Students in an introductory cell biology class (BIO 156) were coached how to think critically. They completed two surveys, one to assess their beliefs about the appropriate use of biotechnology, and another to assess the emotions they experienced before, during, and after two assignments, one that did not contain controversial subject matter and one assignment about a bioethical dilemma. Observations were made about the students’ level of engagement and use of critical thinking skills during both assignments. Data from the questionnaires were analyzed to compare the emotions experienced during each type of assignment and the effect of students’ pre-existing beliefs on their academic emotions. Results suggest that controversial subject matter evokes a higher degree of negative academic emotions while at the same time contributes to greater student engagement. Results also suggest that students’ existing beliefs can play a role in their level of engagement and can affect their ability to think critically. Further, the study results indicate that lessons in bioethical dilemmas can promote student engagement and critical thinking as well as a deeper understanding of biological concepts.
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Introduction

Through the use of classroom lessons in bioethical dilemmas, this action research explored the impact of students’ academic emotions on their achievement, measured as a motivational factor in their classroom engagement and ability to use critical thinking skills. In addition, the study considered whether lessons in bioethical dilemmas can help students learn biological concepts, promote student engagement, and encourage critical thinking.

Emotion in Education

Historical Perspective

In spite of the fact that emotions cannot be separated from learning experiences, little work has been done to research emotions in educational contexts prior to the last fifteen years with the exceptions of extensive research into the area of test anxiety, and research on the attributional antecedents of emotions relating to success and failure (Pekrun, 2005). Beyond these two exceptions, few research studies were conducted prior to the 1990s that linked emotions to learning and achievement. Schutz and Lanehart (2002) in a special issue of emotions in education in *Educational Psychologist* write, “Emotions are intimately involved in virtually every aspect of the teaching and learning process and, therefore, an understanding of the nature of emotions within the school context is essential.”

With the realization that emotions have the potential to influence teaching in both positive and negative ways, Schutz & Pekrun argue that by implication there is a great need to study emotions in educational contexts (2007), and the focus of recent research has broadened
beyond studies of anxiety and its relation to achievement to include not only all types of achievement emotions that link to achievement outcomes, but also studies that include emotional responses to the achievement activity as well as the outcome (Ainley, Corrigan, & Richardson, 2005).

Science education researchers increasingly recognize the need to research emotions in education. “Science education research has embraced cognitive psychology with almost unseemly haste, but there is little research on the affective response of students to our teaching, and on what exactly is happening as so many students get put off by our approach to science at just the age when they begin to consolidate their adult identities.” (Lemke, 2001)

The Link between Achievement and Emotion

It is difficult to separate the concept of academic achievement from overall motivation, self-regulation, identity, beliefs, goals, and cognition. Emotions are clearly intermingled with all of these constructs, and they all tie to achievement in academic settings.

Students’ emotions. Emotions that are directly tied to student learning, classroom instruction, and achievement are termed academic emotions by Pekrun et al (2002). These researchers suggest that by using academic emotions in this way, the term academic is used as is commonly done with terms such as academic motivation or academic self-concept, and in doing so, the domain of academic emotions would include students’ achievement emotions experienced in school or university settings as well as going beyond emotions relating to success and failure by also covering, for example, emotions relating to instruction or to the process of studying.

Interaction between emotion, motivation, and cognition. Emotions are intertwined in students’ beliefs and actions, constituting an integral part of the interpersonal processes that create classroom contexts, and there is a need to integrate emotions, motivation, and cognition as
equal components in the social process of learning (D.K. Meyer & J.C. Turner, 2002). This need to integrate emotions, motivation, and cognition into our understanding of students’ experiences in academic settings is addressed in a variety of ways in the research literature.

Mary Ainley’s research on interest (2006) suggests that the state of interest has antecedents in the shape of the dispositions students bring to their learning, and consequences for students’ performance. She argues that interest as the immediate reaction to a new learning task is an affective state that involves feelings of arousal, alertness, attention, and concentration, and is a key variable in the motivation of learning; and in new situations perceptual and appraisal processes draw on the content of salient affective-cognitive processing structures to generate interest. Moreover, Ainley suggests that the affective state of interest might mediate the relation of achievement goal orientations and efficacy to cognitive processing and engagement.

Why is it Important to Study Emotion in Education?

Students experience a variety of emotions in academic settings that influence their perceptions and behavior. Results from studies by Pekrun, Goetz, Titz, and Perry (2002) show that academic emotions are significantly related to students’ motivation, learning strategies, cognitive resources, self-regulation, and academic achievement, and their findings indicate that affective research in education should acknowledge emotional diversity in academic settings by addressing the full range of emotions experienced by students. Emotions can affect students’ achievement as well as their interest, engagement, and personality development, in addition to affecting the social climate in classrooms and educational institutions (Pekrun, 2006).

Goals of the teaching profession are to improve instructional strategies and educational outcomes. Those goals can be attained in part by understanding how and under what circumstances emotion either negatively or positively affects students’ motivation, cognition, and...
achievement in academic settings.

Critical Thinking

There has been a longstanding concern that students lack the attributes and the skills necessary for critical thinking. All educational disciplines have reported this difficulty as well as the struggle to impart critical thinking skills. In its 1983 ground-breaking report “A Nation at Risk”, the National commission on Excellence in Education warned: “Many 17-year olds do not possess the “higher-order” intellectual skills we should expect of them. Nearly 40 percent cannot draw inferences from written material; only one-fifth can write a persuasive essay; and only one-third can solve a mathematics problem requiring several steps.” Additionally, research indicates that employers believe college graduates lack problem-solving skills and question whether colleges are successful in educating students to think critically and analyze problems. Some worry that educators do not promote critical thinking. Too often educators are more concerned with telling students what it is they should think instead of encouraging them to analyze their thinking and come to decisions based on problem-solving skills and critical thought. Educators often do an excellent job of transmitting the subject matter or content of the academic discipline to students – in other words, what to think. However, they often fail to impart the correct way to understand and evaluate this subject matter – i.e., how to think. The ability to properly understand and evaluate the subject matter is termed critical thinking.

If students aren’t learning to think critically, it may be that schools aren’t doing the job of promoting critical thinking in the classroom. Critics express concern that students are not encouraged to think critically in their college courses, suggesting that educators should teach critical thinking skills more deliberately and intentionally.
Bioethics

Bioethics is an excellent means by which to engage students in critical thinking. New technologies force us to make ethical choices. Bioethical dilemmas often result in a question of values, or determining priorities in competing values. Students must be able to understand the difference between fact, opinion, and values and reflect on those differences to make decisions about controversial issues.

Students often come to conclusions about bioethical issues from an emotional basis without considering evidence, facts, and various situations. Students often have trouble distinguishing fact from opinion often because they do not take the time to do so or because they lack the knowledge it takes to make a decision based on information and facts. Students often jump to conclusions. When asked why or how they came to a specific conclusion they fall back on emotional responses or can’t articulate why they feel the way they do.

"Broadly speaking, critical thinking is concerned with reason, intellectual honesty, and open-mindedness, as opposed to emotionalism, intellectual laziness, and closed-mindedness. Thus, critical thinking involves: following evidence where it leads; considering all possibilities; relying on reason rather than emotion; being precise; considering a variety of possible viewpoints and explanations; weighing the effects of motives and biases; being concerned more with finding the truth than with being right; not rejecting unpopular views out of hand; being aware of one's own prejudices and biases, and not allowing them to sway one's judgment" (Kurland, 1995). If educators give students opportunities to analyze problems and think critically, they can begin to rely on reasoning rather than emotions to reach important decisions and understand complex topics that underlie bioethical dilemmas.

Bioethics assignments help students see the relevance of biology in their lives, and
exploring compelling dilemmas provides powerful motivation to understand the science that underlies the dilemma. Every day our students are faced with new ethical choices posed by these discoveries and the inclusion of bioethics in the college biology classroom is indeed appropriate and important. Science topics are not void of personal values and are often subject to interpretation. Additionally, the ambiguities of ethical viewpoints challenge students to use critical thinking skills. After students become interested in an ethical problem at the emotional level, they are more interested and motivated to better understand the dilemma and think about alternative views. A bioethics discussion does not have to be about having students make up their minds on an issue; rather it can be about exploring other points of view and perspectives. Students must gather information, analyze and classify complex viewpoints, develop realistic alternatives, and then express their findings in cogent, organized fashion. A bioethics discussion is asking students to demonstrate critical thinking skills in an authentic situation.

*The Effect of Pre-existing Beliefs on Emotional Reactions when Studying Bioethical Dilemmas*

Students bring to the classroom their own set of beliefs and ideas about the world, and sometimes those beliefs and ideas are especially challenged when dealing with controversial subject matter such as bioethical dilemmas. Students can hold a myriad of different beliefs about the appropriate use of biotechnology ranging from complete acceptance of biotechnology, to a range of beliefs about how biotechnology impacts moral and social outcomes.

A person’s belief system comprises much of their identity, and the interplay between identities, beliefs, and emotions is complex. Any pre-existing belief that a person holds can lead to a variety of emotional responses especially when challenged, and in the section that follows I will discuss emotions in education, providing what research in education tells us about the link between emotions and achievement.
The Project

Participants

The participants for this study were 16 undergraduate student volunteers between the ages of eighteen and forty-five enrolled in an introductory cell biology course at a small community college in the southwestern United States. The majority of students were female (77%), pre-nursing (85%) with various academic backgrounds. Eleven students participated in the non-controversial session and thirteen students participated in the controversial session but only nine students completed both questionnaires and attended both classroom sessions.

Procedure

Data were collected during regularly scheduled class time. Students participated in two biology lessons, one with non-controversial subject matter (structure and function of DNA) and one with controversial subject matter (embryonic stem cell research). Prior to the controversial lesson, students were given a belief’s questionnaire (see appendix) to assess their pre-existing beliefs about the appropriate use of biotechnology. After both the non-controversial and controversial lessons students completed the Achievement Emotions Questionnaire (AEQ) (see appendix) to assess the academic emotions they experienced before, during, and after the lesson. The AEQ assessed the positive emotions of pride and enjoyment and the negative emotions of anger, shame, and hopelessness. Observations were made regarding the level of engagement during both lessons and the use of critical thinking skills during the controversial lesson. All students were given a test identification number to keep their responses confidential.

Lessons. The non-controversial lesson was delivered in a standard lecture format supplemented with PowerPoint slides. After the lecture students were divided into groups to review and discuss the content for approximately 20 minutes. The controversial lesson consisted
of a short lecture about stem cells after which the students viewed a short (15 min.) Nova Science Now clip titled “Stem Cells—what are they and how do we find a balance between hope for cures and respect for life” (see appendix). After viewing the film clip, students discussed the bioethical issues in small groups using a “Bioethics Worksheet” (see appendix) as a framework and guide for critical thinking.

Summary of Results

*Questionnaires*

**Beliefs.** The results from the Beliefs questionnaire indicate that many types of biotechnology conflict with students’ personal religious or cultural beliefs. Students did not believe that all types of biotechnology were good, nor did they believe that all types of biotechnology are bad. Although most students indicated it was okay to use biotechnology to develop new agricultural plants for human consumption, to develop new types of insect resistant crop plants, or to develop new medicines and procedures to combat disease, most students indicated it was not okay to use animals for biotechnology research. All students agreed it was okay to use biotechnology for applications that are ethical and safe.

**Emotions.** Results from the AEQ show the mean emotion response for the negative emotions of anger, shame, and hopelessness are higher with the controversial subject matter when compared with the non-controversial subject matter. Conversely, the mean emotion response for the positive emotions of pride and enjoyment are higher with the non-controversial subject matter when compared with the controversial subject matter, indicating students react to controversial subject matter with stronger negative emotions.
Students displayed higher levels of engagement and more interest during the controversial lesson. They reported that the opportunity to think critically and discuss the controversial issue led to an increased awareness and understanding of other viewpoints in addition to a greater understanding of the subject matter. One student stated after class that the discussion “cleared up a lot of things for me that I didn’t understand about stem cell research”. Many students displayed enthusiasm and asked if they could continue the discussion at the next class meeting. One student asked if she could “do something more with this for extra credit”. Several students sought me out after class to tell me they enjoyed the class with the controversial subject matter and the opportunity to discuss their viewpoints with each other in a structured format. They indicated they would like to participate in more assignments like this in the future.
Summary

Overall results suggest the following: controversial subject matter evokes a higher degree of negative academic emotions while at the same time contributes to greater student engagement; students’ existing beliefs can play a role in their level of engagement and can affect their ability to think critically; and lessons in bioethical dilemmas can promote student engagement and critical thinking as well as a deeper understanding of biological concepts. The study contributes valuable insight into the teaching and learning of science by examining academic emotions which has been largely ignored in the science education research literature, and reminding science educators the importance of using teaching methods that will promote engagement and the use of critical thinking as well as to bring real-world examples to the classroom.

*Note: Please contact the author for complete descriptive statistics or for statistical information about the validity and reliability of the questionnaires.
References


APPENDIX

Bioethics Assignment One – Embryonic Stem Cell Cloning

Background Information:

Embryos hold great promise in research that may lead to treatments for everything from spinal cord injury to growing organs for transplant. This research requires the destruction of human embryos. Standing in the way of many revolutionary medical breakthroughs are questions about how we should use human embryos. For those who view embryos as human lives deserving of the same respect as a child or adult, research that kills embryos is no more acceptable than would be research that killed adults. For those who view embryos as a collection of cells similar to other human tissue, research is acceptable and relatively uncontroversial. And yet many people feel that the status of human embryos lies somewhere in between these two views. An embryo seems to represent some kind of life, with a different potential than either the sperm or egg from which it began only a few minutes before. And that potential strikes many of us as deserving of respect in how the embryo is used or treated. But how far should that respect go? Does it matter that the proposed use offers great benefit? Does it matter where the embryos come from? These are but a few questions that stir amidst the controversy.

At the beginning of the assignment, you will view a short video segment. The video clip shows how scientists create embryonic stem cells. The segment explains how stem cells are used for the purpose of researching cures for disease. People who favor this procedure explain their position, and people who oppose it express their feelings of concern. How do we find a balance between hope for cures and respect for life? This assignment challenges you to think through a bioethical dilemma.
Procedure:

http://www.pbs.org/wgbh/nova/sciencenow/3209/04.html

This is the screen you will see:

2. Click on the blue arrow under the picture of the test tubes titled “Watch the Segment” and view the 15-minute Nova Science broadcast segment.

3. Work in your assigned groups to discuss the film clip and the bioethical dilemma. Use the “Bioethical Analysis” worksheet on the following page as a framework for your thinking.

   Without necessarily working to achieve complete agreement, think through both sides of the argument. For example, you might decide that allowing stem cell research from embryos already created by in vitro fertilization is acceptable, but that creating embryos for the sole purpose of research is not.
Bioethical Analysis Worksheet

What is the dilemma?

- What is the bioethical issue or decision? Summarize the problem and list all biological, legal, and social considerations.

- Who should make the decision?

- What factual information is important and why?

Who is affected?

- List everyone and everything that is affected by or has a direct interest in the situation or outcome. Think of as many as possible including non-human entities such as the environment.

- What are the immediate priorities of each interested party?

What are the alternatives and tradeoffs?

- What are the alternative courses of action and possible solutions? Be sure to include all options even if you do not agree with them.

- How would each interested party be affected by the alternatives?

- Which one makes the most sense to you as an individual and why?

What is your proposed solution?

- What decision or solution do you propose?

- Who and what will be affected by your decision?

- Identify the values that play a role in the decision. Think about your values and the values of society. Describe any legal, moral, ethical, and social concerns that others may have.

- Why does your choice seem best? How would you convince others?
Beliefs about the Use of Biotechnology

People hold many different beliefs about the appropriate use of biotechnology such as stem cell research, sex selection, cloning, etc. Below are several statements representing a range of positions about these types of issues. Read each statement carefully and circle the number that indicates the degree to which you agree or disagree with the statement.

1. All types of biotechnology are good; scientists should pursue any biotechnology research and applications.
   |       -3     -2     -1     0     +1     +2     +3       |
   | strongly disagree  neutral  strongly agree |

2. All types of biotechnology are bad; humans should not tamper with the natural world.
   |       -3     -2     -1     0     +1     +2     +3       |
   | strongly disagree  neutral  strongly agree |

3. It is okay to use genetic testing to develop new medicines and procedures to combat disease.
   |       -3     -2     -1     0     +1     +2     +3       |
   | strongly disagree  neutral  strongly agree |

4. It is okay to use biotechnology to develop new types of insect-resistant crop plants.
   |       -3     -2     -1     0     +1     +2     +3       |
   | strongly disagree  neutral  strongly agree |

5. It is okay to use genetic engineering to develop new agricultural plants for human consumption.
   |       -3     -2     -1     0     +1     +2     +3       |
   | strongly disagree  neutral  strongly agree |

6. It is okay to use biotechnology for applications that are ethical and safe.
   |       -3     -2     -1     0     +1     +2     +3       |
   | strongly disagree  neutral  strongly agree |

7. It is okay to use animals for biotechnology research.
   |       -3     -2     -1     0     +1     +2     +3       |
   | strongly disagree  neutral  strongly agree |

8. Many types of biotechnology conflict with my personal religious or cultural beliefs.
   |       -3     -2     -1     0     +1     +2     +3       |
   | strongly disagree  neutral  strongly agree |
Class-Related Emotions

Attending college classes can induce different feelings. This questionnaire refers to emotions you might have experienced before, during, or after class today. Please read each item carefully, and respond honestly to each of the statements using the following scale to indicate your agreement or disagreement with each of the following statements by circling the number that best describes your feeling.

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<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
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BEFORE CLASS

The following questions pertain to feelings you may experience BEFORE being in class.

Please indicate how you feel, typically, before you go to class.

1. I get excited about going to class. 1 2 3 4 5
2. It’s pointless to prepare for class since I don’t understand the material anyway. 1 2 3 4 5
3. Even before class, I worry whether I will be able to understand the material. 1 2 3 4 5
4. Being confident that I will understand the material motivates me. 1 2 3 4 5
5. I am looking forward to learning a lot in this class. 1 2 3 4 5
6. Because I’m so nervous I would rather skip the class. 1 2 3 4 5
7. I am confident when I go to class. 1 2 3 4 5
8. I wish I didn’t have to attend class because it makes me angry. 1 2 3 4 5
9. I am full of hope. 1 2 3 4 5
10. Even before class, I am resigned to the fact that I won’t understand the material. 1 2 3 4 5
11. I am motivated to go to this class because it’s exciting. 1 2 3 4 5
12. I worry whether I’m sufficiently prepared for the lesson. 1 2 3 4 5
13. My confidence motivates me to prepare for class. 1 2 3 4 5
14. The thought of this class makes me feel hopeless. 1 2 3 4 5
15. I worry whether the demands might be too great.  
16. My hopes that I will be successful motivate me to invest a lot of effort.  
17. Thinking about class makes me feel uneasy.  
18. Because I’ve given up, I don’t have energy to go to class.  
19. When I think about class, I get queasy.  
20. I am optimistic that I will be able to keep up with the material.  
21. I feel scared.  
22. I’d rather not go to class since there is no hope of understanding the material anyway.  
23. I am hopeful that I will make good contributions in class.

DURING CLASS

The following questions pertain to feelings you may experience DURING class. Please indicate how you feel, typically, during class.

24. I enjoy being in class.  
25. I worry the others will understand more than me.  
26. I’m tempted to walk out of the lecture because it is so boring.  
27. When I say something in class I feel like I turn red.  
28. I feel frustrated in class.  
29. Because the time drags I frequently look at my watch.  
30. I take pride in being able to keep up with the material.  
31. Because I don’t understand the material I look disconnected and resigned.
32. My enjoyment of this class makes me want to participate. 1 2 3 4 5
33. I get restless because I can’t wait for the class to end. 1 2 3 4 5
34. When I say anything in class I feel like I am making a fool of myself. 1 2 3 4 5
35. I get tense in class. 1 2 3 4 5
36. I get bored. 1 2 3 4 5
37. I am confident because I understand the material. 1 2 3 4 5
38. After I have said something in class I wish I could crawl into a hole and hide. 1 2 3 4 5
39. I feel anger welling up in me. 1 2 3 4 5
40. I am proud that I do better than the others in this course. 1 2 3 4 5
41. It’s so exciting that I could sit in class for hours listening to the professor. 1 2 3 4 5
42. I get so bored I have problems staying alert. 1 2 3 4 5
43. I get embarrassed. 1 2 3 4 5
44. Thinking about the poor quality of the course makes me angry. 1 2 3 4 5
45. I start yawning in class because I’m so bored. 1 2 3 4 5
46. When I make good contributions in class, I get even more motivated. 1 2 3 4 5
47. I’m embarrassed that I can’t express myself well. 1 2 3 4 5
48. I feel hopeless. 1 2 3 4 5
49. I enjoy participating so much that I get energized. 1 2 3 4 5
50. I feel nervous in class. 1 2 3 4 5
51. The lecture bores me. 1 2 3 4 5
52. Because I get embarrassed, I become tense and inhibited. 1 2 3 4 5
53. I am proud of the contributions I have made in class.  
54. Because I’m angry I get restless in class.  
55. I have lost all hope in understanding this class.  
56. I get scared that I might say something wrong, so I’d rather not say anything.  
57. During class I feel like I could sink into my chair.  
58. I am ashamed.  
59. Thinking about all the useless things I have to learn makes me irritated.  
60. When I do well in class, my heart throbs with pride.  
61. Because I get bored my mind begins to wander.  
62. When I talk in class I start stuttering.  
63. I find this class fairly dull.  
64. If the others knew that I don’t understand the material I would be embarrassed.  
65. When I don’t understand something important in class, my heart races.  
66. I think about what else I might be doing rather than sitting in this boring class.

**AFTER CLASS**

The following questions pertain to feelings you may experience **AFTER** having been in class. Please indicate how you feel, typically, after class.

67. After class I start looking forward to the next class.  
68. I am ashamed because others understood more of the lecture than I did.  
69. I wish I could tell the teachers off.  
70. I am proud of myself.
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71. I am happy that I understood the material.  
72. I’d rather not tell anyone when I don’t understand something in class.  
73. I am angry.  
74. I think that I can be proud of what I know about this subject.  
75. I feel so hopeless all my energy is depleted.  
76. I am glad that it paid off to go to class.  
77. Because I take pride in my accomplishments in this course, I am motivated to continue.  
78. When I think of the time I waste in class I get aggravated.  
79. I feel hopeless continuing in this program of studies.  
80. I would like to tell my friends about how well I did in this course.