Undergraduate Biology Students' Attitudes towards the use of Curriculum-Based Reader's Theater in a Laboratory Setting

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Abstract: In the undergraduate biology laboratory, many freshmen are apathetic towards the content of the course. Curriculum based reader's theater (CRBT) is an instructional method that can increase interest the students in the content of the course while improving student communication, collaboration and understanding. This research is an examination of the student's attitudes about participating in a non-traditional teaching method such as CRBT in a biology laboratory setting. A reflection document was given to the students before and after their experience with the CRBT in the biology laboratory to determine the attitudes of the students about the experience with this novel instructional method. Qualitative methods were used to code and examine the student reflections along with three other data sources. Most of the students were initially positive about performing a reader's theater as a part of the biology lab, while 81 % of the students who had originally negative perceptions of the reader's theater, changed their perceptions from negative to positive after the reader's theater experience. The findings of this research indicate that students respond positively to the use of curriculum based reader's theater in a biology laboratory as an alternative instructional method.

Keywords: science, undergraduate biology, drama, reader's theater, instruction, alternative instructional methods, curriculum, student attitudes, student perception, communication, collaboration, content knowledge

After a certain high level of technical skill is achieved, science and art tend to coalesce in esthetics, plasticity, and form. The greatest scientists are always artists as well. –Albert Einstein

INTRODUCTION

In my experience as an undergraduate biology laboratory instructor, I faced a constant battle to motivate students. Freshmen tend to be unexcited about the subject matter, as indicated by their detached stares, blasé attitudes and inability to see how the course will apply to their major or career goals. Passivity can be reduced and performance increased in the classroom when students are actively involved in the instruction (Nash, 2013). Collaboration, communication, and arts integration are all classroom techniques that can actively engage students in the instruction. As Zemelman, Daneils & Hyde (2005) stated, students need "more cooperative, collaborative activity"; the classroom should be "an interdependent community" (p. 8). Group activities that convey the content and foster positive relationships among the students can aid in the formation of this type of community classroom atmosphere (Stepanek, 2000). The Howard Hughes Medical Institute (Jarmul & Olson, 1996) stated that biology curriculum must reach beyond the standard curriculum to promote critical thinking and collaborative experiences. The National Research Council (2003) recommended that science laboratories implement project-based curriculum and "provide opportunity for students to work cooperatively in groups" (p.75).

Collaboration and communication can be increased in the science laboratory by integrated a curriculum based reader's theater (CBRT) as form of the dramatic arts into the science curriculum. According to Flynn (2007), CBRT is an excellent way to directly involve students in the communication of the content of the course while giving them opportunity to build collaboration skills in groups. A curriculum based reader's theater (CRBT) incorporates the content of the course into a reader's theater script that the students perform during the class. When students act out the content information, their ability to remember and retain the information is improved over listening to or reading the content, this has been described as the "enactment effect" by Rinne, Gregory, Yarmolinskaya, & Hardiman (2011), and occurs when students "physically acting out material leads to improved recall relative to simply reading or hearing material" (p. 91). As a science educator, I became interested in uncovering the attitudes of students towards incorporating drama or storytelling into a biology laboratory setting as I was exposed to these instructional methods in graduate school. Research has supported incorporation of a CBRT into the biology laboratory classroom curriculum (Brooks & Nahmias, 2009; Dorian, 2009; Fels 1999; Flynn, 2007; Prescott, 2003). I wanted to know how my students, college freshmen, would respond to such a radical shift from the traditional lecture-based

methods of science teaching. The research question framing this study is: What are the attitudes of undergraduate students toward incorporating a curriculum based reader's theater (CRBT) into a biology laboratory setting?

Literature Review

Fels (1999) incorporated drama into an integrated science class for pre-service teachers. Academic performance is defined by Fels (1999) as "a theory of performance as learning". Fels went on to say "it is through performance that cognition or learning may be realized". Fels (1999) investigated how dramatic performance of a scientific concept could be a viable pedagogy. The findings of this study suggest that the incorporation of drama and storytelling into instruction improved students' understanding of the content knowledge, improved students" ability to communicate science content knowledge, and improved students' skills for collaboration.

Fels and Meyer (1997) created performance opportunities in their undergraduate elementary education physical science class. Through inquiry the students were allowed to experience science concepts and then find creative ways to express their knowledge. This teaching method established a foundation of knowledge based on experience and helped the students develop new questions about the science concepts (Fels & Meyer, 1997). As the students began to express their knowledge of the concept through performative methods such as reader's theater, poetry, plays, and other arts and drama, Fels and Meyer realized that the students' level of knowledge was consistently increasing because of their appropriate use of science terms and concepts that reflected the original concept. The students' foundational knowledge developed through inquiry combined with the design of their performances opened new questions and depths of knowledge for the students to pursue (Fels & Meyer, 1997).

Brooks and Nahmias (2009) studied the engagement and vocabulary retention of a group of seventh grade students in a life science class using CBRT. They chose a narrative style book to teach the science concepts required by their state standards. The teachers assigned groups of students to write reader's theater scripts based on the book. Brooks and Nahmais (2009) determined that their project was successful because the students mastered the learning objectives, scored strongly on the vocabulary assessments, and communicated the science concepts clearly in their reader's theater scripts.

Ødegaard (2003) stated that drama in the science classroom "helps to develop knowledge development through complex negotiations of meaning" (p. 81). Two methods of using drama for science instruction were investigated in the study. These methods were using drama to enact abstract concepts and allowing the students to role play about science issues within a global context. The Ødegaard (2003) ethnographic case study was done in a British school for students between the ages of twelve and sixteen years of age. Observations and interviews with the students and teachers revealed that the students benefitted from the use of drama within the classroom as part of the curriculum. Drama helped teachers and students improve expression of science concepts, collaborate as part of a scientific community, and invest themselves as active participants of the curriculum.

Research Setting

This research was conducted at a small private liberal arts university in Texas in an undergraduate biology laboratory where I (the researcher) was employed as the biology laboratory instructor. The freshman level biology course is specifically designed for students who are science majors, and whose ultimate career goals include graduate school, medicine, pharmacy, physical therapy and other related fields. The laboratory room holds approximately twenty-four students around laboratory tables that seat four people. The purpose of the laboratory class is to complement the lecture style biology class by giving students a chance to build science laboratory skills that coincide with the biology lecture class. This research was implemented midway through the 2nd semester of the course, so as the instructor, I had developed rapport and relationships with the students over a period of six months previous to the implementation of the research.

Participants

The majority of the 57 study participants were college freshmen majoring in science or pre-health degrees. The class was a mix of male and female students whose average age was 18 or 19. The participating students were included due to their enrollment in a freshmen level course of biology for science majors and known as major's biology. The major's biology class had a laboratory requirement, which consisted of three hours in a laboratory environment per week. There were four different sections of the course; each of them presented with the curriculum based reader's theater and student reflection forms in the same manner. The choice of these students was purposive due to ease of access, prolonged engagement, and persistent observation by the researcher (Lincoln & Guba, 1985; Spradley, 1980).

Methodology

Qualitative research was determined to be the best fit for this research study because of its naturalistic setting, the instructor as a participant observer, and the open-ended research question (Denzin, 2001, Erlandson, et al., 1993; Lincoln & Guba, 1985). Rallis and Rossman (2011) also suggest that when researching new types of instructional methods, a qualitative study is appropriate. Since I wanted to

specifically capture the students' attitudes towards the use of CRBT as a novel instructional method in a science laboratory, a qualitative survey with open ended questions allows students to express their attitudes in a personal manner, as opposed to a quantitative survey that has pre-set attitude choices. In addition, student attitudes can be conveyed by students through body language and vocal expression within a classroom, which I captured through observation.

METHODS

As I began reflecting on how to incorporate drama in to the biology laboratory, I chose a simple laboratory exercise over the content for designing a testable research question. In my previous experiences, the freshman biology students often struggled with the ability to create a testable research question to design a research experiment around. Traditionally, a lecture or PowerPoint would be presented to the students about how to design a testable research question along with potential examples of good and poor research questions. I chose to write a brief reader's theater about fictional students who had designed testable and untestable research questions. I included examples of testable research questions and untestable research questions. After the reader's theater, the students would then begin drafting their own research questions for a simple scientific method based experiment they would perform at home as an assignment for the class. I did not tell the students before the lab began that our instructional time would be changed, I wanted to get an authentic student attitude response when presented with the idea of the reader's theater, so they did not know prior to the class time that they would be performing a CRBT. As the students walked into class, I handed them the short anonymous survey consisting of two open ended questions at the beginning of class. I instructed them to only answer the first question, "How do you feel about your biology lab teacher incorporating drama or storytelling into a biology lab setting?" The students had several minutes to think about their answers and record their answers on the survey papers. I then explained to the students that instead of giving the students a short lecture or directions in a bulleted list about completing a laboratory experiment, which was the typical procedure for the lab, I would be asking for volunteers to read a script, called a reader's theater. Several students reluctantly volunteered to read the short reader's theater script. A portion of the reader's theater script is included here:
Setting: 4 students, Mark, Jane, Sher, Quintin are standing in the hall talking about a lab project given to them by their teacher, Mrs. Jones.
Mark (disgusted tone): Ughh, Mrs. Jones wants us to do a science fair project, that is so 5th grade.
Jane: It's not that bad, and Mrs. Jones will help us.
Sher: I just don't get why she didn't like my idea.
Jane: Why, what was it?
Quintin: She hated mine too!
Sher: I just thought it would be interesting to know which lipstick is best.
Mark: what the heck does that mean?
Sher: you don't get it because you don't wear lipstick.
Jane: Well, what do mean, best? Best color, best lasting, what?
Sher: I don't know, which is just the best!
Quintin: Well, she said I needed to rethink mine and it is way better than that.
Sher: that's rude.
Quintin: I don't mean yours is bad, listen. I want to see which golf ball goes farther when you hit it.
Mark: Dude, hit it with what? A driver, an iron, a putter, what?
Quintin: Dude, driver, duh.
Mark: But, what if you hit it different each time? And there are way too many golf balls to hit, you would be golfing all day.
Quintin (grinning): that's the point.

The content of the reader's theater incorporated four main concepts of scientific method through designing simple experiments, they were: simplicity, organization, potential for replication, and practicality. These four concepts were written into the reader's theater, and were also assessed by the grading rubric for the student's experiments.

After the reader's theater, as a class activity, we discussed the different character's research questions within the reader's theater and why some would or would not be testable. After the discussion, I then asked the students to answer the next question on their anonymous survey which was, "After listening to the reader's theater, how did your perspective on incorporating drama into science lab change?" Before and during the reader's theater I made notes and observations about the climate of the classroom based upon student voice level and body language. After the class period, I recorded my experiences in my researcher's journal.

RESULTS

Data Sources and Analysis

Observations

The first data source was the researcher's participant observation written in field notes during the reader's theater activity. These observations were memoed in the field notes according to the suggestions of Charmaz (2010) and Corbin & Strauss (1990). Since the research question addressed the attitude of the student, I made an effort to document the climate of the classroom, the vocal expressions of the students, and the body language of the students.

The field notes taken during the participant observation were analyzed for emergent themes

(Lincoln & Guba, 1985; Spradley, 1980; Strauss & Corbin, 1994). Open coding was used to determine what indicated a positive student reaction or a negative student reaction (Lincoln & Guba, 1985; Strauss & Corbin, 1994). I documented the sounds of the students' voices, body language and facial expressions, and the climate of the class environment as a whole. Laughing, smiling, and a relaxed posture indicated a positive attitude toward the reader's theater, while frowns, silence, and stiff postures indicated a negative attitude of the reader's theater. This method of descriptive observation was done according to Spradley (1980)'s recommendation of documenting three primary elements of social situations which are place, actors, and activities. Here is an excerpt from my reflexive journal based upon my field notes memoed during the reader's theater.

The air in my classroom was a bit tense and thick as I announced that I needed 4 volunteers to "read something". There was a low chorus of "no's" echoing across the room, the faces of the students were apprehensive. I took a deep breath and mentally steeled myself for utter rejection and scanned the room for interested faces. Some students were nervously looking down at their desks, hoping I would not look at them, a few were looking back at me with tentative smiles, and those were the students that I honed in on. "Any volunteers?" I asked. There were two "I will's" that spoke up, a girl and a boy. The students came to the front of the room, I handed them their scripts and said, "This is a reader's theater. Go ahead and begin." One of the girls rolled her eyes, another scanned her page and smiled. One boy was obviously nervous and read his page intently, the other glanced at his page and did a fist pump, ready to read his role. The students began speaking.

As the reader's theater progressed, the students began to relax, smile, laugh, and make comments; this indicated a student perception of acceptance and even enjoyment. The primary emergent theme that arose from the observation data was that the students' attitude toward the reader's theater activity was apprehensive at the beginning of the reader's theater, but by the end the students' attitude suggested enjoyment and ease.

Student Reflection Document

The second data source was the student questionnaire. The students were given a sheet of paper at the beginning of class with two questions. They were informed that this questionnaire was to be anonymous. The questionnaire asked students to write responses for two questions: "How do you feel about your biology lab teacher incorporating drama or storytelling into a biology lab setting?" and "After listening to the reader's theater, how did your perspective on incorporating drama into science lab change?" The students were required to answer the first question before the curriculum based reader's theater began. The students answered the second question after the CBRT activity. The student survey gave the students opportunity to anonymously write their attitude toward the reader's theater in the biology laboratory before and after their experience. This document was collected immediately after the students wrote their responses to the reader's theater activity. Fifty-seven students completed this form. The two questions were on the same piece of paper and the students anonymously answered each respective question before and after the reader's theater. The data analysis indicated a primarily positive theme and a negative theme as the comments were coded according their positive and negative wording, as is shown in Table 1.

The words and phrases the students used to describe their feelings about the use of drama in the biology lab were the primary focus of the data analysis. The recurrence of words was noted in the analysis considering the context of the word. There

Table 1. Survey questions and thematic responses

Question 1-How do you feel about your biology lab teacher incorporating drama or storytelling into a biology lab setting?
• *Positive response-If it explains the material in a more exciting and effective way, I think it is a great technique*
• *Negative response - I think things should be kept more scientific in a lab setting*
Question 2 – After listening to the reader's theater, how did your perspective on incorporating drama into science lab change?
• *Positive response – My perspective grew stronger, I think it was very effective*
• *Negative response – Theatrics are fine every once in a while, but I prefer a lecture to theatrics when it comes to science.*

were three words that could be considered either positive or negative depending on the context and the opinion of the reader. The word, "ok" was used twelve times, and the word "fine" was used seven times. These words were not considered as positive because they may indicate lack of interest or passivity toward the activity. The word "interesting" occurred twenty times among the fifty-seven student responses, the word "fun" occurred thirteen times, the word "better" occurred ten times. Some of the negative words and phrases included, "don't like it" and "inappropriate." These only occurred once each in the fifty-seven student reflection documents.

Before the reader's theater, the analysis of the student language indicated that positive language was dominant in 41 of the 57 (72%) student reflections and negative language was prevalent in 16 of the 57 (28%). Again, this is prior to the implementation of the reader's theater. This data is compelling as 72 % of the students were open to the incorporation of drama into the biology lab before the reader's theater occurred. After the students actually performed the reader's theater, the positive language in the student reflections increased. Fifty-four (54) of the 57 (95%) total student reflections were primarily positive. Of the sixteen originally negative reflections, 13 of those students changed (81%) their response from negative to positive after participating in the reader's theater. This indicates that of the original 16 negative responses, only 3 remained negative (5%) after the reader's theater. A summary of this data is compiled in the graph in Figure 1.

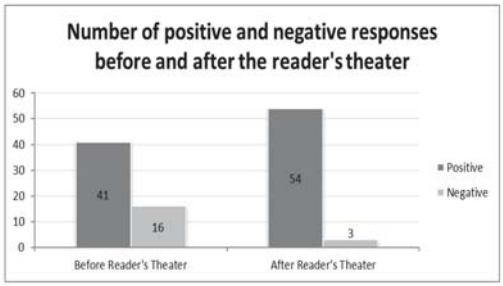

Fig. 1. Number of student positive and negative survey responses before and after the reader's theater

The Researcher's Reflexive Journal

The third source of data was a researcher's reflexive journal. The journal incorporated my own reflections about the experience with reader's theater in each of the lab sections and my reflections about the experience as a whole. The reflections were documented immediately after implementing the reader's theater in the laboratory.

Modified grounded theory (Glaser & Straus, 1967) was used to find emergent themes in the reflexive journal, the third source of data. The identified themes indicated disparity in my own attitude before and after the reader's theater activity, corresponding to that found in the documented participant observations. Before the reader's theater I had documented and observed apprehension and skepticism in the students. After the reader's theater, I observed a more relaxed, comfortable, genial atmosphere. I wrote,

Being a science person I would have never thought that art and science could mesh and be such a positive experience. These kids WANT this, they liked it, they need it. Apparently, they are desperate for something besides lecture and PowerPoint.

Trustworthiness

Lincoln and Guba's (1985) methods of triangulation of emergent themes from data sources were followed to ensure trustworthiness of the analysis. Emergent themes from the four sources of data were examined and compared for similar ideas. The common themes present in the three different data sources indicate a reliability of data, the credibility of the researcher, and the transferability of the data analysis, and the ability of another researcher to repeat and corroborate the researcher's claims. Purposive sampling, thick descriptive narrative, audit trail, and triangulation were done according to the qualitative research guidelines of Lincoln and Guba (1985), Erlandson, et al. (1993); Strauss & Corbin (1994) to ensure the trust worthiness and rigor of this research.

Discussion of Findings

Science teachers need to be aware and open to the idea that the incorporation of drama into a laboratory setting is an appropriate instructional strategy and appears to be supported by the students' positive viewpoints of such methods. One of my students wrote that incorporating drama in the science lab "would be a gratifying change"; another wrote, "it would be different and attention getting. It could also potentially relate the science to real world experiences", while another student wrote, "I will more likely remember the info from a more creative presentation of the material." The findings of this research indicate that students' attitudes towards new and different instructional methods, such as CRBT are primarily positive, and there seems to be a student need for a change from the traditional instructional methods in a college biology classroom and laboratory. This indicates that the freshmen participants were open minded towards alternative methods of teaching in a biology lab setting. The findings of this study are similar to the findings in the research of Fels and Meyer (1997), Ødegaard (2003), and Brooks and Nahmias (2009).

Assessment of Curriculum Based Reader's Theater Success as a Curricular Tool

In conjunction with the qualitative analysis of the student's viewpoints about the incorporation of the reader's theater into the biology laboratory, the

Table 2. Sample of assessment rubric for student designed scientific experiments

Concept	*Mastery of Concept*	*Knowledge of Concepts*	*Needs Improvement*	*Re-teaching needed*
Organized	Well thought out, implemented with precise procedure, data collected and displayed in an organized manner	Some evidence of organization, procedure, data collection and organization needs some refinement	Student did experiment on the fly with little planning or organization, data collected and displayed in haphazard way	No forethought about experiment, poor data collection and poor communication of data

students were required to design a simple experiment to perform at home and present in class as a graded assignment for the course. This assignment was graded by myself as the instructor of the laboratory and also independently by my laboratory assistant also with a degree in biological sciences to ensure reliability and consistency in the scoring of the grades for the assignment.

The rubric that was used to grade the student designed experiments included an evaluation each of the four concepts (Simplicity, Practicality, Organization, and Replication) presented in the reader's theater with a corresponding level of mastery. A "mastery of concept" level of evaluation means that the student had indeed mastered the concept, performed the skill in their investigation, and presented it appropriately. A "knowledge evident of concept" level of evaluation means that the student's knowledge of the concept was evident however, there is room for improvement to reach the mastery of the concept. A "needs improvement" level of evaluation indicated that the student made a good effort in the content area, but there were errors or room for improvement in order to reach mastery of the content area. A "re-teaching needed" level of evaluation indicates that the student was completely unable to show any understanding of the concept, did not make effort to understand, and needs significant intervention in order to achieve understanding. A sample of that rubric is included in Table 2.

The assessment data indicated 73% of the students mastered the four primary concepts illustrated in the reader's theater through designing, implementing and presenting a simple science experiment. Seven percent of the students showed knowledge of the concepts presented in the reader's theater within their experiment, but refinement was necessary. Twenty percent of the students showed some comprehension of the concepts from the reader's theater in their science experiments, but they needed to improve on one or more of the four basic components of scientific method. While zero percent of the students were rated as needing re-teaching of the concepts from the reader's theater. The assessment data is summarized in *Figure 2*.

DISCUSSION

The findings of this study indicate that incorporation of drama into a laboratory setting is an effective instructional strategy and appears to be supported by the students' positive viewpoints of such methods. One of my students wrote that incorporating drama in the science lab "would be a gratifying change"; another wrote, "it would be different and attention getting. It could also potentially relate the science to real world experiences", while another student wrote, "I will more likely remember the info from a more creative presentation of the material." The findings of this research indicate that students' attitudes towards new and different instructional methods, such as CRBT are primarily positive, and there seems to be a student need for a change from the traditional instructional methods in a college biology classroom and laboratory. This indicates that the freshmen participants were open minded towards alternative methods of teaching in a biology lab setting. The findings of this study are similar to the findings in the research of Fels and Meyer (1997), Ødegaard (2003), and Brooks and Nahmias (2009).

While this study primarily focuses on the student participant's responses to the CRBT, there is also value in the assessment of the student's ability to synthesize the information from the reader's theater and design, perform, and present an actual scientific experiment. The majority (80%) of the students in

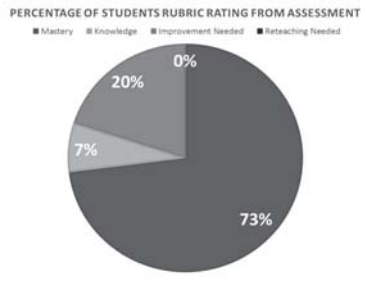

Fig. 2: Assessment results indicating student's ability to design and perform their scientific experiment

the biology laboratory were able to master or show knowledge of the concept illustrated by the reader's theater and were able to successfully design, implement, and present their own scientific research, and for many it was their first time to do so. Science teaching should be empowering students to design research, collect their data, and present their findings, this laboratory curriculum accomplished that goal.

Educational Implications

Science teachers need to realize that the time is right to exchange their traditional science teaching for alternative instructional strategies. According to the American Association for the Advancement of Science (AAAS) document *Vision and Change for Undergraduate Biology Education: A Call to Action* (Brewer & Smith, 2011), students are ready for professors to implement different instructional strategies in the biology laboratory that provide the students "more opportunities for creativity" (p. 30). *Beyond Bio 101* (Jarmul & Olson, 1991) states that future scientists need to be able to "write and speak clearly, work in groups, and act ethically" (p.27). A CBRT activity trains students to do all of the above as they participate in active and collaborative experience while learning to understand and communicate the content.

Conclusion

Max Planck (1968), father of quantum theory, proposed that pioneering scientists "must have a vivid intuitive imagination, for new ideas are not generated by deduction, but by an artistically creative imagination" (p. 109). The freshmen biology students in this study were not only ready and willing participants in the reader's theater, but were also receptive to the incorporation of the reader's theater into the laboratory environment as an alternative method of teaching. The findings of this study suggest students are ready for change in methods of science education. May they inspire the teachers to change as well.

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