

THE EFFECTS OF FEEDBACK IN BIOMEDICAL SCIENCE

by

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of the requirements for the degree

of

Master of Science

in

Science Education

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ABSTRACT

The goal of this research project was to determine if feedback had an effect on students' academic achievement in a principles of biomedical science course. Students participated in two treatment units and two non-treatment units that alternated. During non-treatment units, students were only given academic grades and did not receive peer or teacher feedback on assignments, papers, or projects. During treatment units, students received teacher feedback on papers and projects, had assignments peer edited before submission and there was small group or one on one conferencing with students to clear up misconceptions. The results of this study suggest that feedback increased student achievement in principles of biomedical science and students had a new mindset toward the purpose of feedback in the classroom.

INTRODUCTION AND BACKGROUND

Wando High School is a public school located in Mount Pleasant, South Carolina that serves just under 4,300 students in ninth through twelfth grade. It was the largest high school in South Carolina for the 2017-2018 school year. This public school does not have requirements for admission, however to be in honors classes or classes that can count for college credit, students need to have met the requirement to be in the Advance Placement Academy. Some of these requirements included past teacher recommendation, final exams from the previous year, and class ranking. In this school, I was one of three principles of biomedical science (PBS) teachers and the course was the first class in a series of four. This Project Lead the Way course was designed to expose students to college level labs like gel electrophoresis, gram staining, and crime scene analysis while at the freshman and sophomore level. Students in this program had the opportunity to receive college credit for the class if the appropriate grade of an 85% or higher is earned in the course and a satisfactory grade of a 4 out of 9 on the end of course test is achieved. I met each of my PBS classes for 90 minutes daily for one semester.

In my PBS classes this past semester I had 24 males and 28 females split into two classes. The students came to my class with various science backgrounds. Ten percent of students have taken or were simultaneously enrolled in chemistry, forty-two percent of students have taken or were simultaneously enrolled in biology or honors biology, and forty-eight percent of students have taken or are simultaneously enrolled in earth science. Forty-eight of my students identified with Caucasian descent with the other four students of African American descent. Thirteen percent of the students qualified for the free

breakfast and lunch program at the school according to the last published record in 2016 (<https://wandohigh.ccsdschools.com/>).

I have been a science teacher for the past 14 years but relocated to South Carolina in 2016. Having seen the differences in education from state to state and newly having been given the PBS class, I found myself in a time of reinvention. During my coursework at Montana State University, I was introduced to many new assessment strategies and had tried them with my classes. During this trial, one thing I discovered was when given specific and immediate feedback, students did better on future assessments with similar questions. That being said, I observed that students had an adverse reaction to feedback at first, oftentimes complained and felt they were being judged. I found this difficult to combat as a teacher, since I knew that feedback helped them improve so much.

To help me determine the true problem, I tried a variety of new strategies to see if the type of feedback or the way it was presented to my students made a difference. I used a site called goformative.com for students to turn in daily work like warm-ups and exit tickets. This site allowed me to give them a numeric score and feedback very quickly. Because it was a computer application, I felt students valued the feedback more than when I would write feedback on their papers and hand it back or give them verbal feedback during labs. That particular site also allowed them to resubmit answers if the teacher allowed that application. I found that when feedback was given to directly help with improvement, students took that critique and used it to make changes, which then improved their understanding.

Besides being a teacher, I was also a sports coach and a dance and theatre instructor. In a performing arts classroom or on the sports field, students were given feedback regularly to help improve their skills. That feedback was usually gladly accepted and each student would begin working to achieve the best results possible. In a traditional classroom setting, I have seen the opposite. Students often do not want feedback other than being told if an answer is right or wrong, and very little is usually done on the student's part after the initial grade to improve their actual skills. My goal quickly became to make my PBS classroom more like a sports or performing arts environment. I wanted my students to respect and accept feedback willingly and eventually get my classroom learning environment to a place where students value feedback more than the academic grades given.

My experience with my classes this year lead to the creation of my focus statement: What is the effect of feedback on student academic growth in biomedical science? Besides the main focus question, sub questions were created as follows:

1. Do classes that receive feedback on specific skills perform better on assessment questions that relate to those skills?
2. Is it possible to change student attitudes towards feedback?

CONCEPTUAL FRAMEWORK

In the classroom, much of what is shared with students is only numeric grades that include tests, papers, projects, labs, and exams. Students' grade point averages and rankings weigh heavily on a student's ability to get scholarship money and can influence acceptance decisions to universities. With such emphasis on numeric grades as a basis to

judge and compare students, students are not developing the skills needed to be a part of a rigorous academic program and lack the ability to take criticism and make changes unless it will improve their grade. Although grades should be noted as an important factor, it is not the only piece of information students should be receiving if the goal is to improve the student as a whole (Tanner, 2014).

As many schools and districts switch to more performance-based standards, the question of what effective teaching looks like has been a theme. It is important to understand as educators that the goal should not just include reaching objectives, but the goal should include helping students become better suited for the real world by providing them with tools for success. Research shows this type of student growth can be achieved through teacher and peer feedback (Dou, 2013).

The first step in making this happen is to believe that all students are able to learn and grow. While this should be a principle all educators believe, many times teachers put their students and classes into boxes that fit. They help build their students up to a specific potential or restrict them and keep them in a scripted norm. Students are able to see what is expected of them and will often rise to the occasion or in this case, stop rising if there is a restraint (Tweed, 2009). Tweed suggests that creating an environment with a series of formative assessments can improve the classroom culture and improve student grades. When doing formative assessments, students should not be given a letter grade that is included in their average. The teacher should instead give students immediate or relatively quick feedback. This feedback should be goal or standard specific and should indicate how that student can grow in a specific task. After creating an environment

where students feel comfortable with a model of feedback for improvement, students can then learn how to give and receive feedback from others and in the end decide to make changes to their work themselves. This type of community takes time to create, but ultimately can allow the development of a collaborate-environment where all students want to learn and improve (Bookhart, 2008).

Teachers should use their evaluation process as a model. Like students, if teachers were just given a grade when being evaluated, it would be less likely that they are able to make changes and improve. When teachers are observed by colleagues or administrators, they are often told where they fall on specific standards or goals and are given feedback to help them improve. Teachers are able to make meaningful change using that feedback as opposed to seeing a grade and trying to decide if it is something you want to make better or not, without really knowing the criteria to get better. It is suggested that teachers allow students the opportunity to give them feedback about their own teaching style and strategies. Students are with their teachers the most and have the best overall picture of the teachers' performance in the classroom. By allowing students to give a teacher feedback followed by the teacher making changes, the teacher has not only participated in this growth from feedback trial but has in a sense served as a model of how to use feedback to make changes to improve (Seldin, 1997).

To make this teaching style effective and impact students and the classroom environment, teachers must be cautious of common types of feedback that they generally give to classes. Many teachers want students to feel good and often make statements like "nice try" or "good answer." For feedback to be successful in a classroom, it should be

done to bridge the gap in understanding. It should not be used as simple pats on the back. When a teacher models giving direct feedback to a student of something that can get better, the feedback and learning become cohesive. Students stop looking for praise as validation and actually work harder on a daily basis (Hatti & Timperley, 2007).

Teachers have the ability to create real change in their students, not only academically but on their work effort. By tailoring the type of comments made to students, teachers are able to help their students achieve true mastery. Another recommendation to make this an effective tool in the classroom is to allow students to rate the feedback given by teachers and their peers. Students need to understand the process before it is expected that they become good at it themselves. If students are able to rate feedback on whether it was accurate and effective to the goal or task at hand, the teacher is able to see misconceptions the student has on feedback and address it immediately. As the student understands the purpose of feedback, it is more likely they will begin to master this tool (Lipnevich & Smith, 2009).

METHODOLOGY

My study compared content units from my PBS class at Wando High School. The study received approval from the Institutional Review Board (Appendix A). The course covered six units but due to the time frame of the study, only four units were used. Two units were treatment units alternated with two units which were non-treatment units. During my study classroom procedures, types of assessments and projects, and delivery of instruction remained the same. My typical class began with a warm up on goformative.com. Students then researched the topic of the day in a format designed by

Project Lead the Way. The research would then lead into the hands-on learning activity or a pre-lab that would lead into a full lab the following day. What was different between my treatment and non-treatment unit was that during non-treatment units, students only received numerical grades. They were scored on a scale of 1-10 on goformative.com for their warm-ups, received numeric grades for their classwork, labs, and assessments. No feedback was given. During treatment units, students would receive feedback and numeric grades on their warm-ups, classwork, labs, quizzes and assessments. During treatment units, students also participated in peer editing for papers and projects during class the day prior to turning them in using the rubric I would be using to score them. During peer editing, students received written feedback from their peers and would then have a conference with that peer where they could ask any clarifying questions. It was suggested to students to have that peer reread their final project after changes were made. Students also received written teacher feedback along with their numerical grades on daily bell work on goformative.com. The written teacher feedback prompted students to add more detail to their answers, to clarify statements that were not complete, and addressed misconceptions at an individual level. Students were allowed to resubmit bell work after they made changes. Students had the option to redo assignments for a grade change during treatment units if they used feedback to change their work. Lastly, when students participated in a writing prompt like muddiest point or minute paper, I pulled students into smaller groups to address concerns verbally with students and had students redo those questions after a better understanding was mastered. Major misconceptions were addressed to the whole small group followed by individual verbal teacher feedback

if necessary. During non-treatment units students completed very similar assignments. On their daily bell work on goformative.com, students would only receive a numerical score and not feedback. For papers and projects, students had the same time to complete them but peer editing and teacher feedback on their work was not a scheduled part of class. When doing misconception probes, students got responses back in a timely manner but it was only indicated if their answer was right or wrong. All data sets were collected from January 22 through May 11, 2018. The unit breakdowns were as follow: Treatment Units consisted of Unit 1: Crime Scene and Unit 3: Sickle Cell. Non-Treatment Units consisted of Unit 2: Diabetes and Unit 4: The Heart.

The purpose of my study was to analyze the effects of feedback on student achievement and comprehension in the PBS classroom. To measure this growth and effectively compare my treatment to non-treatment group, I used three tools. The first tool used was the PBS Pre and Post Test (Appendix B). These tests were identical and covered all content taught in the course. The PBS Pre-Test was given on day three of the course and the PBS Post Test was given on the last day of unit four. Question breakdown is summarized below:

Table 1
Breakdown of Pre and Post Test Questions by Treatment vs Non-treatment Units

Units	Treatment or non-treatment	Question numbers
Unit 1: Crime Scene Processing	treatment unit	1-4,
Unit 2: Diabetes	Non-treatment unit	5-17
Unit 3: Sickle Cell	treatment unit	18-25
Unit 4: The heart	Non-treatment unit	26-37

Since all students should have improved from the pre to post test, the purpose of this tool in my study was to compare the growth from the pre to post-test in my treatment units to my non-treatment units to see if my treatment had an effect on their comprehension and academic performance. This was done using normalized gains. Normalized gain scores of less than .3 are considered low, .3 - .7 are medium and greater than .7 are high (Hake, 1998). I chose to display this data set as a bar graph showing scores for the pre to post test for each unit.

The second tool I used was the Effects of Feedback Survey that focused on students' attitudes toward feedback. This Likert style survey was used to see if student attitudes toward feedback changed over the course of the study (Appendix C). It consisted of seven questions with response choices of strongly agree, agree, disagree and strongly disagree. This survey was delivered electronically at the beginning and end of the study to all students ($N=52$). The purpose of the instrument was to see what misconceptions students have about feedback and see if that changed during the course of study due to the treatment. I chose to present this information in a stacked bar graph showing the survey question along with the number of students that responded to each choice. The pre and post survey showed the numerical change of how many students related to a specific response. This survey reflected on the attitude students had toward feedback both pre and post treatment.

The third instrument I used was the Biomed Student Interview Questions tool (Appendix D). I interviewed a small sample of students after the course of study to inquire about their experience and attitude toward feedback ($N=14$). Their answers

provided me a qualitative data set that that provided insight on how their attitudes changed as a result various feedback styles (Table 2).

Table 2
Data Triangulation Matrix

Data Source	Questions		
	<i>Focus Question:</i> What are the effects of feedback on student achievement and comprehension?	<i>Secondary Question:</i> Did teacher or peer feedback help students the most?	<i>Secondary Question:</i> Did students perception of feedback change during the course of this study?
Pre and Post Course Test	X		
Pre and Post Survey on Feedback	X	X	X
Interview Questions		X	X

DATA ANALYSIS

The results of treatment during my study showed that students increased their content knowledge, had greater growth during treatment units and changed their attitude toward feedback. This was supported by the results of the Biomed Pre and Post Test, the Effects of Feedback Survey, and the Biomed Student Interview Questions. The results of the Biomed Pre and Post Test had a normalized gain of .95 for Unit 1 and .84 for Unit 3, both indicating high gains. Unit 1 and Unit 3 were both treatment units (Figure 1). Normalized gains show the percent of growth students had from their pre to their post-test. For non-treatment units, there was a normalized gain of .54 for Unit 2 and .65 for

Unit 4 from the pre to post test. These are both medium gains. Normalized gains were much greater on treatment units compared to non-treatment. Students obtained overall higher scores in treatment units compared to non-treatment units with treatment units scoring a 96 % and an 86% while non-treatment units scored a 61% and a 67%.

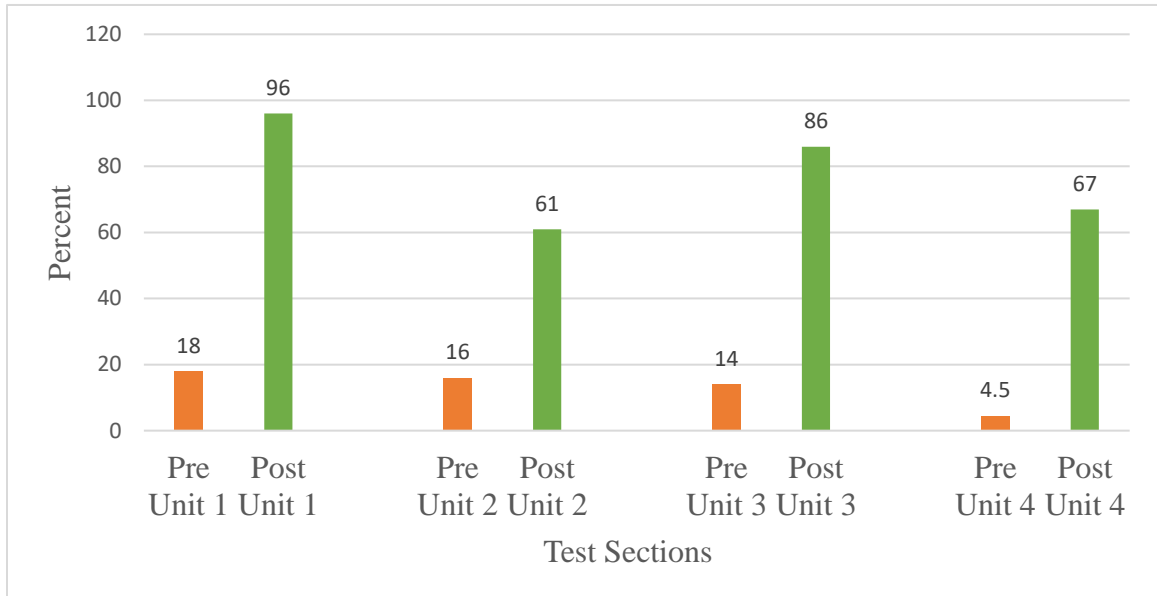


Figure 1. Biomed Pre and Post Test Results showing student academic growth by units, ($N=52$). Unit 1: Crime Scene; Unit 2: Diabetes; Unit 3: Sickle Cell; Unit 4: The Heart.

During treatment units, students were exposed to various types of feedback. To help determine the type of feedback that helped them more, interview questions about feedback types were asked. When asked what type of feedback students preferred, 72% of students preferred teacher feedback over student feedback. That was then broken down into 58% of students preferred written teacher feedback where 14 % of students preferred teacher oral feedback (Figure 2).

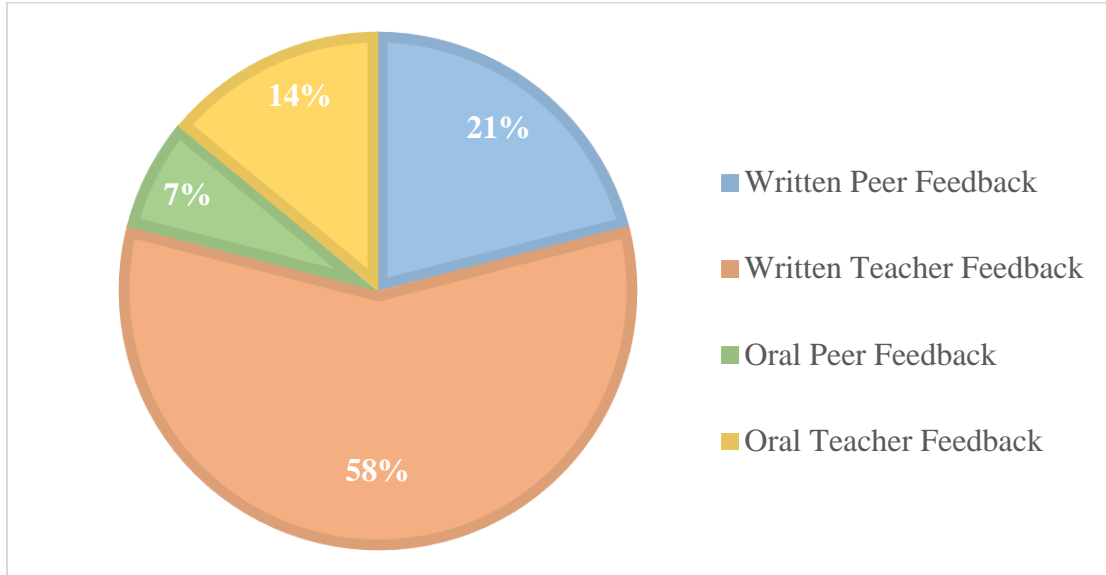


Figure 2. The type of feedback students preferred by percent, ($N = 14$).

The results of the Biomed Pre- Treatment Survey showed that most students did not originally understand or appreciate feedback. The pre-treatment survey showed that 94 % of students did not think feedback helped them understand content better (Figure 3). One student stated, “I never thought peer editing was important, but during peer edits I often realized my own paper was missing something I saw in a classmate’s paper or project and their feedback usually helped me make my paper or project even better.” This shifted to 83 % of students saying they strongly agree with the statement that feedback has helped them understand content better on the post-treatment survey (Figure 4). When asked if they felt criticized when given feedback, the pre-treatment survey showed 92 % of students agreed or strongly agreed that they felt criticized (Figure 3). The post-treatment survey showed 96% of students disagreed or strongly disagreed that they felt criticized when given feedback (Figure 4). The pre-treatment survey stated that 100% of students disagreed or strongly disagreed that student feedback was important (Figure 3). That shifted to 83% of students agreeing that student feedback was important

on the post- treatment survey (Figure 4). Lastly, the pre-treatment survey showed that 96% of students disagreed or strongly disagreed that teacher feedback was important (Figure 3). One student stated, “I used to feel criticized when getting corrections from the teacher, but the way we do them in this class I feel like the teacher is trying to help us get an A. I don’t always take all the suggestions and sometimes get a B or C if I’m being too lazy to make the corrections.” This trend shifted on the post treatment survey which showed 96% of students selected agree or strongly agree that teacher feedback was important (Figure 4).

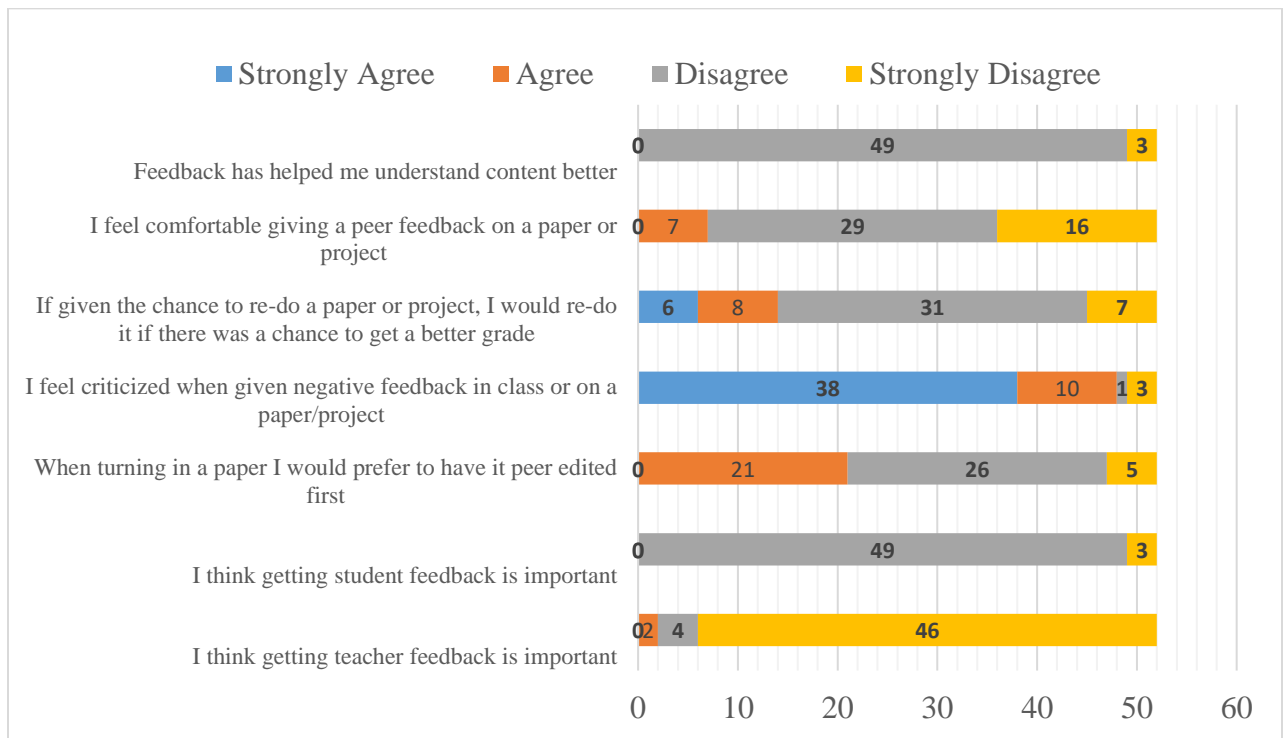


Figure 3. Pre- Treatment Survey on the importance of feedback distributed by number of students that selected each answer, (N=52).

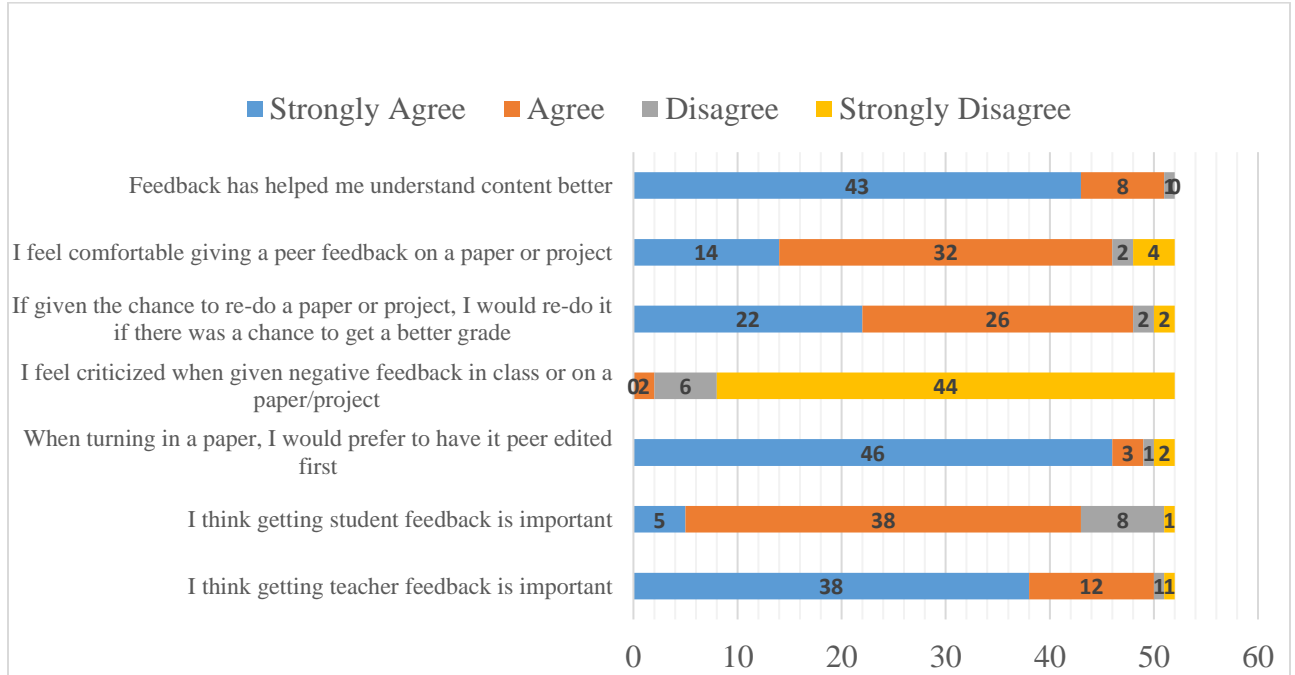


Figure 4. Post- Treatment Survey on the importance of feedback distributed by number of students that selected each answer, (N=52).

INTERPRETATION AND CONCLUSION

The results of my study suggested that feedback did enhance student academic growth and was able to change students' mindsets toward feedback in the Biomedical Science classroom. The results of the Biomed Pre and Post-test suggested that although all students increased their score from pre to post tests in each unit, students showed greater growth during treatment units. Students were also able to score higher overall on treatment units which showed that more content had been mastered. During treatment units, students had more direct feedback which lead to a greater understanding of the content they were processing. Students had tremendous change in their thoughts on the purpose of feedback from their pre to post survey suggesting that there were many misconceptions around feedback. Students went in to the study placing very little value on feedback or its purpose in the classroom. As seen in the results of the student

interview questions, 58 % of students preferred written feedback from their teacher but when asked similar questions in the beginning of the study most students disagreed that teacher feedback was even important.

VALUE

This study was very eye opening for me as a teacher. I was able to get a clear idea of how my students felt about feedback and how it changed over the course of treatment. I always thought students understood that feedback was meant to help them, but as I began my study with a class survey, I was quickly shown how mistaken I was. I could not believe how many students thought feedback was either not important or was criticism. Most students preferred someone telling them “good job” or nothing at all before treatment and after treatment more students craved constructive and precise feedback. I am part of a Personalized Learning Team at Wando High School, and although feedback does not only take place during personalized learning, since it is such a big part of it, I discussed my study with my team of five teachers and three administrators. They were very impressed at how the students were able to grow not only academically, but how they were able to display a growth mindset in terms of how they viewed feedback. Many of them gave the survey to their own students in the subject matter of human geography, English and Spanish to see if their students had the same feelings toward feedback. Due to their interest in my project, I am running a few professional development sessions in the fall on effective feedback tools, and how feedback can impact one’s classroom. I personally saw a great change in my student’s

attitudes towards feedback and how students in general seemed very confused about what feedback is and when it should be used.

There are a few things I would do differently if doing my study again. I first think it could have had more participants. I conducted my study with 52 students. I do teach an additional 26 students but did not include my first period class in the study because attendance is often an issue with first period classes. I thought conducting my study with just my second and third period classes would have more true data, but while reporting data, I felt a larger sample size could have been useful. The second thing I wish I would have done differently is create my own pre and post-test for the course that contained an equal number of questions for each unit or had students take a pre and post-test for each unit. The pre and post-test I used had less questions from treatment units than it did non-treatment units. Although the data sets collected from the pre and post-test showed that students performed better during treatment units, having an equal number of questions for each section could have helped tighten up my results.

This study has definitely changed how I plan to use feedback in my classroom in the future. Although it took some adjusting, students did a great job with peer editing and found use out of the process of being the editor and getting someone's feedback to help shape their own papers and projects. That is a tool I plan to keep in place in the future. Students also expressed how much teacher feedback, instead of just numeric grades, have helped them. I plan to incorporate direct and personal feedback on all projects student turn in as well as pulling them aside for personal or small group help to advance their skills and content knowledge.

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APPENDICES

APPENDIX A
IRB EXEMPTION



INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
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MEMORANDUM

TO: Christine Cleary and John Graves
FROM: Mark Quinn *Mark Quinn CJ*
 Chair, Institutional Review Board for the Protection of Human Subjects
DATE: January 2, 2018
RE: "The Effect of Feedback on Student Achievement" [CC010218-EX]

The above research, described in your submission of January 2, 2018, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.
- (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX B
BIOMED PRE AND POST TEST

PBS: Biomedical Science
SLO Pre-Post Test

Taking part in this interview is voluntary and participation or nonparticipation will not affect your grades or standing in class in any way.

Multiple Choice

1. This person is a medical doctor, usually a pathologist, who can perform autopsies.
a. medical examiner b. coroner c. mortician d. chiropractor

2. Which of the following is a violation of HIPAA?
a. Two doctors discuss a patient's case in the hospital cafeteria without using any names.
b. Test results are left on a patient's office voice mail.
c. No one answers so a message is left on the patient's voice mail to call the doctor's office.
d. Parents are told the results of a 12 year old son's lab results without his permission.

3. Antibodies are produced by WBCs to protect against foreign cells that enter a body. Which pairing of blood type and antibodies would you expect to find in a healthy patient's blood?
a. Type A blood, A antibodies
b. Type AB blood, no antibodies
c. Type O blood, only A antibodies
d. Type B, both A and B antibodies

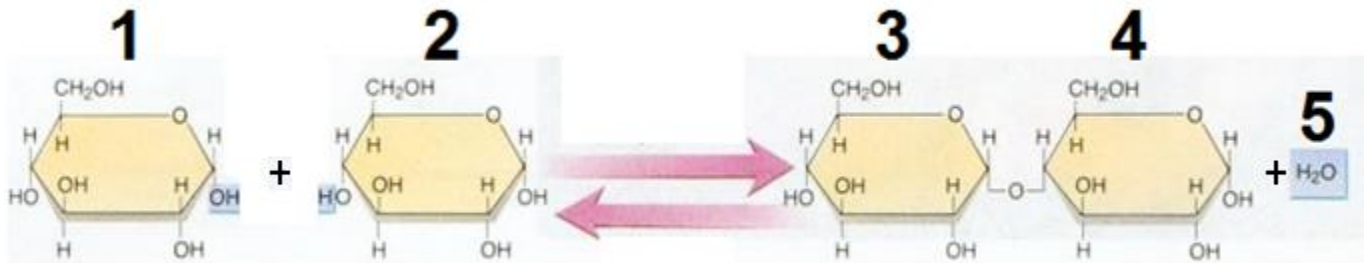
4. The following terms, **cell membranes, antigens, blood typing, and RBCs** are connected because:
a. A, B, AB and O antibodies are found on the cell membranes of white blood cells.
b. Red blood cells have either A, B, O or AB antigens on their cell membranes.
c. Antibodies are found on the surfaces of all red blood cells.
d. These terms are not connected.

5. During a Glucose Tolerance Test if blood glucose levels increase but the insulin levels remain low, what diagnosis would be correct.
a. The patient has Type 1 diabetes.
b. This patient has Type 2 diabetes
c. This patient is a pre-diabetic.
d. This patient has a normal insulin/glucose relationship and does not have diabetes.

6. What effect does a lack of insulin have on the body?
 - a. Cells in the body cannot take in glucose.
 - b. Cells dehydrate in response to an increase in blood glucose levels.
 - c. Production of ATP is diminished.
 - d. Osmotic homeostasis is disrupted because of excess blood glucose levels.
 - e. all of the above

7. Which of the following is associated with homeostasis and the body striving to maintain a specific set point?
 - a. Glucose and insulin regulating blood sugar levels
 - b. insulin and glycogen regulating blood sugar levels
 - c. glucagon and insulin regulating blood sugar levels
 - d. none of the above

8. If a person is overweight they are diabetic; and dieting and watching sugar intake can **cure** type 1 diabetes.
 - a. Both statements are true.
 - b. Neither statement is true.
 - c. The first statement is true and the second is false.
 - d. The first statement is false and the second is true.



9. Using the figure above; the process that allows the two reactants on the left to combine to make the products on the right is called
 - a. Hydrogen bonding
 - b. Ionization
 - c. Dehydration synthesis
 - d. Hydrolysis (hydration synthesis)

Matching (Each answer can be used more than once if necessary)

- a. nucleic acid b. lipids c. carbohydrate d. protein

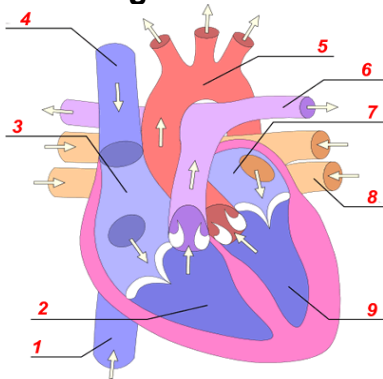
10. Quick/immediate energy molecule in the body
11. Makes up the cell membrane of a cell
12. Amino acids are the monomers
13. Biurets turns purple
14. Contain only C, H and O in a 1:2:1 ratio
15. Includes DNA and RNA
16. Include enzymes and muscle tissue
17. Benedict's solution changes from blue to green to yellow to red.

Multiple Choice

18. If a DNA strand contains 15% guanine, what percent of adenine would be expected on the strand?
a. 15% b. 25% c. 35% d. 45%
19. If a patient has sickle cell disease, which amino acid would be found in the protein where the mutation occurs?
a. alanine b. glutamic acid c. valine d. guanine
20. A hematocrit is a measure of the ratio of
a. platelets to white blood cells
b. white blood cells to plasma
c. red blood cells to plasma
d. platelets to plasma
21. If both the mother and the father are carriers of the sickle cell trait, what is the probability that their child have the disease.
a. 25% b. 50% c. 75% d. 100%
22. Which of the statements below defines a codon?
a. a protein that begins transcription by breaking apart H bonds
b. a free-floating base that attaches to an open DNA strand
c. the genetic code word for three bases on mRNA that specify one amino acid
d. the strong bond between two complementary nitrogen bases
23. What is the role of tRNA during translation?
a. bonds with the DNA strand to carry the code for protein synthesis out of the nucleus
b. carries ribosomes to the site of protein synthesis
c. breaks apart mRNA and send it back to the nucleus so that it can be reused
d. carries amino acids to the site of protein synthesis

- d. carries amino acids to the mRNA for correct placement into the protein chain
24. Which statement correctly compares normal RBCs and sickle RBCs?
- Normal RBCs are circular and greater in width than the half moon-shaped sickle cells.
 - The length of normal RBCs is greater than the length of sickle RBCs
 - The sickle cell is 6 times the width of the normal cell
 - The sickle RBC is more flexible than the normal RBC
25. A segment of DNA that codes for proteins is known as a_____.
- Protein
 - Gene
 - Chromosome
 - mRNA

Use the diagram below to answer the following 2 questions.



26. The chamber labeled 7 in the drawing:
- Receives deoxygenated blood from the body
 - Receives oxygenated blood from the superior vena cava
 - Receives oxygenated blood from the pulmonary arteries
 - Receives oxygenated blood from the pulmonary veins
27. The valve between chambers 3 and 2 is the
- tricuspid valve
 - mitral valve
 - bicuspid valve
 - pulmonary valve
28. The molecule produced to carry oxygen in the human body consists of
- 4 iron atoms
 - 2 alpha-globin molecules
 - 2 beta-globin molecules
 - all of the above
29. Which statement below is correct?
- Arteries carry oxygenated blood and veins carry deoxygenated blood

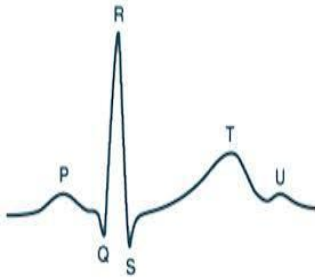
- b. Veins have valves that aid in blood flow.
 - c. Arteries have thinner muscle layers than veins
 - d. Structurally arteries and veins are almost identical.
30. How can a person's risk of heart disease be assessed using measurements of blood HDL levels?
- a. HDL levels indicate the percentage of clogged arteries supplying the heart with blood.
 - b. HDL levels indicate how much tissue damage a heart has after a heart attack.
 - c. High HDL levels are linked with clogged arteries.
 - d. Low HDL levels are linked with clogged arteries.
31. Which of the following statements is correct?
- a. A normal EKG is around 70 beats per minute.
 - b. A normal heart rate is around 80 mmHg
 - c. A normal total cholesterol level is around 300 mg/dl
 - d. A normal blood pressure is 120/80 mmHg
32. To diagnose blockage in the coronary circulation or other major arteries, one of the first diagnostic tests that would be done would be a
- a. Glucose Tolerance Test
 - b. Chest x-ray
 - c. Angiogram
 - d. Insulin response test
33. An unsaturated fatty acid has at least one double bond in its carbon chain; therefore, it is a fat and is solid at room temperature.
- a. Both statements are correct.
 - b. Neither statement is correct.
 - c. Only the first statement is correct.
 - d. Only the second statement is correct.
34. Where is LDL produced within the body?
- a. Within the HDL
 - b. Within the pancreases
 - c. Within the liver

d. Within the cholesterol

35. The blood pressure number that represents the contraction of the heart muscle is referred to as:

- a. Anastolic pressure
- b. Diastolic pressure
- c. Systolic pressure
- d. Ventricular pressure

36. Using the image to the right, the _____ wave occurs when the atria contract



- a. P wave
- b. R wave
- c. T wave
- d. QRS complex

37. Which sequence below is correct for tracing the electrical impulse through the heart muscle?

- a. AV node, SA node, Purkinje Fibers
- b. SA node, Purkinje Fibers, AV node
- c. Purkinje Fibers, AV Node, SA node
- d. SA Node, AV node, Purkinje Fibers

38. Viewing a slide under the microscope after gram staining revealed **purple stained, spherical-shaped** organisms. These results indicate the organisms being studied are a

- a. gram positive cocci.
- b. gram negative protists.
- c. microscopic, gram negative worms.
- d. gram positive viruses.

39. Which statement below is correct?

- a. Patient Zero refers to the first person to be treated for a specific disease during an epidemic.

- b. It is impossible to establish a patient zero during an epidemic.
 - c. Once a patient zero is established in an epidemic, the disease can be cured.
 - d. Patient zero is the first person in an epidemic to get sick from the disease.
40. Which one of the pathogens below is unicellular?
- a. viruses
 - b. protists
 - c. helminthes
 - D. prions
 - e. none of those listed

APPENDIX C
EFFECTS OF FEEDBACK SURVEY

Name _____

Taking part in this interview is voluntary and participation or nonparticipation will not affect your grades or standing in class in any way.

Statements	Strongly Disagree	Disagree	Agree	Strongly Agree
1. I think getting teacher feedback is important.				
2. I think getting student feedback is important.				
3. When turning in a paper, I would prefer to have it peer edited first.				
4. I feel criticized when given negative feedback in class or on a paper/project.				
5. If given the opportunity to re-do a paper to make corrections, I would choose to redo it for the chance at a better grade.				
6. I feel comfortable giving a peer feedback on a paper or project.				
7. Feedback has helped me understand content better.				

APPENDIX D
BIOMED STUDENT INTERVIEW QUESTIONS

Interview Questions:

Taking part in this interview is voluntary and participation or nonparticipation will not affect your grades or standing in class in any way.

1. Has your outlook on feedback changed? Explain.
2. Did you find a specific type of feedback more helpful to you as a student (teacher, peer, written feedback, oral feedback)?
3. During units with no feedback, did you find yourself wishing that tool was there to help you?
4. Did you look over old assignments that had feedback during units with no feedback? If so, was that helpful?
5. Did you get any benefit from editing other's work and providing feedback?
6. Do you think feedback helped your grade in the course improve?
7. If you had the choice of receiving feedback or not receiving feedback in the future, what would you prefer? Why?