

UNDERSTANDING THE EFFECTS OF USING CASE STUDIES ON
STUDENT LEARNING IN THE COMMUNITY COLLEGE
APPLIED SCIENCE CLASSROOM

by

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ABSTRACT

Students in the Applied Science for Healthcare Majors class have illustrated that using case studies is a valuable learning method. Prior to this action research project, students in this class were accustomed only to lecture, then exam, methods. Literature reviews indicated that case studies were effective tools in science classes. Therefore, pre- and post- assessments, formative assessment techniques, student surveys, student interviews, and instructor journaling were monitored and assessed for changes in student learning, retention, and value. The action research-based approach was replicated in two sections of the Applied Science class.

Quantitative data collected during the project was conflicting. One section demonstrated a statistically significant change in learning, whereas the other did not. Both sections had insufficient evidence to suggest a statistical change in retention. However, qualitative data from students and the instructor overwhelmingly indicated that the case study method is an effective tool to support student learning techniques.

INTRODUCTION AND BACKGROUND

*“CASE STUDIES are stories with an educational message”
(National Center for Case Study Teaching in Science, University at Buffalo)*

I am currently the instructor and coordinator of the Pharmacy Technician program at the University of Rio Grande/Rio Grande Community College (URG/RGCC). This program consists of eight different classes all arranged as traditional learning experiences heavily laden with lectures and exams. Instructing students in health care technical studies can be challenging at times due to the career training demands. Students in this setting would greatly benefit from student-driven learning methodologies.

The Pharmacy Technician program is one of many non-traditional opportunities we provide for area students. URG/RGCC is a small, rural community college combined with a university. Our mutual university-community college affords students financial aid that is typically not seen in a traditional stand-alone institution. Our campus boasts close to 2,400 students, with over 96% receiving financial aid (Rio.edu, 2015). However, my program has limited equipment and funds. Providing students with the best learning experience without the facilities of a well-funded program has been thought-provoking.

Students in the Pharmacy Technician program could benefit from more student-led, inquiry style strategies to increase comprehension and retention. Due to limited resources, I focused my attention on case studies. “A scenario-based story,” or case study, “is a situation, problem, or issue that is used to help students grasp the learning objectives of a lesson” (Trujillo-Jenks, 2014, para. 2). My focus question became “How the use of case study methodologies affects student learning?” More specifically, my sub-questions included the following:

- How does student comprehension change with the use of case studies?
- How will case studies affect long-term retention of material?
- How do students and the instructor value case studies as a way to learn?

CONCEPTUAL FRAMEWORK

Current literature illustrates multiple positive gains when students are active in their learning. Transitioning from faculty-centered, lecture-only classrooms towards student-centered methodologies requires the efforts of both the instructor and students. There are multiple options to create a vigorous, student-centered environment. However, to effectively create the transition, students must actively participate in their learning. Student learning must be successfully guided and monitored throughout the process with tools such as exit slips and instructor journaling. Case studies were identified as an effective technique in this student-centered transformation.

During a recent meeting of the American Association for the Advancement of Science (AAAS), professors, scientists, and others urged undergraduate science programs to begin the move from traditional classrooms to more student-centered learning opportunities. The idea is to “integrate core concepts and competencies throughout the curriculum” while keeping the “focus on student-centered learning” (Brewer & Smith, 2011, p. xiv). Multiple methods were presented to “recommend inquiry-rich, investigative experiences for all students” (p. 21).

AAAS identified five core concepts necessary to create student-centered classrooms which included “interactive, inquiry driven, cooperative, collaborative, and relevant” atmospheres (Brewer & Smith, 2011, p. 22). As change occurs from traditional instruction methods, student trepidation of the unknown can create an uncomfortable

experience. Also, instructors identified concern over losing curriculum depth and breadth. To alleviate content anxiety, AAAS encouraged that lecture remain “as one of many tools for teaching” (p. 26). The student and instructor apprehensions will be replaced by the critical, active student learning that will occur (Brewer & Smith, 2011).

Another study determined that although students seem to prefer traditional lectures, student-centered activities do indeed have a positive impact on learning (Fletcher & Ershler, 2014). The researchers identified 24 allied health students enrolled in a biochemistry course who completed a 4-hour project on using computer molecular modeling. Little instructor guidance was given during the process. Although the quantitative data indicated higher lab report and final exam scores compared to the control, qualitative data regarding the project was highly negative. Students reported confusion and anxiousness about the student-centered project. At the same time, students indicated they understood concepts and that this method was more interesting compared to lectures. Student understanding increased; yet, students were not open to the idea of new learning experiences in this project.

Understanding student thinking during the transition must be monitored. As one teacher researcher identified, using exit slips are a “ritual for thinking” and allow the student and teacher “to become active, critical listeners to discussion, and as a result, more reflective thinkers” (Leigh, 2012, p. 189). In Leigh’s article, 44 education majors participated in a 14-week study that generated over 600 exit slips. In an effort to understand the data, Leigh categorized and coded each by identified major themes. Coding also allowed her to compare learning based on date completed. Most

importantly, the dialogue created through reflection also became an invaluable tool between the teacher and students (Leigh, 2012).

Nixon and Fishback (2009) recognized that instructor guidance is also necessary for effective student learning. Students worked in small groups while organizing new vocabulary terms followed by a class-wide discussion. Students were then required to complete individual chapter readings. Student attitudes were assessed based on exit slips, surveys, and interviews. The authors noted there was a “certain level of frustration necessary for learning to occur” but that the key was effectively guiding students through their “intellectual struggle (Nixon & Fishback, 2009, p. 21).

One way to fundamentally change teacher ideologies surrounding instruction and learning is to journal. Watson (2010, p. 17), in an effort to teach pre-service teachers the value of journaling, illustrated that active journaling increases student learning through “document[ing] breakthroughs, acknowledg[ing] strengths and weaknesses” and “create[ing] connections between practice, content and context.” An interesting way to look at journaling is through peer support. Humble and Sharp (2012) set out on a two-year research to verify if peer-to-peer journaling was beneficial to the teacher. Major themes they identified for successful journaling included to be clear and confident, schedule time to write, be honest, and maintain confidentiality of students (Humble & Sharp, 2012). Journaling reflects on student attitudes towards learning and affords a wealth of data collection opportunities (Mills, 2014).

The idea of student-centered learning is not new. This concept comes from the educational theory called constructivism which, “is not a theory of teaching; it is a theory of learning” (Fosnot, 2005, p. 4). At its core, constructivism illustrates a change in

thought processes and allows students to begin constructing their own justifications (Fosnot, 2005). As classrooms move towards student-centered experiences, learning and inquiry must be kept at the forefront. Simply modifying instructional methods will not aid the student in true learning.

A common misinterpretation of constructivism in science is that inquiry activities must always be hands-on (Llewellyn, 2007). Llewellyn (p. 14) suggests for true inquiry to take place, students must be “minds-on” in their learning. Also, instructors must “empower students with the skills and knowledge to become independent, lifelong learners,” which will allow students “to assimilate and anchor their prior experiences and knowledge with newly formed experiences” (p. 18). This inquiry-based learning should focus on assisting our students in “structural shifts in cognition” (Fosnot, 2005, p. 5).

Using case studies allows students to construct ideas on their own. In scenario-based case studies, “guiding questions are created and used to help students think about the different outcomes that could occur and possibly prepare for confronting an issue in the real-world” (Trujillo-Jenks, 2014, para. 3). Lunsford (2002, p. 235) states, “Allowing community college students to experience science is preferable to just telling them about it.” Case studies are an opportunity where students can learn through another’s experience.

The question then becomes, do case studies fit the realm of inquiry? According to Herreid, Schiller, & Herried (2012) the answer is an astounding yes because students when using case studies “put learning into context” (p. x). Considering Bloom’s taxonomy, focusing learning primarily on lecture is never indicative of higher-order learning and leads to short-term memorization only (Herried, 2004; Herreid, Schiller, &

Herreid, 2012). Thus, the use of real-life application stories, such as case studies, should move the student from memorization towards analysis and evaluation (2012). In an effort to gauge faculty perceptions in using case studies as an instructional method, one research team surveyed over 100 college instructors throughout the United States and Canada. The vast majority of those surveyed indicated positive impacts on student learning including developing deeper understanding of concepts, demonstrating stronger critical thinking skills, and ability to make better connections to the content (Yadav et al., 2007).

Student-centered learning is not a novel concept. Making the transition from lecture-based methodologies to student-centered learning can prove difficult to some (Brewer & Smith, 2011), but will best allow students to begin constructing their own explanations (Fosnot, 2005). Through the literature review presented, multiple sources indicated that student learning increases when students are active in their own education. The use of case studies seems to be an effective manner to allow students to actively engage in their learning (Herreid, Schiller, & Herreid, 2012). Monitoring learning throughout the process and appropriately using feedback will allow the teacher to best equip students in their learning journey (Leigh, 2012; Mills, 2014).

METHODOLOGY

The primary purpose of this study was to discover the effects case study methods had on student learning. Secondary goals were to determine if students retained information better through the use of case studies and to gauge the value the students and instructor placed on the extent of learning assisted by the use of case studies.

Researching student and instructor interest, motivation, and acceptance of case studies

through surveys, interviews and journals helped to understand how much value should be placed on this learning strategy.

Participants and Implementation of the Intervention

This action research-based project was completed with the assistance of my Applied Science for Healthcare Related Careers II students. Applied Science II had two sections taught at two separate campuses. Section 1 had 16 students enrolled, 15 of whom were female. Section 2 had 13 students enrolled with 11 female students. All students in both Applied Science II sections were of Appalachian descent and ranged in age from 18 to 40. Four students (two from section one and two from section two) were excluded from the data analysis because they failed to complete all parts of the non-treatment and treatment units. This was an introductory course presenting basic anatomy, physiology, and disorders in a community college preparing students for technical work in healthcare related fields. The methodology completed during this project was in compliance with both the Montana State University's and University of Rio Grande's Institutional Review Boards working with human subjects standards (Appendix A).

My capstone study lasted approximately four months from January to April 2016 (Table 1). I integrated three different case studies into our unit on the respiratory system. To determine the effectiveness of case studies in multiple sections, I repeated the treatment phase in both sections. In an effort to maintain consistency, continuity, and to reduce variation between groups, the sections were kept on the same unit schedule. The only difference between the two sections was the weekly schedule. Section one met on Tuesdays and Thursdays for 75 minutes each, where section two only met on Thursdays for 150 minutes. In an effort to gauge long-term retention, students completed two case

studies, one from each unit, four weeks after the completion of the treatment. Also, a final exam was administered at the close of the semester.

Table 1
Intervention/Comparison Sections

Dates	Section	Unit	Focus
January 12 – February 4, 2016	One & two	Cardiovascular	Non-treatment
February 9 – March 3, 2016	One & two	Respiratory	Treatment
March 31, 2016	One & two	Review cases	Retention
May 5, 2016	One & two	Final Exam	Retention

Data Collection Tools

To determine the effectiveness of case studies in the Applied Science class, I first researched student understanding through traditional lecture and assessments of the cardiovascular system as the non-treatment unit (Table 2). Students were given a pre-test to assess prior knowledge of the cardiovascular system (Appendix B). After the pre-test, class resumed with typical instructor delivered methodologies such as lectures with Power Point® slides, handouts, and discussions. At the end of the non-treatment unit the unit exam which included all of the pre-test questions was administered. Towards the end of the unit, I asked students to write their Muddiest Points (Angelo & Cross, 1993) as exit slips. I then used student responses to direct a study discussion the day before the unit exam. The process took four weeks to complete. Student learning was assessed by comparing normalized gains from pre- to post-test results (Hake, 1998).

Table 2
Project Timeline

Unit	Duration	Topic Covered	Methods
1. Non-treatment	4 weeks	Cardiovascular system	Traditional lecture/tests
2. Treatment	4 weeks	Respiratory system	Case studies, lectures/tests
3. Retention	1 day (occurs 4 weeks after treatment unit)	Cardiovascular & respiratory systems	Case study review
3. Final	1 day (occurs 8 weeks after treatment unit)	Course overview	Final exam

Following the completion of the cardiovascular unit, we moved into the treatment unit studying the respiratory system. Again, I assessed prior knowledge through a pre-test of the respiratory system (Appendix C). Then, the class divided themselves into groups of three to four students. Each group completed the first case study (Appendix D) pertaining to climbing and respiratory health. This was a direct case study (Mintzes & Leonard, 2006) where each student took time to read the narrative, then, in the groups answered directed questions from the reading. Students were not permitted to use external sources of information to complete the first 11 questions. At the end of the first part, groups were assigned one of four respiratory disorders (pneumonia, COPD, asthma, or bronchitis) to research using their text or Internet sources and describe how three new vocabulary terms from the article, respiration, ventilation, and perfusion, were affected by their assigned disorder. Each group presented their findings to the entire class at the end of the period.

To gauge student involvement and understanding throughout the process, I used Minute Papers (Angelo & Cross, 1993) as an exit slip. Once collected, I organized

comments from the exit slips into three categories: understood, muddy, and general comments (Leigh, 2012). During our lecture class time, I then used the data from the exit slips to guide lectures and discussions. I had used these assessment techniques previously to eliminate any effect that exit slips might have on this treatment unit.

I continued the respiratory unit with a modified and shortened lecture series. As previously mentioned, lecture should, and can be, “one of many tools” a teacher uses to increase student understanding (Brewer & Smith, 2011, p. 26). Halfway through the lecture, I assigned a case study question from the textbook as homework (Appendix E). Students turned in their answers the next class. Answers were categorized as correct or incorrect for identifying both the syndrome and the cause.

As we finished the unit, I implemented the final case study (Appendix F). This was an interrupted, or, “decision-forcing case” which revealed parts of a story at a time while requiring the students to answer questions before continuing to the next narrative (Golich, Boyer, Franko, & Lamy, 2000, p. 1; Mintzes & Leonard, 2006). As with the first case, students worked in groups of three or four to complete the case study and completed a Minute Paper as exit slips (Angelo & Cross, 1993).

As a culmination of student discussions during each case study, feedback from exit slips, and questions asked during class time, I created a “review the cases” outline to answer any outstanding questions or concerns students from both sections identified during the unit (Appendix G). Finally, the end of unit exam identified student comprehension of the topics covered and assessed. This unit took four weeks to complete. To discover whether or not student learning had increased through case studies, I analyzed normalized gains obtained using Hake’s (1998) method, and assessed

significance with the Wilcoxon signed rank test. I organized data from all sources in Excel® worksheets and analyzed them using Excel® and the R-program, version 3.2.4.

To determine if retention was affected by the treatment, I implemented three strategies. First, four weeks after the treatment unit, each student completed directed case studies (Mintzes & Leonard, 2006) for two different patients: one suffering from a cardiovascular disorder and one a respiratory disorder (Appendix H). Each case study consisted of a narrative with four questions. I marked student answers as correct or incorrect and compared the total appropriate responses for both patients. Second, I administered a final exam the first week of May 2016 (Appendix I). Selected questions from both the non-treatment and treatment units were included on the exam. Again, I analyzed for normalized gains with Hake's (1998) method between the pre-tests and the selected questions on the final exam with the Wilcoxon signed rank test. Last, I gave students a survey at the end of the semester to assess their perceptions of case studies (Appendix J).

I used three methods to assess the value-added in learning. First, students were given an open-ended survey at the beginning of the semester asking their opinions of prior learning/teaching techniques experienced (Appendix K). Second, random student interviews at the completion of the treatment unit occurred to gauge student understanding and feelings with using case studies to augment learning (Appendix L). During the treatment unit, students were placed in groups of three to four. A student was randomly selected from all groups by placing group member names in a box and selecting one student representative from each group. This way, the selection remained random, but each group was represented in the interview process. Last, I kept a daily

journal of all activities, focusing on defining and frustrating moments for both students and teacher (Appendix M). I analyzed surveys, interviews, and journal entries by categorizing themes and by developing a concept map to illustrate trends and relationships (Mills, 2014).

In summary, utilizing data from multiple methods is only valid once results are triangulated and valid conclusions are drawn. Oliver-Hoyo & Allen (2006) “suggest the use of multiple methods of data collection in order to develop a full picture” (p. 46-47). Triangulating multiple qualitative and quantitative data collection strategies used in this project (Table 3) allowed for a more accurate representation of student and instructor attitudes and helped reveal achievement differences that applying case studies provided.

Table 3
Data Triangulation Matrix

Research Question	Data Source 1	Data Source 2	Data Source 3
1. How does student comprehension change with the use of case studies?	Unit pre-test/post-test	Formative assessments	Student surveys
2. How will case studies affect long-term retention of material?	Delayed case study answers	Unit pre-test to delayed post-test(final exam)	Student end of semester survey
3. How do students and the instructor value case studies as a way to learn?	Student surveys	Student interviews	Instructor observation journaling

DATA AND ANALYSIS

The purpose of this study was to determine the effects on learning, retention, and the ways students and instructor value learning when using case studies in a community college health care course. Multiple data sources were collected and triangulated to best answer the research questions. Quantitative and qualitative data helped to understand the true affect the case study treatment had on the student learning.

Impact of Case Studies on Student Comprehension

To determine how comprehension might have been affected by case studies, students first completed a pre-test to gauge prior knowledge levels in both the treatment and non-treatment units. At the end of each unit, a post-test was administered. Boxplots of the non-treatment unit for both sections illustrate increases in mean post-test scores, with a large range of scores (Figure 1). Both sections began with mean pre-test scores below 50%.

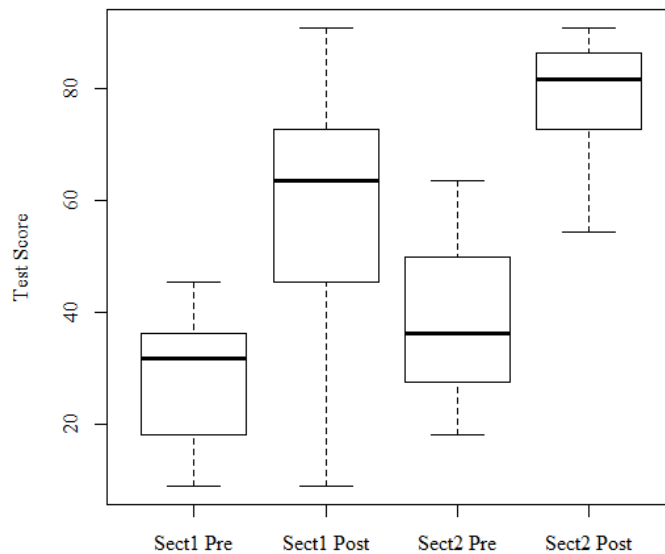


Figure 1. Boxplot for sections one and two pretest versus unit exam, nontreatment unit. Section 1, ($n=14$), section 2, ($n=11$).

Comparing the sections within the treatment unit, the addition of case studies also illustrated growth in comprehension (Figure 2). Again, there is a definitive increase in mean scores from pre-test to post-test in both sections, with pre-test scores in both sections below 50%. However, the spread of post-test data in this unit is more uniform when compared to the non-treatment unit earlier.

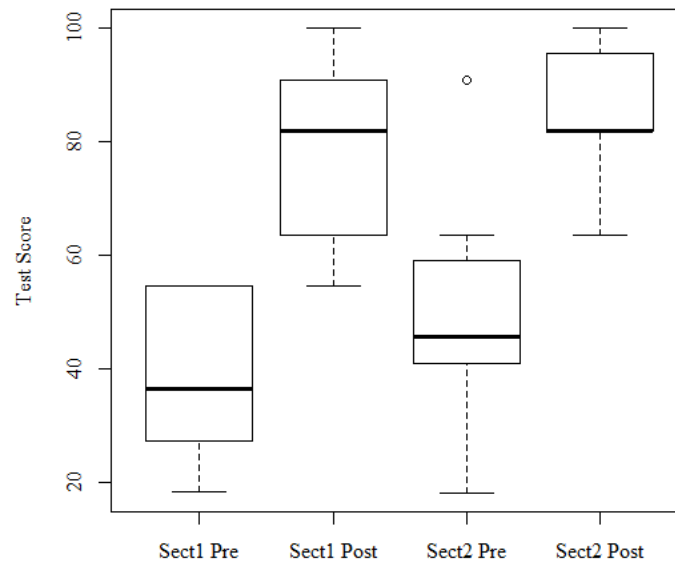


Figure 2. Boxplot for sections one and two pretest versus unit exam, treatment unit. Section 1, ($n=14$), section 2, ($n=11$).

Visually, there appears to be an increase in student learning in both units. To draw a more accurate conclusion, Hake's (1998) method of normalized gains was used to compare the two sections and units (Figure 3). Section one illustrated an increase in normalized gains when comparing the non-treatment to the treatment unit. However, section two illustrated a decrease in gains. This is in part due to a student in section two who had a lower post-test score in comparison to his pre-test score. In both sections combined, this is the only student with a decrease in post-test scores for both units.

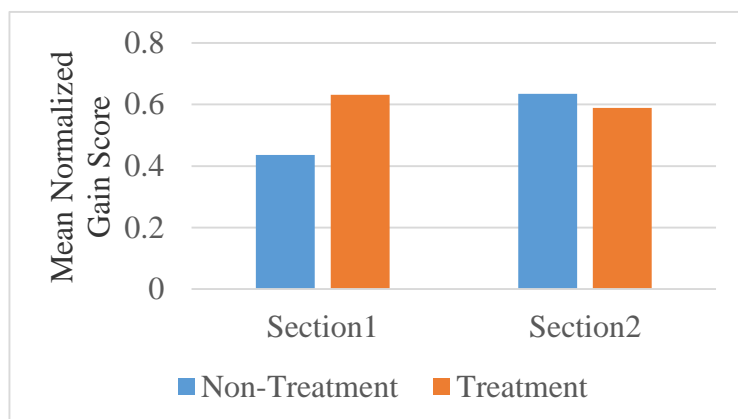


Figure 3. Normalized gain scores for pre- to post- tests in both the non-treatment and treatment units. Section 1, ($n=14$), section 2, ($n=11$).

To determine statistical significance, I ran the Wilcoxon signed-rank test using R (The R Foundation for Statistical Computing). The Wilcoxon signed-rank test compared the normalized gains in post-test scores from the non-treatment unit versus the treatment unit for both sections. Section one had a resultant $p=0.016$ which suggests a statistically significant difference between the two units. Section two did not show sufficient evidence of any statistical change between the units ($p=0.32$). However, the one student with a negative gain could be a cause of this high p -value. Running the Wilcoxon signed-rank test without the one student's negative gain data yielded a $p=0.084$ for section two. Although treating the one student as an outlier gave a lower p -value, there is still insufficient evidence to suggest any statistical change between units in section two.

Formative assessments were monitored and collected while using case studies. To gauge student comprehension after the first case study, students were asked to write a Minute Paper (Angelo & Cross, 1993). Nine students in section one correctly identified focus concepts or new vocabulary presented from this case study. Example responses from section one included, "Pressure is the key," "Pressue (air) required to make lungs

work,” and, “blocking air flow like fluid build-up will stop gas exchange & (make it) difficult (to) breathe.” This technique also provided an opportunity to answer questions, and correct misconceptions and inadequate responses from some students. During the next lecture, I used responses such as, “Why does working hard mean extra pressure on the system,” and, “How does pressure affect ventilation or really causing all of this?” to guide discussion prompts. Out of the 14 students who completed the task, only 2 missed the focus of the case study and instead wrote on how climbing causes motion sickness.

Section two students also provided a wealth of information from their first exit slip. Out of 11 students present in the first case study, 9 identified the correct concepts in their Minute Papers (Angelo & Cross, 1993). Examples of responses from section two students included, “Pressure affects the body in many ways, especially the lungs,” “Ventilation, respiration, and perfusion all work together to get oxygen to the body organs,” and, “Less atmospheric pressure makes it harder to breath [sic] and the body works harder.” Section two students formulated more questions in their papers than misconceptions. One student asked, “What causes the respiratory diseases?” Questions like this were beneficial in developing future lectures.

The second case study was assigned as homework and consisted of two main questions, “What syndrome is the patient experiencing and what is causing the patient’s distress?” Answers were marked as correct or incorrect. Table 4 illustrates the total number of correct responses for both sections. Most incorrect responses were due to incorrect syndrome selection (question one), or not fully describing the cause (question two). Incorrect responses again helped to guide future lecture discussion points.

Table 4
Correct Responses to Case Study 2

Section	Question one correct	Question two correct
One (<i>n</i> =14)	11	9
Two (<i>n</i> =11)	9	9

The final case study was presented as group work similar in style to the first case study. Again, the Minute Paper (Angelo & Cross, 1993) was utilized as an exit slip to conclude the activity. Students seemed more open with information on this paper. Since more data were collected, I placed responses in four categories: understood, misguided, muddy, and off-topic (Table 5). “Misguided” responses included those that were correct in some ways, but not necessarily in the context of the case at hand; whereas, “muddy” responses illustrated a question or concern from the student. Off-topic responses had no relevance to the case at hand. Most students had multiple responses. Examples of “understood” comments included correctly identifying triggers of an asthma attack, reviewing the structures of the respiratory system, and the cause of labored breathing during an asthma attack. “Muddy” interpretations included, “How does asthma cause a blood clot,” and, “I’m still confused on perfusion and gas exchanges.”

Table 5
Categorical Responses to Case Study 3

Section	Understood	Misguided	Muddy	Off-topic
One (<i>n</i> =14)	8	6	5	3
Two (<i>n</i> =11)	7	4	7	3

The final data source for student comprehension came from student comments during the case studies and the survey after the unit test. All surveys collected in both sections (*N*=25) were positive towards case studies. Students’ comments during the

actual case studies included, “I actually understood today’s lesson,” “I feel this exercise was very helpful and I enjoyed it!” and, “This helped me think the process through.”

Case Study Effects on Long-Term Retention

Retention of student learning was monitored in three ways. Four weeks after the completion of the treatment unit, students were assigned two case studies to complete on their own (Appendix H). Each case study had four questions, one from each of the following categories: identifying signs/symptoms, system structure, condition, and application. The results from section one are presented in Figure 4.

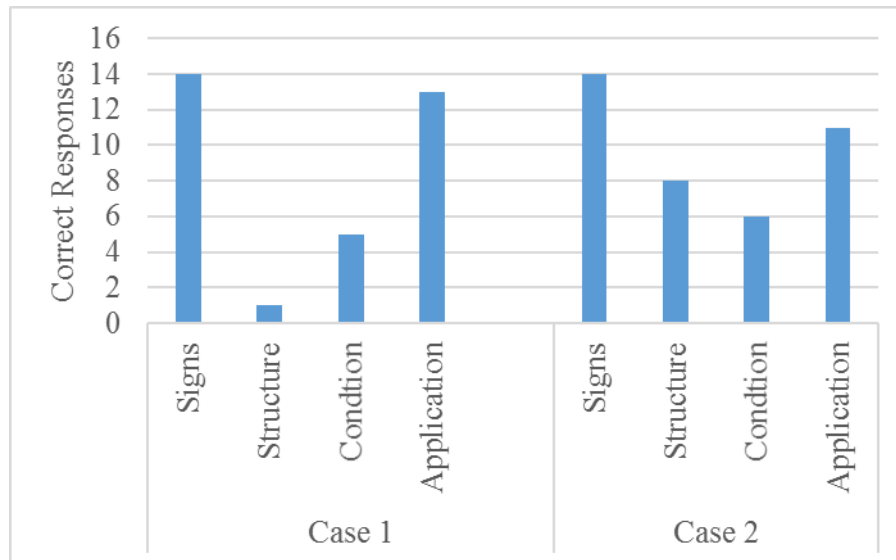


Figure 4. Delayed case study results, section one ($n=14$).

As noted in section one, students were able to correctly identify signs and symptoms from the case studies, but struggled with structure and condition questions. Section two students had similar results (Figure 5). However, section two students displayed a greater difficulty with condition questions compared to section one students.

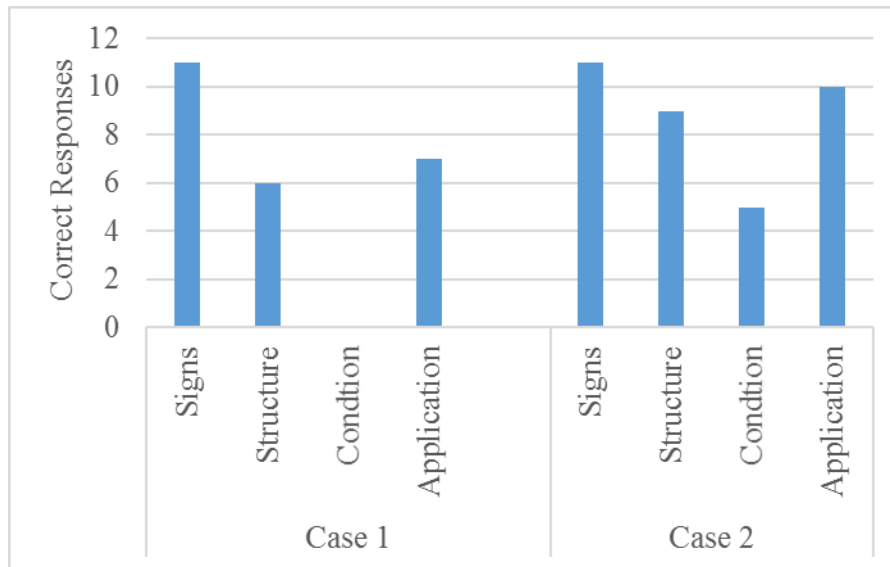


Figure 5. Delayed case study results, section two, ($n=11$).

The second method I used to determine long-term retention was the course final exam. I compared student responses on the pre-test to those on the final exam for changes in scores. Both sections demonstrated mean test score growth in the non-treatment unit questions (Figure 6).

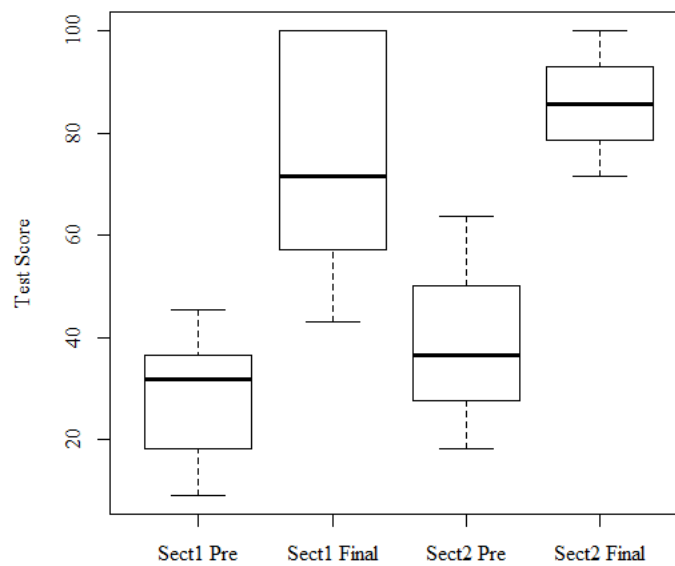


Figure 6. Boxplot for sections one and two pretest versus final exam, nontreatment unit. Section 1, ($n=14$), section 2, ($n=11$).

Comparing student responses between the pre-test and the treatment unit final exam questions illustrated similar gains in mean scores (Figure 7). Both sections had positive increases in student correct responses.

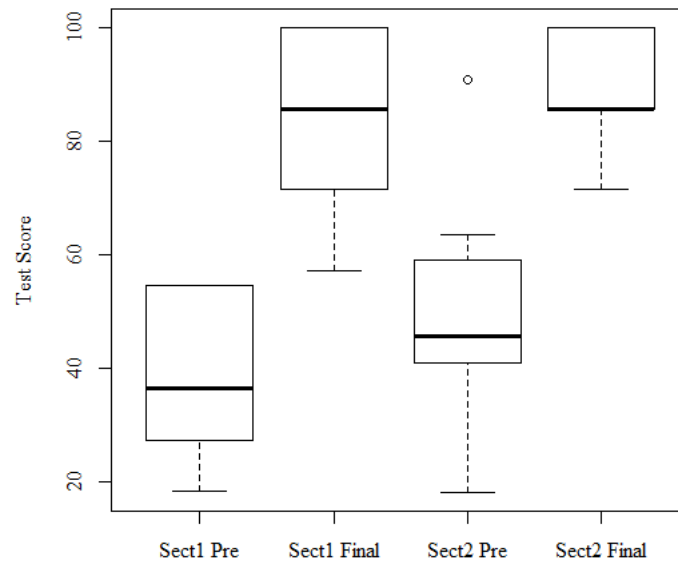


Figure 7. Boxplot for sections one and two pretest versus final exam, treatment unit. Section 1, ($n=14$), section 2, ($n=11$).

To determine a relevant, statistical decision regarding retention, I first evaluated normalized gains using Hake's (1998) method between pre-test and final exam scores in both sections (Figure 8). Visually, there appears to be little difference between the units in both sections. Then, using student normalized gains, I ran the Wilcoxon signed-rank test to compare pre-test to final exam gains. Section one had a $p=0.638$ and section two had a $p=0.767$. Both p values suggest there was insufficient evidence of any statistical change between units in the final exam; yet, retention appears evident when comparing means (Figures 6 & 7).

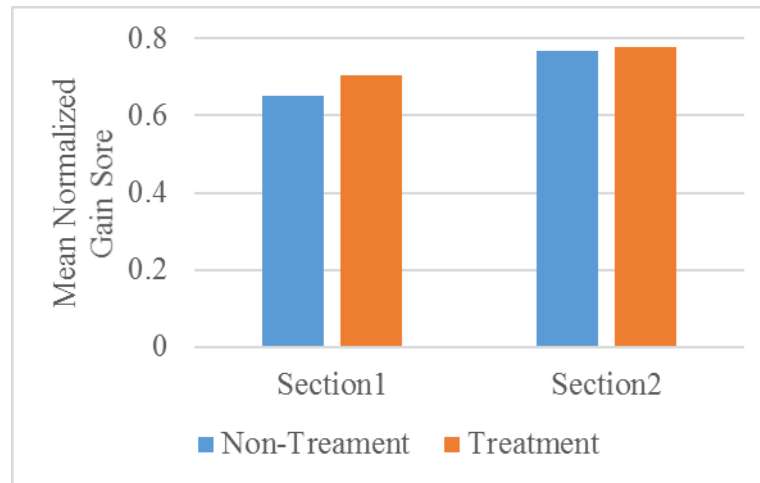


Figure 8. Normalized gain scores for pre-test to final exam in both the non-treatment and treatment units. Section 1, ($n=14$), section 2, ($n=11$).

Finally, student responses from the end of semester survey were evaluated for retention changes. Most students in both sections indicated that the case study methods introduced in the class helped them learn the material. Out of both sections ($N=25$), only one student indicated that she felt case studies did not help her learn and stated, “It [sic] just did not make any sense to me.” Another student noted that she felt case studies helped her learn but, she “didn’t like doing it.” Overall, 24 out of 25 students indicated positive results from case study methods on learning and retention.

Student and Instructor Value of Case Studies

To gain a better understanding of student value of case studies, I first administered a survey at the beginning of the semester. Student results in both sections were mixed in their opinions of methods to best learn. Overall, more students in both sections combined identified lecture format as the best way to learn (Figure 9).

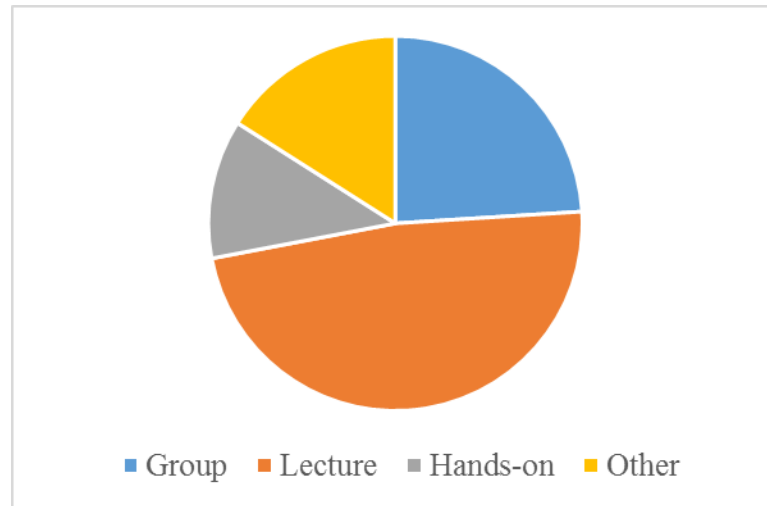


Figure 9. Initial survey responses to “How do you best learn in a classroom?” (n=25).

Group work was the second most mentioned method in both the *best* and *hinder* questions. Section two students identified “overbearing students” as another hinderance to learning. This section contained a student who liked to ask numerous questions in an attempt to understand topics, which became a distraction to others. Figure 10 illustrates the wide variety of responses to classroom activities that hinder learning. Interestingly, lecture again shows up as the most common *hinder* activity.

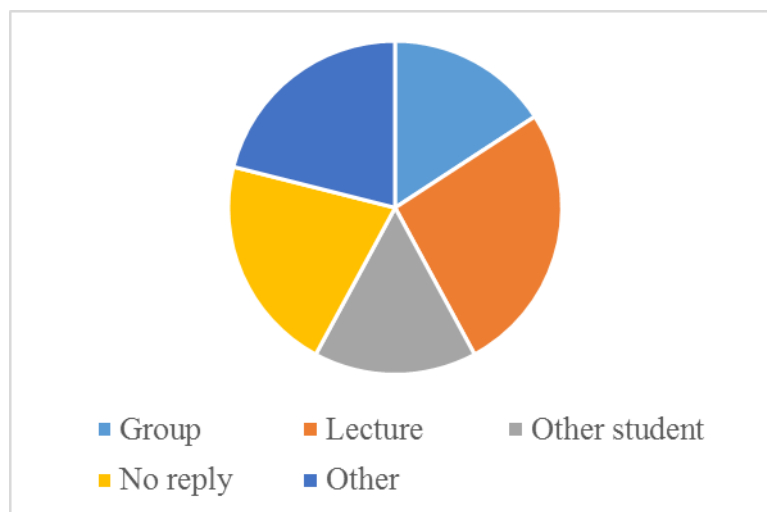


Figure 10. Initial survey responses to “What activities hinder learning?” (n=25).

Comparing the initial survey to the end of the semester surveys yielded similar responses in both sections. After implementation of the treatment, most students identified case studies as the method that best helped them learn. One student noted, “Doing the case studies, getting into small groups, and discussing different opinions on different disorders and diseases” best helped her learn. Another student indicated the value added by case studies, “I feel it helped as it made you feel more involved, as if it were real.” Very few students identified lecture as a method to *best* learn in the class (Figure 11).

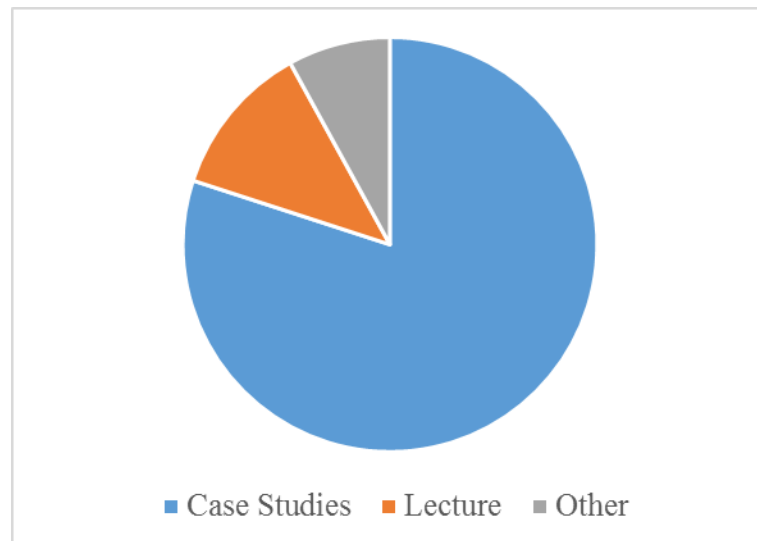


Figure 11. Final survey responses to “What classroom activities helped you learn best?” (n=25).

In the *hinder or not like* question, the final survey indicated that most students did not see any learning methods as an issue for this class (Figure 12). One student had great issue with the formative assessment techniques I used to monitor progression through the class, “I did not like having to list the items for Minute Papers [sic] and put my name on them. I think if you did not want to be involved you should not have to be involved.”

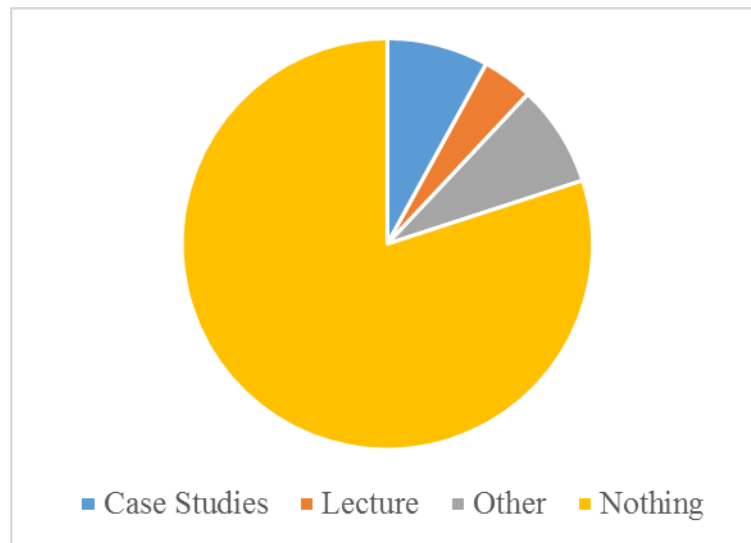


Figure 12. Final survey responses to “What did you not like about this class?” ($n=25$).

Student interviews also provided great insight into understanding the effect case studies had on the learning environment. All students interviewed in both sections ($n=7$), had positive comments regarding case studies. Most positive comments illustrated that the students valued the purpose of the case studies. One student mentioned that working through case studies, “Makes you think about all the different possibilities – details matter.” Another student commented that the use of cases, “Helped [them] to learn new definitions and understand the different diseases.” The interviewees identified group work ($n=2$) and too much information ($n=2$) as main concerns with the case study work. One student mentioned, “There was too much going on. Focus on only one aspect, not an entire unit review.” All seven interviewees mentioned that case studies helped their understanding of the material. Only one student mentioned that case studies might work best as individual work instead of group work. Finally, when asked if there is anything else the students wanted me to know, one student commented that, “Mixing lecture with case studies really worked well together and helped to simplify the unit.”

Finally, I kept a journal during the research to discover what value I placed in case studies as a learning method. On our first day, January 12, I journaled, “Pre-test scores are l-o-w! Nowhere to go but up!” which illustrated my positive attitude and eagerness to start the research. As the non-treatment unit progressed, most days I wrote about how bored the students appeared and on my difficulty with lecture days. One day I mentioned, “Lecture-boring. Students are too busy copying notes and/or not paying attention. Makes me wonder if any of this is sinking in!” Towards the end of the treatment unit mini-lecture, I noted, “Last lecture day. Way off topic – they have decided the best way to keep from taking notes is ask random questions. We plowed through.”

Journal entries during the actual case studies were mostly positive. Section one took more time to settle in and begin the first case. I allowed students to select their own groups, which for the most part, was effective. However, one group did not work well together. I noted in the journal, “Mix groups up? Or, ask more probing questions to keep certain groups on task.” Section two’s case occurred about a week later, which gave me time to think about different strategies. In this section, I had students present their answers to the final question. I commented in the journal, “This worked really well! Wish I had thought of this for the first group!”

I continued to learn as I progressed through the last group case study. Time management was the major concern as this case had four separate parts. I noted, “Watch the clock! Maybe assign times to each section, and allow for discussion as a whole.” Another interesting set of comments in section one revolved around students questioning me, “Is this right?” I would reply, “Talk to your group – think it through.” Then, as the

case began to wrap-up, and the disorders were identified, the same students were heard saying, “We were right! Yea!”

Section two had an “off day” resulting from multiple tests in other classes. Their agitation and tiredness bled through to our class time; most students only read through the cases and discussed, but did not record their own answers. Even with all the distractions, I had multiple positive comments in the journal for February 25. Many of my comments revolved around excellent questions I overheard groups asking each other that helped them uncover what disorder the patient was exhibiting. Despite all the troubles, I had multiple “smiley faces” and positive comments throughout my journal.

INTERPRETATION AND CONCLUSION

This study provided evidence that the use of case studies in a community college health care course was beneficial. Reflecting on the quantitative data alone would lead to an inconclusive analysis. However, triangulating the quantitative data with the qualitative data gives a more accurate picture of the gains in comprehension, retention, and value. Repeating the case study treatment in two separate classes did not show a statistical significant change.

Whether comprehension changed with the use of case studies cannot be answered confidently. Quantitative data, including normalized gains and the Wilcoxon signed-rank test, illustrates more study is warranted. Yet, considering the small sample sizes, one can understand and respect the use of data triangulation methods to answer research questions. Repeating this study in subsequent years with different students may yield a greater quantitative understanding of the primary question by analyzing a greater sample of students. Qualitative data, including formative assessments and student surveys,

illustrated greater gains when using case studies versus traditional lecture-only learning methods.

Retention data illustrated mixed results. The most intriguing and identifiable issue presented from the delayed case study was student difficulty identifying the correct condition presented in the cases. After careful examination, I noted that the wording of the questions in each case study could have caused misinterpretation. In most cases, students could correctly identify parts of a condition, but not fully answer the question. Taking the first delayed case condition question, “Looking at Ken’s history and symptoms, what could be some possible causes for his current condition?” the anticipated responses would be heart attack, heart failure, COPD, or any disease/disorder that could cause chest pains. Out of both classes, most students listed Ken’s history and current symptoms that were causing the current problem. I learned that wording of questions is vital to outcomes since anticipated responses were not the actual student answers. Changing the language, even slightly, by removing the first half of the question, may have produced different results. Proofreading and anticipation are vital when measuring learning.

Using the final exam as a method to interpret retention proved to be difficult. Statistical analysis indicated there was insufficient evidence to suggest any change in retention between the non-treatment and treatment unit questions in both sections of students. All students illustrated an ability to retain information well for the final exam. This could be attributed partially to the fact all students studied have been in classes with me before. I typically recycle exam questions for the final exam. By this point, students have grown accustomed to my teaching methods and assessment techniques. Therefore,

this may not have been the best method to evaluate long term retention of material or compare said retention between two units.

Evidence for student and instructor value of case studies was overwhelmingly positive. Student comments on both surveys and interviews yielded gains in using case studies instead of lecture-only methods. Journaling, not only illustrated my positive outlook towards case study value, but also helped to mold future uses of case studies in the classroom.

Quantitative data from this study seemed somewhat conflicting. However, all data considered, case studies are a valuable tool to increase student comprehension. In the analysis of pre- and post-tests, one could assume that learning was not affected. However, triangulating this information with formative assessments and surveys illustrates that learning was positively changed with the addition of case studies. Finally, although not measured by this study, students increased their higher order thinking and problem solving skills as observed throughout the research.

VALUE

Completing this action research study provided me with an opportunity to reflect on my teaching methods and on better ways to connect material for the learners. As I move the Pharmacy Technician program away from traditional lecture and test methods, I plan to incorporate more case studies in the process. The data from my action research reaffirmed my commitment to utilize more student active learning methods.

There were a few setbacks that actually turned into valuable teaching moments for me. First, do not underestimate the value of pre-tests and uncovering misconceptions. Through this process, I realized the need to touch base with the students prior to learning

new material. The use of pre-tests and formative assessments will continue in my future classes. Second, make sure to align exam questions to the learning goals. Although I had been developing this study for two years, I had not finalized the case studies used before developing the pre-test. Thus, the focus questions on the pre- and post-tests did not directly align with the subject matter presented in all three cases. Were the questions important? Yes. Were the questions appropriately aligned to the learning goals of the cases? No. For subsequent action research, I will better align goals with assessments. Finally, careful proofing and anticipating student understanding of what is being asked is vital to excellent question development skills.

Case studies are an excellent method to introduce, reinforce, and assess learning of new subject matter. I originally did not plan on assigning the second case as homework. However, weather created multiple snow days and delays that forced the use of homework to evaluate one of the cases. What seemed to be an issue became a rewarding experience. Students uncovered the topic presented in the second case on their own without instructor influence. This led me to introduce one of our later units entirely within the context of case studies. Genetics, a part of our reproductive unit, had no lecture component, only case work. Students again enjoyed learning collaboratively while uncovering and reaffirming new vocabulary and concepts. This was my first attempt allowing student learning of an entire unit without lecture. If I had not completed this action research project, I may have never turned the class over to student directed learning. I will continue to utilize case studies in the future and am hopeful for an eventual “flipped classroom” where students become more actively involved in their learning.

I am reminded of my opening quote, “Cases studies are stories with an educational message” (National Center for Case Study Teaching in Science, n.d.). Both my students and I enjoyed this process. Case studies will grow to greater importance in my classes and program. This learning method is a unique way to connect real-life concepts and stories to sometimes dry rote memorization of facts and vocabulary. I look forward to continuing active research in new ways to effectively increase student comprehension, retention, and value of learning.

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APPENDICES

APPENDIX A
IRB APPROVAL LETTERS



INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
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MEMORANDUM

TO: Keith McKinniss and Peggy Taylor

FROM: Mark Quinn *Mark Quinn CJ*

DATE: November 6, 2015

RE: "Understanding the Effects of Using Case Studies on Student Learning in the Community College Classroom"
[KM110615-EX]

The above research, described in your submission of **November 6, 2015**, 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.

Administrator Approval

I, Richard Sax, Provost, University of Rio Grande and Rio Grande Community College,
verify that I approve the classroom research conducted by Keith Alan McKinniss.

Richard Sax, Provost & VPAA
(Signed Name, Title of Position)

RICHARD SAX
(Printed Name)

5 November 2015
(Date)



Richard Sax, Ph.D.
Provost & Vice President for Academic Affairs

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Administrator Exemption Regarding Informed Consent

I, Richard Sax, Provost, University of Rio Grande and Rio Grande Community College, verify that the classroom research conducted by Keith Alan McKinniss is in accordance with established or commonly accepted educational settings involving normal educational practices and that I approve the project. To maintain the established culture of our school and not cause disruption to our school climate, I have granted an exemption to Keith Alan McKinniss regarding informed consent.

Richard Sax, Provost & VPAA
(Signed Name, Title of Position)

RICHARD SAX
(Printed Name)

5 November 2015
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APPENDIX B

PRE-TEST NON-TREATMENT UNIT

APPENDIX C
PRE-TEST TREATMENT UNIT

Applied Science II

Name: _____

Respiratory System PRE-TEST

8. Which is the correct flow of air INTO the body?
 - a. Bronchi → trachea → pharynx
 - b. Trachea → bronchi → alveoli
 - c. Bronchi → alveoli → trachea
 - d. Trachea → bronchi → pharynx

9. Which of the following would be true if you inhaled air through your MOUTH instead of your NOSE?
 - a. Inhaled air wouldn't reach the lungs at all.
 - b. Inhaled air would be warmer and moister.
 - c. Inhaled air would be cooler and drier.
 - d. You cannot inhale through your mouth, you will die.

10. Respiration is actually controlled by changes in air _____ between the outside and inside of the lungs.
 - a. Pressure
 - b. Temperature
 - c. Surface area
 - d. Weight

11. Which of the following disorders/ diseases of the respiratory system would be considered curable?
 - a. Emphysema
 - b. Asthma
 - c. Pneumonia
 - d. Chronic bronchitis

12. You can suffocate yourself just by consciously holding your breath.
 - a. True
 - b. False

13. Smoking is known to cause many health disorders and diseases. There are multiple substances in tobacco smoke that are dangerous. **Identify** ONE (1) of these substances **and describe** a negative effect this substance has on the body.

14. **Summarize and explain** the two main functions of the respiratory system.

APPENDIX D
GROUP CASE STUDY #1

Please note: The “Everest/First Ascents” case was originally found online, <http://www.biologycorner.com/anatomy/respiratory/Everest%20Article.doc>. I asked permission from the author of this website to publish her work in my paper. She did not have original ownership to the case, only the questions. She agreed that I may modify, use, and publish the questions in this action research paper. Attempts to locate and acquire permission to publish the actual case have fallen short. The original document, that students may read, can be found at the following website:

<http://blog.eddiebauer.com/2009/04/05/above-pheriche-dangers-altitude-begi/>

Questions for students to answer:

1. How does the body adjust to a higher altitude?
 - a. respiration rate increases
 - b. heart rate increase
 - c. blood pH alters
 - d. all of these

2. What is perfusion?
 - a. the delivery of oxygen to the tissues
 - b. an increase in heart rate
 - c. tiredness due to lack of oxygen
 - d. a severe headache

3. The first sign of acute mountain sickness is:
 - a. nausea
 - b. lassitude
 - c. headache
 - d. lack of appetite

4. The main point of the article is to:
 - a. describe the scenery as hikers travel to the top of the mountain
 - b. describe the physiological changes the body undergoes at high altitudes
 - c. warn climbers about the dangers of acute mountain sickness
 - d. describe the anatomy of the heart and lungs in relation to elevation

5. What is one way to avoid getting mountain sickness?
 - a. drink lots of fluids
 - b. ascend slowly
 - c. breathe faster
 - d. eat food high in carbohydrates

6. How does a person cure mountain sickness?
 - a. descend to a lower altitude
 - b. take aspirin
 - c. spend time in a hyperbaric chamber to repressurize the lungs
 - d. do aerobic exercises

APPENDIX E

HOMEWORK CASE STUDY FROM TEXTBOOK

The following case study was assigned as homework during the lecture portion of the treatment unit. The case study is found in our textbook, *The Human Body in Health & Disease*, page 473.

“Curtis was having fun alongside a neighborhood swimming pool when he was accidentally pushed into the pool. Although he is a good swimmer, the suddenness of the fall caught him off guard and he inhaled some water before he was able to gain control of the situation. Luckily, a nearby swimmer assisted Curtis to the edge of the pool, but Curtis continued to have great difficulty in breathing. Can you name the syndrome that Curtis must be exhibiting? Explain what happened to Curtis’s lungs to cause his breathing difficulty” (Patton K. & Thibodeau, G., 2014, p. 473)

APPENDIX F
GROUP CASE STUDY #2

“Driving Can Be Dangerous to Your Health: An Interrupted Case Study in Physiology”
Modified from an original case written by Phil Stephens, Villanova University
Used with permission of the National Center for Case Study Teaching in Science, all rights reserved.

Part 1: The Grandparents Arrive

Dave pulled the cell phone out of his pocket, cursing himself for not putting it on vibrate. The children, Jason and Laura, were both asleep, and he knew that the rest of the day would not be fun if they were awakened from their naps.

“Hi, Dave. We’re just a few minutes away,” said his father.

“OK, see you soon.”

Dave looked at his wife Jen, who smiled. “Come now, Dave, you know your Mom and Dad. There’s no stopping them once they get going; driving 1200 miles in one day. I guess they’re impatient to see their granddaughter. Mom never got over the fact that her hip replacement was scheduled at the same time that Laura was born.”

“I know, Jen. She takes being the only grandmother very seriously.”

A car pulled into the driveway and Dave and Jen went out to greet their visitors. They all crept into the house and sat in the kitchen quietly drinking coffee. His mother was breathing heavily, which made Dave recall his childhood and what it had been like to grow up with an asthmatic mother.

“Hi Grandpa,” said Jason, as he ran into the kitchen in his pajamas.

“Hi, big guy. Wow, you’ve grown. How old are you, now?”

Jason smiled as he held up four fingers. He extended both arms so that his grandfather could lift him onto his lap. He stood on his grandfather’s legs and looked over his shoulder for presents. Everything stopped when they heard crying from upstairs.

“Let’s wait and see if she goes back to sleep.”

They all sat quietly, but the crying got worse. Both women stood up.

“I’ll get her, Mom. She is beginning to recognize faces, and I don’t want to start you off on the wrong foot.”

“Come on, buddy, let’s go out to the car and see what we brought you from Florida.”

Dave watched his father and son walking hand-in-hand out the front door, as his wife and daughter come into the kitchen. His mother's arms went out and he could see the pleasure in her eyes when she held her granddaughter. Laura was holding a stuffed toy bear in her arms.

"My goodness, is that your old bear, Dave?"

"Yes. We found it in one of the boxes you gave me, and Laura latched onto it. It's a bit dusty, but we've been afraid to wash it because it may fall apart."

Laura giggled as her grandmother cooed to her while carrying her around the kitchen. Muffy the cat rubbed up against grandma as she played with Laura in her arms.

"Should you be doing that?" Dave asked his mother. "With your hip and all."

"I'm fine, just a little breathless. Guess I'm a little out of shape for babies."

She gave Laura back to her mother and sat down. Her breathing was labored, and Dave recognized the signs of an oncoming asthma attack. He rushed to the door and shouted to his father to get the nebulizer. Dave could hear his mother's wheezing as she tried to breathe.

His father calmly placed the liquid medicine into the nebulizer cup, plugged in the machine, and turned on the compressor. He helped his wife hold the mask to her face.

Soon, her breathing was regular; deeper than normal, but regular.

Jen noticed that Jason was alarmed, and she wondered whether he had forgotten that his grandmother had had some attacks during their last visit.

"It's okay, Jason," she said. "Grandma sometimes has a problem with her breathing. But you can see that her medicine makes her better quickly."

Jason looked relieved and smiled.

Questions:

1. What do you think triggered grandma's asthmatic episode in this case?
2. What are grandma's symptoms?
3. Describe asthma. What happens to block air flow?
4. Map the movement of air through the structures of the respiratory system. Start with the nose.
5. Which respiratory structures are typically affected during an asthmatic episode? Why?
6. In an asthma attack, which of the mechanisms of breathing would be MOST affected – ventilation, respiration, or perfusion? Explain.

Part II – That Night

“I’m glad they went to bed early,” said Dave. “They look really tired.”

“Yes,” agreed, Jen. “They really shouldn’t have done the entire trip in one day. Florida to New Jersey in 19 hours; must be a record.”

Hours later, Dave’s father woke from a deep sleep. His wife’s breathing was labored, and she was wheezing.

“Are you okay, Barb?” He knew that his wife was awake, but he did not wait for an answer. He opened the bedroom door and turned the light on in the bathroom. He set up the nebulizer, carried it into the bedroom, and gave the mask to his wife as he plugged it into the outlet. Her breathing became more regular, but it was fast; she was wheezing and seemed anxious. Even in the dim light, Barb looked pale.

“I have this pain in my chest and neck, John, and it’s making its way down my left arm.”

He reached for her hand and it felt cold and sticky. He placed his finger on the inside of her wrist and felt her pulse racing.

“I think we need to go to the hospital, Barb.”

“I know, but the pain gets worse when I move. It was just an ache before you went to the bathroom, but now it really hurts and I feel like I am going to pass out.”

Dave knocked on the open bedroom door and entered his parents’ room. His father was dressed and his mother was clearly distressed.

“I heard Mom coughing. Is everything okay?”

“I’m not sure. This is the worst attack she’s ever had. I think we need to get her to the hospital.”

Dave pulled on some clothes and in no time he and his father had his mother in the backseat of the car. The hospital was only a few miles away. He could hear his mother coughing and watched her closely. She held a tissue back that she just coughed into and it is covered in blood. Barb began to cry.

Questions:

1. What new symptoms is Grandma Barb experiencing?
2. Is she experiencing another asthma attack? How do you know?
3. With the new symptoms in mind, what else, if anything, do you think is going on with Barb?
4. Describe how you think the hospital will help Barb now considering your new diagnosis.

Part III – The Hospital

As soon as the three arrived to the hospital, a nurse rushed Barb to the emergency room when she heard Barb complain of chest pain. Immediately, the nurse began to evaluate Barb and placed a nasal cannula in her nostrils to give Barb extra oxygen. Barb's initial evaluation, and normal results were recorded by the nurse:

Test	Barbara's results	Normal results
Pain?	YES, chest	None
Breathing	Wheezing, labored	Normal, regular
Blood pressure	90/58	110/60
Pulse (heart rate)	95	75
Pulse oximetry oxygen level	80	100

The nurse stepped back when the doctor entered the cubicle and she began to examine Barbara. John told her about the asthma attack that afternoon, and the second unusual attack that had happened in the last hour.

"Did your wife complain of chest pain?"

"Yes, she said that it was in her chest, neck and left arm. I thought that she was having a heart attack."

"That is possible," continued the doctor. "Are your wife's legs usually swollen?"

John explained that his wife's legs often swelled when they took road trips because they were in the habit of driving long distances without stopping. The doctor frowned at John.

"Did you notice that the swelling is worse in her right leg?"

"No doctor," replied John. "But her right hip was replaced about six months ago."

"Your wife had major surgery, and you drove how far?"

"That was my fault," said Barbara. "My granddaughter was born around the time I had my hip surgery, and I wanted so desperately to see her."

"If my initial prognosis is correct," the doctor continued, "you may be staying here for a few days." She reached down and turned on the flow of oxygen through the nasal cannula, and made notes on a chart.

"An orderly will take you to your room. I'll schedule you for some more tests."

Questions:

1. Which of Barb's initial tests are abnormal?
2. Why does the lack of movement while riding in a car cause Barb's legs to swell?
3. Why is the doctor concerned with only one leg swelling?
4. What are you thinking could be wrong now?
5. What additional tests do you think the doctor will order?

Part IV – Tests, tests, and more tests

The doctor ordered cardiac enzymes to check for a heart attack, chest X-rays, a V/Q scan, and blood gas levels.

Since Barb has lived with asthma her entire life, she understood x-rays, blood tests, etc. But, she wasn't sure what a V/Q scan was or would show. She asked the technician a few questions.

“What is this V/Q scan you're about to do to me?”

“Well, Mrs. Smith, the V/Q scan is one of many tests we use to see air flow and blood flow through your lungs” explained the technician. “This is a relatively easy procedure. You will inhale a radioactive powder, then I will take some detailed pictures with this machine. Then, I'll inject you with another material and repeat the pictures. There is no pain or discomfort.”

“Good,” said Barb. “I use a nebulizer regularly, so inhaling the powder shouldn't be a problem.”

Barb's test results were as follows:

Test	Barbara's results	Normal results
Cardiac Enzymes	Normal	Normal
Chest X-ray	Blockage in left lung	Negative
V/Q scan	High Probability	Low Probability
Blood Oxygen pressure	78	100
Blood Carbon dioxide pressure	45	40

The doctor returned to Barb's room and started to explain what happened.

“Good to see you again, Barb, and you look much better!”

“I feel better. The medicines and rest have helped a lot. Thank you so much!”

“That's good news. Let me explain what has happened. You have formed a blood clot in your leg. Sometime during your trip, this clot has moved to your lungs. The V/Q scan and chest X-ray have confirmed this. We now need to give you medication to help your body dissolve the blood clot. You will be here a few days and will go home once the clot has stabilized.”

“Thank you doctor,” exclaimed Barb as she and John hugged.

Questions:

1. Define and describe respiration and perfusion.
2. Which tests above show Barb is having difficulty with respiration?
3. Which tests above show Barb is having difficulty with perfusion?
4. What is a blood clot that moves to the lungs called? How dangerous is this?
5. Wrap it up. Describe how asthma and the blood clot worked together to give Barb the worse breathing and painful event ever last night.

APPENDIX G
REVIEW THE CASES

Review the Cases

Folks – I've reviewed all of your case studies along with your understood/muddiest point papers. Below is a quick review from your feedback.

Remember – your Exam is THURSDAY, March 3rd and will cover the **RESPIRATORY SYSTEM = chapter 17 and lecture notes. The three cases help you study for this exam.**

Email me with any questions.

- Keith

Case Study #1: Mount Everest

- The focus here was to introduce 3 new vocabulary terms
 - o Ventilation – mechanics of bringing air in/out
 - o Respiration – exchange of gasses (OXYGEN and CARBON DIOXIDE) in the lungs
 - o Perfusion – exchange of gasses at the tissues
- AND to introduce the concept of PRESSURE
 - o Pressure differences control the respiratory system
 - If pressure is greater outside than in the lungs, air rushes in (breathe in)
 - If pressure is greater in the lungs than outside, air rushes out (breathe out)
- So, to wrap it all up,
 - o If air pressure (outside) is low, like climbing a mountain, it makes it harder for the body to do all three (ventilation, respiration, and perfusion). Without air pressure, we are unable to bring air in/out of the body and unable to exchange gasses. Gasses ALWAYS travel from high pressure areas to low pressure areas!

Case Study #2: Drowning (homework from the book)

- Our patient is having difficulties because the water displaced SURFACTANT – the oily substance that keeps the alveoli from collapsing.
- What are alveoli? The tiny air sacs where gas exchange occurs. So, if alveoli collapse, oxygen doesn't get into the body, and carbon dioxide (waste) doesn't get out = we can die!

Case Study #3: Grandma and the Long Drive

- The focus here was to review ASTHMA and PULMONARY EMBOLUS diseases/disorders
- Asthma is an inflammatory condition usually started by a TRIGGER (dust, pet dander, etc.)
- Pulmonary Embolus is a blood clot that moved usually from the legs and gets lodged into the lung capillaries, blocking blood flow to/from lungs. DEADLY.

- Keep this in mind for our test: Focus study on RESPIRATORY issues – not the blood clot. We talked clots last chapter/exam.
- With an asthma attack, she couldn't VENTILATE well – air in/out!
- With the pulmonary embolus, she now is having difficulty with RESPIRATION and PERFUSION. Air is getting into her lungs, but she cannot exchange gasses well due to the clot.
- We also reviewed air flow. You should know this well!
 - o Nose → pharynx → Larynx → Trachea → Bronchi → smaller bronchi → bronchioles → alveoli

APPENDIX H
DELAYED CASE STUDIES

A couple of cases...

Name: _____

Please read the following questions and answer to the best of your ability WITHOUT help from others, your notes, the internet, or your book. Please turn in as you leave today. Thank you!

Case #1 – A “pain”-ful experience!

Ken woke up early one morning experiencing tightness and a “heavy” sensation in his chest and he is very short of breath. Nothing he did helped to relieve the pain. He is 65 years old, two pack-a-day smoker, with high blood pressure and high cholesterol. His father died of heart complications at age 58.

1. Which of Ken’s symptoms are concerning?

2. Looking at Ken’s history and symptoms, what could be some possible causes for his current condition?

3. Which of the following is a true statement?
 - a. The heart receives oxygen as blood pools in the atria.
 - b. The heart receives oxygen as blood pools in the ventricles.
 - c. Oxygen is supplied to the heart through systemic circulation.
 - d. Oxygen is supplied to the heart through the coronary arteries.

4. What should Ken or his family do now?

APPENDIX I

FINAL EXAM FOCUS QUESTIONS

Applied Science II
FINAL EXAM

Name: _____

Place your final answer in the answer document. ONLY the answer document will be graded. Turn both this test and answer document in at completion. Have a wonderful summer break!

Multiple Choice. Read each question and all answers carefully. Select the BEST response.

1. Which of the following is a function of the blood?
 - a. breaking down fats and storing energy
 - b. transporting carbon dioxide to the muscles and other tissues
 - c. transferring impulses from one cell to another
 - d. transporting oxygen and nutrients through the body

2. Which of the following is a true statement?
 - a. The heart receives oxygen as blood pools in the atria.
 - b. The heart receives oxygen as blood pools in the ventricles.
 - c. Oxygen is supplied to the heart through systemic circulation.
 - d. Oxygen is supplied to the heart through the coronary arteries.

3. What is the correct flow of circulatory structures in the human body?
 - a. Capillaries → veins → arterioles
 - b. Arterioles → venules → capillary
 - c. Arteries → arterioles → capillary

4. Which of the following could donate blood safely to a patient with type AB blood?
 - a. A
 - b. B
 - c. AB
 - d. O
 - e. All blood types can safely

5. The heart is only controlled by the autonomic nervous system and if these nerves are destroyed the heart cannot beat.
 - a. True
 - b. False

6. Most heart diseases can be understood by identifying risk factors. Which of the following would be examples of controllable risk factors to heart diseases?
 - a. Genetics
 - b. Age
 - c. Diet
 - d. Smoking
 - e. All of the above
 - f. Only A & B
 - g. Only C & D

7. What is the main difference between arteries and veins?
 - a. Arteries have larger, muscular walls to withstand the blood pressure from the heart.
 - b. Veins have larger, muscular walls to withstand the blood pressure from the heart.
 - c. Arteries carry blood toward the heart.
 - d. Veins carry blood away from the heart.

8. Which is the correct flow of air INTO the body?
 - a. Bronchi→trachea→pharynx
 - b. Trachea→bronchi→alveoli
 - c. Bronchi→alveoli→trachea
 - d. Trachea→bronchi→pharynx

9. Which of the following would be true if you inhaled air through your MOUTH instead of your NOSE
 - a. Inhaled air wouldn't reach the lungs at all.
 - b. Inhaled air would be warmer and moister.
 - c. Inhaled air would be cooler and drier.
 - d. You cannot inhale through your mouth, you will die.

10. Respiration is actually controlled by changes in air _____ between the outside and inside of the lungs.
 - a. Pressure
 - b. Temperature
 - c. Surface area
 - d. Weight

11. Which of the following disorders/ diseases of the respiratory system would be considered curable?
 - a. Emphysema
 - b. Asthma
 - c. Pneumonia
 - d. Chronic bronchitis

12. You can suffocate yourself just by consciously holding your breath.
 - a. True
 - b. False

13. _____ is a substance found in tobacco smoke known to be addictive and raise the heart rate.
 - a. Nicotine
 - b. Carbon monoxide
 - c. Tar

14. The main functions of the respiratory system include(s)
 - a. Method to exchange gases
 - b. First line of defense against harmful particles in the air
 - c. Method to process food for energy
 - d. Both A & B
 - e. All of the above

APPENDIX J

END OF SEMESTER STUDENT SURVEY

APPENDIX K

OPEN-ENDED INITIAL STUDENT SURVEY

INITIAL STUDENT SURVEY

Please Note: Participation in this research is voluntary and participation or non-participation will not affect your grades or class standing in any way.

Student Name: _____

1. How do you best “learn” in a classroom? Identify what classroom activities seem to help you the most.
2. What classroom activities seem to hinder your learning or you feel are less effective?
3. What is one way I, as your teacher, could best assist your learning?

APPENDIX L

POST-TREATMENT UNIT STUDENT INTERVIEW QUESTIONS

STUDENT INTERVIEW QUESTIONS

*The following will be read to the interviewee prior to the interview starting:
“Please Note: Participation in this research is voluntary and participation or non-participation will not affect your grades or class standing in any way.”*

Student interviewed: _____ Date interviewed: _____

Interview discussion prompts:

1. What worked best with the case study method used this unit?
2. What didn't go so well with the case study work?
3. How was your understanding of this unit affected by using case studies?
4. Give a way this technique could have been improved?
5. Is there anything else you would like me to know?

APPENDIX M
INSRUCTOR JOURNAL PROMPTS

