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An Analysis Of The Effectiveness Of The Higher Education Anatomy Educational Software Mastering Anatomy & Physiology

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ABSTRACT

Higher education in the 21st century contends with a greater variety of conditions than ever before. Classes can operate in a full-time, part-time, hybrid, seated, or online format. This diversity in modality can lead to inconsistent curricula with inconsistent rigor. Instructors are challenged with designing a curriculum they believe to be rigorous but at the same time engaging to their students. This research focused on the evaluation of the higher education software program *Mastering Anatomy & Physiology* (MAP) from Pearson Education. The research included an analysis of student scores who had repeated an identical introductory anatomy course in a strictly online format. Quantitative data for this research included student performance on identical assessments over a period of two and a half calendar years, or eight academic grading periods. The research also included data collected from a focus group which consisted of anatomy instructors who have used the software as a critical part of their course instruction. The results of this research were inconclusive. Some data suggested that MAP is an effective tool in online instruction of anatomy curricula while other data suggested it had little/no effect. Additional studies of the software including larger sample sizes are recommended.

Keywords: Online instruction, anatomy, online assessment, nontraditional instruction, curriculum design, higher education

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

Introduction

At its core, the skill of learning goes far beyond that of simple memorization of facts. Using only one form of understanding, e.g., rote memorization, to produce knowledgeable students, the education system fails to generate a well-rounded student with the necessary critical thinking skills to survive the classroom and outside world (Snyder & Snyder, 2008). Without the ability to think on their own, students will become puppets who can only recall memorized information (Casagrand & Semsar, 2017). Memorization is useful in limited scope within the classroom, i.e., vocabulary, while in other areas it supports temporary knowledge (Snyder & Snyder, 2008). Promoting independent thought through the students' own interpretation of the information presented allows them to draw conclusions which invoke their deduction, reasoning, and critical thinking skills. An important component of developing such skills is how the content is delivered to students (Bergman, Verheijen, Scherpbier, Vleuten, & Bruin, 2013).

Higher education in the 21st century contends with a greater variety of conditions than ever before (Allen & Seaman, 2014). Classes can operate in a full-time, part-time, hybrid, seated, or online format. This diversity in modality can lead to inconsistent curriculum (Bridges, 2000). Educators face several challenges regarding to designing a curriculum (Brew, 2013). One challenge is the relative emphasis an instructor puts on some content compared to others in a course (Bergman, Van Der Vleuten, & Scherpbier, 2011). If a student is not terribly interested in a topic, their motivation to learn will decrease (Yuksel, 2010). Instructors must design a curriculum they believe to be rigorous but at the same time engaging to their students (Hartling, Spooner, Tjosvold, & Oswald, 2010). Also, students' capacity and knowledge cannot be assessed by a one-size-fits-all type of assessment as different people learn in different ways and different

people exhibit different abilities concerning knowledge meaning making (Yuksel, 2010). Whether the final word on the curriculum falls to the individual instructor or to their administration, the decision on a course's content and delivery method can have a lasting impact on the students' success (Bridges, 2000).

Curriculum Design

Quality assurance of courses have meant an increasingly formal approach to their design. In this context, *design* refers to lesson plans, validation documents, and course handbooks which are routinely produced as evidence for quality enhancement or professional review (Beetham & Sharpe, 2013). Design is a significant aspect of professional practice in education. The process of design involves multiple steps (Beetham & Sharpe, 2013).

1. Investigation - Who are my users? What principles are theories are relevant?
2. Application - How should these principles be applied?
3. Modelling - What solution will best meet my students' needs?
4. Iteration - How useful is the design in practice? What changes are needed?

Teaching has always involved *design*, though it has also recognized the process of learning as emergent, valuing the capacity of teachers to respond in the moment and in person. With the use of digital technologies, new elements of learning need to be planned for in advance. Teachers may continue to be responsive to their students, but these interactions may be through a digital medium and asynchronously (Redmond, 2011). For practitioners, who are rarely involved in the design of their source materials, the crucial questions are now how does one choose from, use, adapt, and integrate the supplied course materials to provide a coherent experience for your students?

Assessment of Learning

Assessment is an important aspect of teaching (Benson, 2003). The appropriate integration of assessment processes improves teaching and learning. In other words, any theory of assessment presumes and informs a theory of learning (Speck, 2002). While assessment practices have developed in traditional seated environments, the fundamental principles of assessment do not change for students in an online environment (Benson, 2003).

Traditional assessment positions learners as recipients of information, where learning is measured as knowledge and comprehension (Robles & Braathen, 2002). This type of assessment does not allow for higher-order thinking skills including synthesis or analysis (Speck, 2002). However, alternative assessment assumes the role of students as actively engaged inquirers in the learning process. Here, assessment activates learning at higher-order thinking levels and embraces collaboration (Anderson, 1998). Whether formative or summative, assessment plays an important role in the learning process to inform progress and further learning.

Assessment is important in guiding the design of online courses by using a variety of tools, such as self-assessment and peer-assessment methods, as well as tasks that encourage critical thinking and collaboration of students in their learning and assessment activities (Wright, Sunal, & Wilson, 2006). Assessment strategies need to provide multiple opportunities for students, as well as instructors, to evaluate learning. Effective assessment techniques can improve an instructor's understanding of student needs and support the development of a learner-centered classroom.

As the success of students in online learning relies on self-monitoring, assessment should provide multiple avenues for formal and informal approaches. Consequently, the instructor's role in the online environment requires reconstructing assessment practices traditionally used in a

face-to-face setting. Instructors need to balance immediacy with providing students a reasonable amount of time and opportunity to respond (Rovai, 2001). Recognizing the influence of a culture of immediacy and student expectations might inform strategies for facilitating learning and metacognitive processes. Given these circumstances, instructors can structure a feedback mechanism that will encourage student inquiry, collaboration (Vonderwell, 2003), and self-assessment strategies. Promoting sustainable high levels of student performance depends not only on a thorough knowledge of the content, but also on a well-designed assessment process that concurrently informs teaching and promotes learning.

Hybrid Course Instruction

A course with hybrid instruction falls under the general umbrella term of *online learning*. Online learning includes a student receiving their instruction through the internet in some manner. Online learning has grown considerably within the last decade, and there are no indications of its expansion slowing down. More than 29% of higher education students took at least one online course during the fall 2009 term, a 21% increase over the number reported the previous year (Allen & Seaman, 2010). Additionally, hybrid courses have a seated component or "on ground" aspect to their instruction. For example, a science course could have lecture notes delivered online but the laboratory exercises that are conducted in person with an instructor. This research focused on students in a purely online environment, where both the lecture and laboratory elements of the course were delivered via a computer without any in-person contact being necessary.

Statement of the Problem

The Science Department of the institute where this research occurred, henceforth known "the College," includes a variety of disciplines including Biology, Chemistry, Anatomy, and

others. The Science Department is one of the largest at the College and contains several foundational courses such as anatomy and physiology. Students take these courses primarily because they are a prerequisite for multiple programs at the College and four-year universities in the area including exercise science and nursing. According to Shaffer (2016), anatomy and physiology courses play a pivotal role as gatekeeping courses for students pursuing careers in the medical field. It is therefore essential that those courses are well designed as instructors need to evaluate and maintain the quality and rigor of their instruction.

Currently, individual members of the Science Department decide on which curriculum to use by discipline. For example, all the chemistry instructors meet and discuss among themselves which publisher and educational materials they wish to use. This pattern continues for each discipline of the department including anatomy (Science Department chairperson, personal communication, March 1, 2019). Due to the costs of the materials and their capacity to be used for multiple years, these decisions have long-range consequences. Once a decision on curriculum has been made, the department will continue using the recommended resources for several years at a time. Some reasons that could lead the department decision makers into making curriculum changes include overwhelming negative feedback from students, the introduction of a newer edition of the textbook from the publisher, and enduring poor student performance (Science Department chairperson, personal communication, March 4, 2019). However, there is no formal process used by the anatomy instructors to evaluate their current curricula or associated software. This research is intended to be the first step in the development of such a process.

Purpose of the Study

This study analyzed the effectiveness of the College's current online anatomy and physiology curriculum in two ways: First, by mapping student success through various chapters

as measured by the results of quiz scores. Second, by comparing the overall course performance of students who have repeated the identical course with the same software program known as *Mastering Anatomy & Physiology* (MAP) from the publisher Pearson Education. This research analyzed student performance since the software's introduction in the Fall 2016 semester to the end of the Spring 2019 semester and focused on students who had taken the coursework at least twice during that time frame in a completely online environment. The College offers the coursework using multiple delivery methods including completely online, completely seated, and a hybrid course which contains online and seated elements. To address the purpose of the study, this research examined online students only.

Research Questions

This study was guided by the following three research questions:

What patterns in student achievement do anatomy instructors observe when comparing student performance between the same online courses taken multiple times?

How do anatomy instructors of fully online courses use student data to inform instructional decisions?

Is the Mastering Anatomy & Physiology software an effective tool in promoting independent thought in students of an online anatomy course?

Conceptual Framework

This research utilized two conceptual frameworks: the conceptual framework of Lewin's action research and group dynamics (Adelman, 1993) and higher education curriculum development. Lewin's framework was chosen due to the group interactions among the faculty of the department and between the anatomy instructors, students (Mills, 2018). As decisions are made about the curricula, Lewin described some important items all groups should consider

(Adelman, 1993). Lewin (1947) warned those in a group dynamic to not confuse discussion and decision. Once a decision has been made, the group decision provides a background of motivation where a person is ready to cooperate as a member of the group rather than an individual (Lewin, 1947).

In addition to Lewin, research of McNiff was also used. McNiff's work on action research focuses on how any changes to be made are implemented. Action research, as described by McNiff (2013), is more about finding ways to encourage change. However, that change must be acted upon from the premise that 'I change me' rather than 'I change you.' This approach to action research is helpful when considering the work of others. When examining the data, it is important to remember that people are free to make up their own minds regarding any changes they deem necessary. As participants in a colleague's professional life, one can advise but cannot tell people what to do (McNiff, 2013).

Further, a framework that focuses on curriculum development was also used for this research. Deciding on which delivery method is best for a course or which instructional materials to use can affect how well a student learns (Khan & Law, 2015). Moreover, there is a growing need for higher education institutions to respond to the changing environment in a positive and learner-centered manner through quality curriculum (Khan & Law, 2015). For example, students who have learned to adapt to change and adapt their abilities to a variety of contexts and situations, develop managerial competencies for a turbulent world (Pacheco, 2000, cited in Bounds, 2009).

Bere and Mattick (2010) concluded that anatomy must be taught in a more robust way to improve overall student understanding of the material (p. 580). Additionally, research by Havet et al. (2011) showed that active learning can positively impact a student (p. 82). Their work

showed how students who performed literature reviews in their coursework obtained a deeper level of knowledge of medical content. Regarding nontraditional instruction, the methods that produced the most positive results were those that encouraged active learning and interaction with others. This instruction is characterized by product-based and problem-based learning techniques. Frank and Barziliai (2010) also drew this conclusion about project-based learning research.

Assumptions, Limitations, Scope

The researcher assumed the data supplied from the College was accurate and complete based on the parameters given to the College by the researcher. The researcher assumed the data was from students whose enrollment in the specified anatomy course were verified by the College and occurred during in the timeframe indicated. Also, the researcher assumed the various course assessments and final course grades awarded to the students were accurately recorded by their instructors before being reported to the College. An analysis of incomplete or inaccurate data would severely limit the depth and scope of this research. The researcher was solely responsible for the design, implementation, data collection, and analysis of this study.

Rationale and Significance

The data from this study could potentially lead to a complete reformatting of how anatomy instructors at the College design their courses. If the data show that the current anatomy curriculum tools are not seen as meaningful or effective by the Science Department's instructors, the department members may adopt a new curriculum for future semesters.

Definition of Terms

Community College – nonresidential junior college established to serve a specific community and typically supported in part by local government funds (Community college, n.d.).

Critical Thinking – disciplined thinking that is clear, rational, open-minded, and informed by evidence (Critical thinking, n.d.).

Curriculum – the regular or a particular course of study in a school, college, etc. (Curriculum, n.d.).

Pedagogy – the function or work of a teacher; teaching (Pedagogy, n.d.).

Conclusion

The effectiveness of any curriculum can have a far-reaching impact on students. This is particularly true with an anatomy course. With the course having a prominent role in the foundational education of many healthcare-related careers, a substantial curriculum in a prerequisite course such as anatomy can help develop students and ensure they are better prepared for their future education. The subsequent chapters of this research include a review of the relevant literature, a description of the methods used to collect data, the results of that collection and its analysis, and a conclusion drawn from the data collected.

CHAPTER 2

Literature Review

This chapter will examine several topics including: academic content, its delivery, curriculum models, knowledge integration approaches, assessment of course level learning, the need for Action Research, and the gaps that currently exist within the literature. This study was guided by three research questions. First, what patterns in student achievement do anatomy instructors observe when comparing student performance between the same online courses taken multiple times? Second, how do anatomy instructors of fully online courses use student data to inform instructional decisions? Third, is the *Mastering Anatomy & Physiology* software an effective tool in promoting independent thought in students of an online anatomy course?

Academic Content

Academic courses such as anatomy & physiology form the cornerstone for medicine, nursing, and the allied healthcare fields (Cohen-Schotanus, Muijtjens, Schönrock-Adema, Geertsma, & Van Der Vleuten, 2008). Inadequate instruction in a course such as anatomy leads to inadequately trained professionals, and therefore a poorer quality of healthcare (Bere & Mattick, 2010).

Before moving forward, it is important to distinguish the definition of key terms used throughout this research. The terms *curriculum* and *pedagogy* may be viewed by a layperson as being interchangeable. However, there are differences between the two. It is worth mentioning that for such a frequently used term, there is not a shared meaning for the word *curriculum* (Brew, 2013). Within the literature there is a consensus on what the term refers to, but few sources cite an explicit definition (Annala, Lindén, & Mäkinen, 2015). Curriculum may be viewed as unidirectional, as in the instructor crafts the content to be delivered to the students

(Annala, Lindén, & Mäkinen, 2015). There is evidence in the literature to suggest that curriculum should work in both directions, with the students being a partner in the development process (Brew, 2013). Those who favor this arrangement believe it would help students become more invested in their education and lead to more student engagement (Brew, 2013).

For the sake of clarity in this research, the *curriculum* includes content, instructional materials, and the methods used to deliver them to students (Curriculum, n.d.). Curriculum develops through the dynamic interaction of planning, action and reflection (Annala, Lindén, & Mäkinen, 2015). Pedagogy is a more general term that includes the act or the profession of teaching.

Traditional and Nontraditional Delivery

Traditional instruction for anatomy and physiology follows a pattern used in a standard classroom. The instructor guides the class through the lessons while the students listen and take notes on the material being discussed. Like many higher education science courses, the class is divided into a lecture portion and a laboratory component (Nursing, n.d.). An instructor leads the discussion on the material during the lecture portion of the course. The information is then re-enforced during the laboratory component, where students often receive some type of hands-on experience with the information. For example, a medical student may learn about the cardiovascular system in their lecture, and then examine actual heart specimens in the laboratory later (Khot, Quinlan, Norman, & Wainman, 2013).

A major obstacle to traditional instruction is how it is limited by the staff and resources available to the school (Bridges, 2000). Instruction is limited by the number of students who can be gathered in a room at any given time, the number of classrooms and laboratories available,

and the number of available instructors capable of leading the class (Arts & Science division dean, personal communication, January 24, 2019).

Additionally, research has shown that students' anatomical knowledge is impaired due to negative effects from several factors, including teaching by non-medically qualified teachers, diminished use of cadaver dissection and neglect of vertical integration of anatomy teaching (Bergman, Van Der Vleuten, & Scherpbier, 2011). Regarding the lack of qualified teachers, in the time between 1975 and 1997, the numbers of biomedical scientists in academia fell 10% while the number in private industry quadrupled (National Research Council, 2000, p. 22).

Nontraditional instruction.

The demand for such courses has transformed the academic landscape, forcing institutions to develop novel ways to deliver more courses with their current staff and resources (Swinnerton, Morris, Hotchkiss, & Pickering, 2016). Many colleges and universities have used technological advances such as distance learning, hybrid courses, and online instruction to create nontraditional techniques to help in their content delivery (Yang, Newby, & Bill, 2005). Nontraditional instruction is an umbrella term that includes any form of instruction beyond the basic seated classroom and laboratory model. Examples of nontraditional instruction include product-based learning, project-based learning, and computer-based learning. The term "computer-based learning" is often used interchangeably with terms such as "computer-assisted learning" or "online learning." In this format, course content is delivered from the human instructor to the student via the use of a computer's Internet connection (Garrison, Anderson, & Archer, 2001). The student accesses the course through a course management system (CMS) program such as Blackboard or Moodle. By using a CMS, a student can access instructional material for a course including lecture notes, videos, assessments, etc. During their time in the

course, a student would have little direct human interaction with their instructor. The independence that comes with an online course can either be a great benefit to the student or a great hindrance (Frank & Barziliai, 2010).

Being able to attend classes, review course content, and complete assignments according to one's personal schedule is a great convenience offered by online classes. However, the isolation that comes with an online course often leads to attrition. This attrition is related to issues of isolation, disconnectedness, and lack of technological skills. Other problems included the demanding nature of the program and lack of communication with instructors, which increases the feelings of isolation. Additional reasons that lead to withdrawals from online courses include the student's family situation, employment, and available study time. Due to these unique factors related to online learning, retention and persistence should be monitored closely. Compared to traditional courses, the drop/fail rate is higher among online courses (Frank & Barziliai, 2010).

The methods of problem-based and product-based learning are commonly confused with each other, but there are some key differences between them. Although both product-based learning and problem-based learning are referenced by their acronym PBL, these represent two different approaches to learning (Frank & Barziliai, 2010). While related to one another they are not the same process. Both are student-centered and encourage learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a solution to a problem (Havet, Duparc, Peltier, Tobenas-dujardin, & Fréger, 2011). However, the two differ in their structures. In general, project-based learning follows general steps while problem-based learning provides specific steps. Also, project-based learning is often multidisciplinary and longer, whereas problem-based learning is more likely to be a single subject and shorter (Casagrand &

Semsar, 2017). Regardless of the name, both pedagogies encourage active learning.

Attitudes toward nontraditional instruction.

The attitudes toward nontraditional instruction vary greatly depending on the source. The opinions are the most divided between the students who take the nontraditional instruction and the faculty, administration who manage those courses (Barnett, 2004). Computer-assisted learning offers students the opportunity to access higher education through online platforms when they might not have been able to attend traditional seated classes (Barnett, 2004). These programs are aimed at those who wish to pursue education, but due to family and work obligations, find seated classes inconvenient or inaccessible. Online courses allow the instructor to use a variety of multimedia and Internet resources in the course, in addition to presenting expanding range of software and technology. However, the primary concern that arises with online courses (especially in a scientific field) is whether the rigor of an online course is on par with the same course in a seated environment (Bergman, Prince, Drukker, van der Vleuten, & Scherpbier, 2008). This is particularly true for courses that have a laboratory component to them.

In a traditional seated laboratory, students can experiment hands-on with specimens; that is not exactly the case with an online course. Technology has advanced to the point that lab courses can now be offered with a virtual component, or through lab kits that students purchase along with a textbook (Science Department chairperson, personal communication, January 19, 2019). Nonetheless, resistance to accept these courses continues by some faculty. Despite the advances in technology, the perception remains that online courses are less rigorous than traditional seated environments (Larsen, Butler, & Roediger III, 2008). Also, students and faculty have expressed the belief that taking anatomy and physiology courses in the traditional

format is more appropriate for students, primarily due to the laboratory element of the course (Bridges, 2000).

In addition to the science faculty finding it a challenge to fully implement purely online courses, the effort also creates new problems for the administration (Arts & Science division dean, personal communication, February 2, 2019). Many schools and faculty members have voiced reluctance to allow fully online anatomy courses to receive transfer credit from other institutions to their schools. This is due to their importance as the foundation for allied health programs and the extensive laboratory component that is critical to adequately cover the content (Director of Nursing, personal communication, January 22, 2019). Another concern of administrators involves the ability of students to achieve learning objectives in an online format. Low student success can impact an institution's accreditation as well. As a result, gauging which students will be successful candidates for online programs is important. Unsuccessful online students become part of attrition statistics, which is not only detrimental to the student, but affects their institution financially (Arts & Science division dean, personal communication, February 2, 2019).

Using Project-based Learning to Enhance Critical Thinking

Critical thinking skills are a necessity in the classroom to bring about higher-level cognitive thinking (Casagrand & Semsar, 2017). Celuch and Slama (1999) found that traditional instructional methods focus on short-term knowledge and students may lack the ability to apply that knowledge in new situations. Such methods are inadequate to teach critical thinking because of their focus on rote memorization and lecture. Research by the Society for Human Resource Management (SHRM) indicated that there is a bias in college-centered teaching toward rote memorization rather than practical application (SHRM, 2007).

Critical thinkers can argue logically (Smith & Stitts, 2013). Well-educated students should have an opportunity to think freely and to effectively and respectfully challenge other students' ideas with their own. Arguments have been made that the educational experiences of both undergraduate and graduate students should include their development of critical thinking skills (Barnett, 2004; Facione, 1998; Garrison et al., 2001; Yang et al., 2005; Yeh, 2006). Research by Smith and Stitts (2013) led to recommendations that applied skills such as critical thinking and problem solving must be taught in academic, content-rich courses, rather than as standalone modules.

Importance of critical thinking.

Critical thinking teaches students to think their way to conclusions, consider a wide variety of viewpoints, and transfer ideas to new contexts (Paul & Elder, 2005). In other words, it leads to deeper learning and content mastery. Several teachers build their instructional methods on the premise that memorization is the key to learning (Paul & Elder, 2005). This follows the behaviorist perspective, as though new concepts could be poured into the student's mind and recalled later. This is especially true when it comes to a field like anatomy, where one finds an ever-increasing amount of vocabulary. However, it takes more than strong memorization skills to be successful in anatomy. Without critical thinking guiding the process of learning, rote memorization becomes the primary recourse, with students rarely internalizing powerful ideas (Paul & Elder, 2005). Critical thinking helps the student understand the relationships between points of information that at first seem unrelated. It encourages students to change from being passive absorbers of information to active learners seeking knowledge (Ho, n.d.).

Integrating Knowledge

Bere and Mattick (2010) concluded that anatomy must be taught in a more robust way to improve overall student understanding of the material (p. 580). Additionally, research by Havet et al. (2011) showed that active learning can positively impact a student's knowledge (p. 82). Their work showed how students who performed literature reviews in their coursework obtained a deeper level of knowledge of medical content.

Regarding nontraditional instruction, the methods that produced the most positive results were those that encouraged active learning and interaction with others. This is demonstrated by product-based and problem-based learning techniques. Project-based learning researched by Frank and Barziliai (2010) also led to this conclusion. In their work, high school students responded positively to community-based projects, suggesting it gave them an opportunity to reflect more deeply on the material (p. 49). This data was confirmed by a separate study of high school students by Kaldi, Filippatou, and Govaris (2011) that showed how students could benefit through project-based learning and group work skills (p. 37).

Perspectives on Learning

In Spillane's research on learning (2002), he described three different perspectives: behaviorist, situated, and cognitive. While each address the process of learning, they are each unique, based on the point of view from which the process originates. In a behaviorist perspective, knowledge is passed on from a higher level of a hierarchy down to the next (Paul & Elder, 2005). This continues until everyone within the organization has received the information. This type of perspective appeared the most often in Spillane's (2002) research. The downside to this method is if the flow of information stops, everyone who is "downstream" from that point will not receive the information. An analogy to illustrate this passing on of knowledge is a relay

team passing a baton to the team's next member (National Research Council, 2000). If the second member of the team drops the baton, team member number three and beyond will never get the exposure to that information, regardless of their capabilities.

In a situated perspective, learning comes from being involved in a community of practice, as social interaction is a key element (Spillane, 2002). This interaction leads to learning both inside and outside of school, and advances through collaborative social interaction and the social construction of knowledge (Smith, 2013). Students are expected to have a higher level of interaction with one another. This allows for the ongoing inquiry of reflection and ideas centered on the material (Spillane, 2002).

In the cognitive perspective, the teacher is seen as the primary learner. The belief is once the teacher has a mastery of the material, they are better suited to educate others with the information. This perspective was the least common in Spillane's research. The specific features of this perspective are still being developed and are commonly confused with constructivism by teachers (Spillane, 2002).

Constructivism.

Constructivism is a theory about how people learn (Olusegun, 2015). It describes how people, through their own personal experiences, construct their understanding and knowledge of the world. Whenever learners are presented with new information, it is reconciled with previously learned knowledge (Spillane, 2002). At its core, constructivism describes learning as an active process (Olusegun, 2015) as new information is analyzed relative to older material.

Oftentimes, students are merely asked to write down facts rather than to question or reflect on what they have learned (Kaldi, Filippatou, & Govaris, 2011). As a result, students may be incapable of conversations about complex topics within their material (Karbalaei, 2012). In a

constructivist classroom, the focus moves from the teacher to the students. Students must take a more active role in their learning. The teacher is merely a facilitator who mediates the process for the students (Olusegun, 2015). The increased level of activity necessary for learning in this type of environment is an important factor in the development of critical thinking skills.

Outcomes of Traditional Versus Nontraditional Techniques

In quantitative research conducted by Cohen-Schotanus et al. (2008), data were collected regarding the anatomy students' use of different instructional techniques. College students were typically divided into two or more groups with each group receiving a different type of delivery method. Some groups received a traditional method while others received their course content through a nontraditional means (Cohen-Schotanus et al., 2008). The collected data included an initial assessment of all students prior to them being exposed to any course content, to get a baseline comparison among the students without the influence of any technique. Once the courses were complete, the students were given a second assessment to measure what (if any) impact the various instructional techniques had on the student's performance. The data of students who received nontraditional instruction were compared to students who had received traditional instruction. In addition, those who received nontraditional instruction were compared among each other to assess the individual influence of nontraditional methods.

The review process is summarized according to a flow diagram generated by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Appendix A). PRISMA is an evidence-based minimum set of items for reporting in systematic reviews and meta-analyses (PRISMA, n.d.). While the items selected for this study are similar, there are some differences among them that could produce some bias. For example, most of the final items used for this study focused on higher education anatomy students from North

American institutions. However, some of the resources used included anatomy students from an advanced high school level or those from European institutions. Although the content of the anatomy courses may be similar in nature, the depth of material and the pace of instruction must be considered when evaluating any performance assessment in this or other studies.

When comparing traditional versus nontraditional methods, research conducted by Cohen-Schotanus et al. (2008) showed that students who follow problem-based learning techniques score no better or worse than students with a traditional background. In their study, students were divided into separate cohorts of the same approximate size, one of students who used traditional instruction and the other PBL methods. The results showed that students who were graduates of PBL methods demonstrated no appreciable differences in clinical competence compared to those of traditional methods (Cohen-Schotanus et al., 2008). However, with such a small sample size it is too soon to make any definitive connection between PBL and course performance. Research by Hartling, Spooner, Tjosvold, and Oswald (2010) also addresses the topic of content retention of students who used problem-based learning. Their research showed that, while students who received PBL had an increase in diagnostic accuracy, they showed no increase in knowledge acquisition compared to students who did not receive PBL.

In regard to nontraditional instruction, the methods that produced the most positive results were those that encouraged active learning and interaction with others. This is demonstrated by product-based and problem-based learning techniques. Project-based learning researched by Frank and Barziliai (2010) also makes this conclusion. In their work, high school students responded positively to community-based projects, suggesting it gave them an opportunity to reflect more deeply with the material. This data was confirmed by a separate study of high school students by Kaldi, Filippatou, and Govaris (2011) which showed how students can

benefit through project-based learning and group work skills. Further, Casagrand and Semsar (2017) showed that active learning techniques over a period increased a student's performance. Their study showed that by adding evidence-based active learning over a period of four years, students scored higher on assessments that required higher-level cognitive skills.

Research by Havet et al. (2011) also showed that active learning can positively impact a student. Their work showed how students who performed literature reviews in their coursework obtained a deeper level of knowledge of medical content. Further research by Shapiro et al. (2009) also shows how students who perform work outside of the traditional classroom can benefit. In their study, first year medical school students were given the option of completing two creative projects, one after the first exam and the second just before the final exam. Students were allowed to use any artistic medium they could to reflect on their experience in anatomy. The results showed that students who completed the projects reported they led to a reduced level of stress in the course in addition to a greater respect for the complexity of anatomy (Havet et al., 2011).

With regards to the use of technology, its overall effect is still unclear. While technology offers incredible tools that can supplement instruction, there is a danger of relying on it too much. Jaffar (2012) described how students using online videos via YouTube responded they felt the videos helped them understand some aspects of anatomy. However, without knowing for certain which videos were watched and for how long, it was too soon to claim that using social networks will directly increase knowledge retention of anatomy topics (Jaffar, 2012). The concern that instructors may end up depending too heavily on technology is echoed by the research of Swinnerton, Morris, Hotchkiss, and Pickering (2016). Their work focused on the use of Massive Open Online Courses (MOOCs). These are stand-alone courses that can be accessed

by anyone in the world through an Internet connection. Their work showed that, although students are supportive of using tools like MOOCs as a supplemental resource, students did not support their use as a primary instructional method.

Research by Nguyen, Barton, and Nguyen (2015) involving iPads also showed a mixed response, mainly due to the backgrounds of the people involved. High school students had a positive response to using iPads in the courses, saying they were more motivated to study their material because of them. However, they acknowledged the devices could serve as a distraction for some students. Academics at the students' school also had a mixed response to the devices. Some were excited about the possibilities for their use, especially in developing countries where equipment problems are a concern (Nguyen, Barton, & Nguyen, 2015). Others were concerned about the stability of the applications being used as well as their connectivity.

An online tool that did show positive results is discussed in research by Thompson and Oloughlin (2014). In their study, college students used an addition to Bloom's Taxonomy that focused on the anatomical sciences. Bloom's Taxonomy is commonly used by teachers to assess the cognitive level associated with course assignments. A recent addition to this tool is specific for anatomy courses called the Blooming Anatomy Tool (BAT). A selection of students was divided into two groups, one using the BAT and the other using the more traditional Bloom's Learning Objectives (BLO) to test their knowledge of anatomy-focused multiple choice questions. Results showed that the students who used the BAT consistently performed at a higher level than those using the BLO. The students commented on how they felt the BAT was a more useful tool compared to the BLO. The authors suggest a larger number of students and a longer duration of time should be used before a legitimate connection between performance and the BAT can be made.

The methods of instruction that consistently produced positive results were those that taught information in its proper context and multiple times. When comparing the use of plastic models and computer-generated models of the same structure, research by Khot, Quinlan, Norman, and Wainman (2013) showed that students who learned from the plastic model scored significantly higher on assessments compared to the students who only used a computer-based format. This evidence is also confirmed in a study conducted by Shaffer (2016). In his research, students reported that reading the textbook and working with anatomical models were the most important in their ability to retain the course material.

In a more striking example, Regan and Mattick (2010) concluded that anatomy must be taught in a more robust way to improve overall student understanding of the material. Medical students in their study scored poorly on basic information because it had not been taught in context or repeatedly. The standard rote approach does not give a student the proper context they need. In related research, Bergman et al. (2008) concluded that there was a uniform deficiency in clinical anatomical knowledge at a Dutch medical school. This deficiency was evident regardless of the didactic approach of the instructors. However, the students did test well after anatomy topics were covered multiple times and within context. Bergman et al. (2008) suggest that these factors have a greater impact on a student's performance compared to a curriculum that was problem-based or traditional. Bergman et al. (2013) also addressed concerns about the decline in medical student quality. They suggest that an increased use of vertical integration and more independent research could improve the general quality of a medical student. Schifferdecker and Reed (2009) propose changes that should be made in order to improve anatomy curriculum. The authors discuss how an increased emphasis on mixed methods research, and the development of

a standard research model, can lead to higher cognitive function and improved integrity of research (Schifferdecker & Reed, 2009).

Larsen, Butler, and Roediger (2008) demonstrated that the repetition of knowledge increases its retention regardless of the topic. In their work, the authors analyzed data from an experiment involving students learning foreign language vocabulary with flash cards. High school students were divided into groups and each group varied on how often they studied the list, regardless if they were able to correctly match the vocabulary words. The results showed that the groups who continued to repeat their studying of the list, even after initially passing the vocabulary test, performed higher than those who had studied the list less often. The authors suggest that this type of repetitive instruction over time can benefit medical students' retention of information.

The Case for Action Research

The term *action research* can be defined as "work that does not separate the investigation from the action needed to solve the problem" (McFarland & Stansell, 1993, p. 14). Through action research, teachers learn about themselves and their students, and can determine ways to continually improve. Educators involved in action research become more flexible in their thinking and more open to new ideas (Pine, 1981). Studies by Little (1981) suggest positive changes in patterns of collegiality, communication, and networking. Through these discussions with colleagues they develop stronger relationships. As the practice of action research becomes part of the school culture, there is increased sharing and collaboration across departments, disciplines, grade levels, and schools. Action research should not be perceived as simply about actions, but also as about thinking. In particular, how a method of thinking informs types of actions (McNiff, 2013).

There are different types of action research depending upon the participants involved (Coghlan & Brannick, 2019). A plan of research can involve a single teacher investigating an issue in his/her classroom, a group of teachers working on a common problem, or a team of teachers and others focusing on a school- or district-wide issue. Large scale research involving multiple schools across a district are often cumbersome and complex. This means that most of the daily dilemmas of teaching, top-down policies and large-scale research are not detailed or nuanced enough to be useful. Individual teacher research usually focuses on a single issue in the classroom (Coghlan & Brannick, 2019). The teacher may be seeking solutions to problems of classroom management, instructional strategies, use of materials, or student learning. Action research helps teachers focus on one aspect of their practice they would like to improve (Adelman, 1993). Specific questions and a finite time period bind each iteration. This ensures natural pauses for reflection and planning (Mills, 2018). This series of actions is illustrated in Figure 1.

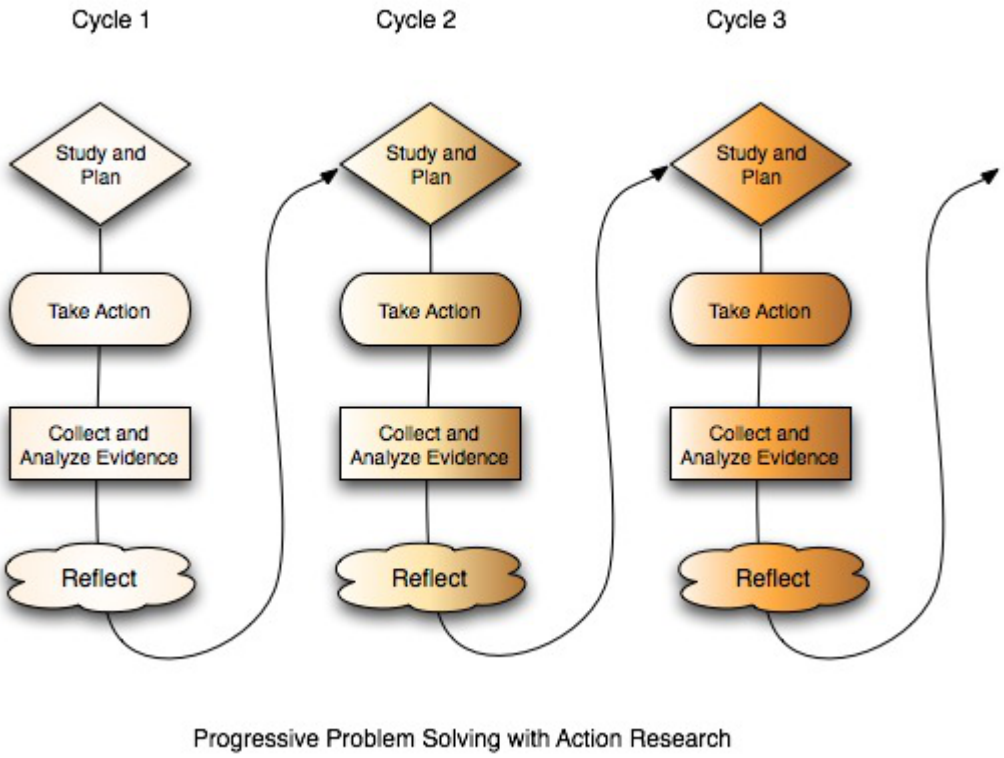


Figure 1. Progressive Problem Solving with Action Research

By Margaret Riel - http://cadres.pepperdine.edu/ccar, CC BY-SA 3.0,

https://commons.wikimedia.org/w/index.php?curid=8652138

Implicit in the term action research is the idea that practitioners will begin a cycle of posing questions, gathering data, reflection, and deciding on a course of action. It is based on the following steps from Mills (2018) and illustrated in Figure 2:

- Identifying an area of focus
- Collecting data
- Analyzing and interpreting that data
- Developing an action plan

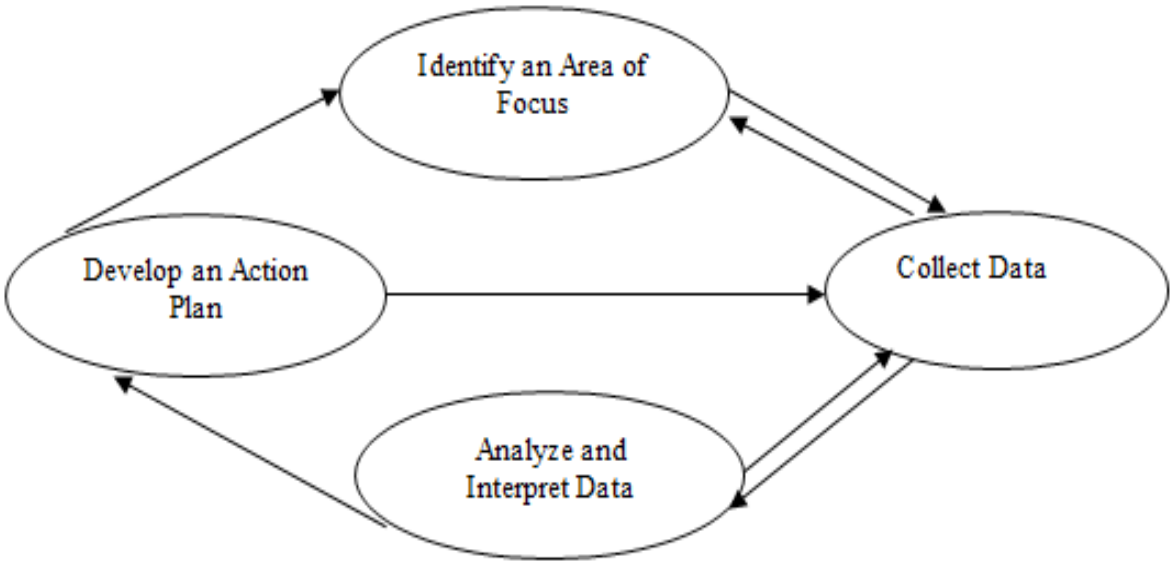


Figure 2. The steps involved with Action Research.

Action Research is not without its critics (Coghlan & Brannick, 2019). People opposed to Action Research claim there is a high risk of the practitioner not being able to be truly objective as they evaluate their work (Adelman, 1993). If the data cannot be trusted, how can the results of such a study be considered legitimate? Also, since the details of an Action Research study cannot be truly replicated for another class, should it even be viewed as a scientific endeavor?

Gaps Within the Literature

Many of the items used for this review focused on higher education anatomy students from North American institutions, although some of the sources used included anatomy students from an advanced high school level or those from European institutions. Although the content of the anatomy courses may be consistent in nature, the depth of material and the pace of instruction in these different settings must be considered when evaluating course performances in

this or other studies. It would be appropriate to only compare students of the same relative level of educational experiences. Also, a large proportion of the literature reviewed dealt with medical school students. It would be inappropriate to assume that medical students and introductory anatomy students will have the same levels of proficiency. With very few examples of research specific to beginning anatomy students available, more sources of information are needed. Based on that fact, it is possible that this research could lead to more detailed studies involving higher education anatomy instruction.

Conclusion

The literature reviewed here addressed multiple topics relating to anatomy curriculum including academic content, its delivery, curriculum models, integration knowledge approaches, assessment of course level learning, and the need for Action Research in education. Concerning the various methods of delivery, the literature indicated that due to a variety of factors, it is difficult to label one method as more effective compared to another. Each delivery method discussed in this chapter has its positive characteristics as well as negative. In addition to the methods themselves, other variables also play a role in a student's performance.

The literature suggests that having access to quality resources, having the necessary skills to properly use such resources, and receiving quality instruction can either help or hinder a student's success in a course. The literature also suggests that in regard to curriculum design, online courses should maintain a balance of having both systematic and creative elements. The requirements for completing any given assignment and the guidelines for how the course operates should be regimented. At the same time, there should be a variety of opportunities available to students to facilitate their learning of the material. This is also true in the assessment of a student’s performance in the course. More thorough and specific study in this field is needed

before any causality can be determined. Regarding action research, the literature indicated it is an effective method used by educators to evaluate the effectiveness of programs both on the small and large scale.

CHAPTER 3

Methodology

This research used an intrinsic case study approach to examine the usefulness of a commonly used software tool geared toward online anatomy students. In addition, a focus group of anatomy instructors who use this software was held to discuss its merits regarding student performance. The interactions among the instructors about the software's continued use reinforced the importance of action research by the group, and demonstrated the dynamic described by Lewin (1947). The purpose of this research was to analyze the effectiveness of the current anatomy and physiology instructional software used by the College. This was done by mapping student success as measured by selected chapter quizzes and by comparing overall repeating students' performance on identical coursework.

Research Questions and Design

This research was driven by three questions. First, what patterns in student achievement do anatomy instructors observe when comparing student performance between the same online courses taken multiple times? Second, how do anatomy instructors of fully online courses use student data to inform instructional decisions? Action Research (AR) is an appropriate approach for the study because a team of educators are collaborating to understand a problem of practice. Third, is the *Mastering Anatomy & Physiology* software an effective tool in promoting independent thought in students of an online anatomy course?

There are various forms of AR, all of which depend on target participants (Coghlan & Brannick, 2019). Action Research can involve an entire school or district, a collaboration of a group of teachers, or an individual teacher investigating an issue in their own classroom (Coghlan & Brannick, 2019). This research included one of the researcher's own anatomy

courses. The purpose of AR is to allow the practitioner the opportunity for reflexive inquiry (Noffke & Stevenson, 1995). A practitioner who uses AR should be prepared to objectively analyze their results and to take action based on their findings (Crow1234's Blog, 2010). The benefits of action research are that it is problem-focused rather than solution-focused. That is, the practitioner looks objectively at the problem and the problem that guides the action taken.

Action research assists teachers to focus on one aspect of their practice they would like to improve. Specific questions and a finite time period bind each iteration. This ensures natural pauses for reflection and planning (LeGeros, 2018). Due to its nature, AR is now often seen as a tool for professional development, bringing a greater focus on the teacher than before (Noffke & Stevenson, 1995). It is not problem-solving in the sense of trying to find out what is wrong, but rather a quest for knowledge about how to improve (Coghlan & Brannick, 2019). Action research is not about learning why we do certain things, but rather how we can do things better. It is about how we can change our instruction to have a more positive impact on students (Beetham & Sharpe, 2013). In this study, action research was used to analyze the perceived effectiveness of the current anatomy curriculum.

This research used an intrinsic case study approach as an appropriate method to evaluate an academic programs within a department where the case itself is of primary interest (Creswell, 2007). The data collected allowed the researcher to conduct a detailed analysis of submitted work by students who have taken the course at least twice between the fall 2016 and spring 2019 semesters strictly in an online environment. Assessments by individual chapter quizzes and overall course grades were analyzed for each student per each iteration of the course. The comparison of so many data points over an extended amount of time allowed the team to investigate the effectiveness of the MAP delivery method.

Site Information and Population

The site of this research was the Science Department at a community-college located in the southern United States. The College is a public two-year community college that serves students from an assortment of backgrounds and educational experiences. Typical of a community-college, the College offers a diverse selection of courses and programs.

Half of the academic programs within the Arts & Science division offered at the College result in the awarding of an associate degree, such as the Associate in Applied Science and Associate in Arts degrees (Academic Programs, n.d.). A majority of the students who pursue these degrees frequently transfer to a four-year university or college (Arts & Science division dean, personal communication, January 15, 2019). Another common path taken by these students is to seek acceptance into some of the more selective programs at the College, including the nursing program (Arts & Science division dean, personal communication, January 16, 2019).

The nursing program at the College currently offers three career paths: An Associate in Nursing degree (ADN), a license in Practical Nursing (LPN), and a hybrid Licensed Practical Nursing-Registered Nursing (LPN-RN) degree. According to the Director of the Nursing program (personal communication, January 22, 2019), the three programs receive approximately 400 applications each academic year with an acceptance rate of only 40%, and despite it becoming more difficult to gain acceptance, the number of applicants to the nursing programs increases each year. With programs in such high demand, this also means the prerequisite courses are in high demand as well. A prime example of such a course is anatomy.

Prerequisite courses such as anatomy and physiology play a key role in a student's acceptance into the nursing program at the College (Nursing, n.d.). In order to gain acceptance, students must earn points based on various factors such as grade point average (GPA), the

science courses taken, and standardized test scores. Students earn more points if they complete their anatomy and physiology courses at the College. In addition, students may earn more points on their application if they have a higher GPA in biology-specific courses such as anatomy. Although not a guarantee, performing well in anatomy and physiology courses will greatly benefit the student as they continue with their nursing education (Director of Nursing, personal communication, January 22, 2019).

Within the College, there are six instructors in the Science Department who teach at least one section of this course each semester. The maximum enrollment for an instructor is 24 students per section for a traditional seated course and up to 60 for the online format. The anatomy curricula are divided into two separate courses at the College: Anatomy & Physiology I and Anatomy & Physiology II. The individual courses are taken in different semesters, usually part one in the fall semester and then part two in the spring semester. The material introduced in these courses lay the foundation for future classes within various programs such as exercise science and nursing.

As directed by state law where the College is located, each of its 58 community-colleges teach identical introductory anatomy & physiology courses. These courses are regulated by a legislative policy known as the Comprehensive Articulation Agreement, or CAA (College Transfer Articulation Agreements, 2017). This policy was established to acknowledge the commonality of courses and their intended outcomes and competencies. Therefore, the courses are recognized has having the professional integrity of other public post-secondary institutions and are deemed transferable to other institutions.

Participants

The research involves the participation from anatomy instructors at the College as they evaluated archival data of 15 students.

Instrumentation and Data Collection Procedures

There were two types of data collected for this study: Student scores within the anatomy course and the transcript of instructors' review of student and course-level data within a focus group setting.

Student Records

The quantitative data collected was composed of the final course grades and scores from selected chapter quizzes from 15 students enrolled in the introductory anatomy course that included application of the MAP software. Those chapters were chosen based on the quizzes that covered information from single chapters only. Quizzes taken later in the course span multiple chapters of the textbook. By selecting quizzes that concentrate on single chapters, the data produced is more focused on a single body system of interest rather than several at once. This information was collected with the assistance of fellow anatomy instructors at the College as well as through the College's Office of Institutional Effectiveness (Arts & Science division dean, personal communication, March 30, 2019). Information collected from the Office of Institutional Effectiveness included an Excel spreadsheet which contained student identification numbers of approximately 700 students, each semester the student was enrolled in the anatomy course, and their final grades for the course. Information collected from instructors included Excel spreadsheets of the instructors' final gradebooks. The instructors' data included student names, each assignment given that semester, and the students' scores on each assignment. All data collected from instructors and the Office of Institutional Effectiveness were kept on a secure

flash drive that was stored in the researcher's private office on the College's campus. Only the researcher had access to both the office and the flash drive. Once data collection and analysis were completed, all student data were deleted from the flash drive.

Focus Group

Additional data was collected through a focus group meeting that included instructors from the College's Science department who have experience using the MAP software. The focus group was moderated by a non-anatomy instructor from the College and a set of questions prepared by the researcher was used to prompt responses from the group. The moderator was chosen due to their lack of experience with any type of anatomy-centered software, and therefore would be more impartial while questioning the group. As the researcher is a current anatomy instructor at the College who uses the MAP software, there was potential for bias which could taint the other instructors' responses. To mitigate this possibility, the researcher was not selected as the moderator but was present during the meeting. Both the moderator and the researcher took notes during the focus group to highlight responses they deemed to be important.

Before the focus group began, the instructors were told that the meeting was part of doctoral dissertation research. Also, the instructors were told that their participation was completely voluntary, and they were free to leave at any time and/or refuse to answer any questions. Further, attendees were told their consent would be necessary before any data would be collected. Lastly, the instructors were told that the audio from the meeting would be recorded with a Sony ICD-UX560 digital recording device to be transcribed after the meeting.

Data Analysis

Student Record Data

Data included the overall course grades and scores on individual chapter quizzes for every incidence the student took the online introductory anatomy course. Once collected, it was entered in a spreadsheet. This information was then developed into multiple data tables and graphs that allowed comparison of the various data points. Data was analyzed on the overall student performance in the course as well as each individual's chapter quiz score. The students' scores were compared to their own performances in each attempt of the course as well as other students who met the criteria for this research to identify any possible trends within the course or modules. The amount of change between the students' personal scores were classified as either having a "major increase/decrease" or a "slight increase/decrease." For this research, a "major" change resulted from a difference of 10% or more in either a positive or negative direction; a "slight" change resulted from a difference of less than 10% points.

Focus Group Data

It is worth noting that while the researcher is an anatomy instructor at the College who regularly uses the MAP software, their participation in the focus group was extremely limited. The only function the researcher served during the focus group was to remind the instructors present that the meeting was part of a doctoral dissertation. The researcher's primary responsibility during the focus group was to take note of responses they viewed as notable. The researcher also offered clarity on the graphical data presented to the group when needed.

Immediately after the focus group meeting ended, the researcher transcribed the audio recording. Each of the responses for the prompted questions were listened to a minimum of three times in order to obtain an accurate record of the meeting. The written transcript was recorded as

a Microsoft Word document and was stored on the same secure flash drive where the original course data was kept. Only the researcher had access to this drive or its stored location within the researcher's office at the College.

During this process, any key phrase or concept the researcher deemed to be significant was highlighted within the transcript as a color chosen by the researcher. For clarity, specific ideas and phrases were grouped together under more generic themes by the same text color. For example, ideas/phrases that related to the length of time students took to repeat the anatomy course were highlighted in orange; ideas/phrases that referenced a major decrease in a grade were highlighted in red. The purpose of this color coding of the transcript was to organize statements made at random during the focus group meeting and develop common themes that could be tracked by the researcher. The colors which appeared the most frequently commanded deeper analysis from the researcher.

Limitations of the Research Design

Credibility

Credibility refers to the extent to which a research account is believable and appropriate (Mills, 2010). A concern for any research involving focus group data is the potential for different people giving similar or identical answers to prompted questions. Attendees may feel an unconscious need to parrot previously given responses rather than developing their own answers. The researcher believes the questions given to the focus group by the moderator were open-ended enough to guide the attendees in forming unique responses.

Member Checking

Member checking is a qualitative technique used to establish the tenet of credibility in trustworthiness ("Member Checking," 2019). The researcher supplied each of the attendees of

the focus group meeting a brief written summary of the findings from the analysis of the transcript. There were no conflicts or errors reported.

Transferability

Transferability refers to the degree to which the results of qualitative research can be generalized or transferred to other contexts or settings (Trochim, 2006). The transferability of this research relies on one key characteristic: the edition of textbook and version of the MAP software must be the same as those used for this research. A variation in either one of these could lead to a different set of chapter quiz questions, course organization, or perhaps both. At that point it would be necessary to retool the research parameters.

Dependability

Dependability can be defined as the stability of data over time and over conditions ("Dependability in Qualitative Research," n.d.). As the attendees of the focus group meeting were all science instructors with previous experience using the MAP software, the researcher is confident in their abilities to objectively critique the usefulness of the program.

Confirmability

There are several factors that could influence the effectiveness of this research (Mills, 2018). First, the number of students who repeated the introductory course a minimum of two times were lower than anticipated. This potentially smaller sample size could make the data less reliable. Second, there is a possibility that the instructors using the MAP software did not cover the identical chapters from the textbook. It would be inappropriate to compare data concerning chapter quizzes unless each instructor gave similar assessments for common chapters. The less commonality between the instructors' assessments, the greater the risk of skewed data.

Conclusion

This study addressed quantitative data regarding the instructional software platform *Mastering Anatomy & Physiology* from Pearson Education. By examining this verifiable student data, the researcher sought to determine the platform's overall effectiveness regarding content retention by students and the development of a robust, integrated anatomy curricula.

Additionally, this research examined qualitative data taken from a focus group environment. Taking part in a client-participant focus group, anatomy instructors were asked various questions about their experiences with the MAP software and their opinions on the student performance data reported to them. After the focus group meeting ended, a transcript was prepared and coded by the researcher. Major themes that emerged from the transcript are explained in the following chapter.

CHAPTER 4

Data Analysis and Findings

Data collected for this intrinsic case study consisted of (a) the final course grades and scores on individual chapter quizzes from 15 students enrolled in online sections of the College's introductory anatomy course in - BIO 168, (b) individual scores by each student on their attempts of chapter quizzes taken throughout their time in the course, and (c) a focus group with anatomy instructors from the site's Science department. The data was initially collected with consent from the College's Office of Institute Effectiveness and then followed with assistance from individual anatomy instructors from the College. The data scores for this research was gathered from students who met three qualifying criteria. First, they must have been a registered student in the College's BIO 168 course (Anatomy & Physiology I) between the fall 2016 and spring 2019 semesters. Second, the section of this course must have been fully online. Third, the students must have repeated the course in another fully online section at least once more during that same time frame. By selecting only repeating students enrolled in strictly an online course, more attention can be directed to the delivery software used in the course. In the same BIO 168 course that includes a seated rather than online component, the decision as to which assignments were to be incorporated into a final course grade was left to the individual instructor. The students' scores in this research are reflective of their responses on identical chapter quiz questions given to all students in an online section of BIO 168.

The researcher contacted the Office of Institute Effectiveness in September 2019 and described the data which was needed. The data was then emailed as a Microsoft Excel spreadsheet to the researcher three days later. The data included every student who had enrolled in the BIO 168 course at least twice during the established time frame but in each available

format at the College. This beginning list included over 700 names of students from online, hybrid, and seated sections of the course. Information related to students from seated and hybrid sections were deleted, leaving a remaining list of 75 online students. Of those students, 46 were withdrawn from the course by their instructor due to a lack of attendance or poor performance, and thus were not considered for this research. Additionally, a total of 14 students were eliminated due to their enrolling in at least one section of the course but never having submitted any assignments. The final number of students remaining after the deletions was 15.

Analysis Method and Presentation of Results

This researcher analyzed three different levels of student data. The first was the final course grades earned by the students in the introductory anatomy course. The letter grades issued by the College were based on a 10-point percentage scale and correspond to the following:

Letter grade of A: 90% - 100%

Letter grade of B: 80% - 89%

Letter grade of C: 70% - 79%

Letter grade of D: 60% - 69%

Letter grade of F: 59% or less

The second level of data was individual scores by each student on their attempts of chapter quizzes taken throughout their time in the course. For example, a student's score on the quiz from Module #8 would be compared to the score on an identical quiz from the same Module #8 during their second attempt in the course. All quizzes in the online sections of the introductory anatomy course are the same in the questions asked, quiz length, and time limit regardless of the instructor. This data regarding specific assignment grades was compiled with the assistance of the anatomy instructors directly.

The third level of data was generated from the focus group. Members of the College's Science department who have used the MAP software were presented student performance data to analyze. Further discussion from the group included the software's level of contribution to the course.

Final Course Grades

At the completion of an academic term, students are issued their final course grade. These grades are recorded on each student's official transcripts and illustrate the student's level of mastery of the course content. The College issues final course grades as letter grades such as A, B, C, D, or F. For this research, the final course grades for each attempt the student made at the course were compared to one another. The coursework leading up to the development of a final grade is identical for each student in an online section of the BIO 168 course.

Comparing the final course grades produced a mixed result. There were improvements in six of the initial group of students' grades, but two showed a decrease. The remaining seven students either performed at the same level as on their first attempt or withdrew during the course. This created incomplete data for the students, so an equal comparison was not possible. The possible grades a student could earn were A, B, C, D, F, and WI. The grade of WI indicates the student withdrew from the course before the course ended that semester. Figure 3 displays the number of each grade earned by the students in their first attempt of the course compared to their second attempt. For students who repeated the course more than twice, only their first two attempts were considered for this research. This was done to keep the amount of exposure to the course material equal for all students involved.

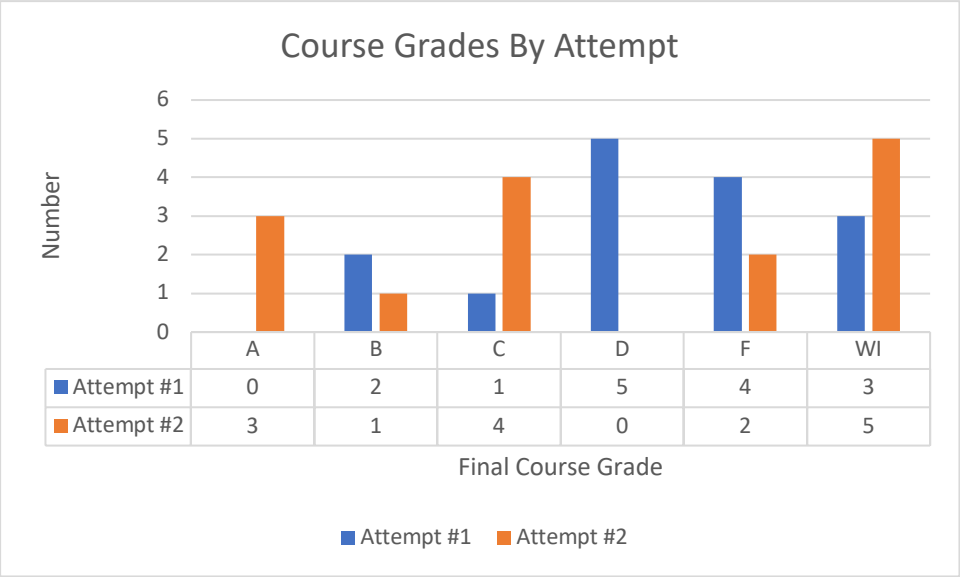


Figure 3, Course Grades by Attempt

The positive outcomes taken from this data were that four distinct categories improved. Those include an increase in the number of A grades earned (an increase from zero to 3), an increase in the number of C grades earned (an increase from 1 to 4), a large decrease in the number of D grades earned (a decrease from 5 to zero), and a decrease in the number of F grades earned (a decrease from 4 to 2). However, the data also shows an increase in the number of students who withdrew from the course during their second attempt (an increase from 3 to 5). This means the students who did not withdraw during their first attempt earned another grade. This difference could affect the overall totals of grades, especially those which showed a large increase/decrease in numbers. Also, the number of B grades earned decreased slightly (a decrease from 2 to 1). However, the small number of students in this category make it difficult to make any definitive conclusion about this data set.

Individual Scores by Student

As applicants to the nursing program submit increasingly more compelling applications, the competition for a limited number of available spots increases. Student applicants seek different methods to improve their application. A common technique used by the student applicants is to improve their grades from required courses. The only way to improve a final grade in any course is to retake the entire course during a different semester. The BIO 168 anatomy course is one which falls into this category.

The BIO 168 course is a prerequisite course for many scientific tracks at the College including the nursing program. The minimum standard for applying to the nursing program includes earning a grade of "C" or better in the course. Due to a variety of reasons, many students end up repeating the course. Some students are forced to retake the course as they failed to reach the stated grading threshold. However, there are students who have already met the threshold yet voluntarily choose to retake the course. Further, some students end up retaking the course several times in order to reach the grading threshold or to obtain a personally desired grade.

Figure 4 shows the length of time between attempts of the BIO 168 course for the students involved in this research. A full calendar year includes three academic semesters at the College: fall, spring, summer. The passing of each would be counted as a semester. For example, if a student first attempted the course in the fall of 2016 and then repeated the course in the spring of 2017, that would be counted as one semester. Also, the students are only identified with a generic student number. These numbers are applicable throughout the remainder of this research.

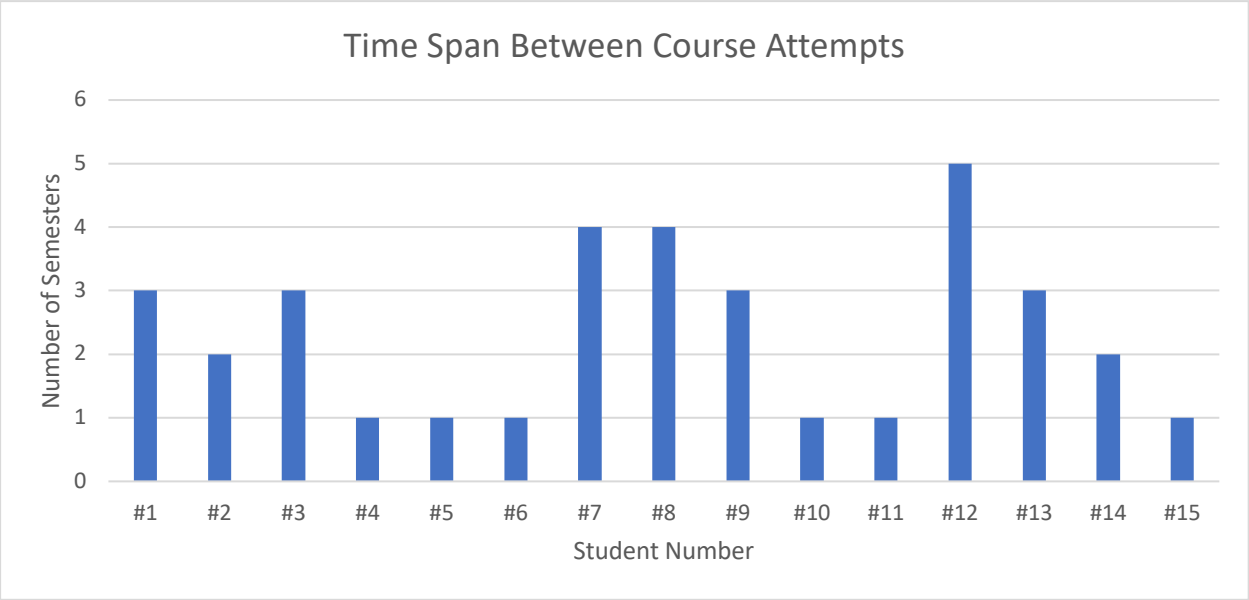


Figure 4, Time Span Between Course Attempts

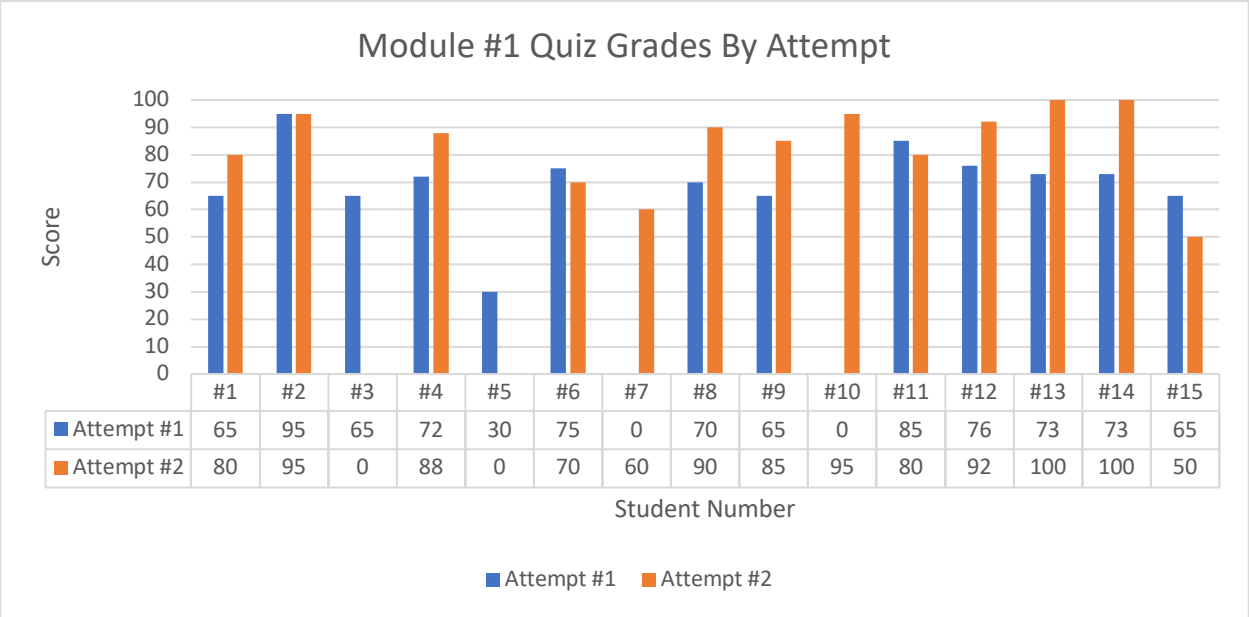
The data shows that, while some students in the research repeated the course only one semester later (40%), more of them waited longer. A quarter of the students (25%) waited three semesters before their second attempt, and 19% of the students waited four or more semesters. The BIO 168 course is offered every academic semester at the College by multiple instructors in a variety of formats. This data reflects the length of time between multiple attempts by the same students in online sections of the course only.

Due to the volume of information covered by the course, the material was divided into 10 modules. Each module discusses individual chapters from the course textbook. Some modules cover only one chapter while other modules have a range of two or three chapters.

Module #1 Comparison.

Module #1 references Chapter One titled “The Human Body: An Orientation.” This chapter defines and contrasts between anatomy and physiology and the general organization of the human body. Also, essential concepts including the complementarity of structure and

function, the hierarchy of structural organization, and homeostasis (maintaining a stable internal environment) are introduced (Marieb & Hoehn, 2019). Lastly, this chapter discusses the basics of the language of anatomy - the terminology that anatomists use to describe the human body and its parts. The *Mastering Anatomy & Physiology* software is used to further explain those concepts through a series of matching exercises, animations, and guided tutorials.



	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15
Attempt #1	65	95	65	72	30	75	0	70	65	0	85	76	73	73	65
Attempt #2	80	95	0	88	0	70	60	90	85	95	80	92	100	100	50

Figure 5, Module #1 Quiz Grades by Attempt

Overall, there was a positive result with the scores on the quiz from Module #1 when compared to the students' second attempt. Nine out of the 15 students (60%) in this research showed a major increase in their quiz scores. For the purposes of this research, a "major increase/decrease" is defined by a change of 10 or more percentage points; a "slight increase/decrease" is defined by a change of less than 10 percentage points. Figure 6 shows a general breakdown of the results by performance. A factor that affects the breakdown is that four

of the students in this research did not take the Module #1 quiz a second time. Therefore, the information for “major increase” and “major decrease” will be skewed.

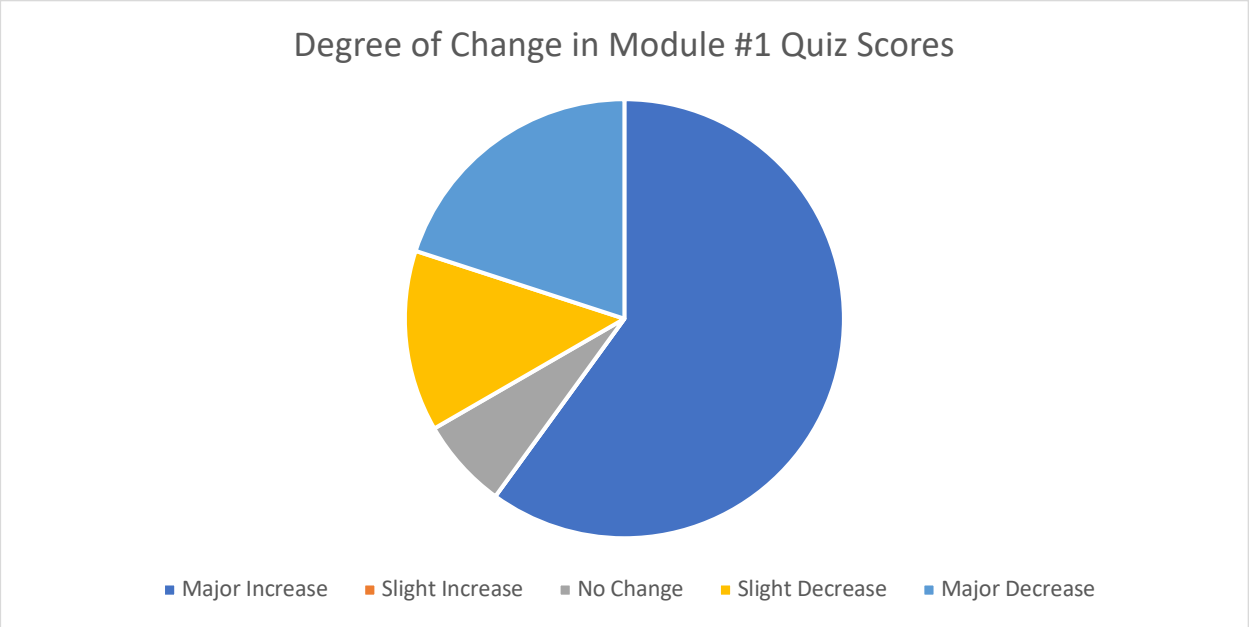


Figure 6, Degree of Change in Module #1 Quiz Scores (n=15)

Module #2 Comparison.

Module #2 references the basics of chemistry regarding human anatomy and is titled “Chemistry Comes Alive.” This chapter presents the basic chemistry and biochemistry (the chemistry of living material) needed to understand body functions (Marieb & Hoehn, 2019). Topics which are discussed include the principle components of an atom, the various types of chemical reactions, and examples of the different organic compounds found within a human body. The *Mastering Anatomy & Physiology* software is used in this module to develop a three-dimensional model of a typical atom, to show students exactly how atoms interact with one another, and to detail why the structural differences of the organic compounds make a difference to their functions.

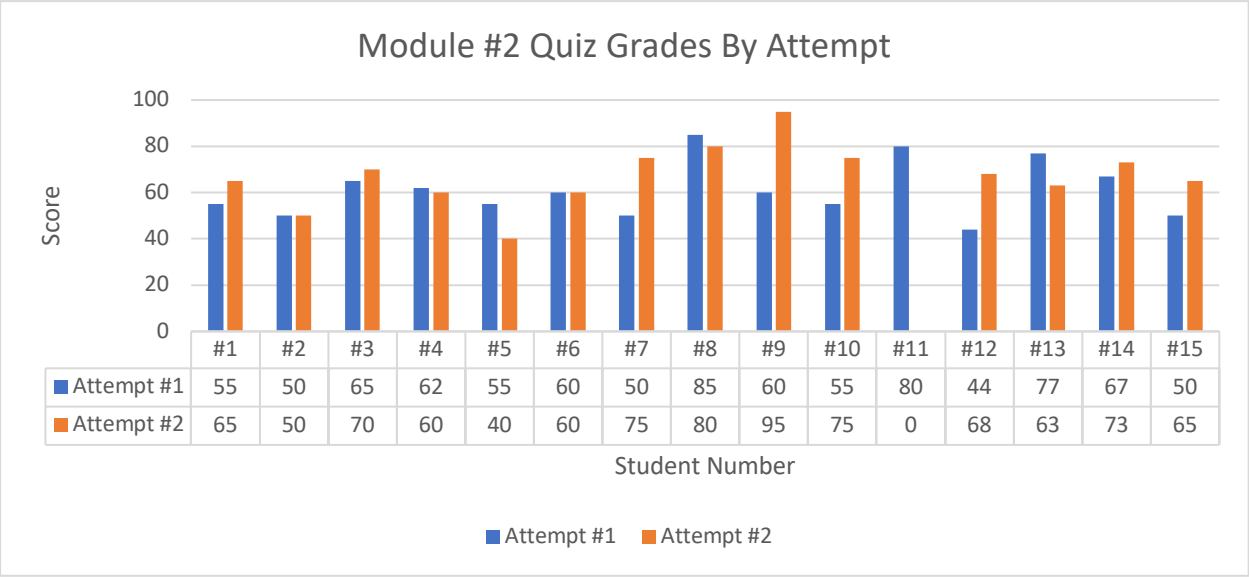


Figure 7, Module #2 Quiz Grades by Attempt

The most striking detail about the data found in Module #2 is how many students saw a dramatic change in their scores. Six students (40%) showed a major increase and three students (20%) showed a major decrease in their scores. The remaining students showed only a slight change in their scores (three students, or 20%) or no change at all (three students, or 20%). Figure 8 demonstrates this breakdown for Module #2.

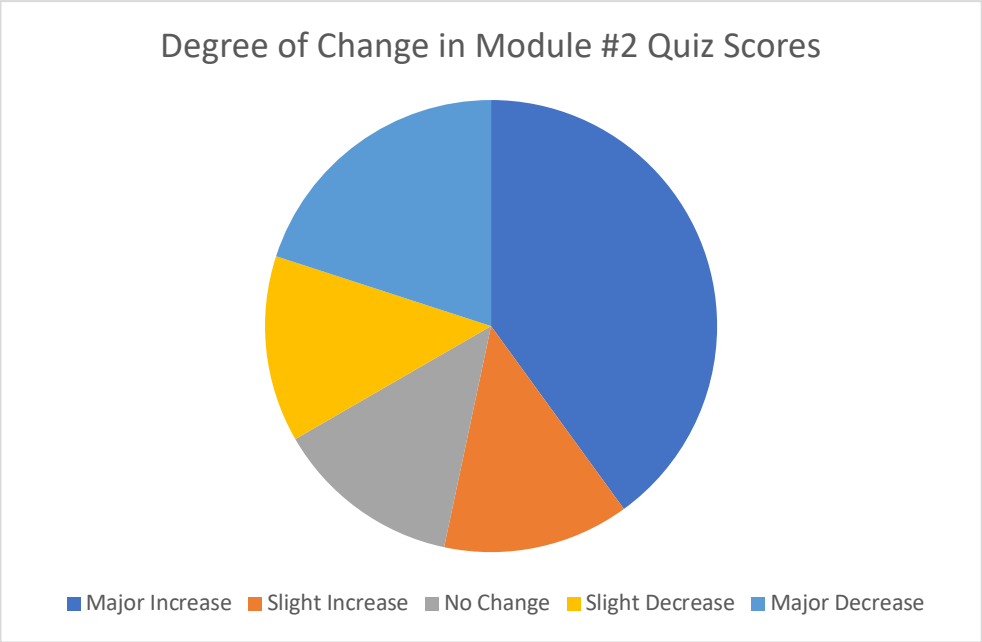


Figure 8, Degree of Change in Module #2 Quiz Scores (n=15)

Module #3 Comparison.

Module #3 covers chapter three of the course and is titled "Cells: The Living Units." This chapter focuses on structures and functions shared by all cells. Major topics that are discussed include the individual components of a cell and their functions, the processes involved with the movement of material in/out of a cell, and the development of proteins (Marieb & Hoehn, 2019). The *Mastering Anatomy & Physiology* software is used extensively in this module, especially regarding the movement of materials into/out of a cell. There are seven different methods discussed in the chapter. Each method is explained through a series of animations, real-world examples, and tutorials. Having a solid understanding of these processes is important for this course and for understanding future concepts.

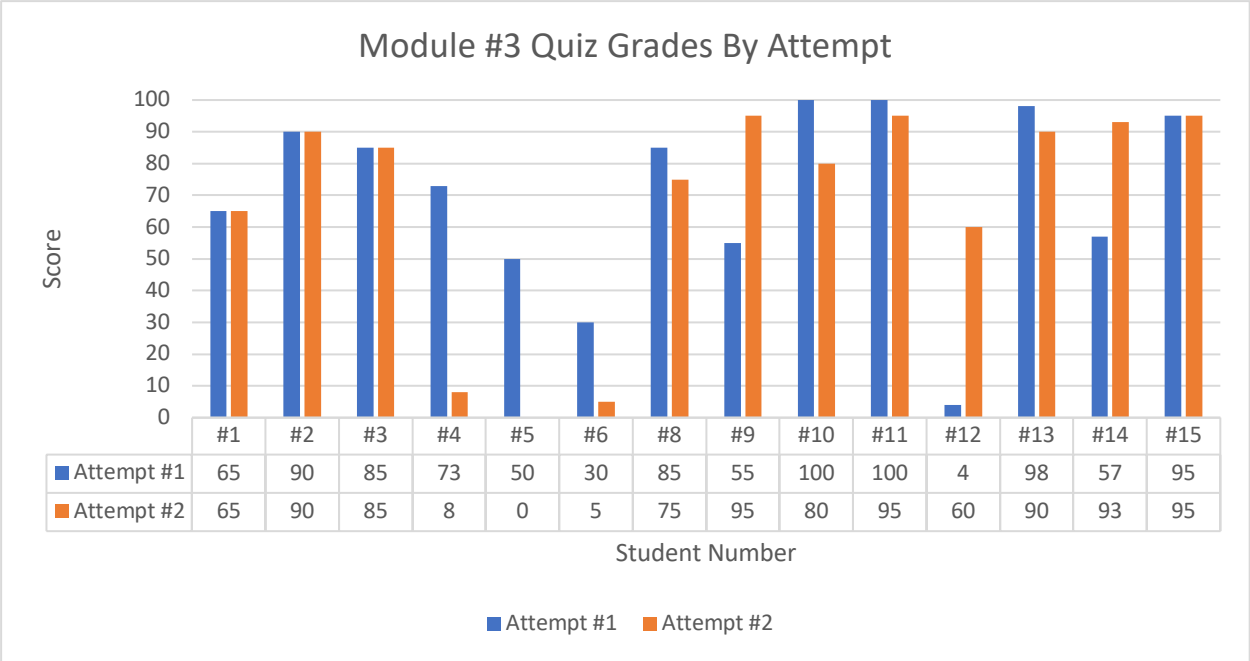


Figure 9, Module #3 Quiz Grades by Attempt

Module #3 is the first module of the course where students exhibited a more negative effect on their quiz scores. A total of 43% of the students had either a slight or major decrease in their scores, and 29% showed no change at all. This is also the first module where the sample size is smaller than preceding ones, decreasing from an initial sample of 15 students down to 14. There was no data for Student #7 for the quiz in Module #3 in either attempt of the course. Therefore, it was not possible to measure any change in scores for this student. Figure 10 shows a summary of the students' performance for this quiz.

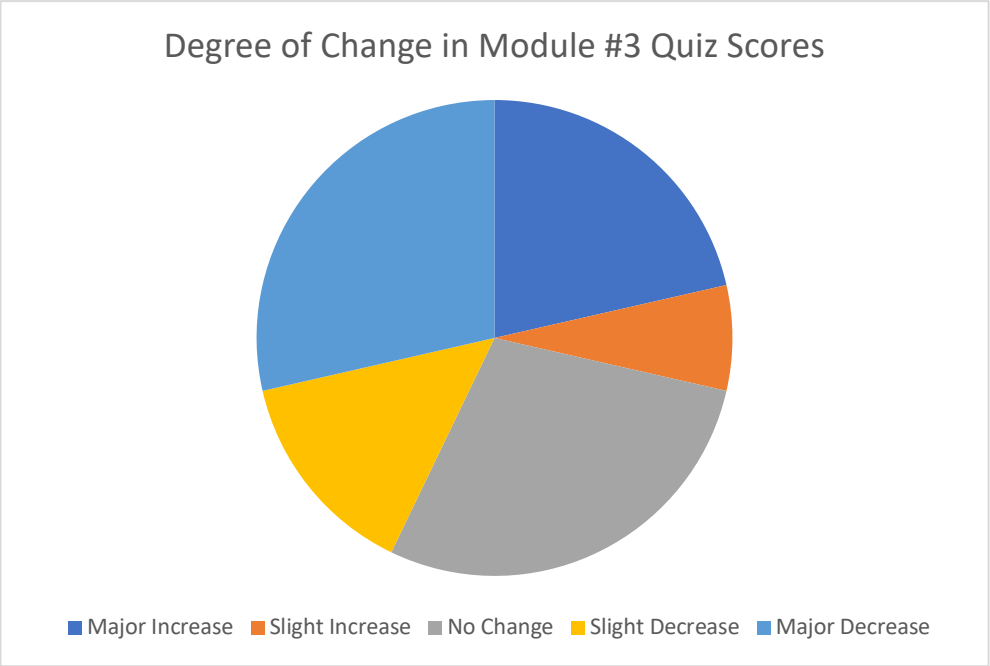


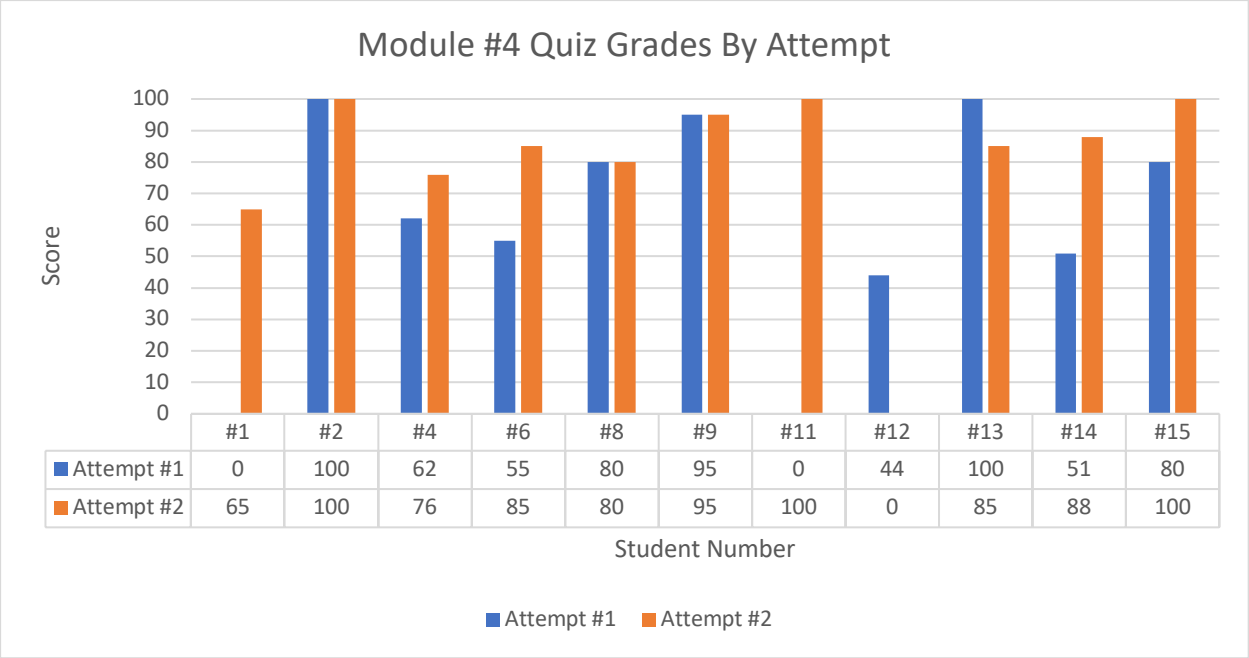
Figure 10, Degree of Change in Module #3 Quiz Scores (n=14)

Module #4 Comparison.

Module #4 of the course is titled "Tissue: The Living Fabric." This chapter introduces the definition of a tissue and the four major types of tissues found in human anatomy (Marieb & Hoehn, 2019). Multiple examples of each type of tissue are discussed in further detail. The different examples are contrasted with each other in order to explain their various functions. Students must be able to identify the individual tissue types by histological images. The course focuses on sixteen different examples, although the textbook mentions even more. Due to the high number of examples named and the depth of the material, this chapter is quite long in its length.

For this module the *Mastering Anatomy & Physiology* software is used to explain how to recognize the various tissues from a prepared histological slide. This is performed by tutorials,

practice quizzes, and animations that focus on the individual examples. Additionally, this module represents a beginning trend of students starting to withdraw from the course. As such, the sample size of this and future modules also starts to decrease. While the original sample size in Module #1 was 15 students, the number of students for Module #4 was 11.



	#1	#2	#4	#6	#8	#9	#11	#12	#13	#14	#15
Attempt #1	0	100	62	55	80	95	0	44	100	51	80
Attempt #2	65	100	76	85	80	95	100	0	85	88	100

Figure 11, Module #4 Quiz Grades by Attempt

The scores from Module #4's quiz show a very positive result, with six students (55%) earning either a slight or major increase in their scores. There were three students who showed no change in their scores (27%) and two students (18%) who demonstrated a major decrease in their scores. It should be noted that the sample size for this module has decreased from the original set of 15 students. Student #10 did not submit any quiz attempts for this module. Also, at this point Students #3, #5, and #7 had withdrawn from the course. With no comparable data

between their attempts in the course, those students' information was not analyzed for this research. Figure 12 explains the breakdown of the performance for Module #4.

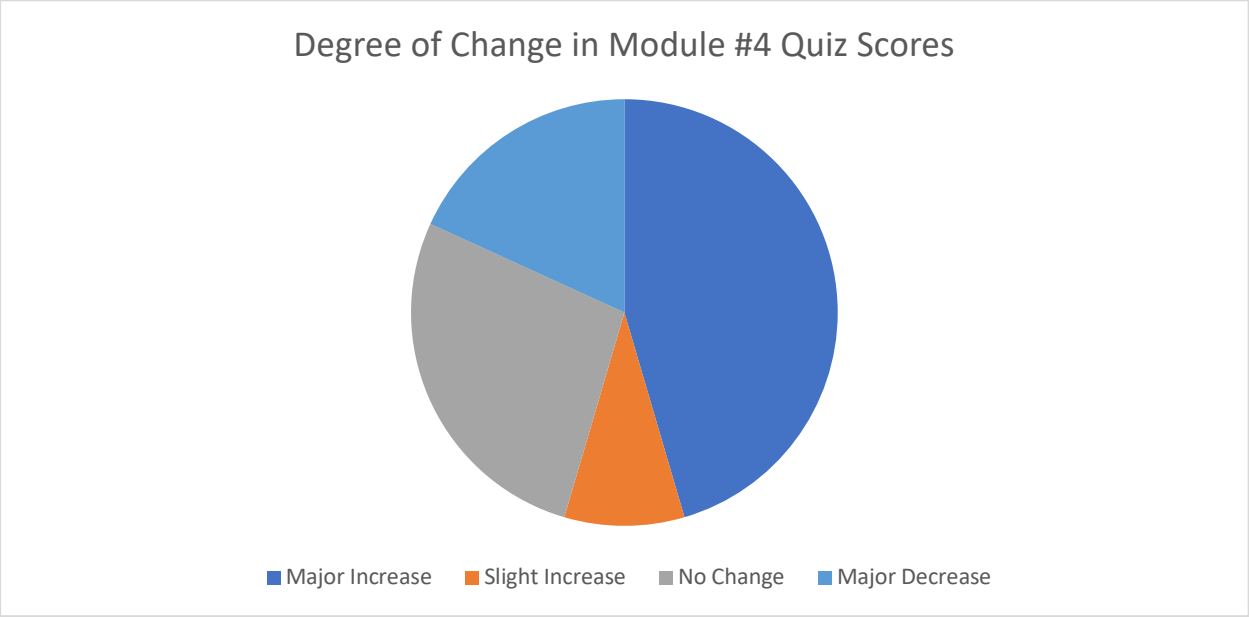
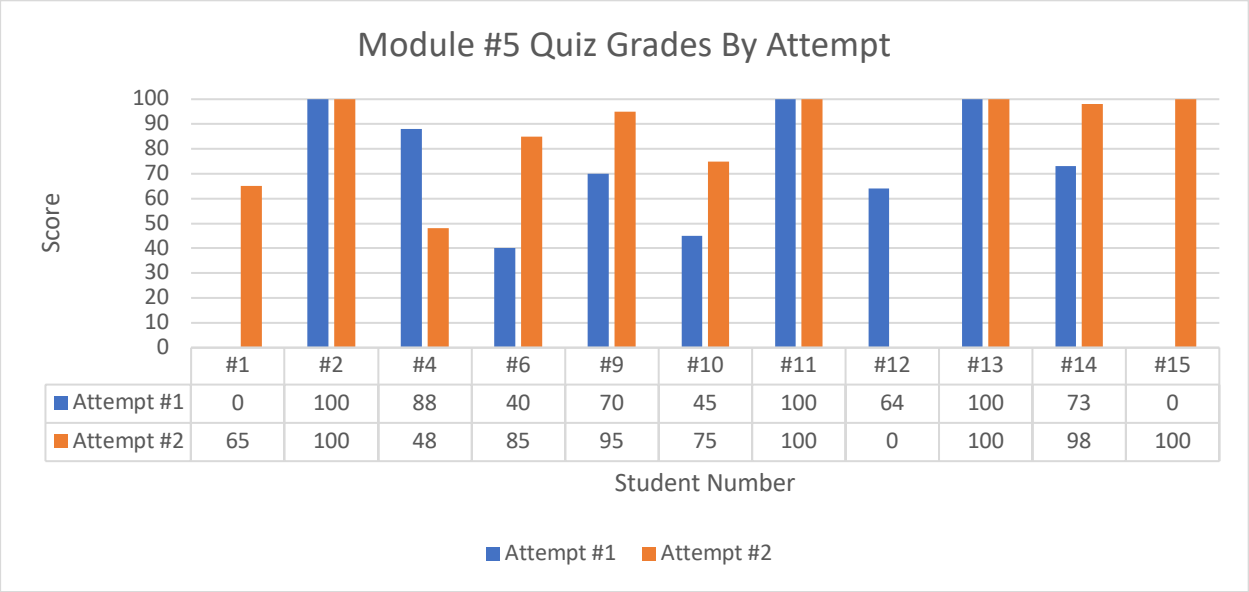


Figure 12, Degree of Change in Module #4 Quiz Scores (n=11)

Module #5 Comparison.

Module #5 focuses on chapter five of the course and is titled "The Integumentary System." This chapter is the first of the course that discusses an entire body system for the whole chapter. The integumentary system includes the multiple layers of the skin and its associated appendages including the hair, nails, and a variety of glands (Marieb & Hoehn, 2019). Students must be able to distinguish between the separate layers of the skin as well as identify the different types of glands from prepared images. Student #8 did not submit any information for this module, so data were not able to be collected. For this module the *Mastering Anatomy & Physiology* software is used to detail concepts such as the differences in the multiple types of glands and what those differences mean, the cycle of a cell as it moves from one layer of the skin

to another, and to show the growth of a hair or nail. This is done with the use of illustrations and real-life imaging, animations, and tutorials on each major topic of the chapter.



	#1	#2	#4	#6	#9	#10	#11	#12	#13	#14	#15
Attempt #1	0	100	88	40	70	45	100	64	100	73	0
Attempt #2	65	100	48	85	95	75	100	0	100	98	100

Figure 13, Module #5 Quiz Grades by Attempt

The results from Module #5 created only three categories. Students showed either a major increase, a major decrease, or no change in their quiz scores. There were six students who earned a major increase (55%), three students who showed no change in their scores (27%), and two students who showed a major decrease in their scores (18%). Figure 14 summarizes this information.

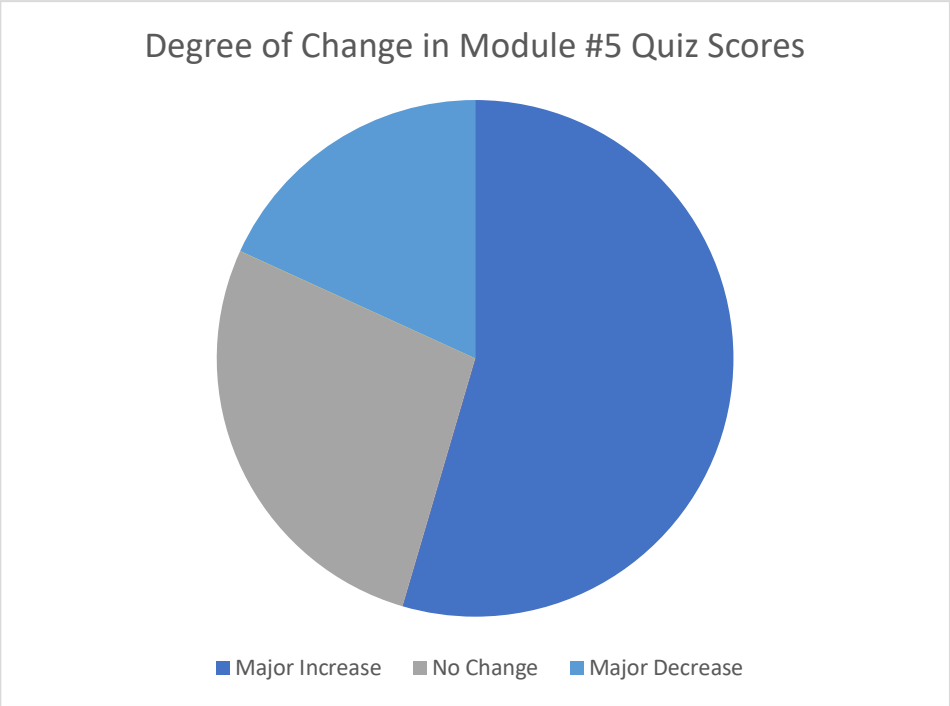


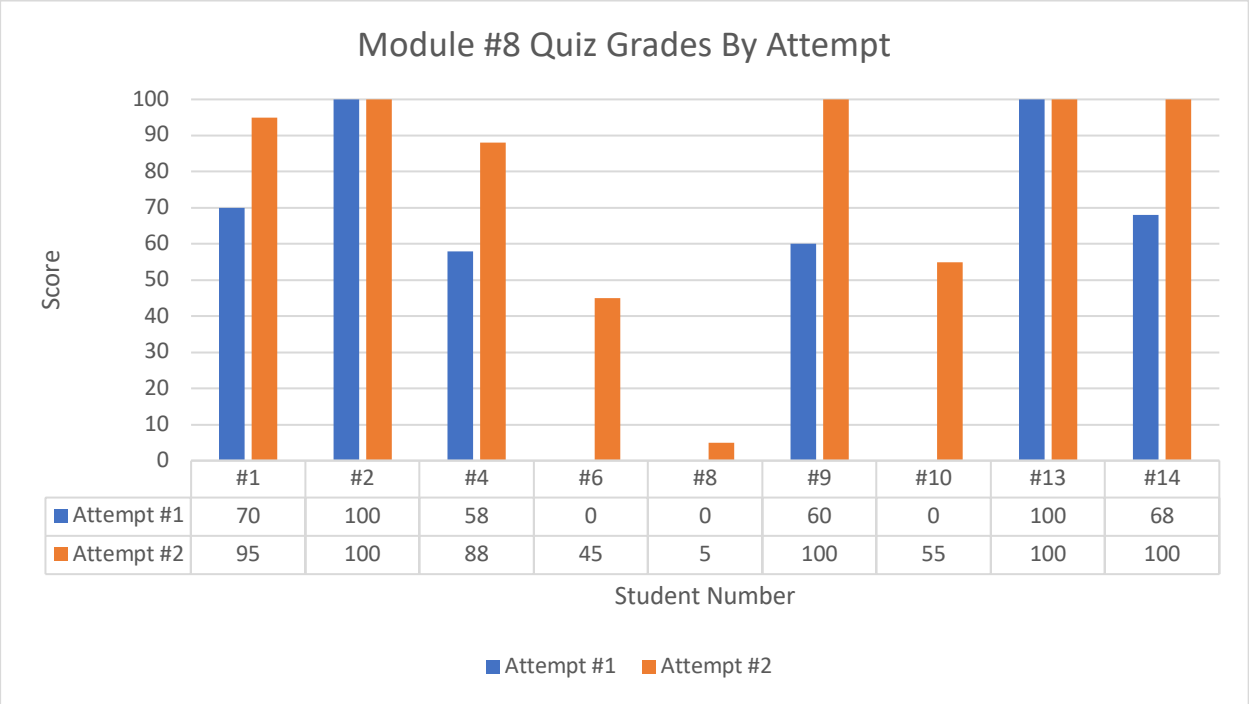
Figure 14, Degree of Change in Module #5 Quiz Scores (n=11)

Module #8 Comparison.

Module #8 focuses on chapter eleven of the course and is titled "Fundamentals of the Nervous System and Nervous Tissue." This chapter gives an overview of the functions and organization of the nervous system. This chapter also introduces the functional anatomy of the basic nervous tissue cell, the neuron. Other major topics discussed in this chapter include the various types of nervous system cells and their roles, the process of how neurons communicate with each other, and the actions of neurotransmitters within the system (Marieb & Hoehn, 2019). Although this chapter is officially an introduction to the nervous system, it is still quite long in length and deep in its content.

For this module the *Mastering Anatomy & Physiology* software is used a great deal, as many of the concepts from this chapter are not easy and detail heavy. Major topics presented by

the software include how to distinguish between the six different types of neurons, the process of how information travels through a neuron (the action potential), and the process of how neurons send information to one another (the synapse). These are completed by a series of very specific illustrations, animations, and tutorials for each process.



	#1	#2	#4	#6	#8	#9	#10	#13	#14
Attempt #1	70	100	58	0	0	60	0	100	68
Attempt #2	95	100	88	45	5	100	55	100	100

Figure 15, Module #8 Quiz Grades by Attempt

Module #8 was the only module in this research where all the results were positive. Every student showed either a major increase (6 students, or 67%), slight increase (1 student, or 11%), or no change (2 students, or 22%) in their quiz scores. The sample size of students completing this module features a drawback. In addition to the previously mentioned students, three more students (Student #11, Student #12, and Student #15) have also withdrawn from the course at this point. This creates the smallest sample size of the research with a total of nine students. Figure 16 recaps the performance of the students for this module.

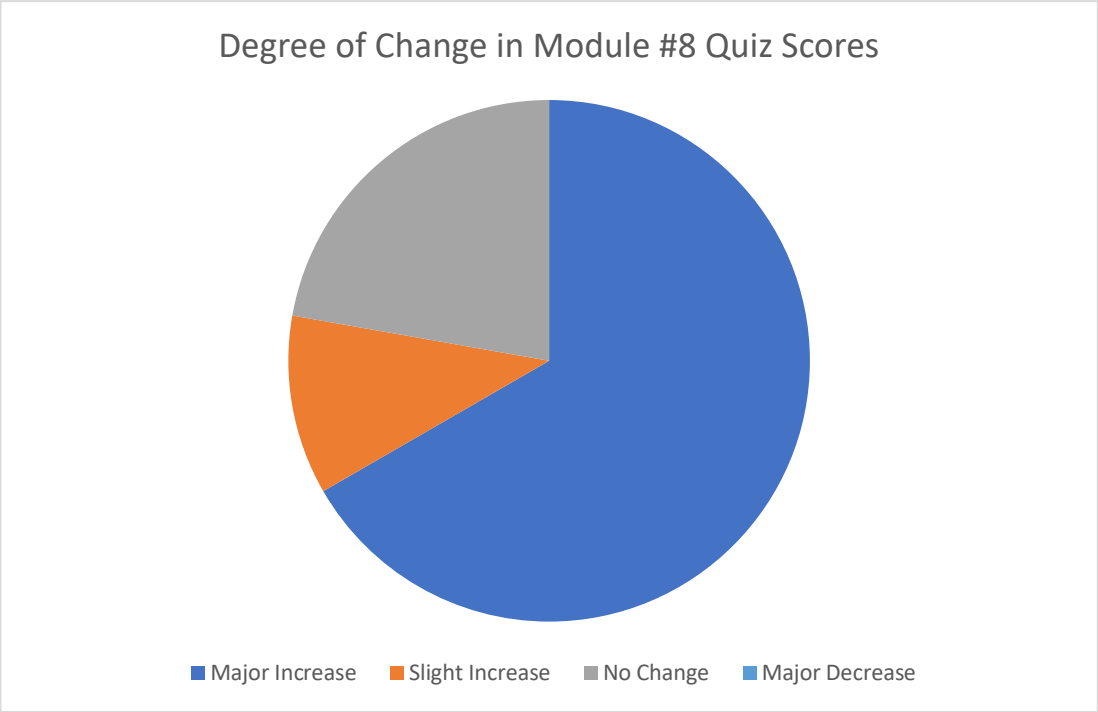


Figure 16, Degree of Change in Module #8 Quiz Scores (n=9)

Quiz Completion Rate

There were examples in every module of a students who did not submit at least one quiz during one of their attempts of the course. For example, in Module #1 the total number of students was 15. With each student taking the chapter quiz twice the total number of quizzes submitted for this module should have been 30. There were four quizzes that were not taken, however, leading to a grade of zero being issued for that attempt. This created a completion rate of only 87% for Module #1. A breakdown of completion rates by module can be seen in Figure 17.

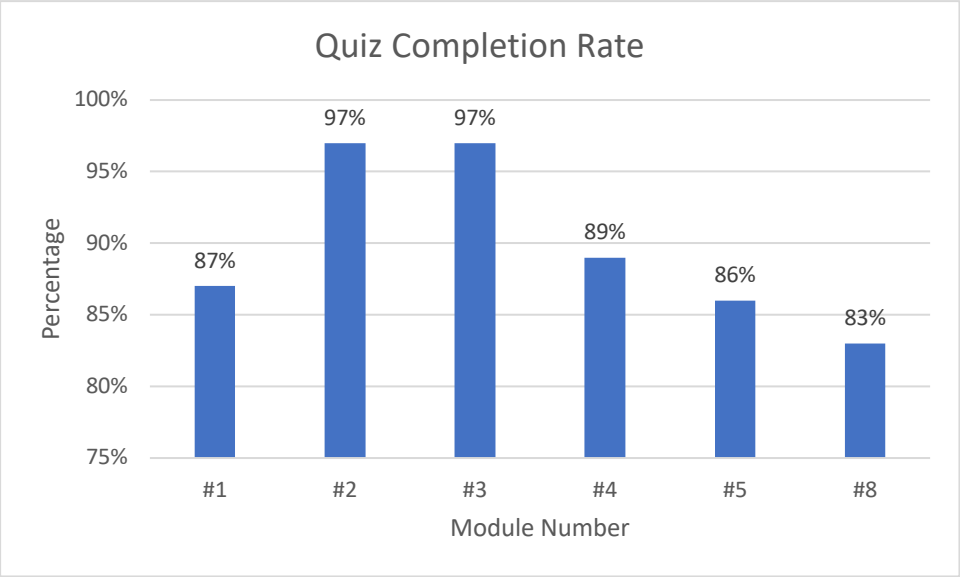


Figure 17, Quiz Completion Rate by Module

This completion rate resulted in one of two situations: any score of 10% or higher for the comparative attempt would show a major increase in score; a score of zero on their second attempt would be show a major decrease. These incidents skew the breakdowns of each module listed in this research. Further, the sample size of this research continued to decrease as the course progressed. This factor should be taken into consideration when examining the data from Module #4 and forward.

Grade Comparison by Student

At the end of this evaluation of scores, only nine students remained. The final course grades for the introductory anatomy course are listed in Table #1. One student (Student #6) earned the same grade is both attempts of the course, a grade of F. Students #2 and #8 received lower grades in their second attempt, with Student #2 going from a B to a C and Student #8 going from a D to a F. The other six students each earned higher grades in their second attempts. Students #10 and #13 each went up by one letter grade, while Students #1, #4, #9, and #14 each improved by two letter grades.

Table 1, Final Course Grades by Student

Student	Final Grade, Attempt #1	Final Grade, Attempt #2
#1	F	C
#2	B	C
#4	D	B
#6	F	F
#8	D	F
#9	C	A
#10	D	C
#13	B	A
#14	D	A

Focus Group

In addition to analyzing the performance of repeating students, this researcher also collected data from anatomy instructors from the Science Department at the College. This collection of data was completed in a focus group setting with five instructors who have experience with the *Mastering Anatomy & Physiology* program. Each of the instructors have taught the introductory anatomy course on which this research is focused. All elements of the course are identical in every way regardless of the instructor, including the module quizzes.

Focus Group Information

The formal focus group meeting took place approximately one week after the instructors were presented with this graphical breakdown of student performance on the module quizzes. Five of the instructors who currently use the *Mastering Anatomy & Physiology* program at the College participated in the formal focus group, including this researcher. To avoid potentially directing responses improperly, the researcher's participation within the focus group was limited. Two fellow instructors were not able to attend the meeting as scheduled.

The focus group was held in a private conference room on the main campus of the College and was moderated by an instructor of the Science Department who does not teach an

anatomy course. The moderator was chosen as they have no previous experience with the MAP software and thus would be more objective than the researcher. The researcher has vast experience with the software and did not want any conscious or unconscious bias to affect the focus group's discussion. The moderator informed attendees of three key points. First, the meeting was part of a doctoral dissertation and their participation was strictly voluntary. Second, the instructors were informed that declining to answer questions would not negatively impact them in any way, and they were free to leave at any time during the meeting. Third, each instructor would need to give their written consent before any data could be collected from the meeting. The attendees were told an audio recording of the meeting would be collected with a Sony ICD-UX560 digital recording device in order to maintain accuracy of comments made during the meeting. The participants were informed that the researcher would be the only person who would have access to the recording at the completion of the meeting. Consent forms were disseminated (Appendix B) to the attendees for their review. Each instructor present signed and returned the form to the researcher.

While conducting the focus group, the moderator asked a series of prepared questions designed to initiate discussion related to the *Mastering Anatomy & Physiology* software (Appendix C). Questions covered such topics as the software's effectiveness, affordability, and necessity. Once the moderator delivered each question, the group was free to engage each other in their responses. While this researcher was a member of the focus group, the involvement in the discussions was intentionally limited. This was done in order to not bias the general direction of the comments made by others in the focus group. Also, both the moderator and researcher kept personal notes of any statements made during the meeting which they determined to be important.

Once the focus group ended, the researcher transcribed the audio for proper attribution of any key responses. This was done by the researcher playing the audio three times and typing the text into a Microsoft Word document. This transcript was compared to the notes collected by the moderator and the researcher for accuracy. When cited in this research, instructors are only identified by the order they initially spoke during the meeting. For example, the instructor who spoke first is indicated as "Instructor #1" and the last instructor of the five who were present to speak is indicated as "Instructor #5."

Presentation of the Module data

The graphical analysis of the module quizzes was presented to seven instructors initially in an informal, one-on-one meeting. The researcher presented each instructor with the breakdown of the module quiz data and informed them that a formal focus group would be held in the future to discuss the results with their colleagues. The instructors were also told that their participation in the focus group meeting was completely voluntary and the data collected at this meeting would be used as part of a doctoral dissertation.

Analysis of the focus group transcript

The following data was compiled from the questions prompted to attendees of the focus group:

1) To what extent do you use Mastering Anatomy & Physiology in your course?

All the instructors replied that due its strictly online format, MAP was the main source of graded assignments for their course.

2) Which features of the software do you use the most/least often and why?

Instructors #4, 6, and 7 replied their most often used feature was the study modules as they help to reinforce the content the students are studying.

Instructors #2, 3, and 5 added that their most often used feature were the lab exercises as they help the students to think critically about the content. They also give the students the opportunity to see the information used in a real-world environment.

Instructor #1 responded their most used feature was the Study Area since it is a great location for students to find multiple types of resources.

3) Which features you would like to see added to the software in the future?

Instructor #7 responded the method to import instructor-made questions to assignments should be easier. All instructors agreed that the method of importing grades from MAP to their Blackboard gradebooks should be more efficient and avoid the delays that exist currently.

4) Use three words you feel best describe your experience with the software.

Instructors #2, 3, and 6 responded "helpful, easy, intuitive."

Instructors #1, 4, 5, and 7 responded "frustrating, overwhelming, intimidating."

5) In your opinion, why (or why not) is the software a helpful tool for students?

All instructors commented that MAP has some very helpful components to it, such as the study modules and the Study Area. Instructor #2 added, "Those things are great but only if the student knows about them and actually uses them."

6) Why would you recommend (or not) the software to fellow instructors and students?

The volume of resources and material available with the software led to the consensus that MAP is in general an effective tool for students. However, while all instructors present said they would recommend the software, Instructor #7 qualified their support by adding, “This is the best option we have at the moment, so we don’t really have a choice.”

7) If the department had the option to change publishers or software tools today, what reasons would lead you to want to make a change?

Instructors #1, 4, 5, and 6 replied ease of use would be their main reason for making a change.

Instructors #2, 3, and 7 replied that cost would be their main concern in making any changes.

During the focus group the instructors referenced two themes, regardless the question that was asked. The themes were (a) the helpfulness of the software to the students, and (b) the software’s usefulness to instructors. Instructor #3 noted the large gap in time for some students between course attempts:

> I was shocked by how long some students waited before they repeated the course. There were so many who waited almost two full years, or longer! How can we say that *Mastering* is really useful when [students] go so long without using it?

Instructor #2 questioned the overall improvement of student performance based on the data presented:

> The first thing I noticed was the difference in the number of students who earned Ds. The number was zero during the second attempt. My guess is the students withdrew before

> they could be issued a bad grade. That's more likely than the students going from earning a D to a B.

During further discussion, Instructor #1 highlighted another possible issue with the data, particularly with Module #3:

> The scores were surprising. There's a very sharp decrease for students #4, #5, and #6 for the second attempt. It makes me think they weren't able to complete that quiz or just didn't answer many of the questions. That would definitely throw off the analysis for this module.

Additionally, Instructor #4 noted that students who are repeating a course already have an advantage compared to students who have not. While mentioning the data for Module #8, Instructor #4:

> Module #8's positive results are about what I expected. The students who are still in the course at that point are typically more motivated in general. Repeating students have already seen this info before and know how difficult it can get. Knowing that fact before you even start should help some students.

There was a consensus among the instructors that while this research is a good first step, the research should go on. "We should probably continue to keep records on this data in the future, just to get a larger sample size. That's the best way to tell if *Mastering* is consistently helping students" (Instructor #5).

Analysis of module data review

Regarding the usefulness to instructors, the focus group mentioned a vital element of the software: its ability to help instructors save time. Each instructor present noted how much time they were able to save by using various features of the program. This was due primarily to incorporating previously made assignments or by the software automatically grading submitted assignments. “Since the quizzes are already made, all we have to do is copy them over each semester. Having to do that for 10 modules every semester would be exhausting” (Instructor #2). This sentiment was echoed by Instructors #4 and #5, with Instructor #5 adding, “Having all of the assignments graded and linked to our gradebooks in Blackboard is a huge help. Some of my online sections have over 50 students.”

Summary

Analysis of the collected data shows the impact of the *Mastering Anatomy & Physiology* software to be inconclusive yet trending in a positive direction. Of the nine students who completed two full iterations of the course analyzed by this research, six of them (67%) earned a higher grade after their second attempt in the course. Two of the remaining students (22%) earned a lower grade, and one student (11%) earned the same grade as their first attempt. There were some trends that conversely went in a negative direction including the number of withdrawals. The number of students who withdrew from the initial course attempt was three out of the original 15, or a rate of 20%. During the second attempt, the withdrawal rate went up to a total of 5 students, or a rate of 33%. It is worth noting that the grade and pass rates in this research were influenced by these student withdrawals, as they lowered the sample size being studied.

CHAPTER 5

Discussion

This research concentrated on the use of an educational program directed towards higher education anatomy students, *Mastering Anatomy & Physiology*. The program can be utilized in anatomy courses in a variety of formats including traditional seated, hybrid, or strictly online. This research focused only on students in an online, introductory anatomy course at the College. This research analyzed quantitative data of students who had repeated the online introductory course at least twice between the fall 2016 and spring 2019 semesters. Further, qualitative data collected from a focus group including anatomy instructors who have used the *Mastering Anatomy & Physiology* program was analyzed for this research.

The quantitative data collected included archival scores on individual chapter quizzes from the anatomy course as well as the students' final course grade. The scores were critiqued in several ways including (a) comparison of students' final course grades for each attempt at the course, (b) comparing individual students' scores from each quiz for each iteration of the course, and (c) the amount of increase/decrease in those scores over time. While the data from this research suggests that *Mastering Anatomy & Physiology* may be a benefit to online students, this research was limited in its scope. The data set became smaller as the anatomy course progressed, making the information more susceptible to being miscategorized.

One word that could be used to summarize the results of this research is *ongoing*. Efforts were made to eliminate as many variables as possible and focus as much as possible on the *Mastering Anatomy & Physiology* software. These efforts included selecting students from an online-only section of the course rather than a hybrid or a seated section, and only analyzing data from the students' first two attempts in the course. By selecting strictly online students, all the

coursework, including the chapter quizzes, would be identical regardless of the student's instructor. Also, the hybrid and seated sections of the course rely less on the *Mastering Anatomy & Physiology* software compared to the online sections. For the online sections, the entirety of the assignments in the course are completed through the software. For other sections, in-class assignments and in-person lab exams are elements of the course. The uniformity of the online sections makes it easier to evaluate the software as an educational tool. Further, limiting the data being examined to the student's first two attempts of the course was done to equalize the amount of exposure students had to the course materials. A student taking the course four times, for example, would have had twice as much access to the material as a student who took the course twice. Taking such steps led to a relatively small sample size due in part to the time frame established by the researcher.

There were some promising data resulting from this research regarding the effectiveness of the software. In this context effectiveness is defined as helping a student become more proficient with the course material, thus earning a better grade after their second attempt at the course. Much more detailed research over an extended amount of time is the best way to truly evaluate the program's value.

Interpretation of Findings

When considering the research questions that guided this study, the following findings are noted:

RQ1. What patterns in student achievement do anatomy instructors observe when comparing student performance between the same online courses taken multiple times?

It appears that the use of the software did have a somewhat positive effect (e.g. higher grades) on the students. Many of the quiz grades and overall course grades increased during the

students' second attempts. Similar results have been demonstrated with medical school residents after undergoing repeated testing on the same information. This may suggest that repeated retrieval in the form of testing may result in a higher degree of retention (Larsen, Butler, & Roediger, 2009). However, the increased number of course withdrawals might have skewed the results in the final analysis.

RQ2. How do anatomy instructors of fully online courses use student data to inform instructional decisions?

Course instructors examine whether the tools being used are beneficial for their students in helping them explain various complex concepts. The tools examined include items such as the online textbook, library of laboratory activities, practice quizzes, content animations, and imaging exercises. A deeper understanding of the material being covered can be exhibited by earning higher scores on the various chapter quizzes. There were many examples of students showing an increase in their comparable quiz scores. However, there are also many examples of students showing a decrease as well. If a program is not deemed to be effective by its instructors, its continued use is unlikely. These decisions will likely be made on an individual or perhaps institutional level, as research that specifically addresses what constitutes "best practices" regarding online education is still emerging (DiPietro, Ferdig, Black, & Presto, 2010). This creates a recursive problem. Without proper research on "best practices," it is difficult to develop such policies.

RQ3. Is the *Mastering Anatomy & Physiology* software an effective tool in promoting independent thought in students of an online anatomy course?

It is unclear at this point due to the inconclusive results. While there were positive results from this research, the small sample size and inconsistent data from the students makes it

extremely difficult to definitively say whether the program can be described as effective. Supporters of online learning environments suggest that the flexibility and creativity needed in an ever-evolving society can be developed virtually while critics suggest asynchronous interactions fall short in their rigor (Reese, 2014). Educational software programs such as *Mastering Anatomy & Physiology* offer students a wide assortment of features that can address a multitude of learning styles. Further research in a more robust manner is needed before a judgment on its effectiveness can be determined.

Analysis of the findings

Many of the findings from previously mentioned literature were reaffirmed with the data from this research. For example, research by Bridges (2000) noted how institutions are becoming increasingly limited on which courses they can offer due to staffing restraints. The College is also limited by the amount of available staff and physical locations to host a course. Therefore, the College has turned to offering several online courses to combat the lack of available space on its campuses. This also correlates to research conducted by Swinnerton, Morris, Hotchkiss, and Pickering (2016). This movement towards full online courses has many critics.

It is unavoidable that institutions would look for novel ways to increase the methods of how they deliver their content. The College's move towards hosting fully online classes follows research conducted by Yang, Newby, and Bill (2005). However, the movement to integrate science courses completely online has instructors questioning the potential rigor of those courses. This is especially true of courses with a laboratory component to them (Bridges, 2000).

This view that online courses are potentially less rigorous than a seated course is echoed by the research of Larsen, Butler, and Roediger (2008). The BIO 168 course analyzed for this research includes a laboratory component. Typically, the laboratory portion of a course was

meant to reinforce the information being learned within the lecture component. The push towards fully online laboratory sections means the loss of students having a tangible model or specimen to examine in person. The lack of this vertical integration of instruction could lead to a decreased level of understanding (Bergman, Van Der Vleuten, & Scherpbier, 2011). This might explain the lower student performances in Modules #3 and #5. This idea is also discussed in the research by Bergman, Prince, Drukker, van der Vleuten, and Scherpbier, (2008). The concern for the lack of rigor is not focused simply on the laboratory sections of a course.

Multiple sources from the literature emphasize how anatomy must be taught in a robust manner in order to be effective. The work by researchers including Barnett (2004), Facione (1998), Garrison et al. (2001), Yang et al. (2005), and Yeh (2006) all describe how student understanding of the content comes directly from a robust structure of the course. The concern is whether the *Mastering Anatomy & Physiology* program meets that standard. While this research may not be able to fully address this question, it is a good starting point for more detailed future research.

Implications

Implications in research indicate the results discussed *could* potentially be important for the changing of policies or for future research. They do not suggest the urgent specific actions that a recommendation would. The primary implication of practice from this research is the sample size of this study needs to be increased. Since this research concentrated on students who repeated a fully online course at least twice in a set time period, the potential pool of students was small. This pool continued to decrease as the course progressed and students withdrew from the course. The best way to combat this attrition may be to extend the time period for several more semesters. This would increase the number of students in general and therefore the

potential to find repeating students is higher. However, there is no reliable method to prevent students from withdrawing from a course. The reasons why a student withdraws are varied and can not be addressed by a single precautionary approach.

Recommendations for Action

While this research offers some insight into the effectiveness of the *Mastering Anatomy & Physiology* software, there are too many variables involved such as a smaller sample size and brief time frame to make any type of definitive connection between the use of the software and student and/or software performance. However, this research serves as the starting point for multiple paths of future research. First, the general plan of analyzing comparable module quiz scores and final grades could be continued but expanded upon by extending the time frame used in the research. Rather than limiting the research to eight academic semesters as in this study, future research could add future semesters. This would increase the student population pool and increase the potential for students who meet the study's criteria. This would be applicable only if the College uses the current form of the *Mastering Anatomy & Physiology* software. Any alterations to the software may mean a change in module designs, organization, or quiz questions.

Second, the research could be expanded by adding a section that analyzes specific questions from the various module quizzes. Individual questions could be identified as ones that were commonly missed by students. Possible explanations on why those specific questions were frequently missed could also be explored with future research. A search for any similar traits on the commonly missed questions could also be implemented. Such traits could include question length and question type, for example.

Third, future research could be focused on the time involved and the frequency of repeating the BIO 168 course. Almost half of the students from the original data set took three or more semesters before they repeated the course. That equates to a full calendar year or longer. Additionally, many students repeated the course multiple times during the time frame established in this research. Each time a student repeats a prerequisite course they are delaying their progression within their field of study. This delay could be only a few months but for some students the delays end up being years. Further, the delay also means higher tuition costs.

Conclusion

The purpose of this study was to measure the overall effectiveness of a commonly used instructional tool used for online anatomy students. This research analyzed various aspects of student performance within an introductory anatomy course from students who had repeated the online course at least twice. The research addressed the problem of whether the instructional software had helped the students achieve a higher level of performance within the course, either in part or for the course's entirety. By comparing selected chapter quiz grades and final course grades with the assistance of Microsoft Excel, there is an indication that the software was of benefit to some students. Applying Lewin's action research conceptual framework to the focus group findings also showed indications of the software's benefits.

Based on the limited data of this research, the general impression of the *Mastering Anatomy & Physiology* software is a positive one. Its detailed animations, guided tutorials, and practice evaluations discuss complex concepts in a very detailed manner. Topics that are difficult for many students to grasp, such as the mechanics of a synapse or the action potential, are broken down in a systematic way that helps students comprehend the overall process as well as the individual steps. This is demonstrated by the strong performance in the students' second attempt

of the later modules of the course such as Module #5 and Module #8. However, this improvement may also be due to the students' increased familiarity with the material, as the higher scores came in their second attempt in the course. Therefore, more study is required before a recommendation can be made on the general effectiveness of the software or its continued use.

The data collected by this research should be viewed as a first step towards future studies. The software could continue to be used to analyze subsequent semesters by adding current student information to data already collected by this research. In addition to its use with strictly an online format, MAP has the potential to be used in other ways which may benefit students. For example, the software could be used to compare the overall effectiveness of the different delivery methods of the anatomy course such as seated, hybrid, and online. Additionally, MAP could be used to study how repeating students perform in two different delivery methods. Any tool used to examine a course's rigor could potentially assist both the instructor and student.

References

Adelman, C. (1993). Kurt Lewin and the Origins of Action Research. *Educational Action Research, 1*(1), 7-24. doi:10.1080/0965079930010102

Allen, I. E., & Seaman, J. (2014). *Opening the Curriculum: Open Educational Resources in U.S. Higher Education* (pp. 1-52). Pearson Education. (ERIC Document Reproduction Service No. ED572730)

Allen, I. E., & Seaman, J. (2010). *Class differences: Online education in the United States, 2010.* Needham, MA: Sloan Consortium.

Anderson, R. S. (1998). Why Talk About Different Ways to Grade? The Shift from Traditional Assessment to Alternative Assessment. *New Directions for Teaching and Learning*, *1998*(74), 5–16. doi: 10.1002/tl.7401

Annala, J., Lindén, J., & Mäkinen, M. (2015). Curriculum in higher education research. *Researching Higher Education,* 171-189. doi:10.4324/9781315675404-10

Barnett, R. (2004). Learning for an unknown future. *Higher Education Research and Development*, *23*(3), 247-260.

Beetham, H., & Sharpe, R. (2013). *Rethinking pedagogy for a digital age: designing and delivering e-learning*. London: Routledge.

Benson, A. D. (2003). Assessing participant learning in online environments. *New Directions for Adult and Continuing Education*, *2003*(100), 69–78. doi: 10.1002/ace.120

Bere, S. R., & Mattick, K. (2010). From anatomical 'competence' to complex capability. The views and experiences of UK tutors on how we should teach anatomy to medical

students. *Advances in Health Sciences Education, 15*(4), 573-585. doi:10.1007/s10459-010-9220-0

Bergman, E. M., Verheijen, I. W., Scherpbier, A. J., Vleuten, C. P., & Bruin, A. B. (2013). Influences on anatomical knowledge: The complete arguments. *Clinical Anatomy, 27*(3), 296-303. doi:10.1002/ca.22341

Bergman, E. M., Prince, K. J. A. H., Drukker, J., van der Vleuten, C. P. M., & Scherpbier, A. J. J. A. (2008). How much anatomy is enough? *Anatomical Sciences Education, 1*(4), 184-188. doi:10.1002/ase.35

Bergman, E. M., Van Der Vleuten, C., & Scherpbier, A. J. (2011). Why don't they know enough about anatomy? A narrative review. *Medical Teacher, 33*(5), 403-409. doi:10.3109/0142159x.2010.536276

Bounds, M. M. (2009). Curriculum content for small business management modules. In L. Cameron, & J. Dalziel (Eds), Proceedings of the 4th International LAMS Conference 2009: Opening Up Learning Design (pp. 17-27). Sydney, Australia. Retrieved from http://lamsfoundation.org/lams2009sydney/papers.html

Brew, A. (2013). Understanding the scope of undergraduate research: A framework for curricular and pedagogical decision-making. *Higher Education, 66*(5), 603-618. doi:10.1007/s10734-013-9624-x

Bridges, D. (2000). Back to the Future: The higher education curriculum in the 21st century. *Cambridge Journal of Education, 30*(1), 37-55. doi:10.1080/03057640050005762

Casagrand, J., & Semsar, K. (2017). Redesigning a course to help students achieve higher-order cognitive thinking skills: from goals and mechanics to student outcomes. *Advances in Physiology Education, 41*(2), 194-202. doi:10.1152/advan.00102.2016

Celuch, K. and Slama, M. (1999). Teaching critical thinking skills for the 21st century: An advertising principles case, *Journal of Education for Business, 74*(3), 134-139, DOI: 10.1080/08832329909601675

Coghlan, D., & Brannick, T. (2019). *Doing action research in your own organization, (3rd ed)*. Los Angeles: Sage.

Cohen-Schotanus, J., Muijtjens, A. M. M., Schönrock-Adema, J., Geertsma, J., & Van Der Vleuten, Cees P M. (2008). Effects of conventional and problem-based learning on clinical and general competencies and career development. *Medical Education, 42*(3), 256-265. doi:10.1111/j.1365-2923.2007.02959.x

College Transfer Articulation Agreements. (2017, June 02). Retrieved from https://www.nccommunitycolleges.edu/academic-programs-college-transferarticulation-agreements

Community college [Def. 1]. (n.d.). In *Dictionary.com*. Retrieved January 6, 2019, from https://www.dictionary.com/browse/community-college

Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five traditions* (2nd ed.). Thousand Oaks: Sage.

Critical thinking. (n.d.). Retrieved from https://www.dictionary.com/browse/critical-thinking

Crow1234's Blog. (2010, October 29). Pros and Cons of Action Research and Participant Action Research (PAR) [Web log post]. Retrieved from https://crow1234.wordpress.com/2010/10/29/pros-and-cons-of-action-research-and-participant-action-research-par/

Curriculum. (n.d.). Retrieved from https://www.dictionary.com/browse/curriculum?s=t

Dependability in Qualitative Research. (n.d.). Retrieved from https://universalteacher.com/1/dependability-in-qualitative-research/.

DiPietro, M., Ferdig, R. E., Black, E. W., & Presto, M. (2010). Best practices in teaching K-12 online: Lessons learned from Michigan Virtual School teachers. *Journal of Interactive Online Learning*, *9*(3), 10.

Facione, P.A. (1998). *What It Is and Why It Counts*. Millbrae, CA: California Academic Press.

Frank, M & Barziliai, A. (2010) Integrating alternative assessment in a project-based learning course for pre-service science and technology teachers. *Assessment & Evaluation in Higher Education, 20*(4), 41-61. doi: 10.1080/0260293042000160401

Garrison, D.R., Anderson, T. & Archer W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education*, *15*(1), 7-23.

Gaston College. (n.d.). GC Academic Program. Retrieved from https://www.gaston.edu/gc-academic-program-panel

Hartling, L., Spooner, C., Tjosvold, L., & Oswald, A. (2010). Problem-based learning in pre-clinical medical education: 22 years of outcome research. *Medical Teacher, 32*(1), 28-35. doi:10.3109/01421590903200789

Havet, E., Duparc, F., Peltier, J., Tobenas-Dujardin, A., & Fréger, P. (2011). The article critique as a problem-based teaching method for medical students early in their training: A French example using anatomy. *Surgical and Radiologic Anatomy, 34*(1), 81-84. doi:10.1007/s00276-011-0911-x

Ho, W. (n.d.). Systems Theory. Retrieved from http://www.personal.psu.edu/wxh139/System_Talk.htm

Jaffar, A. A. (2012). YouTube: An emerging tool in anatomy education. *Anatomical Sciences Education, 5*(3), 158-164. doi:10.1002/ase.1268

Kaldi, S., Filippatou, D., & Govaris, C. (2011). Project-based learning in primary schools: Effects on pupils learning and attitudes. *Education 3-13, 39*(1), 35-47. doi:10.1080/03004270903179538

Karbalaei, A. (2012). Critical thinking and academic achievement. *Íkala, Revista de Lenguaje y Cultura*, *17*. 121-128.

Khan, M. A., & Law, L. S. (2015). An integrative approach to curriculum development in higher education in the USA: A theoretical framework. *International Education Studies, 8*(3). doi:10.5539/ies.v8n3p66

Khot, Z., Quinlan, K., Norman, G. R., & Wainman, B. (2013). The relative effectiveness of computer-based and traditional resources for education in anatomy. *Anatomical Sciences Education, 6*(4), 211-215. doi:10.1002/ase.1355

Larsen, D. P., Butler, A. C., & Roediger III, H. L. (2008). Test-enhanced learning in medical education. *Medical Education, 42*(10), 959-966. doi:10.1111/j.1365-2923.2008.03124.x

Larsen, D. P., Butler, A. C., & Roediger, H. L. (2009). Repeated testing improves long-term retention relative to repeated study: A randomised controlled trial. *Medical Education*, *43*(12), 1174–1181. doi: 10.1111/j.1365-2923.2009.03518.x

Leech, N. L., & Onwuegbuzie, A. J. (2007). A typology of mixed methods research designs. *Quality & Quantity, 43*(2), 265-275. doi:10.1007/s11135-007-9105-3

LeGeros, L. (2018, December 07). Why do action research? (Web log post). Retrieved from https://tiie.w3.uvm.edu/blog/why-do-action-research/#.XF2lHKB7ncs

Lewin, K. (1947). Frontiers in group dynamics. *Human Relations, 1*(1), 5-41. doi:10.1177/001872674700100103

Little, J.W. (1981). *School success and staff development: The role of staff development in urban desegregated schools*. Boulder, CO: Center for Action Research, Inc.

Marieb, E. N., & Hoehn, K. (2019). *Human anatomy & physiology* (11th ed.). Hoboken, NJ: Pearson.

McFarland, K.P., & Stansell, J.C. (1993). Historical perspectives. In L. Patterson, C.M. Santa, C.G. Short, & K. Smith (Eds.), *Teachers are researchers: Reflection and action*. Newark, DE: International Reading Association.

McNiff, J. (2013). *Action research: Principles and practice*. London: Routledge.

Member Checking in Qualitative Research. (2019, August 9). Retrieved from https://www.statisticssolutions.com/member-checking-in-qualitative-research/.

Mills, A. (2010). Credibility. Retrieved from https://methods.sagepub.com/reference/encyc-of-case-study-research/n91.xml.

Mills, G. E. (2018). *Action research: A guide for the teacher researcher*. NY, NY: Pearson.

National Research Council. (2000). *Addressing the nation's changing needs for biomedical and behavioral scientists*. Washington, DC: The National Academies Press. https://doi.org/10.17226/9827.

Nguyen, L., Barton, S. M., & Nguyen, L. T. (2015). iPads in higher education—Hype and hope. *British Journal of Educational Technology, 46*(1), 190-203. doi:10.1111/bjet.12137

Noffke, S.E., & Stevenson, R.B. (Eds.). (1995). *Educational action research: Becoming practically critical*. New York: Teachers College Press.

Nursing - Registered Nursing, A.A.S. (n.d.). Retrieved from http://catalog.gaston.edu/preview_program.php?catoid=20&poid=2913&returnto=813

Olusegun, S. (2015). Constructivism learning theory: A paradigm for teaching and learning. *IOSR Journal of Research & Method in Education, 5*(6), 1st ser., 66-70. doi:10.9790/7388 - 05 61 66 70

Paul, R., & Elder, L. (2005). *A guide for educators to critical thinking competency standards* (Publication). Retrieved from http://www.criticalthinking.org/resources/PDF/CT-competencies 2005.pdf

Pedagogy. (n.d.). Retrieved from https://www.dictionary.com/browse/pedagogy?s=t

Pine, G.J. (1981). *Collaborative action research: The integration of research and service*. Paper presented at the annual meeting of the American Association of Colleges for Teacher Education, Detroit, MI. Retrieved from https://eric.ed.gov/?id=ED199221

PRISMA. (n.d.). Retrieved from http://prisma-statement.org/

Redmond, P. (2011). From face-to-face teaching to online teaching: Pedagogical transitions. In G. Williams, P. Statham, N. Brown & B. Cleland (Eds.), *Changing Demands, Changing Directions. Proceedings Ascilite Hobart 2011*. (pp.1050-1060).

Reese, S. A. (2014). Online learning environments in higher education: Connectivism vs. dissociation. *Education and Information Technologies*, *20*(3), 579–588. doi: 10.1007/s10639-013-9303-7

Regan, d. B., & Mattick, K. (2010). From anatomical 'competence' to complex capability. The views and experiences of UK tutors on how we should teach anatomy to medical students. *Advances in Health Sciences Education: Theory and Practice, 15*(4), 573-585. doi: http://dx.doi.org.une.idm.oclc.org/10.1007/s10459-010-9220-0

Riel, M. (n.d.). File: Riel-action research.jpg. Retrieved from https://commons.wikimedia.org/w/index.php?curid=8652138

Robles, M. & Braathen, S. (2002). Online Assessment Techniques. *Delta Pi Epsilon Journal, 44*(1), 39-49. Retrieved November 25, 2019.

Rovai, A. P. (2000). Building and sustaining community in asynchronous learning networks. *The Internet and Higher Education*, *3*(4), 285–297. doi: 10.1016/s1096-7516(01)00037-9

Schifferdecker, K. E., & Reed, V. A. (2009). Using mixed methods research in medical education: Basic guidelines for researchers. *Medical Education, 43*(7), 637-644. doi:10.1111/j.1365-2923.2009.03386.

Shaffer, J. F. (2016). Student performance in and perceptions of a high structure undergraduate human anatomy course. *Anatomical Sciences Education, 9*(6), 516-528. doi:10.1002/ase.1608

Shapiro, J., Nguyen, V. P., Mourra, S., Boker, J. R., Ross, M., Thai, T. M., & Leonard, R. J. (2009). Relationship of creative projects in anatomy to medical student professionalism, test performance and stress: an exploratory study. *BMC Medical Education*, *9*, 65. http://doi.org/10.1186/1472-6920-9-65

SHRM (2007). SHRM (2007) Symposium on the workforce readiness of the future U.S. labor pool: Critical skills needed for the changing workforce. SHRM Foundation. Retrieved from http://www.cewd.org/documents/SolutionGuides/WorkforceReadiness.pdf

Smith, M. K. (2013, June 20). Jean Lave, Etienne Wenger and communities of practice. Retrieved from Http://infed.org/mobi/jean-lave-etienne-wenger-and-communities-of-practice/

Smith, J. W., & Stitts, D. K. (2013). Using action learning and critical thinking tools to make changes in higher education. *Contemporary Issues in Education Research (CIER), 6*(1), 73. doi:10.19030/cier.v6i1.7605

Snyder, L.G., & Snyder, M.J. (2008). Teaching critical thinking and problem-solving skills. The *Delta Pi Epsilon Journal, 50*(2), 90-99.

Speck, B. W. (2002). Learning-teaching-assessment paradigms and the on-line classroom. *New Directions for Teaching and Learning*, *2002*(91), 5–18. doi: 10.1002/tl.61

Spillane, J. P. (2002). Local theories of teacher change: The pedagogy of district policies and programs. *Teachers College Record, 104*(3), 377-420. doi:10.1111/1467-9620.00167

SPSS Software. (n.d.). Retrieved from https://www.ibm.com/analytics/spss-statistics-software

Swinnerton, B. J., Morris, N. P., Hotchkiss, S., & Pickering, J. D. (2016). The integration of an anatomy massive open online course (MOOC) into a medical anatomy curriculum. *Anatomical Sciences Education, 10*(1), 53-67. doi:10.1002/ase.1625

Thompson, A. R., & O Loughlin, V. D. (2014). The Blooming Anatomy Tool (BAT): A discipline-specific rubric for utilizing Blooms taxonomy in the design and evaluation of assessments in the anatomical sciences. *Anatomical Sciences Education, 8*(6), 493-501. doi:10.1002/ase.1507

Trochim, W. (2006). *Qualitative validity*. Retrieved from https://socialresearchmethods.net/kb/qualval.php.

Villard, J. (n.d.). Use of focus groups: An effective tool for involving people in measuring quality and impact. Retrieved from https://www.leadershipeducators.org/Resources/Documents/Conferences/Anchorage/villard.pdf

Vonderwell, S. (2003). An examination of asynchronous communication experiences and perspectives of students in an online course: a case study. *The Internet and Higher Education*, *6*(1), 77–90. doi: 10.1016/s1096-7516(02)00164-1

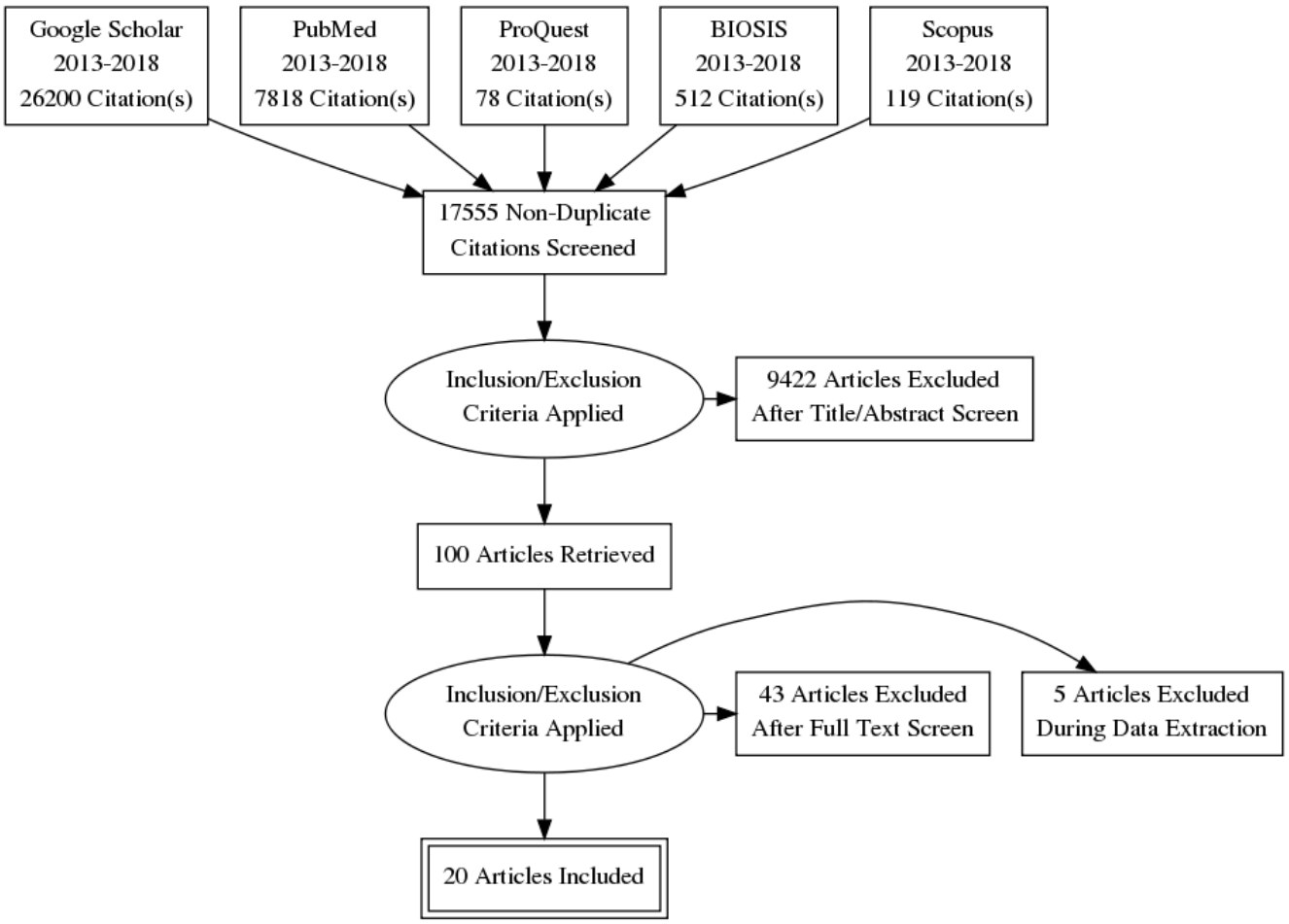
Wright, V. H., Sunal, C. S., & Wilson, E. K. (2006). *Research on enhancing the interactivity of online learning*. Greenwich, CT: Information Age Pub.

Yang, Y.T.C., Newby, T.J. & Bill, R.L. (2005). Using Socratic questioning to promote critical thinking skills through asynchronous discussion forums in distance learning environments. *The American Journal of Distance Education*, *19*(3), 163-181.

Yeh, Y. (2006). The interactive effects of personal traits and guides practice on pre-service teachers' changes in personal teaching efficacy. *British Journal of Educational Technology*, *37*(4), 513-526.

Yuksel, U. (2010). Integrating Curriculum: Developing student autonomy in learning in higher education. *Journal of College Teaching & Learning (TLC), 7*(8). doi:10.19030/tlc.v7i8.138

Appendix A: PRISMA Flow Diagram



Appendix B: Focus Group Consent Form

Project Title: An Analysis on the Effectiveness of the Higher Education Anatomy Educational software *Mastering Anatomy & Physiology*

Principal Investigator(s): Jason L. Moir

Introduction:

- Please read this form. You may also request that the form is read to you. The purpose of this form is to give you information about this research study, and if you choose to participate, document that choice.
- You are encouraged to ask any questions that you may have about this study, now, during or after the project is complete. You can take as much time as you need to decide whether or not you want to participate. Your participation is voluntary.

Why is this research study being done?

To study the effectiveness of higher education anatomy educational software.

Who will be in this study?

Students enrolled in an introductory college-level anatomy & physiology course as well as instructors of the course.

What will I be asked to do?

Respond to prompted questions in a focus group setting with fellow anatomy instructors.

What are the possible risks of taking part in this study?

None

What are the possible benefits of taking part in this study?

Improving the quality of anatomy instruction.

What will it cost me?

Nothing

How will my privacy be protected?

Identifiable information such as name, student ID, Social Security numbers will be removed from the research. Participants in the focus group will only be identified as an *Instructor*.

How will my data be kept confidential?

All interview data will be stored on a private flash drive which will remain in the researcher's possession. Once all the data has been analyzed, the data will be deleted and no longer accessible.

What are my rights as a research participant?

- Your participation is voluntary. Your decision to participate will have no impact on your current or future relations with the University.
- Your decision to participate will not affect your relationship with Jason L. Moir.

- You may skip or refuse to answer any question for any reason.
- If you choose not to participate there is no penalty to you and you will not lose any benefits that you are otherwise entitled to receive.
- You are free to withdraw from this research study at any time, for any reason.
    - If you choose to withdraw from the research there will be no penalty to you and you will not lose any benefits that you are otherwise entitled to receive.
- You will be informed of any significant findings developed during the course of the research that may affect your willingness to participate in the research.
- If you sustain an injury while participating in this study, your participation may be ended.

What other options do I have?

- You may choose not to participate.

Whom may I contact with questions?

- The researchers conducting this study are Jason L. Moir
    - For more information regarding this study, please contact Jason Moir at moir.jason@gaston.edu
- If you choose to participate in this research study and believe you may have suffered a research related injury, please contact Jason L. Moir.
- If you have any questions or concerns about your rights as a research subject, you may call Mary Bachman DeSilva, Sc.D., Chair of the UNE Institutional Review Board at (207) 221-4567 or irb@une.edu.

Will I receive a copy of this consent form?

- You will be given a copy of this consent form.

Participant's Statement

I understand the above description of this research and the risks and benefits associated with my participation as a research subject. I agree to take part in the research and do so voluntarily.

Participant's electronic signature

Date

Appendix C: Prepared Questions for Focus Group

1) To what extent do you use *Mastering Anatomy & Physiology* in your course?

2) Which features of the software do you use the most/least often and why?

3) Which features you would like to see added to the software in the future?

4) Use three words you feel best describe your experience with the software.

5) In your opinion, why (or why not) is the software a helpful tool for students?

6) Why would you recommend (or not) the software to fellow instructors and students?

7) If the department had the option to change publishers or software tools today, what reasons would lead you to want to make a change?